

Research and Economic Development

2007/2008



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German Aerospace Center
(DLR)

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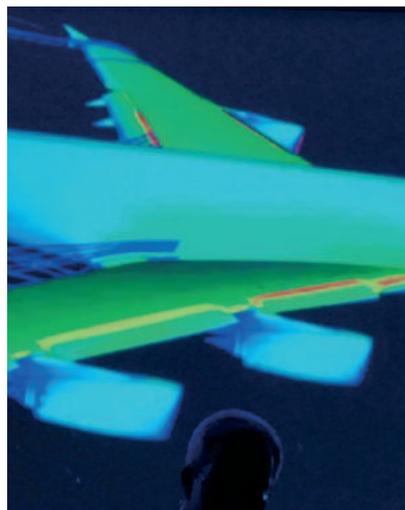


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The page features a large blue graphic on the left side. At the top, the DLR logo is displayed in a glowing, white, stylized font. Below the logo, the letters 'DLR' are written in a larger, white, sans-serif font. The background of this graphic is a dark blue gradient. In the lower portion of the graphic, there are silhouettes of two people, a man and a woman, standing in front of a large screen displaying a grid pattern. The man is pointing towards the screen. The overall design is modern and professional, with a focus on technology and research.

Preface

Unity in the face of diversity – explore the universe, advance aeronautics research, increase mobility by means of networked transport systems, develop sustainable concepts for energy supply. These are diverse objectives, which are closely thematically linked to each other and serve to advance our modern society. Over the past year, we at the German Aerospace Center (DLR) have come a step closer to achieving these objectives.

Society and politics have great expectations regarding research and development. Research must be carried over to beneficial technologies in the medium-term and allowed to develop into innovations. At DLR, we set ourselves this high standard. By means of our own cutting-edge research we bridge the gap between basic university research and applied, industry-orientated research.

At this point, I would like to draw your attention to some outstanding examples of our activities over the past year. At the beginning of 2008, we were able to focus all our efforts on tracking the launch of the European research laboratory Columbus and the first Automatic Transfer Vehicle (ATV) to the International Space Station (ISS). The Federal Chancellor heralds the commissioning of Columbus as a shining light of European cooperation and, as a national research centre, we are proud to have made a significant contribution to its realization.

With high priority in aeronautics, we analyzed and assessed new, efficient engine concepts as well as intelligent airport management. One of the goals is to increase the utilization capacity of civilian airports with the simultaneous guarantee of security. The DLR transportation research colleagues insisted upon pursuing the use of satellite data for traffic data recording and the use of new, lightweight materials for progressive vehicles. A reduction in weight of car front ends of up to 32% is to be expected and with it a massive reduction in fuel. Activities for linking gas turbines and high temperature fuel cells to a hybrid power plant are also particularly promising in terms of increased electricity generation. Our Energy research makes us a leading player and sought-after partner throughout Germany and Europe.

Unity in the face of diversity – we hope to develop new ideas and optimize existing concepts by means of the interdisciplinary collaboration of our activities in aeronautics, space travel, transportation and energy. Satellite technologies are used for transportation research, space robotics is used in the field of medicine and highly-stable materials from aeronautics are used for energy systems. Producing synergies and carrying out innovative research in this way also requires a strong ability to communicate and willingness to cooperate in our lively, globalized

research environment. All our research work is carried out in close cooperation with universities and with the agreement of our industrial and commercial partners.

Throughout the past year, DLR research topics have given rise to fascination and enthusiasm. We have depicted some of the selected scientific highlights of the past reporting year in the first section of our annual report, the "Research Results". Entrepreneurial thought and flexibility have contributed to our economic successes. The second section of our annual report, "Economic Development", provides you with an insight into our activities for enhancing our entrepreneurial skills, for example, with regard to economic viability, well-balanced external funding business, demand-orientated human resources development, support for young scientists and quality assurance as well as for managing the extensive research infrastructure.

It has been possible to achieve many of our demanding scientific and economic objectives thanks to the commitment of our approx. 5,700 members of staff. I am confident that we will be able to retain the momentum generated throughout the coming year and continue to carry out our diverse activities in a cooperative, dynamic and uniform manner.



Cologne-Porz, in December 2008

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



RESEARCH RESULTS





Aeronautics

The research programme for the Aeronautics business division is orientated towards national and European objectives, as they are presented in medium-term programmes with their vision for 2020. The aeronautics programme is characterized by the combination of civil and defence-orientated research. DLR is anxious to further develop its skills in the interests of both fields of application. Civilian work is carried out under the umbrella of the HGF research division Transport and Space, which was evaluated in 2008 with regard to the second programme period 2009 to 2013.

As previously, DLR has also successfully participated, with its research topics, in national and European research programmes within the reporting period. This applies both for the Federal Government's Aeronautics Research Programme (LuFo IV) as well as for the 7th EU Framework Programme for Research and Technological Development, including the Joint Technology Initiative "Clean Sky" as well as the SESAR programme (Single European Sky ATM Research).

Within the context of its aeronautics research areas; fixed-wing aircraft, helicopters, propulsion technologies, air traffic management and the environment, DLR commenced numerous new internal projects during the reporting period: amongst other things, their objectives are to create a process chain for modelling, analyzing and assessing different engine concepts, to simulate scenarios, work processes and task/role allocation in a virtual flight control tower for several airports as well as to quantify the climatic effects of the overall air traffic system using selected representative mission and emission scenarios.

New results and scientific findings from these project developments are contributing to the increase in the performance and competitiveness of the national and European aeronautics and air traffic industry and satisfying political and social requirements.

Unmanned Combat Airplane Vehicle (UCAV) 2010

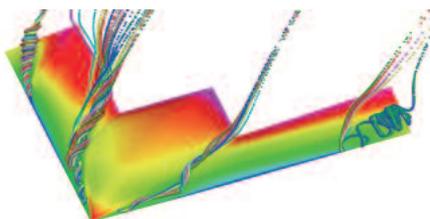
Numerical and experimental analysis for increased aircraft stability

In the UCAV-2010 project, numerical and experimental methods are being developed for investigating the stability and controllability of blended-wing body configurations. The high leading edge sweep of these configurations means that the flow field is affected by strong vortices on the upper surface of the aircraft.

It is difficult to predict the stability and controllability of blended-wing body configurations because of its vortex-dominated flow field, as the longitudinal and lateral stability of the aircraft depends on the stability of these vortices.

Reliable calculation of this flow for a realistic range of angle of attack is only possible using higher quality numerical procedures. For example, the illustration shows the calculated, vortex-dominated flow field around a blended-wing body configuration. In order to successfully determine the stability characteristics of the aircraft, it is necessary to gather adequate numerical data and analyze the driving physical effects.

Analysis of the numerical results leads to an understanding of the controllability of blended-wing configurations. Such understanding then solves a fundamental issue regarding the design of blended-wing body configuration which was previously unclear.



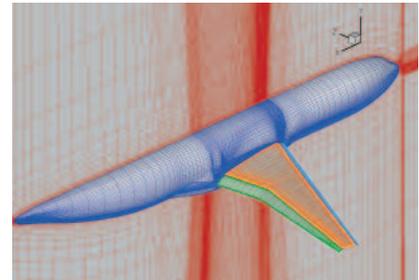
Separated flow around a blended-wing body configuration for angle of attack and sideslip angle at subsonic speeds

Optimizing the Flap Position of the Aircraft

Drag of the wind tunnel model reduced by 2.5%

Within the context of the DLR internal project MegaOpt and the Lufo-III joint research project MEGADESIGN, a gradient-based optimization method was developed which allows the sensitivities of the cost function to be determined efficiently and independently from the number of design parameters, on the basis of the adjoint flow equations. In addition, it was possible to significantly reduce the effort and expense of optimization by skilfully selecting the parameterization and mesh generation strategy (starting basis for the flow solution).

With this optimization chain, a drag minimization of the DLR-F11 wing/fuselage high-lift configuration was carried out by means of optimization of slat and flap setting. It was possible to reduce the drag by approx. 2.5% using six design parameters. The DLR TAU code was used to determine the cost function.



Computational grid for flow simulation around a wing/fuselage high lift configuration



Wind tunnel model of the DLR-F6 configuration in NASA's NTF

Project MDOrmec

Comparison of numerical methods with the experiment

The series of international Drag Prediction Workshops aims at evaluating current numerical methods with regard to their suitability as practical aerodynamic tools by comparing them with high-quality experimental results of the familiar F6 wing/body configuration (made available by DLR) featured local separation but does not exhibit the level of detail and accuracy currently required. Advances of the numerical methods demonstrate that these experiments should be repeated following modern accuracy requirements.

The F6 model is being refitted and geometrically calibrated by DLR in order to achieve first-class experimental results. Furthermore, the deformations anticipated due to aerodynamic forces are being determined in advance by DLR. Measurements are carried out in the National Transonic Facility at Nasa and have been planned for the ONERA S2MA wind tunnel. Analysis of the existing, new measurements proves that the geometrical changes applied on the fuselage reduced the local separation and that knowledge of the anticipated deformations lead to excellently documented experimental results. With the comparative measurements from the ONERA tunnel, brilliantly documented data of outstanding quality can be made available to the Drag Prediction Workshop.

CFC Fuselage for the New Generation of Aircraft

Inductive preforms facilitate tenfold acceleration

For reasons of efficiency, maintenance and image, it is planned that modern carbon fibre semi-finished products ("Carbon") will be used extensively in all important structural components for the next generation of large aircraft. Despite its many advantages, the absence of available fast processes, means that production entails considerable additional costs and that the necessary quantities are not achievable. The use of inductive preform technology developed by DLR and partners means that the most time-consuming manufacturing step can be accelerated tenfold and simultaneously the quality can be significantly improved due to automation, without appreciable additional costs.

In order to manufacture cost-effective fiber-reinforced components, a preform is initially constructed using dry 2D fibre semi-finished products. For this, the 2D semi-finished products are adapted to the 3D geometry of the component being manufactured inside a forming die. A hot melt adhesive is used for fixing the fibre layers. In conventional procedures, this adhesive must be heated by means of hot air or thermal conduction, which is however very time-consuming. The transformer principle familiar in electrical engineering has been adapted in order to significantly accelerate this important process step. Electrically conductive carbon fibres are used as a secondary coil (see illustration) which enables a very large amount of electrical power to be transferred. This means that the melting temperature can be achieved precisely within fractions of a second.

The technology was investigated under a direct contract by Airbus and was first implemented in a prototyping installation

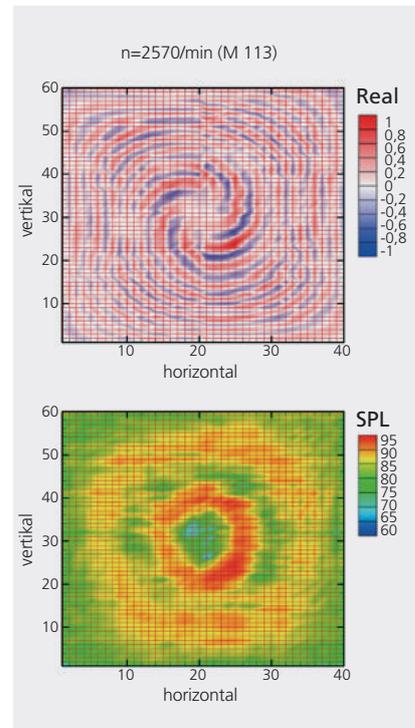
within the scope of the EU “MOJO” project. With this installation, it was possible to manufacture preforms in an automated way and in a very short times. On the basis of this success, the installation technology in the DLR project “CFC Fuselage NG” was further developed for complex 3D components and is currently being used, for example, for integral fuselage doorframe structures. It is expected that industrialization may occur in the short-term so that this technology can be made available for the coming generation of aircraft.

Fan for Future High-Bypass Engines

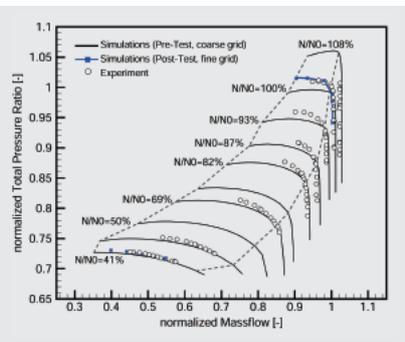
Assessment of aerodynamic performance and the sound radiation of the fan stage

On the basis of concept investigations in the EU “SILENCE(R)” project, a fan demonstrator was aeromechanically and aerodynamically planned, designed and constructed using a scale of 1:3. Experimental investigations of the test compressor (DLR-UHBR Rig), the rotor of which is representative of a fan from future generations of engines with a high bypass ratio, were carried out on DLR’s large M2VP axial-flow compressor test rig in Cologne-Porz. In addition to

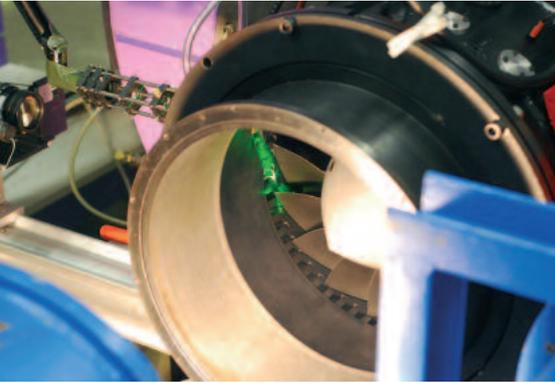
evaluating aerodynamic performance with regard to the requirements of future high-bypass engines, the objective of the extensive experimental and theoretical investigations is to analyze the sound radiation of the fan stage. At the same time, the measured characteristic map of the fan stage, shown in the illustration, documents the fact that the aerodynamic design objective has been fully achieved and is also confirmed by the numerical simulations. Within the context of the acoustic evaluation, a far-field antenna was designed and constructed, which has been integrated into the large settling chamber of the M2V test rig in Cologne, within the scope of the ongoing LuFo III project NASGeT. It contains 40 microphones, arranged equidistantly in a semicircle with a diameter of six metres (see illustration). The microphone installation can also be seen in extreme close-up. The antenna can be turned easily by 180°, so as to cover a semi-circular area around the inlet. The measurement data were recorded with the microphone measurement data within the inlet and with a trigger signal from the rotating UHBR fan model under conditions of chronological synchronism. In this way, the far-field data are averaged synchronous to the rotor in order to clearly separate the emitted tonal sound field components from the sound field components which are not synchronous to the rotor. The attainable dynamics of the far-field image are massively increased in this way and amount to approx. 30dB (see representation of the sound fields).



Sound field in the first harmonics of the blade passing frequency, measured by the far-field antenna in the settling chamber, above: absolute value in dB, below: phase-locked real component with rotating rotor



Construction of the UHBR rig at DLR Cologne's M2VP

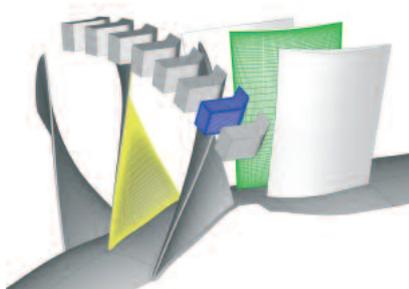


Experimental flow investigation with PIV on the transonic axial-flow compressor with CT at Darmstadt Technical University

Optimizing modern Turbomachines

Combination of modern measurement and simulation technologies for flow investigation

Supporting the optimization of modern turbomachines with regard to increased efficiency and performance requires highly productive, calculation time-optimized flow solvers as well as suitable flow measurement procedures for code validation. In AG TURBO's joint research project COOREFF-T ("CO₂ reduction by means of efficiency"), a casing structuring (so-called "Casing Treatment", abbreviated CT) was implemented on the Darmstadt Technical University's transonic compressor. This casing structuring was designed by MTU Aero Engines GmbH, specifically taking into consideration optimal optical accessibility for the optical measurement technology used. The impact of the CT on the performance and the characteristic map behaviour of the stage were investigated both numerically and experimentally (see illustration). For this purpose, the flow solver TRACE developed at DLR was further developed for the transient and simultaneously calculation time-optimized simulation of any step and CT geometries. With the help of extensive measurement procedures "Particle Image Velocimetry" (PIV, see illustration) used in this project by DLR, it for the first time was possible to make widely spatially distributed flow data from a transonic compressor with CT available for validating TRACE calculations. The result of the study is characterized not only by the outstanding data quality of the PIV measurements, but also in particular by the almost congruent results of simulation and experiment (see illustration), which means that, with the TRACE Code, a highly productive instrument for optimizing the efficiency and characteristic map behaviour of modern turbomachines with variable geometries will be available in the future.



Design of the compressor stage (yellow: rotor, green: stator) with the geometry of the casing structuring (CT, blue)

AVIATOR 2030

Requirement profiles for human operators in future air traffic systems

Regarding the implementation of future Air Traffic Management (ATM) systems, it is anticipated that the predicted increases in traffic are to be facilitated mainly by means of technology-orientated solutions. This has exerted intense pressure to change on traditional careers in aeronautics and throws into question the future ability requirements for air traffic controllers and pilots.

Therefore, in the AVIATOR 2030 project – on the basis of the present situation – the job description-related aspects of the future concepts for air traffic are examined with the involvement of the major professional associations and tested for their effects on future ability requirements. For this, various workshops were carried out within the reporting period with air traffic controllers from DFS Deutsche Flugsicherung GmbH and pilots from Deutsche Lufthansa AG. At the same time, particular reference was made to the Single European Sky Aviation Research Programme's (SESAR CONOPS) Concept of Operations which was published in autumn 2007. The professional associations initially worked on the concept of the workshop for the future, each considering the possible changes in their own professional environment. Later, both groups of participants came together in an integrative workshop with common ideas regarding future concepts in air traffic. Alongside the creation of a future concept in ATM, from the point-of-view of the professional person the central project result consists in the early derivation of the qualifications

required by those concerned. If one presupposes a career span of approximately 35 active years, then it is never too early to consider possible changes to the requirement profile: it should be possible for anyone selected as a trainee air traffic controller or trainee pilot before 2010 to be gainfully employed in the aeronautics industry in 2040.

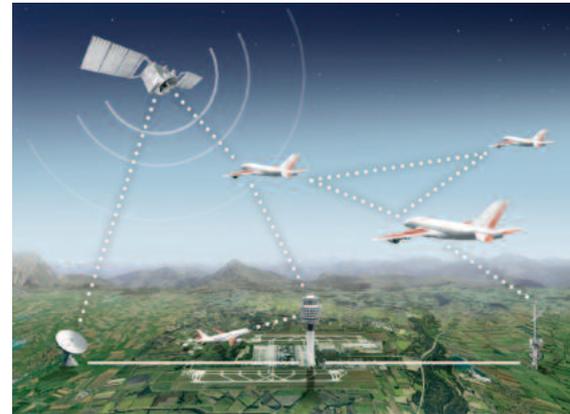
Networking the Sky

Facilitation of cockpit and passenger communication

In the coming years, it is anticipated that pilots and passengers will be able to draw on numerous data connections: data links in VHF and L-band frequencies are available for overland flight routes, a WiMAX standard for very high data rates is currently being developed in areas surrounding airports, new satellite connections are specified for cockpit and passenger communication in different frequency bands. What is currently missing is a concept which enables you to access cockpit and passenger applications efficiently using these different data connections.

Acting as coordinator, the DLR Institute of Communications and Navigation has initiated the research project "Networking the Sky" (NEWSKY) within the scope of the 6th EU Framework Programme. In place of individual communication systems for different air traffic control areas and applications, solutions are being developed for networking these systems. Modular system architecture and standardized interfaces enable a high synergy effect to be achieved.

NEWSKY provides technological support for renouncing proprietary solutions in favour of using widespread Internet technologies in aeronautics. Therefore, NEWSKY is strongly represented both by the ICAO (International Civil Aviation Organization) as well as by the IETF (Internet Engineering Task Force).



Networking aircraft using various data links for cockpit and passenger communication



Hamburg Airport

Field Test Platform at Hamburg Airport

New systems are tested directly at congested airports

At Hamburg Airport, an operational A-SMGCS (Advanced Surface Movement Guidance and Control System) is being installed in 2008/2009 which was planned by Flughafen Hamburg GmbH (FHG) and Deutsche Flugsicherung GmbH (DFS). This system comprises the A-SMGCS Surveillance and Control functions (Levels 1 and 2).

In parallel to the A-SMGCS installation, DFS, FHG and DLR also signed a cooperation agreement in January 2008 which includes the development and use of a field test platform at Hamburg Airport. This unique test environment is split into a R&D room (in the DFS building), the flight control tower and the apron control room. These are currently under construction, whereupon basic structures are already being used in projects (e.g. CARMA = Car Management on Aprons).



Apron Control

The cooperation partners DFS, FHG and DLR intend to develop new and/or auxiliary A-SMGCS system components as well as promising tools in the ATM/ATC sector. They also plan to involve universities and the industry in the R&D work.

Together with the A-SMGCS operational data, this field test platform provides a unique opportunity to test newly developed systems and tools directly at a congested airport using the shadow mode and assess their usefulness. In a constellation like this, the reaction times between innovative new developments and user evaluations are particularly effective.

PAVE

Approaching helipads quietly and safely

The successful use of helicopters in the medical emergency services, rescue operations and military missions is limited due to bad weather conditions, in particular poor visibility. At the same time, helicopters often operate at ground level in scenery with ever-changing obstacles (trees, masts, etc.). Overall, the pilots' workload and risk of accidents is significantly higher in such complex missions than for fixed-wing aircraft.

The PAVE (Pilot Assistant in the Vicinity of Helipads) project is defined against this background. PAVE's main objectives are to increase the pilots' situation awareness through the visualization of significant flight information, to improve the helicopter's operational readiness in bad weather conditions (e.g. fog) and to reduce noise emissions on the ground (helipads are often located near to areas sensitive to noise, e.g. hospitals). For this, intuitively operable flight planning functionalities have been developed to provide

support in complex missions. In addition, flight control algorithms have been developed to calculate the reference variables (speed, heading, altitude), which either serve as input for the flight control system during automatic take off or show the pilot predefined flight paths during manual take-off. An air show with an external pilot in December 2007 impressively demonstrated that PAVE had achieved these objectives. Amongst other things, a considerable part of the flight was completed automatically. Take-off and landing were manually controlled using the PAVE display, which facilitated a particularly quiet landing.

It is anticipated that the expertise developed can be transferred to industrial products over the next few years. It also constitutes the basis for the DLR ALLFlight (Assisted Low Level Flight and Landing on unprepared landing sites) project, the objective of which is to facilitate the manual or automatic landing of an unmanned helicopter with limited or non-existent visibility on an unprepared landing site.



PAVE – Pilot Assistant in the Vicinity of Helipads

GOAHEAD Wind Tunnel Experiment

Comprehensive helicopter wind tunnel measurement completed

All helicopters which are currently airborne underwent considerable aerodynamic modifications after their maiden flight, as design procedures were unable to predict the complex aerodynamic interactions accurately enough. After intensive development work in the German-French projects CHANCE (Complete Helicopter Advanced Computational Environment) and SHANEL (Simulation of Helicopter Aerodynamics, Noise and ELasticity) in the field of numerical fluid mechanics, URANS (Unsteady Reynolds Averaged Navier-Stokes) procedures are now available which have the potential to calculate the aerodynamics of entire helicopters with the required level of precision. Admittedly, suitable validation data had not existed previously in order to provide evidence of this potential.

This gap was bridged in spring 2008, with the successful conduct of the wind tunnel campaign within the framework of the EU project GOAHEAD (Generation of Advanced Helicopter Experimental Aerodynamic Database for CFD code validation). A NH90 main rotor-fuselage-tail rotor configuration was tested in diverse flight attitudes, ranging from slow flight, through high-speed flight, right up to a flight attitude corresponding to spiralling flight under a heavy load. On the basis of the highly extensive instrumentation (pressures on the fuselage, rotors, walls of the wind tunnel, hot films on the fuselage and rotors, infrared images of the fuselage, flow field measurement using PIV, measurement of the blade position and blade shape, micro tufts on all areas with the risk of flow separation), this has been the most complex helicopter wind



GOAHEAD entire helicopter model in the wind tunnel (DNW LLF)

tunnel measurement carried out by the DLR team so far. Consequently, these data provide a solid basis for validating the numerical procedures. The evaluation and validation work within the framework of the GOAHEAD project has started and should be completed for the structured code FLOWer with regard to aerodynamic performance by the end of 2009. Over the course of the coming years, the database shall serve as a point of reference for many CFD methods.

Environmentally Friendly Flight Route Optimization

Selective prevention of condensation trails and cirrus clouds

According to the IPCC report 2007, the climatic effect of air traffic is primarily caused by the emission of carbon dioxide and nitrogen oxide, by the formation of condensation trails as well as by the emission of aerosols, which change the natural conditions for the formation of cirrus clouds and modify their properties. According to the current state of knowledge, the climatic effect of additional clouds caused by air traffic is about as severe as the CO₂ produced.

The research network "Reduction of Condensation Trails by means of Flight Route Optimization", in which the DLR Institute of Atmospheric Physics works together with Deutsche Lufthansa, the German meteorological service and German air traffic control, is investigating the possibility of reducing the climatic effect of air traffic by optimizing flight routes. This "klimazwei project" by the Federal Ministry of Education and Research intends to assess the overall radiation effect of potential condensation trails throughout

their lifetime based on weather forecasts and compare this with the radiation effect of CO₂ (and later also NO_x) emissions, which are produced due to extending the flight routes while reducing the generated condensation trails. The selective prevention of condensation trails and cirrus clouds, which one would expect to contribute considerably to the warming, allows there to be a significant impact on the overall balance of the climatic effect of air traffic. For this, deviation from the optimal flight altitude and route must only occur relatively infrequently.

On the basis of earlier work and optimization procedures already proven in daily practice, the most favourable flight profile should be calculated using the given meteorological situation and taking into account the traffic situation, anticipated radiative forcing and cost/benefit ratio. Since the benefits of an optimization like this are essentially dependent on the reliability of the humidity forecasts and the clouds at flight altitudes, particular attention is paid to measuring and modelling these parameters. Satellite data are used to verify these forecasts. At the end of the project, a comparison of costs and benefits is made available for the developed approaches.

C²A²SE

Europe's fastest computer for aeronautics research

The professional operation of high performance computers and visualization hardware is required in order to meet the ever-increasing requirements of applied research and the air traffic industry. In May 2008, the following activities were commenced with the dedication of the

interdisciplinary centre of excellence in numerical aircraft simulations C²A²S²E (Centre for Computer Applications in AeroSpace Science and Engineering): processes, methods and numerical procedures can only be developed to the extent that they enable high-precision simulation of an aircraft over the entire flying range, before its maiden flight, on the basis of numerical data sets. C²A²S²E is an innovative partnership between Airbus, the state of Lower Saxony and DLR. At the centre Europe's fastest high performance computer for aeronautics research is installed. The establishment of the C²A²S²E centre is planned for a period of at least 15 years. This provides scientists and engineers with a unique research platform for the future of air traffic.



Computer simulation of complete A380

Space Agency and Space R&D

At the German Aerospace Center (DLR), German national and international space flight activities are merged: at the level of research by means of the DLR space research institutes and at the level of space flight politics by means of the DLR Space Agency, which is responsible for implementing the national and international space flight activities on behalf of the Federal Government. DLR's own research institutions provide scientific, technological and operational contributions. The integrated German space programme combines the German participation in the European Space Agency (ESA) programmes, the EUMETSAT participation, the national space programme, the DLR R&D programme "Space" and additional space flight activities in science and industry. In the process, DLR prominently demonstrated its ability and efficiency in national and international space flight missions and research projects in cooperation with its partners. The following examples provide an overview of selected results and events over the past year.

Highlights from the Space Agency

ESA Council

Preparation for the Council of Ministers and election of new chair- persons

Various extraordinary meetings of the programme councils and 4 council working groups (CWGs) have taken place since June 2007 in preparation for the ESA Ministerial Council on November 25/26, 2008 in The Hague. At the conference, alongside the treatment of topics related to space flight politics (reforming voting rights, procurement policies, European space flight politics, ESA centres), a range of fundamental decisions were considered as the core element:

- obligatory activities regarding the general budget, scientific programme and Guiana Space Centre in Kourou,
- lengthening of ongoing programmes on the various topics – primarily Global Monitoring for Environment and Security (GMES), telecommunications, International Space Station (ISS), Ariane, technology,
- as well as new programmes – particularly Meteosat Third Generation (MTG), initiative for monitoring climate change, European data relay system, outer space observation, manned space travel and exploration.

At the ESA Council on March 12/13, the ESA Council elected Mr. Maurici Lucena (Spain) as its new chairman. Mr. Eric Beka (Belgium) and Mr. David Williams (United Kingdom) were elected as deputy chairmen. The new chairmen assume their roles on July 1, 2008 for a period of 2 years.

Columbus and ATV Docked to the ISS

Federal Chancellor heralds the commissioning of Columbus as a shining light of scientific and European cooperation

On February 7, 2008, the European research module Columbus took off with the US space shuttle Atlantis for the International Space Station (ISS). The German astronaut Hans Schlegel and his French colleague Léopold Eyharts were members of the crew on the Columbus mission, which set up and put into operation the space laboratory on the ISS. At a commemorative event in the Federal Ministry of Economics and Technology (BMWi), Federal Chancellor Dr. Angela Merkel heralded the commissioning of Columbus as a shining light of scientific and European cooperation

On April 3, the first Automatic Transfer Vehicle (ATV) docked independently to the ISS. The ATV "Jules Verne" is the most complex spacecraft to be built throughout Europe. It serves the transport of supply goods and experiments as well as the continuous path correction of the ISS. With the commissioning of Columbus and the successful docking of the ATV, the entire programme budget for 2008 amounting to 314 million was approved for awarding contracts in the ISS operating programme.

European Carrier Family

First launch for Sojus carrier and Vega expected at the end of 2009

In 2007, it was possible to reach milestones as regards the expansion of the European carrier family by means of the Russian Sojus carrier and the European

new development Vega. The construction of the Sojus launch facilities is progressing well and the first experts and elements of the ground infrastructure from Russia are expected in the middle of 2008. In the meantime, important milestones have been reached with the capabilities of the Vega carrier rocket. However, there also have been additional delays which mean that the first launch can now not be expected before the end of 2009.

Summit Meeting Satellite Communication

150 experts discussed future trends in the field of space flight technologies

The future of satellite communication was the central topic of the two day national symposium "Satellite Communication in Germany", which was held at the Petersberg near Bonn in March 2008. At the invitation of the Space Agency, guests from politics, industry and research discussed current focal areas and new trends in this field.

In addition to about 40 technical papers, more than 150 experts took part, including representatives from large and medium-sized companies engaged in the field of space flight technology as well as scientists from leading university locations and large-scale research establishments. Furthermore, DLR was able to welcome high-ranking representatives of the BMWi and the German Federal Ministry of Defence (BMVg) as well as ESA delegates to the Petersberg.



ATV docked to the ISS

Bose-Einstein Condensate Generated

Fundamental physical research in the drop tower in Bremen

In November 2007, both a scientific and also a technological breakthrough were achieved in the drop tower in Bremen with the generation of the first Bose-Einstein condensate in the world under zero gravity. It was possible to sustain the condensate made from supercool atoms for one second, which was longer than previously. The apparatus used for this is characterized by its compact properties and robustness in comparison with terrestrial test facilities used previously.

At the same time, this success opens up the best perspectives for excellent fundamental physical research in the drop tower in the future (atom optics) as well as for later experiments on the International Space Station.

Leading German research groups in this field from the University of Hanover, the Humboldt University in Berlin, the University of Hamburg, the Max Planck Institute for Quantum Optics in Munich and the ZARM are involved in the joint research project promoted by the Space Agency.

Networking at the First Space Industry Conference

Major resonance at the first Space Industry Conference in Bremen

In June 2008, the first Space Industry Conference took place in Bremen with well over a hundred participants. At the

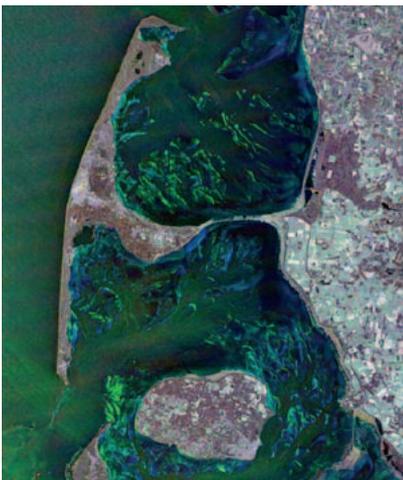
invitation of the Space Agency, representatives from fifty German aerospace companies met in order to improve the cooperation between large as well as small and medium-sized companies in the German aerospace industry. The hosts were the two Bremen-based space companies EADS Astrium GmbH and OHB Technology AG. Current and possible future projects in six application areas (Robotics and Rovers, Experiments Under Weightless Conditions, Power Supplies and Power Electronics, On-board and Ground Simulation Software, Satellite Drives, and Camera Systems and Sensors) were presented and discussed.

Investigation of Carrier Strategies

Cost-effectiveness versus productive efficiency

Within the context of the WOTAN procedure ("Economic Feasibility Studies for Orbital Transport Solutions of Ariane Successor Carriers"), the success of designing carrier strategies on the basis of classical carrier rockets, which have a significant economic advantage compared with today's generation of carriers when it comes to operation, was investigated. From an economic viewpoint, current results show that an expedient minimization of the number of booster rockets leads to a requirement for powerful engines and lightweight structural designs, whose advantages compensate, at least in part, for the higher production expenditure.

Joint projects from Space Agency and Research and Development



Sylt

TerraSAR-X in Operational Mode

Outstanding performance of the satellites facilitates faultless data processing chain

On January 7, 2008, the German TerraSAR-X radar satellite commenced operations in accordance with the deadline agreed by DLR and Infoterra GmbH. As a prerequisite for this, the Operational Readiness Reviews were successfully completed in December 2007.

Over the last few months, scientists and engineers from DLR and EADS Astrium have executed progressively the commissioning of the satellite and a calibration. The benefits of the TerraSAR-X system are universally outstanding. The satellite as well as the associated ground equipment operate without any difficulty and create a functioning data processing chain.

Disaster Assistance from Space

Coordinated deployments of the UN SPIDER during the flooding in Namibia and Myanmar

In the foreseeable future, satellite scenarios and maps generated from them, which were created in connection with disasters, shall be supplemented by additional information gained in the field, coordinated by means of the UN SPIDER programme (SPace-based Information for Disaster management and Emergency Response). The Bonn-based UN-SPIDER office is assisted by, amongst others, the national space programme as well as by the provision of two DFD experts from Oberpfaffenhofen.

An example of when Earth observation was helpful in disaster assistance was with the supply of information regarding the severe flooding in January 2008 in Namibia/Angola and the subsequent tropical cyclone "Nargis", which hit Myanmar on May 2, 2008. The overall extent of the disaster was unknown for a long time due to restrictive official information policies. The precise extent of the flooding could only be determined on the basis of images from the new German TerraSAR-X radar satellite and the Japanese ALOS. The generated map material served the coordination and preparation of international emergency measures.



Flood plain from ALOS/PALSAR data of May 6, 2008 – Irrawaddy Division (scale of 1:100.000)



Galileo test satellite
Giove B (© ESA)

SCIAMACHY

Sixth birthday of the environmental instrument on board the ENVISAT

SCIAMACHY – an environmental instrument on board the European ENVISAT satellites – is a joint project from Germany, Belgium and the Netherlands. In Vaals near Aachen on May 19, 2008, the three participating space agencies, DLR, NIVR (Netherlands) and BIRA (Belgium) celebrated six years of SCIAMACHY being in space. The SCIAMACHY data shows, for example, that the atmospheric composition is changing faster than predicted both as a result of human activity as well as due to changed natural processes caused by climate change. SCIAMACHY sees a sharp rise in nitrogen dioxide in countries and regions with very rapidly growing economies, in particular in China. After an improvement phase in the 1990s due to effective EU regulations, SCIAMACHY now detects a stagnation of the nitrogen dioxide reduction in Western Europe, which could mainly be blamed on increasing traffic volumes. On the east coast of the USA, SCIAMACHY recently observed a reduction in nitrogen oxide emissions in connection with the use of nitrogen oxide filters in coal-burning power plants in order to realize ever-tightening environmental requirements.

Second Galileo Test Satellite Launched

Additional phases in constructing the European satellite navigation system

An additional phase was successfully completed for the European satellite navigation system Galileo. Prior to the first of the total of 30 Galileo satellites

which are to be launched from 2010, it is necessary to put some of the fundamental technologies to the test (atomic clocks, signal generators). For this purpose, after GIOVE A the second Galileo test satellite GIOVE B was successfully launched on April 27, 2008. Until now, all systems have been functioning without interference. The results gained using GIOVE A and B are crucial for the development of Galileo as they reduce the technical risk and, in doing so, contribute to the success of the entire project.

SEA GATE for Galileo Users

Safe navigation in Rostock port

With SEA GATE, the first test environment for the future satellite navigation system Galileo has been made available to users since May 2008 in Rostock sea port. It enables maritime Galileo applications to be tested long before the actual satellite signals become available. In this way, companies are able to develop new products and services at an early stage. The SEA GATE project is being carried out by EADS-RST Rostock System Technik GmbH on behalf of DLR with funding from the BMWi.

The Galileo signals emitted within the SEA-GATE test environment can be used for other logistical and cargo handling processes in the port, for example for container traffic. SEA GATE is monitored by means of a "Monitor and Control Station". From here, various frequency configurations can be realized at the request of registered users.

DLR Parabolic Flight Campaigns

136 experiments carried out in zero gravity

In September and November 2007 as well as in April 2008, DLR arranged the 10th, 11th and 12th parabolic flight campaigns with the Airbus A300 ZERO-G.

Over the total of 12 flight days, DLR provided internal as well as external researchers with the opportunity to carry out 136 experiments in zero gravity (in particular with regard to issues of biology, human physiology, physics and materials research). Approx. 500 international scientists, students and school pupils benefited from this opportunity to experiment during the three campaigns.

Student Competition regarding REXUS and BEXUS

Ideas for experiments on sounding rockets

In November 2007, the DLR Space Agency launched the first ideas competition for experiments relating to sounding rockets and balloons under the names REXUS and BEXUS. Until January 7, 2008, students were able to submit proposals for experiments to be carried out in the gondola of a balloon in autumn 2008 or on rockets in spring 2009.

In June 2008, the DLR Space Agency and the Swedish National Space Board SNSB concluded a contract for the entire REXUS and BEXUS programmes. Half of the rocket and balloon payloads are being made available to German and Swedish students respectively. The SNSB also opened the Swedish share up to students from the remaining member states of the European Space Agency (ESA).

On Orbit Verification (OOV)

Demonstration of innovative technologies under genuine space conditions

In August 2007, DLR and the Russian space agency Roskosmos signed a Memorandum of Understanding regarding the "On Orbit Verification" (OOV) programme. In this contract, both sides came to an agreement regarding the implementation of projects for technology testing on the basis of the German OOV programme.

With the OOV programme, verification flights should be facilitated in order to verify innovative techniques and technologies under genuine space conditions and to demonstrate their function. On the one hand, this relates to the development and the launch of the independent German small satellite platform TET (Technology Test Carrier) on the basis of the BIRD satellite system (Bi-spectral InfraRed Detection) developed by DLR and on the other hand to the preparation of piggy-back flight opportunities for newly developed German equipment on other satellites.



Balloon launch (© SSC)



Corot on the search for extra solar planets

NASA Mission DAWN

Optical mapping by Vesta and Ceres planned

DAWN is a NASA discovery mission, which was successfully launched from Cape Canaveral using a Delta II rocket on September 27, 2007. The DAWN probe should examine both large asteroids Vesta and Ceres in succession from orbit between 2011 and 2015. As one of four payloads, Germany supplies two identically constructed Framing Cameras (FCs) which are primarily used for optically mapping the asteroids but are also required for navigating the probe around the asteroids. For this reason, the FCs are classified as critical to the mission. The recipient of the DLR Space Agency's funding is the Max Planck Institute for Solar System Research (MPS) in Katlenburg-Lindau, which developed and manufactured the FCs in cooperation with the DLR Institute of Planetary Research in Berlin.

COROT Discovers Four Planets

The telescope measures the interior of stars and searches for extra solar planets

On May 20, 2008, at a conference of the IAU (International Astronomical Union) in Massachusetts, USA, three new discoveries were announced by the CoRoT team: two new planets and an object which can be classified as between a brown dwarf, a failed star and a planet. Therefore, CoRoT has discovered a total of four planets and a highly interesting object the true nature of which is still to be clarified. The COROT mission has two scientific objectives: on the one hand, the telescope should measure the interior of the stars (astroseismology) and, on the other hand, it should

locate extra solar planets in selected star fields across the Milky Way. Particular attention is paid to rocky planets whose diameters are roughly the same as that of Earth.

COROT originated under the management of the French space agency CNES. DLR has an interest in this project in many respects. On behalf of the Federal Government and with financial backing from the DLR Space Agency, the on-board software was developed and tested at the DLR Institute of Planetary Research in Berlin over a period of five years. Alongside the control of the instruments and the precise orientation of the satellites, the software also undertakes a share of the data processing and transmission. In return for this, the German researchers receive the measurement data, which they likewise evaluate.

SOFIA – Infrared Telescope

Stratosphere observatory for astronomy

The "Stratosphere Observatory for Infrared Astronomy" SOFIA is a German-American project for research into the universe. The formation and development of stars and planetary systems from the interstellar gas and dust clouds shall be monitored in particular using a 2.7 m telescope. Instruments from the Institute of Planetary Research in Berlin-Adlershof are also used for this.

After the observatory's ten successful first test flights, SOFIA has been based, according to plan, in Palmdale, roughly 80 kilometres south of the NASA Dryden Flight Research Facility, since January 2008.

Icy Moons in the Saturn System

Fascinating images and mapping with Cassini

Nowadays, white areas virtually only ever appear on the map on other celestial bodies, such as Saturn which is more than a billion kilometres from Earth. A group of scientists from the Institute of Planetary Research has compiled an entire atlas of Saturn's moon Dione, which was published by NASA on May 20, 2008.

DLR's cartographers also used image data from NASA's space probe Cassini. Since July 2004, this extremely complex planetary mission has been in orbit around Saturn, the second largest planet in the solar system. In addition to many other measurements, Cassini's camera system has captured fascinating images of the icy moons' in part uncharted surfaces during numerous fly-bys. Aside from scientific analysis, these images also serve the creation of high-precision maps of the moon.

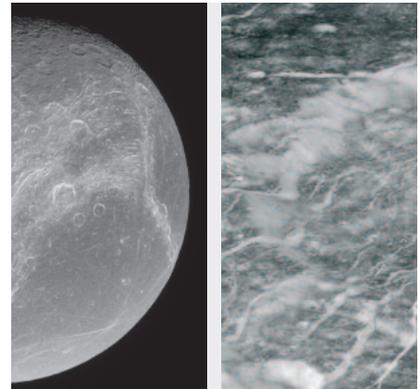
The Dione atlas is the third cartographic complete work of Saturn's icy moons in the world. Prior to this, the DLR group created atlases of the geologically active moon Enceladus as well as of the abnormally-shaped satellite Phoebe. A beneficial use of the maps of Saturn's icy moons has arisen from the opportunity to measure the different diameters of the numerous impact craters as accurately as possible. Statistical analysis of these frequency measurements serves the determination of the surface ages of different geological units.

Earth Observation for Wildlife Rescue

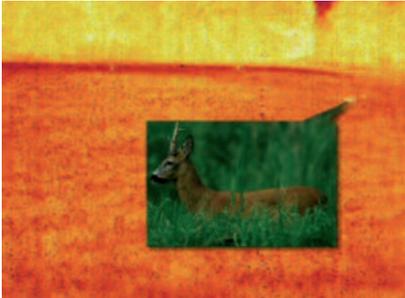
DLR leads the way in wildlife protection in agriculture

Fawns, leverets, and ground-nesting birds hide in tall grass. This can be a dangerous place to hide when farmers are mowing the pastures. Many wild animals are injured or killed by mower cutters. DLR, working with partners from research and industry, has developed new sensor systems which are able to detect the presence of animals at an early stage. From mid-May, these detection methods are put to the test as part of the "Wildlife Rescue" project.

The threat to wild animals is greatest in spring. From mid-May to late June, for instance, the fawns are born in the tall grass, just when the pastures are mowed for the first time. During this period, scientists of the DLR Remote Sensing Technology Institute want to test new sensor systems and methods which they have developed for detecting wild animals. The investigations form part of the "Wildlife Rescue" project, which is supported by the "Microsystems 2004-2009"



Icy moon Dione and its surface structure



Sensors detect wild animals

framework programme of the German Federal Ministry of Education and Research (BMBF). During the three years of the project, a prototype of a wildlife detection system for mowing machines will be developed. Infrared camera, colour video camera, and microwave radar are the technologies which will be tested in order to find the most suitable detection method. DLR's partners in this project will be the medium-sized enterprise ISA, the Department of High Frequency Technology at the Technical University (TU) of Munich, CLAAS Saugau GmbH, manufacturer of agricultural machinery, and the Institute for Agricultural Technology at the University of Hohenheim.

Highlights from DLR's Research and Development

Healthlab on the ISS

Linking psychological and physiological measurements for the first time ever

On May 14, 2008, the cargo spacecraft Progress M64 took off from Baikonur space centre for the International Space Station (ISS). The HealthLab medical equipment developed by the Aerospace Institute was also on board. It is to be used to evaluate and analyze the mental and physiological capability of the astronauts. An objective of the joint German-Russian experiment by the Moscow Institute for Space Medicine (IBMP) and the DLR Institute of Aerospace Medicine is to predict the astronauts' ability to carry out complex tasks.

There is a great deal of evidence to suggest that people react differently under psychological strain, such as stress. It increases the blood pressure and causes sweating and gastric pressure. However, until now it has not been possible to objectively verify the experiences with and in stress situations, either in space or on Earth. In the joint German-Russian experiment, astronauts on the ground as well as on board the ISS are exposed to a controlled stress situation. Mental and physiological reactions are measured during the simulation of a manually controlled docking manoeuvre. This docking manoeuvre is an extremely complex task, both mentally and mechanically.



Preparation of Healthlab

At the same time, six degrees of freedom are to be controlled in space. In compari-

son, driving a car has two degrees of freedom and flying a plane has four. However, a docking manoeuvre such as this is pivotal to the success of an entire mission.

In the future, it will be possible objectively to decide which candidate is in the best position to carry out tasks successfully in a precise situation by evaluating the mental and physiological capability of the astronauts. In the process, psychological test procedures are combined with quantitative physiological measurements for the first time.

Cryogenic Rocket Propulsion System

Reignition successful for the first time

For the first time, in August 2007, a cryogenic upper-stage engine was reignited under space conditions, that is to say in a vacuum, by the testing team at the Institute of Space Propulsion at the Lampoldshausen testing ground.

With this, it was possible to demonstrate one of the most significant characteristics of the Vinci engine recently developed by the French company, Snecma. At the same time, this test series also laid the foundations for the development of a future high-performance version of the European carrier rocket Ariane 5. The ability to reignite an upper-stage engine is the prerequisite for positioning several satellites in different orbits around the Earth.

The rocket motor was ignited after the altitude test facility P4.1 and the Vinci engine were prepared. The first hot run phase amounted to 40 seconds, the second ignition with a hot run duration of the engine of 80 seconds was carried out after a waiting time of a further 148 seconds.

The Vinci engine is run using cryogenic liquid hydrogen, at minus 250 degrees centigrade, and cryogenic liquid oxygen, at minus 180 degrees centigrade, the so-called cryogenic fuels. The hydrogen, which is vaporized due to the diffusion of heat during the combustion process, is simultaneously used to drive the turbo pumps required to inject the fuel. Vinci consequently operates extremely efficiently and is able to reach up to 18 tons of force in a vacuum.

The altitude test facility P4.1 in Lampoldshausen is the only test facility for cryogenic upper-stage engines in Europe. This facility, which is unique in its construction, is able to both simulate the prevalent environmental conditions for the engine in space and ensure that the engine is completely supplied with fuels. The highly-complex and extremely capable facility was developed and constructed at the responsibility of DLR on behalf of the ESA. The test facility P4.1, which was commissioned in 2005, made great demands on the test team with its necessary test procedures. The technology used to create the vacuum conditions in the running engine is a skill which was developed at DLR in Lampoldshausen and is unique throughout the world.

The Institute of Space Propulsion at DLR in Lampoldshausen operates large testing bays for rocket engines. The main engine Vulcain 2 as well as the upper-stage engine Aestus of the European carrier rocket 5 were also tested alongside the Vinci engine.



Vinci engine during the test run in the altitude test facility P4.1



Transport

The Transport programme has developed splendidly over the past five years and falls in the top 10% internationally. This was the conclusion of a review panel made up of internationally renowned representatives from science and industry, which evaluated the Transport programme in April 2008 on behalf of the Helmholtz Association.

The evaluation dealt both with the assessment of scientific capability as well as the transfer potential in concrete applications. All of the passages in the reviewers' report express a great deal of appreciation for our research work. Scientific quality and strategic significance are classified by the Helmholtz reviewers as being very high to extraordinarily high on the basis of international competition. Some research topics are even judged to be unique on an European or international level. The programme participants are acknowledged to be extremely motivated and highly competent and to act in the best possible manner. Consistently, in their report, the Helmholtz reviewers speak in favour of the significant development of DLR transportation research retaining the programmatic orientation.

On the following pages, we will present a small selection from the diverse results of our research work during the period 2007-2008.

DELPHI-Portal

Traffic management for public mass events and disasters

Large-scale events and disasters necessitate intelligent traffic management which is adapted to the specific situation. Otherwise, significant interruptions to traffic flow or problems with deploying rescue personnel and/or the evacuation of those affected is to be anticipated. In order to guarantee the mobility of individuals, goods and services during events, we are working on tools to support national traffic management institutions as well as public authorities and organizations with safety tasks. Within the context of our ARGOS and DELPHI projects, amongst other things, we aim to create a (transport) situation report for the whole of Germany and a prognostic traffic simulation based on it.

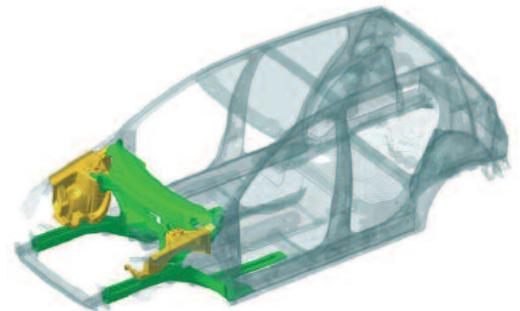
We have arranged two user circles, in Cologne and Munich, in order to determine the precise requirements. All relevant organizations are represented there, i.e. the police, fire brigade, technical relief, traffic management centres, Federal Office for Civil Protection and Disaster Assistance as well as the state ministries. In a first step, a requirement analysis was carried out together with the users. On this basis, we have created a developable version of the DELPHI portal and activated it for external online use. The portal presents the traffic situation and prognosis for the Munich region in real time. Special functions assist the emergency services and rescue personnel in fleet management and operation control on the basis of the current traffic situation. For this, sensor data from the German motorways and the state of Munich as well as Floating Car data are merged and imported into a microscopic traffic simulation. The DELPHI portal is currently the only platform which enables a complete overview spanning all state agencies. Additional supportive tools are being developed over the next few years and gradually integrated into the DELPHI portal.

SuperLIGHT-CAR

New concepts in lightweight vehicle construction

A significant reduction in the weight of the vehicle structure by more than 30% is the stated objective of the EU "SuperLIGHT-CAR" (SLC) project. This is to be achieved by means of new lightweight constructions and innovative material solutions. We hope to realize new, series-production ready vehicle structures in multi-material lightweight constructions in cooperation with 37 partners from research, the automotive industry and its suppliers. Our former project contributions in the field of vehicle conception and design have identified significant potential for weight saving. It is important that this can be achieved with the same or even improved characteristics as well as justifiable manufacturing costs. Our approaches therefore gain widespread recognition.

We have particularly convinced our partners of DLR's lightweight construction concept for a front end featuring a weight saving of 32%, which has been verified by means of simulations. In order to validate the simulations, a decision was taken by the project partners at the beginning of 2008 that our concept should be manufactured in various prototypes in the front end module. A combination of suspension strut mount made of magnesium, an aluminium side-rail structure and adjoining components was chosen for this. This is a remarkable achievement, as competing proposals from renowned institutions failed to be selected. The implementation of our concept is now being driven forward in demonstrations together with SLC partners, such as Volkswagen, Porsche, Daimler and Centro Ricerche Fiat.



DLR lightweight construction concept for a front end (whole vehicle)

Right: virtual traffic management centre Traffic Tower, left: Brenner motorway – arterial road through the Alps



ALPNAP

Prediction of environmental pollution for transalpine transport axes

In the EU ALPNAP project, 11 partners from four countries, experts from universities and research centres in Germany, Austria, Italy and France, have formed a network throughout the Alps. The objective of ALPNAP was to compile and characterize the latest scientifically-based methods for monitoring and predicting air pollution and noise along the heavily polluted transalpine transport axes and to analyze and evaluate the effects on the health and well-being of the population associated with this environmental pollution. These methods can be used both to analyze the effects of transport infrastructures in the planning phase (roads and railway lines) as well as to develop suitable administrative or technical measures for improving quality of life in the alpine region.

By evaluating the weather dependence of the noise and air pollution concentration in the Unterinntal, we were able to demonstrate, together with the ALPNAP partners, that the noise protection walls along the motorways in valleys only protect hillside dwellers to a limited extent. Therefore, the construction of such walls must be thoroughly checked. It was also demonstrated that certain weather conditions in the valleys amplify the impact of noise and pollution and cause limit values to be exceeded. Using these findings as a basis, traffic management measures can now be initiated according to the respective weather conditions, and peaks in pollution can be prevented.

The findings of this EU project, which was further supported by the Transport programme and coordinated by DLR, were presented to the public in January 2008 at a final conference in Innsbruck. They have been documented in an extensive report for experts in the environmental and traffic agencies and are also available in a considerably condensed format as a booklet.

TerraSAR-X

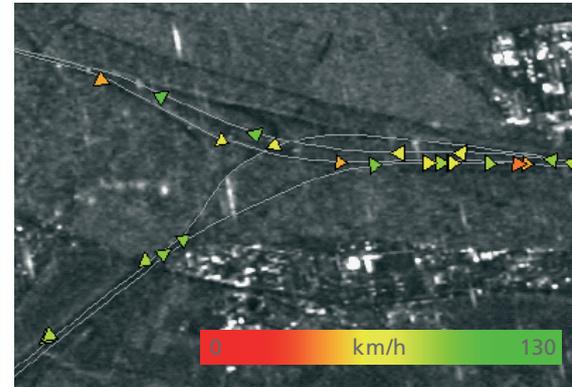
Remote sensing satellite for traffic surveillance

The system for traffic surveillance has been further improved with the aid of the TerraSAR-X remote sensing satellites. For this, a more capable computing machine has been installed in the ground station of the DLR Neustrelitz branch office. It enables traffic information to be reported just a few minutes after the data have been recorded. This includes, for example, the velocity distribution over a route section or the average momentary travel time between two junctions. The capability of the system becomes apparent by means of this example. A 5 km stretch of the A4 motorway to the west of Dresden was recorded using the TerraSAR-X satellite. In this case, the radar satellite was located at a distance of more than 700 km from the road. The system was able to detect 57 vehicles and evaluated these as random inspection measurements. Altogether, extensive tests and reference measurements were carried out in several European countries. After a further revision of the software, a demonstration phase with pilot users will be carried out in 2009. These are generally traffic information centres, which may be distributed throughout Europe. It should be pointed out that information

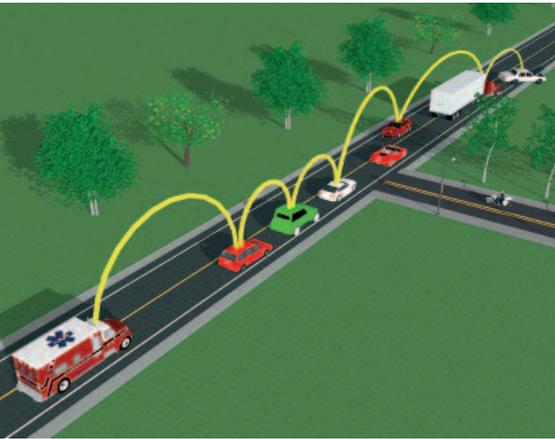
gaps in traffic data recording, which often exist in construction site areas and on ancillary roads, may be closed with the aid of radar satellites. Moreover, it should be pointed out that useful information regarding the passability of roads can also be delivered during disasters and public mass events.

Within the context of cooperation with research institutions in Canada, the supplementary use of the Canadian Radarsat-2 satellites has been tested in order to reduce the period of time between two satellite recordings.

The radar measurements are not dependent on sunlight and also may be carried out in clouds and fog.



Vehicle measurements at the A13/A12 motorway interchange west of Paris using a TerraSAR-X radar image. The colour-coded arrows indicate the detected vehicles and their speed



Traffic news may be forwarded using Car-to-Car communication

Car-to-Car

Communication from vehicle to vehicle

In Oberpfaffenhofen, a new communications network has been brought into operation for communication between vehicles (car-to-car, abbreviated C2C). It is being used to find out to what extent specially-equipped vehicles can inform each other of their relative positions, state and the traffic situation. The aim is totally new applications, leading to increased road safety and traffic-flow efficiency. The possibilities offered by communication from car to car range from calculating the optimum driving speed in a zone with favourably-synchronized traffic lights, through co-operative driver-assistance systems, to management of a complex process such as co-ordinated convoy driving. The 'C2x' communications technology (the x refers either to car-to-car or car-to-infrastructure communications, as appropriate), which DLR helped to develop, is an evolution of the WLAN communications technology. DLR is driving the development of this new communication technology with various partners, principally in the automotive sector, within the framework of the Car2Car Communication Consortium. Using CODAR technology (Co-operative Object Detection And Ranging), information gained from various sensors in the vehicles can be merged, evaluated and processed in line with the current traffic situation. In this way, it is possible to warn a driver of a potentially dangerous situation, such as the end of a tail-back around the next bend or a vehicle approaching from a hidden side road. The possibility of using the technology for the benefit of traffic flows is also being explored. The work is based both on communications and navigation know-how as well as on expertise in the fields of driver behaviour and traffic flows.

Free-piston Linear Generator

Foundation of UMC Universal Motor Corporation GmbH

With the Free-piston Linear Generator, our scientists are designing the first ever combustion engine with variable compression and, at the same time, variable displacement. The management of combustion processes may be adapted flexibly to the respective performance requirements. The benefit of this technology in comparison with conventional combustion engines is significantly increased efficiency, in particular in the partial load operational range. This leads to both decreased consumption and reduced emissions. The most interesting feature of the innovative engine concept is that the crankshaft is replaced by a combination of linear generator and pneumatic spring. The linear generator directly generates electrical energy, which is converted by the vehicle's electric power train to propulsion.

The UMC Universal Motor Corporation GmbH has now been founded by DLR, after 6 years of research work. Its objective for the next four years is to implement a demonstration vehicle with a Free-piston Linear Generator suitable for automotive use. For this, the rights to the Free-piston Linear Generator have been transferred from DLR to UMC GmbH, within the framework of a Technology Transfer Agreement. A major German bank was obtained as an investor.

DLR continues to be involved in the development of the Free-piston Linear Generator within the framework of long-term, extensive assignments by UMC GmbH.

A unique infrastructure of test benches and technical measurement equipment is used for this. Cooperation with UMC GmbH is planned also in the areas of homogenous charge compression ignition and flex-fuel combustion, development of steering and control algorithms as well as for the optimization of piston materials.

Terminal Management

Increased punctuality at airports using What-If simulations

Capacity bottlenecks in aeronautics are not confined to the airspace. Problems on the ground are increasingly coming to the fore as the causes of delays. These frequently involve bottlenecks when passengers and baggage are being checked-in. In particular, security checks on travellers, aircrew and airport staff are pivotal to this.

This is the starting point for the FAMOUS project, whose objective it is, amongst other things, to achieve the more punctual arrival of travellers on the aircraft due to the targeted manipulation of individual passengers or passenger streams. This helps to reduce air traffic delays. On the

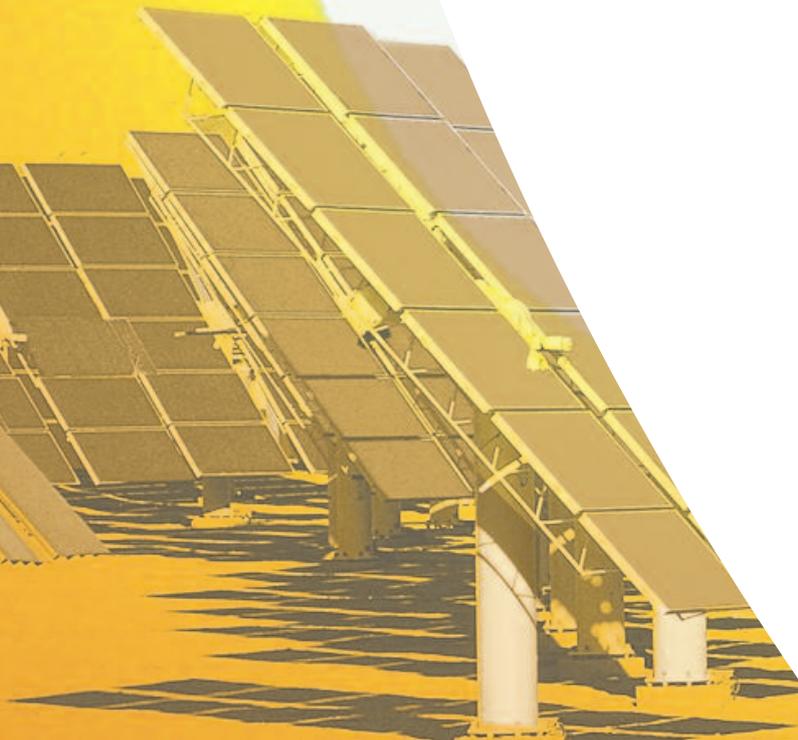
basis of the situation currently being recorded in the terminal, bottlenecks are being identified, analyzed and evaluated by means of What-If simulations and possible further developments are being predicted. In addition, potential approaches are being developed automatically and tested with regard to their efficiency. Interactions with the upstream and downstream processes are also being taken into account.

Various What-If simulations are available to support decision makers; macroscopic simulations serve the investigation of passenger flows and microscopic simulations reproduce the behaviour of the individual passengers. In addition to What-If terminal simulations, FAMOUS procedures are being developed which facilitate an even higher safety standard, improved travel comfort as well as more efficient resource management.

Energy

Energy conversion and usage play a key role in virtually all technical systems. Therefore, it is no surprise that the efficient handling of energy is an important aspect in all of DLR's thematic areas. Power plants, aircraft and vehicles are energetically optimized and, for example, an efficient power supply is of the utmost importance even in space applications. In the Energy business division, DLR is dedicated specifically to efficient and environmentally friendly energy supply and concentrates its activities on stationary applications for electricity and heat supply on a scale relevant to application. In doing so, diverse synergies are exploited using skills from the other business divisions and test facilities are shared. Mobile applications are also supported, to a lesser extent.

The development of stationary gas and steam turbines takes a central position in DLR. With its work in the areas of compressors, combustion chambers and turbines as well as its system competence, DLR also contributes to significantly increasing electricity generation efficiency – independently of the future fuel. Research into fuel cell systems serves the reliability and longevity for future use in the energy supply. It is also particularly promising, that linking gas turbines and high temperature fuel cells to a hybrid power plant leads to an expected increase in electricity generation efficiency of approximately 10% compared with the individual components. Concentrated solar technologies present the option of generating electricity in a highly economical and environmentally friendly manner on a large scale as well as making hydrogen available in the long-term. Systems analysis as a cross-cutting subject provides policy advisory services and supports the thematic orientation of energy research in DLR and in the Helmholtz Association.



Virtual Institute for Solar Thermal Power Plants

Acceleration of the market launch through the development of new calculation methods

With the foundation of a new virtual institute for solar thermal power plants (Virtual Institute of Central Receiver Power Plants – vICERP), DLR's facilities, the Rhine-Westphalian University (RWTH) Aachen, Aachen University of Applied Sciences as well as the Katholieke Universiteit Leuven (Belgium) will for the first time combine their efforts in the field of "solar thermal power plants". The trans-organizational institute, vICERP, is tasked with further developing and implementing new calculation methods for solar thermal power plants. Solar thermal power plants are power plants which concentrate the sun's rays at the top of a tower and, with the aid of absorbers, use it as a primary energy source. The calculations should help to reduce uncertainties which exist regarding the design, regulation and operation of solar thermal power plants in order to accelerate the market launch of this new technology and improve its competitiveness.

The Helmholtz Association of German Research Centres (HGF) selected the proposal for establishing a virtual institute, vICERP, devised under the auspices of DLR and will support this institute over the next three years. In addition, the state of North Rhine-Westphalia will promote the activities of the Institute for the Technological Further Development of Research and the Integration of Local Companies in the Growing Market for Solar Thermal Power Plants.

Solar Energy in the Future even at Night

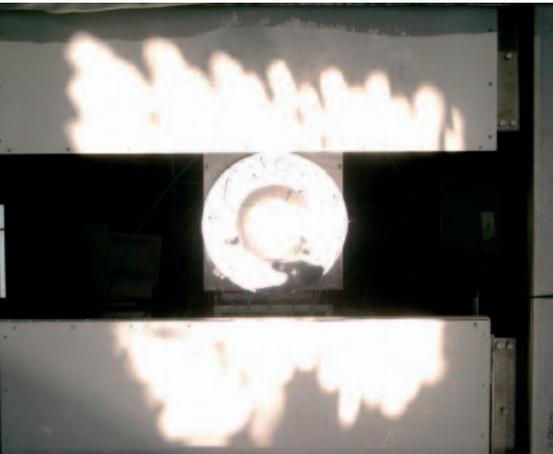
DLR achieves a breakthrough with the new heat accumulator

In the future, power from solar energy will play a key role in providing a sustainable energy supply. Efficient and cost-effective energy storage options are a significant prerequisite for broad market penetration of solar thermal power plants.

Within the context of the EU DISTOR (Energy Storage for Direct Steam Solar Power Plants) project, a latent heat storage for process steam has been developed and successfully tested for the first time with a size relevant to application. Coordinated by DLR, a total of 13 partners from industry and research from five countries are working on the development of innovative storage systems for solar-powered steam generators. The main challenge is to achieve high charging and discharging capacity as well as a high energy density in the storage while simultaneously maintaining moderate costs. This could be realized using a concept of a latent heat storage based on nitrate salts, whereby layers of graphite foil are integrated in the storage material. A patent application was filed for this concept together with the industrial partner SGL and the concept now constitutes the basis for commercial realization.



100 kW pilot heat storage on the test system of the Plataforma Solar in Almería, Spain



Test reactor in operation in DLR's solar furnace in Cologne

Hydrogen Generation with Concentrated Solar Radiation

International interest in new EU HycycleS project

As part of DLR's solar research and as a subject for additional funding by HGF, procedures for generating hydrogen using concentrated solar radiation are being developed in several projects funded by the European Union. In particular, thermochemical cycles have the potential to generate hydrogen efficiently and renewably and without emitting greenhouse gases. During these processes, water is split into hydrogen and oxygen during 2-3 chemical reaction steps at temperatures of up to approximately 1,200°C. It follows that, the more steps a cyclic process such as this has, the lower the required temperature may be, however the worse the level of efficiency.

Over the last few months, DLR has achieved significant breakthroughs with two of these cycles. For example, a pilot reactor for the two-stage cycle on ferrites has been developed, designed and constructed on the solar tower of the Plataforma Solar de Almería in Southern Spain. It not only has a higher output, by a factor of 30, than the reactors previously tested in DLR's solar furnace in Cologne, its control system also integrates all of the necessary components such as solar radiation, solar arrays and gas management for the first time. This allows an automated operation of the facility to a large extent. It was of-

ficially commissioned at the end of March 2008, within the context of a "Solar Fuel Event". However, tests using the facility had already been carried out prior to this.

The HYTHEC project, in which the sulphur-based cycles were investigated, was successfully completed at the end of 2007. The project revealed that, it may also be expedient to use a solar tower for generating hydrogen from an economic viewpoint. The findings are so promising, that the follow-up project HycycleS, coordinated by DLR, commenced in January 2008. The project focuses on developing the key components; solar receivers and heat exchangers. For the first time, associated partners from USA (General Atomics, Westinghouse), Japan (JAEA) and Australia (CSIRO) are involved in the project, as leading players in the 7th EU Research Framework Programme.

Analysis of Innovation Processes

Improved technological evaluation by individually observing the market participants

An understanding of innovation processes constitutes an important building block when it comes to clear-sighted technological evaluation. A project group comprising different disciplines was able to demonstrate that with the so-called "agent-based modelling" approach, interactions between the participating actors and their influence on innovation processes in the energy sector are better presented and understood. Agents may

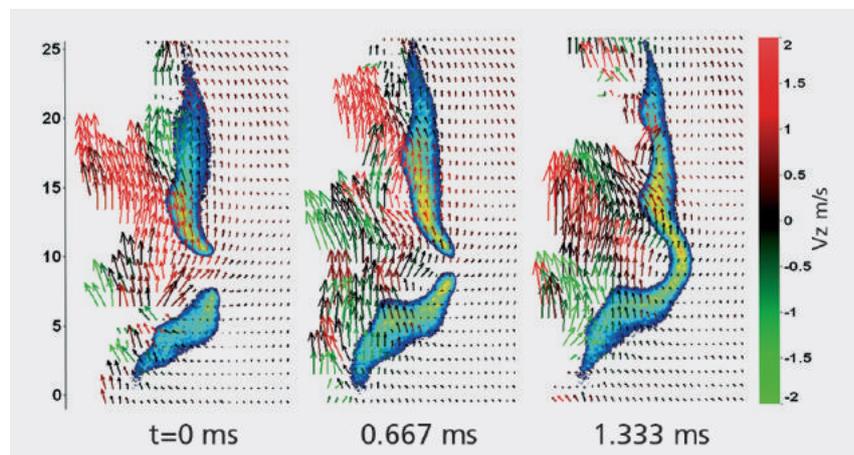
represent both individuals and also larger units, i.e. companies, political parties or research institutions. The concept of multi-agent systems was originally developed by computer scientists in the field of distributed artificial intelligence. Compared to conventional simulation models in which market participants are represented together, here the individual actors are indicated individually. This enables distributed problem-solving processes to be modelled realistically and permits a new type of computer-assisted analysis of the interactions between the participants. The pilot study was financed by the Volkswagen Foundation.

successfully visualize the flame front at the same time as the flow field with refresh rates in the kilohertz range using a new laser measurement system. The measurement technology used is Laser-Induced Fluorescence of OH Radicals and Particle Image Velocimetry. With it, the details of the interaction between turbulent flow and combustion can be made visible and the causes for the flame extinguishing are illuminated.

New Laser Measurement System for Examining Flames

Flame extinguishing visualization for cause detection purposes

Combustion phenomena such as extinguishing, pulsations or flashbacks in the pre-mixing zone are pivotal both as regards technical combustion but also for the theoretical understanding of flames. These processes occur relatively infrequently, but may lead to serious consequences for technical facilities such as gas turbine combustion chambers. Phenomena such as these are attributed to unusually strong flow field and flame front fluctuations, where it was not previously possible to identify the causative connection. In cooperation with the Institute of Energy and Power Plant Engineering at Darmstadt Technical University, it is now possible to



Interaction between the reaction zone (blue/yellow areas) and the flow field (arrows including colour coding for third speed component). In this example, a partially extinguished flame front can become coherent again

Energy Globe Award for Solar Water Treatment

The new solar receiver is efficient, flexible and easy to install

Within the context of the cooperative project SOWARLA (Solar Water Treatment Plant Lampoldshausen) DLR scientists and the participating companies have successfully developed a new, efficient solar receiver, which will rigorously promote the practical feasibility of facilities for solar water treatment. In May 2008 in Brussels, scientists and participating industrial partners were awarded the Energy Globe Award 2007 for national champion project for their work with the SOWARLA technology at the DLR Lampoldshausen site. The award is consi-

dered to be a globally significant and highly respected environmental prize. All in all, 853 projects were submitted from 109 countries.

During the solar water treatment process, organic contaminants which are toxic or not inherently biodegradable are destroyed using light and a photocatalyst. The new solar receiver, which is central to the SOWARLA plant, consists of transparent glass tubes. Compared to the previous concepts of solar reactors, this solar receiver is easier to install and very flexible which enables the construction of plants of any size under different boundary conditions. With a length of 20 metres and width of 160 centimetres, the current plant is capable of purifying approximately 500 litres of (industrial) waste water per hour of all organic and particular inorganic contaminants.



Water treatment using the power of the sun

Fuel cells in aircraft

Emission-free and economical: fuel cells as an emergency power system in ATRA

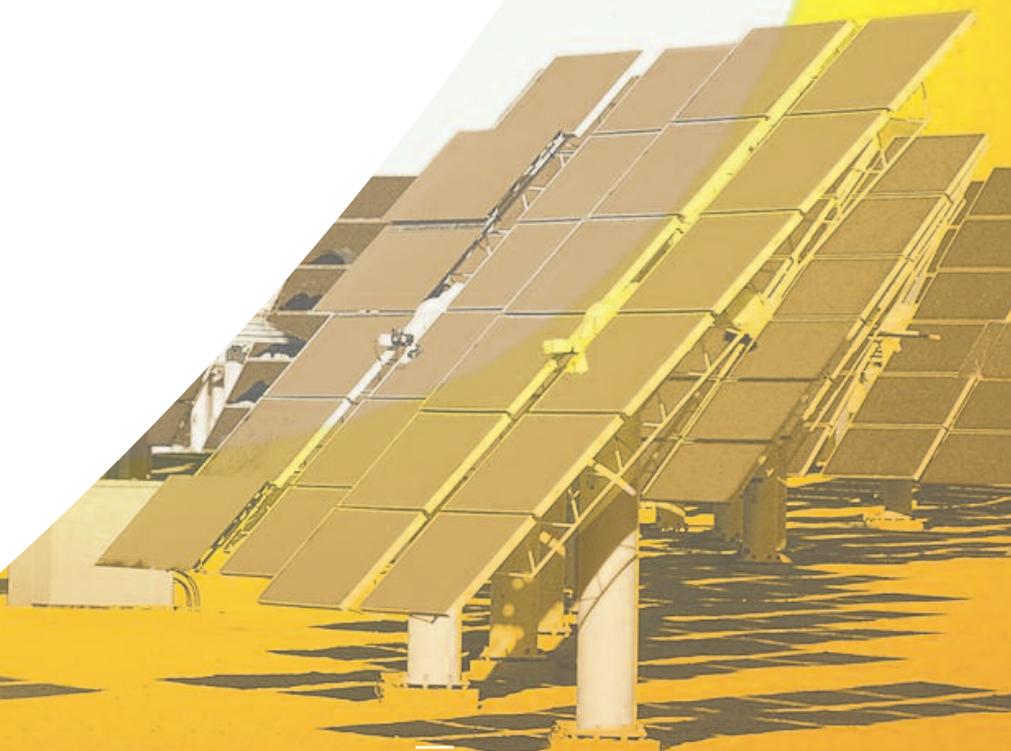
According to the latest forecasts, air traffic is continuing to increase and with it fuel consumption and subsequent environmental pollution. Therefore, solutions for reducing pollutant emissions in flight and ground operations are desperately sought after. Fuel cells could make a significant contribution to this in the future: DLR's new ATRA research aircraft, an Airbus A320, successfully completed its first test flight with a fuel cell system which was used experimentally to supply the emergency power system.

Together with the project partner Airbus, the DLR Institute of Technical Thermodynamics equipped the aircraft with a Michelin fuel cell system. The integrated fuel cells supply the emergency power system for a period of one hour, with zero carbon dioxide or other pollutant emissions. Within the context of emergency supply, the system operates the pump for the hydraulic system used to move the control surfaces in the case of an engine failure.

As the fuel cells only use hydrogen and oxygen to produce electricity, there are no harmful exhaust gases. Besides the end product, electricity, only water and heat are produced in the cells during the electrochemical process. Good further use of these can be made on board an

aircraft. In the current test, the used fuel cells produced ten litres of water. In the future, if the water obtained is fed into the water circulation of the aircraft, this will reduce the quantity of water which will need to be transported and simultaneously the weight and fuel consumption. In addition, the fuel cells are highly efficient and quiet.

The economical aspects make using fuel cells interesting in the medium-term: for example, a system such as this is less maintenance and cost-intensive. In the first phase of the project, separate tanks are fitted for hydrogen and oxygen. In the next step, oxygen from the ambient air should be used, rendering the oxygen tank superfluous. In the future, hydrogen could also be manufactured on board from available hydrocarbons (e.g. kerosene).



Project Management Agencies

Project Management Agency Aeronautics Research

Upsurge in civilian aeronautics research

The Project Management Agency for Aeronautics Research (PTLF) supports the Federal Ministry of Economics and Technology (BMW) in implementing the German Federal Aeronautics Research Programme (LuFo) as well as the states of Bavaria, Hamburg, Brandenburg and Rhineland-Palatinate, which are complementing the federal programme by means of their own development programmes or projects.

Over the last few years, the Federal Government has significantly increased its commitment to civilian aeronautics research. At the first appeal for the fourth Aeronautics Research Programme (LuFo IV), 25% more subsidies were made available than throughout the entire previous programme LuFo III. During the second LuFo IV appeal, started at the turn of 2007/2008, the funding available for new technology projects was further increased by almost 25% compared with the first appeal. All in all, during the first and second LuFo IV appeal, the BMW made available funding amounting to a total of Euro 450 million for the period from 2007 to 2012.

Furthermore, additional funding amounting to Euro 150 million is allocated for the third LuFo IV appeal in the Federal Government's draft budget for 2009. Alongside the Federation, the states have also broadened their efforts in the area of aeronautics research. During the regional aeronautics research activities overseen by PTLF, the states of Brandenburg and Hamburg, in particular, have also significantly increased their commitment in 2008 and provided additional funding for new projects. In 2007, the number of projects handled by PTLF for the states of Bavaria, Brandenburg, Hamburg and Rhineland-Palatinate amounted to 62.

In the reporting period, all projects in the first LuFo IV appeal were able to start on schedule. In 2007, it was even possible for funding to be allocated and work to start on integrated technology projects for the "transdisciplinary fuselage" line of funding of this appeal, which should bridge short-term technological gaps for the construction of lighter, and therefore more fuel-efficient, aircraft. In 2007, a total of 155 new federal technology projects were started in addition to the 211 projects which were already ongoing at a federal and state level.

In the second LuFo IV appeal, which gained Euro 250 million of support, approx. 170 new projects which prioritize these topics are estimated to have been allocated funding. The research activities associated with these should be completed during the period from 2009 to 2012.

The federal and state-based aeronautics research activities are incorporated in the European Framework Programme for Research and Technological Development. In order to ensure coordinated advance-

ments at regional, national and European levels, the PTLF, on behalf of the BMW, also took on the role of national point of contact for the area of aeronautics research in the 7th EU Framework Programme for Research and Technological Development.

The technological skills acquired during the aeronautics research programmes in the states and the Federation have made German companies and research institutions into highly sought-after partners in the European research consortia. It was therefore possible to maintain the high return flow of funds from the European Framework Programme to Germany at approx. 24%, even at the beginning of the 7th Framework Programme for Research and Technological Development.

The EU ERANet "AirTN-Air Transport Net" project with 26 partners from 17 European countries, which was managed by PTLF as its coordinator, has also contributed to this. Since then, it has been successful in forming the first, cross-border research associations to combine specific expertise from the different member states and to utilize it in the respective national programmes. The coordination of national programmes and support mechanisms has also met with a great deal of interest outside of the AirTN. The PTLF is now working together with its project partners on continuing the AirTN and admitting additional members to the consortium.

In addition, in its rotation, Germany took over chairmanship of GARTEUR (Group of Aeronautic Research Europe), which is the oldest research network of the leading European nations for Aeronautics and the heart of AirTN, for the next two years. The PTLF took over the chairmanship of the GARTEUR Executive Committee for the BMW for the period from 2008 to 2009.

As Project Management Agency for the BMW, the PTLF holds a central position as a service provider and source of knowledge in the area of aeronautics research

at EU, national and regional levels and is therefore in the position to effectively support the BMWi in its efforts to provide coordinated and efficient sponsorship of aeronautics research in Germany and to prevent duplicate sponsorships. This specific positioning is unique compared with equivalent institutions in the European Partner countries. Furthermore, as the coordinator for the European ERANet "AirTN" project, DLR's PT-LF is now also linked with virtually all ministries or their agencies in the field of aeronautics research and has at its disposal an expanding knowledge base for aeronautics research in these countries.

Project Management Agency in DLR

5,000 sponsored research projects

The DLR Project Management Agency, PT-DLR for short, has specialized in services in the areas of research and education sponsorship as well as project management. In doing so, the PT-DLR operates on both a national and an international level. Its clients are the Federal Ministry of Education and Research, the Federal Ministry of Economics and Technology, the Federal Ministry of Health, the Federal Ministry of Family, Senior Citizens, Women and Youth, the EU Commission, the Secretariat of the Conference of the Ministers of Education, state ministries as well as various private clients.

At the end of 2007, the PT-DLR employed 585 members of staff. In comparison with the previous year, the total funding awarded by the PT-DLR by means of research sponsorship increased by 12.6% and reached approx. Euro 667 million (see table). In 2007, a total of approx. 5,000 projects was sponsored.

The PT-DLR's spectrum as regards content is extraordinarily broad and comprises most of the scientific and technological fields relevant today. This includes health, environmental and sustainability research, information technology, new media in the economy as well as research into shaping the work environment and services as well as education research/integration/gender research. In addition, the national points of contact for EU programmes as well as for the European research initiatives COST and EUREKA and the EU office of the Federal Ministry for Education and Research (BMBF) are embedded in the Project Management Agency. The international office of the BMBF in the PT-DLR sponsors international cooperation in research and education in all regions of the world. Furthermore, the Federal Ministry of Education and Research test centre for projects co-financed by the ESF can also be found in the Project Management Agency.

With its many years of experience in the areas of research and education research as well as project management, the PT-

DLR is able to provide very good contacts with research agencies and facilities, professional committees and proven experts in the national and international research community.

In 2007, the PT-DLR was once again able to gain numerous new duties and responsibilities: for example, the coordination office "High-tech Strategy for Climate Protection" and the BMBF branch office's "Further Training Innovation Group" as well as the guidance of the framework programme "Empirical Education Research", likewise for the BMBF. The PT-DLR has also accommodated a joint BMBF and BMU initiative since 2007. After successfully organizing the "Year of Humanities, 2007", the PT-DLR received the follow-up order to organize the "Year of Mathematics".

A detailed representation of all assignments and programmes can be found in the annual report for 2007 and on the Internet at <http://www.pt-dlr.de>, under "Services/Publications".

Allocation of budget resources	in 1,000 euros	2006	2007
Information technology		187,391	192,800
Health research/Human genome research		176,433	190,100
Environmental research and technology		74,668	91,000
New media in the economy		36,904	47,600
New media in education (and specialized information)***		30,312	20,400
Labour organization and services**		26,400	23,700
Education research*		26,112	24,500
International office		14,354	11,600
Equal opportunities/Gender research*****		5,886	6,900
HGF strategy funds		4,285	14,700
Office for the Year of Humanities, 2007		5,815	6,600
Humanities		3,596	22,000
Skills agencies****		360	15,500
Total:		592,516	667,400

Co-financing with funding from the ESF (European Social Fund) amounting to:

* Euro 11.4 million ** Euro 0.4 million *** Euro 1.7 million

**** entirely financed with funding from the ESF ***** Euro 1.8 million

Jahreshauptversammlung 2007



Panasonic



ECONOMIC DEVELOPMENT

Future Development of DLR



Current Activities

The 3-yearly review and revision of overall strategy at DLR is currently in progress. The previous strategy is documented in the brochure "Goals and Strategies, 2006 to 2009", which can also be downloaded from the DLR website at www.dlr.de by following the links to "Management" followed by "Corporate Development and External Relations".

An internal development process is actively promoted at this time and is being discussed and implemented with the cooperation of the Executive Board and representatives of the second level of management within the framework of the ZPO Project ("Goals, Processes, Organization"). During the reporting period to June 2008, workshops were held on four topics, namely "From Strategy to Operational Implementation", "Management System", "Technology Marketing/Cross Transfer" and "Management of Investments and Large-Scale Facilities". The concept phase will be completed in autumn 2008, with the results being presented to an internal steering committee for deliberation. Discussions will also touch

on the strategy determination process. The committee's contributions will be taken into account during the preparation of the new goals and strategies. This process takes as a starting-point the current challenges and general conditions DLR faces. Our guiding principles, comprising vision and mission, are currently being discussed with the intensive participation of all employees of the research centre. The goal is to develop a vision and mission that is shared by all. In parallel to this, concrete strategies and strategic goals are being discussed that build on an analysis of internal operating conditions and those of our working environment and in turn will aid us in achieving our common vision.

Presentation of Results

The second part of the annual report that follows – "Economic development" – documents the activities of the organization, showing both in words and figures how we have taken substantial steps towards achieving our goals for the development of the Centre.



Third-Party Funding

Third-party revenue in the 2007 reporting year reached a record level at 294 million euros. At 52%, the proportion of overall revenue from third-party sources was greater than that from the institutional funding of DLR. Income from domestic commercial contracts once again contributed heavily to this very positive result, which represents growth of a further 26% over the preceding year. The main driving force behind this was the increase in space flight activities at the Space Operations Centre and the German Remote Sensing Data Centre (DFD).

At 19.9 million euros, revenue from EU funding also demonstrated an increase on the previous year. The success rate of proposals to the EU remained at a high level of 47%. A sizeable proportion of large EU projects were included in this figure. By contrast, the proportion of coordinator projects dropped to 13%. This can be attributed to the quite considerable proportion of coordinator projects among those EU projects that came to a conclusion during the reporting period. It should also be noted that in the EU project sector the results were also certainly influenced by the transition from the 6th to the 7th EU Research Framework Programme, which took place during the reporting period. It is anticipated that the trends and effects due to the 7th EU Research Framework Programme will become clearer over the course of the coming year.

It was also possible to considerably increase third-party funding in the form of revenue from national state sources. The primary sources of this type of funding are directly funded projects, public contracts and projects from the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) and the Helmholtz Association (HGF). Particularly noteworthy are the increases in income from direct project funding and public contracts from both national and state bodies. Good examples of these include

Third-Party Funding	2005	2006	2007
Total revenue from third-party funding	Euro 275 m	Euro 255 m	Euro 294 m
Revenue growth over preceding year, commercial revenues from domestic R & D activities	1%	41%	26%
Proportion of overall revenue from third-party sources	52%	48%	52%
Proportion of revenue from foreign clients (revenue volume)	31%	29%	22%
Success rate of EU proposals in the last three years (accepted/submitted)	40%	54%	47%
Revenue from EU funding	Euro 15,6 m	Euro 17,3 m	Euro 19,9 m
Ratio of EU projects as coordinator vs. all projects	21%	16%	13%

large-scale national aerospace projects such as Halo, ENMap and Tandem-X. DFG revenues remain largely unchanged.

Income from foreign clients continued the trend of the preceding year. Their contribution to third-party revenues dropped again in this reporting year to now lie at 22%. In addition to the decline in R&D contracts at foreign governmental institutions and in the wider economy, this decrease can partly be attributed, for example, to the slight reduction in ESA projects. This is due to the fact that construction activities for the Columbus Control Centre have now been completed.

the third-party funding procured, which is needed to ensure that research activities are aligned with industry demands. The metrics used for scientific quality and productivity are based on publications, presentations and lectureships, which are continually recorded. Variations can mainly be attributed to project work, personnel fluctuations and activities relating to proposals.

The number of publications in peer-reviewed journals was 511, representing a slight increase compared to 2006. If peer-reviewed publications in proceedings, books, etc. are also included, then this gives a total of 1079 publications that were subjected to expert appraisal prior to appearing in print – also a small increase on the previous year.

Research-Related Results

DLR positions itself as a research organization with high standards for the quality of its scientific work. Consequently, scientific results are of equal importance to

Research-related results	2005	2006	2007
Publications in peer-reviewed journals	561	495	511
Peer-reviewed publications in proceedings, books, etc.	566	536	568
Presentations to scientific conferences, workshops, lectures *	0.81	0.85	0.76
Appointments to universities	9	8	13
Lectureships	177	200	204
Student projects	264	318	326
PhD theses	71	78	83
Postdoctoral qualifications	5	4	4

* Per member of scientific staff at institutes and facilities

By contrast, the scientific staff at DLR were somewhat less active in their proposal activity during the reporting period than in 2006. The upward trend in the number of student research projects completed that has been observed over the last few years did, however, continue.

Technology Marketing

The political, social and industrial goals of national and international innovation policies, with the associated strengthening of technology transfer from publicly funded research and development that these promote, are considered to be a significant success factor in the competitiveness of the national economy. Shortening the "time to market" from research result to market-ready product, process or service is a vital prerequisite here. Through its outstanding research results and technological developments, DLR is able to provide complete value added chains that extend from fundamental research, through application oriented research and development, to new products and services.

Technology Marketing plays an important role in helping DLR to implement these requirements. This activity shapes the development process at DLR, starting with the requirements in every sector of the market, developing and implementing ideas by means of transfer projects, and turning DLR know-how into something that is commercially beneficial. The main goals here are demand-oriented preparation of DLR technologies for the implementation of products with commercial partners, acquisition of new customers, management of proprietary rights, and providing support for start-up companies. Following on from the award of DIN EN ISO 9001:2000 certification for the processes employed by Technology Marketing for the first time in autumn 2005, recognition was further enhanced in June 2008 by the achievement of the first stage of the EFQM model, "Committed to Excellence".

Technology Marketing	2005	2006	2007
Revenues from licenses	Euro 2,7 m	Euro 4,1 m	Euro 3,6 m
Start-up companies	1	2	4
New 'in-house' technology transfer projects	15	13	10
Investments in technology transfer projects	Euro 3,5 m	Euro 2,8 m	Euro 2,44 m

Examples of successful technology marketing

The "SOWARLA (Solar Water Treatment)" transfer project, a collaboration with the companies KACO GmbH and HIRSCHMANN GmbH, is focused on developing a system for solar treatment of wastewater from household and industrial sources. Licensing and marketing agreements have been concluded with cooperation partners HIRSCHMANN and KACO Gerätetechnik and a test system has been installed and successfully operated at the swimming pool in Untereisesheim, Germany. In May 2008 in Brussels, the SOWARLA technology was named Overall Winner Germany 2007 at the Energy Globe Award 2007, a globally significant and highly respected environmental prize.

The "Modular Air-Cooled Low-Temperature Fuel Cell System") technology transfer project has created both a driverless transport system and an airport apron vehicle (German abbreviation: VFF, "Vorfeldfahrzeug") based on a fuel cell drive system. The project was successfully concluded with the nomination of KION (brands: LINDE, STILL and OM) as licensee. KION will establish a field trial at Frankfurt Airport with a fleet of over 20 transport vehicles with fuel cell drives based on the DLR concept.

The "AWFS II" transfer project is aimed at extending the functionality of the Automatic Early Warning System for Forest Fires to also detect smoke at night. It is anticipated that this update will allow the system, which is marketed by IQ

wireless and has already been very successful in the market (over 150 installations to date), to better exploit the full potential of the global market of over 1000 installations.

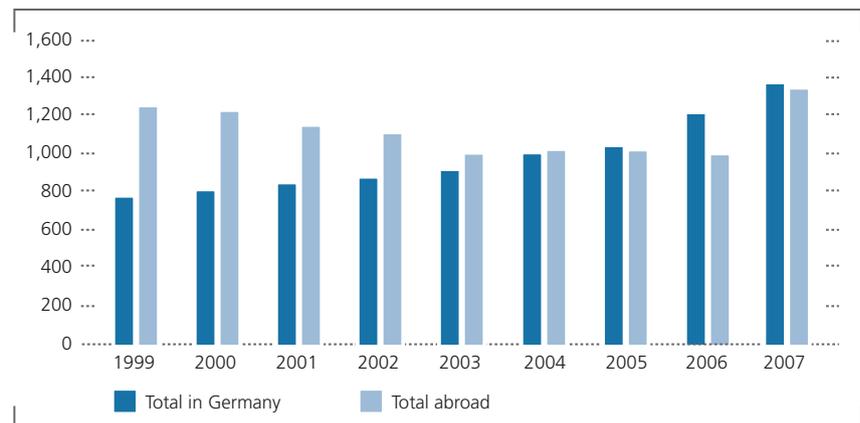
The transfer project "TEMOS" is building a service for delivering patient care overseas and in transit back to the home country. Foreign clinics will be certified and provided with a telemedicine platform in order to improve the care of German patients abroad. In an era of increasing mobility and globalisation, this type of service is becoming increasingly important. Following completion of the prototype phase, DLR will establish a start-up to introduce the service to the market.

In the field of WHIPOX materials, new lamination and joining technologies are being developed to allow the manufacture of larger parts. The licensee for this development is WPX GmbH, a start-up company in which DLR has a shareholding interest. This transfer project enables WPX GmbH to better meet the needs of the market, with DLR profiting from both license revenues and, as a result of its equity stake, from the increasing value of the company.

"Pulverplotter" ("Powder Plotter") is a transfer project aimed at developing a new dry coating technology for membranes. The company IRD/Denmark is the licensee and will use this technology to coat membranes for large-scale fuel cell production.

The Institutes for Materials Research and Space Propulsion are participating in the "Jet Vanes" project. Aims for the project include not only the optimisation of the materials used in jet vanes for abrasive rocket propulsion systems and the advanced development of a test rig designed to test these under real-world conditions, but also the marketing of the test

Proprietary Rights in Germany and abroad



rig to industrial firms for testing of propulsion units. This project also supports the examination and qualification of jet vanes at license holder NAMMO.

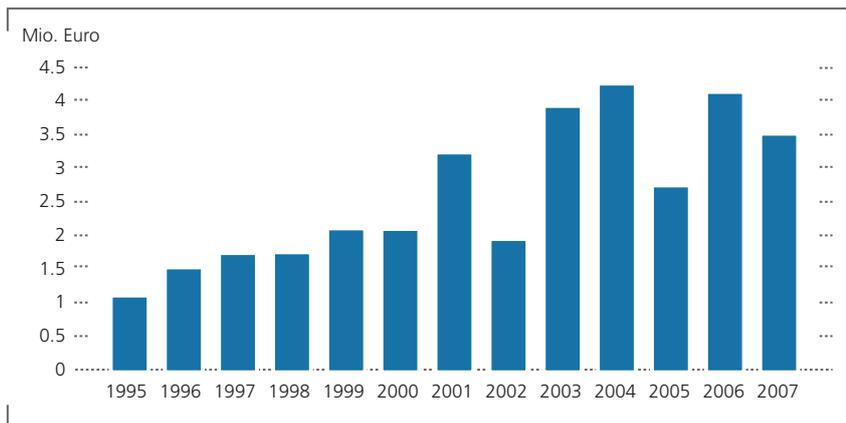
A transfer project with the name "Thermoelectric Generator for High Temperatures – TEG 400" has been launched with co-financing from the technology transfer fund and the Energy and Transport programme directorates. The Institute of Materials Research is extending the temperature range of existing thermoelectric generators from 250 °C to 400 °C in order to increase the efficiency from 4% to around 8%. There is already strong demand for this type of segmented thermoelectric generator from the automotive sector (utilization of waste heat from engines), the heating industry (use of combustion waste heat), and the locomotive industry (use of waste heat from diesel generators). Moreover, there is a wide range of further industrial applications (solar thermal systems, for example). The transfer project is being carried out in cooperation with the Austrian Bioenergy Centre and TEC COM GmbH (Halle, Germany) which correspondingly hold licenses to the technology.

Proprietary rights

One of the activities of Technology Marketing is management of proprietary rights and licenses, which includes responsibility for building and maintaining the DLR proprietary rights portfolio and supervising all marketing contracts with commercial entities, including granting of licenses. The inventory of proprietary rights held by DLR now amounts to over 2600 domestic and foreign patent registrations and patents, including EP and PCT registrations. In 2007, a total of 212 invention disclosures were submitted, keeping pace with the level achieved during the previous two years.

The illustration shows that the number of foreign proprietary rights has recently increased significantly, following a period of continuous decline since 1998. This is the result of the substantial rise in the number of invention disclosures, which have been at more than double the 2003 level for the last two years. Since 1998, and continuing in 2007, DLR has systematically pursued a policy of concentrating the financial means available for pursuing expensive foreign proprietary rights on those inventions that also have actual market potential.

License revenues



Licenses

Revenues of over 3.6 million euros were achieved from licensing in 2007. This represents almost a doubling of the DLR's licensing income compared to that of 2002. The reason for this is that technology transfer projects initiated at the end of the nineties are now entering the revenue phase and are therefore generating additional license revenues for DLR.

Spin-off companies

One of the roles of Technology Marketing is to support spin-off companies originating from DLR institutes and facilities. Employees who are keen to establish a start-up are prepared for their independence with appropriate advice on the selection and preparation of the technology, partly through projects from the technology transfer fund, and receive help in producing the business plan. Suitable initiatives by the institutes and employees can be supported through funding from the Helmholtz Association's Initiative and Networking Fund. Since the establishment of the Helmholtz Enterprise Fund by the Helmholtz Association (previously the EFIL of the BMBF), a total of eight DLR facilities have received support of up to 100 thousand euros to set up a

company. Four new companies were founded by DLR employees in 2007.

The young companies also provide DLR with an additional route to market for the technologies that it creates. The companies are equipped with licenses to utilize DLR technologies and turn these into value-added applications, which in turn provide not only the expectation of license income in the long-term, but also third-party revenues for the institutes in the short-term. Support from the institutes is delivered through engaging selected services that facilitate the transition from research to development enterprise.

Alongside their purely commercial effect on the business activities at DLR, these support initiatives also offer an attractive prospect for employees leaving the organization and their career perspectives. Both the experience of commercial work and the chance to join a young company built on DLR technology can provide the basis for a professional future, particularly for personnel working on temporary contracts.

Start-up companies, particularly those originating in research institutions, have the option of obtaining financing from

the High-Tech Gründerfonds, which acts as a financial partner. The Kreditanstalt für Wiederaufbau (Reconstruction Loan Bank) can also provide a wide range of financing options to these companies.

Technology Marketing supports DLR facilities in the preparation of proposals and – together with the Legal Department – the structuring of contracts with these companies covering collaborative work and licensing issues.

The plan is for DLR to only participate in commercial enterprises that aim to put technologies from DLR at the heart of their business activities. Participation by DLR may, for example, be on the basis of awarding the company exclusive rights – for a limited time – to a significant element of DLR technology, in order to facilitate the positioning of products or services in the market, thereby allowing the company the opportunity to become a going concern. Because of competition regulations, the exclusive allocation of usage rights requires payment of an initial concession fee by the company, which can however be substituted by an allocation of shares to DLR in lieu of a down payment, whereby DLR has the right to generate revenue through the sale of the shares at the end of the participation. New concepts and models are currently being developed for commercial participations by DLR.

Standardization

Standardization is very important to the proper functioning of the economy, the research sector and society at large. Standardization is a strategic instrument for all management, not just a field for specialists.

Standards play a major role in deciding the opportunities for bringing new developments to market and their positioning against European and international competition. They guide the transfer of knowledge and promote innovative potential and technology convergence.

Quality and product assurance, management and safety and environmental protection are the best-known areas in which science is reliant on the application and availability of standards.

As a research institution, space agency and project management agency, expertise in standardization is an important area for DLR when it comes to providing a secure basis for projects and proposals. DLR is involved in various national, European and international standards organizations (e.g. DIN, CEN/CENELEC, ISO) and other associations (e.g. ECSS, CCSDS and ESCC), working together with the European Space Agency and industrial partners to develop consistent standards for European and international space flight projects based on their specific needs.

Standardization of research results within DLR projects and proposals is carried out alongside development work at the various facilities, with support from the Standardization Department.

In 2007, DLR successfully completed the proposed Technology Readiness Level (TRL) standardization project as part of the "Innovation with Norms and Standards" project initiative from the German Federal Ministry of Education and Research and in collaboration with EADS Astrium Transport and the DIN Aerospace Standards Committee. As result of the technical expertise of the working group, it took only half a year to create a European draft standard describing a process for evaluating the developmental maturity of technologies applied in space flight projects. This application-oriented process is currently being developed further and will be tested within the framework of the OOV programme (OnOrbit Verification) at DLR.

Structure and Organization

Development of the Research Centre

Engineering Systems House

The Engineering Systems House is a DLR facility for engineering and the integrated production of scientific equipment. The Engineering Systems House (ESH) was completed towards the end of 2007. The project is divided into two sub-projects.

Thanks to their collected experience in the field of continuous process improvement (CPI), the regional teams put together for the Process Modelling sub-project were successful in incorporating changes to the way that business processes are executed and organized, thereby allowing the whole process landscape at the ESH to be optimised. Part of this review included the extension of the new Integration, Verification and Test business process into the existing process landscape.

A further work package saw the process landscape at the Engineering Systems House, which had been developed previously in a continual improvement process, successfully converted in its entirety into an interactive digital platform. This platform was created with the aid of Sycat software, which is widely deployed throughout DLR, and incorporates the ESH's defined business processes for engineering, precision manufacturing, test support, consultation and integration, verification and test.

Detailed process descriptions were produced by the cross-regional CPI team in order to comprehensively document the business process and to improve the understanding of the corresponding process steps. These will be integrated into the business processes following fine-tuning in cooperation with the regional CPI teams. The participation of these teams in the continuous improvement process will ensure that adjustments are made as necessary to meet customer requirements and will allow processes to be optimised in terms of efficiency.

In order to improve the visual presentation of these business processes, it is intended to also publish these on the DLR intranet in a specially developed, interactive HTML edition.

The goal of the IT Tool sub-project was the development of an IT concept for planning contracts, projects and related issues during the preparation phase, including the real-time provision of transparent cost development information, something which will always be required by the customers of the ESH.

The IT concept created will be used to source data from various areas of activity within the ESH, which will be interconnected according to certain rules and stored for further processing or archiving purposes. An important issue here was to take into account interfaces to previously implemented software, such as Computer Aided Design (CAD) packages, databases for CAD data, Microsoft Office, and the Limbus timekeeping software. Additional interfaces to the DLR timekeeping system (Zerf) and SAP also play a supplementary role in delivering the necessary cost transparency.

The selection and introduction of the most promising concept is now made at the line organization level rather than within the framework of individual projects.

Construction Management

The role of the Construction Management department is to ensure that every DLR site receives all the construction services they need in accordance with building regulations. The idea of reorganizing the various construction activities into an efficient Construction Management system was proposed during an evaluation by external consultants in November 2006. The systematic implementation of the organizational structure as a regional model began in 2007. The main aims of Construction Management during this process were to optimise the individual construction processes and to provide the technical infrastructure systems, while at the same time maintaining alignment with the organizational objectives of DLR.

The unification of the processes used for planning and implementing construction activities resulted in new, clearly defined interfaces between Construction Management and operators. In addition, the introduction of clear processes and line management responsibilities has led to improvements in operational efficiency, due to the increased effectiveness and efficiency with which construction activities are addressed.

This was clearly demonstrated in a doubling of the construction volume handled in 2007, with only a slight increase in the number of construction personnel. Furthermore, there was a marked increase in the number of construction projects that, due to their high construction volumes, were managed through German federal ministries. Examples include the control centre in Oberpfaffenhofen and the aircraft hanger in Braunschweig.

Another focus area in the field of Construction Management was the further development of the Baumonitor (Construction Monitor) IT tool. This is the prototype for an information and control tool, which is oriented towards the individual construction activities that make

up the new construction process (project idea, project concept, project plan and project implementation with transfer to site management). This IT tool was developed primarily to aid the creation of non-location-specific plans for construction activities at all thirteen DLR sites.

Initial results of the implementation of the traffic-light functions, which serve to identify deviations from planning and to create standardized reports being useful at the outset, demonstrated the excellent possibilities that are achievable with the prototype Baumonitor, even at the test stage. The Baumonitor will run on top of the existing systems at DLR (e.g. SAP).

The improvements in Construction Management were achieved through an organization-wide deployment of specialist construction knowledge combined with utilization of the synergy effects of the regional organizational structure. In addition to this, a simplified capacity balancing process now allows technical construction resources to be made available across all locations.

Construction Management and the ESH are also focusing on the introduction of an integrated management system that complies with DIN ISO 9001 and 14001 that will be applicable to every site. Internal audits were successfully completed across the whole TS section during 2007 and the start of 2008. Certification was awarded by external auditors in March 2008. The schedule of responsibilities for Technical Services (GVP) was fully compiled, checked and released.

Military science research

DLR integrates its military science research into its overall objectives. This approach promotes reciprocal research and technology transfer between civil and military scientific activities, which is carried out in collaboration with the relevant ministries and their subordinate agencies. Civil research results can therefore be used extensively in order to supplement speci-

fic aspects of military science through dedicated research and development projects. The goals are:

- To contribute to fulfilment of demand and closing of capability gaps in the armed forces through phenomenon-oriented and application-oriented research.
- To provide procedures and facilities, and to carry out demonstrations for the purpose of trialling and evaluating new technologies.
- To maintain and expand assessment and consulting expertise on behalf of the BMVg and the German Federal Office of Defence Technology and Procurement (BWB), their subordinate agencies, and the scientific sector at large. These goals are intended to ensure that new and superior technologies are continuously found.

A long-term financial basis is required in order to guarantee that DLR continues to retain this capability into the future. This forms the foundation on which DLR can apply for additional third-party financing from sources such as European funding programmes to assist in completing research proposals. A longer-term source of financing must be available in order to ensure that the appropriate knowledge and facilities remain at DLR over the longer term.

Scientific competitions at DLR

To be a thought leader for up and coming technologies; to promote inventiveness and creativity; to acknowledge services rendered and scientific excellence. It is with these goals in mind that DLR regularly holds two types of scientific competition. The "Visionary Projects" competitions encourage staff to have imagination and curiosity for new technologies, the "DLR Centres of Excellence" competitions test the professionalism of larger clusters in the execution of standalone and networked research.

Visionary Projects competition

“Enabling the future” – this was the slogan with which Prof. Wörner opened the final gathering for the “Visionary Projects 2006/07” competition in June 2008. Ten scientists presented the results of their research in impressive fashion following two years of support from the programme. Particularly pleasing here was the degree of success in linking and bringing together various methods, such as early warning systems for earthquakes, and intelligent materials and structures.

The Executive Board invited submissions to this second round of the “Visionary Projects” competition in summer 2005, selecting the three best visionary and creative ideas from around 60 suggestions to receive a two-year support package. Each project was judged for its scientific, social, technological and programmatic relevance, and the way in which it linked in to external partners. Six further topics were chosen to receive a lower level of assistance. One suggestion was removed from the competition due to its high level of relevance to all four DLR programmes, thereby allowing it to be provided with special support. The researchers concluded their studies after two years. During their presentations, they demonstrated that their work in these diverse subject areas had yielded astounding results. In fact, certain aspects have laid the groundwork for (inter-) national funding and led to patents being registered. It is planned to publish a brochure presenting the results and to invite proposals for a new competition.



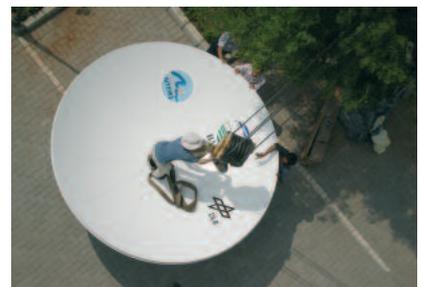
Winner of the Visionary Projects competition and representatives of the programme directorates and the Strategy Division with Prof. Wörner, Mr. Reiter and Prof. Szodruich at the final presentation

DLR Centres of Excellence

A competition is held every year to reward outstanding performance over the previous three years, with the winner being awarded the title “DLR Centre of Excellence” (CoE) by the Executive Board. The criteria for selection are: scientific excellence; scientific progress; national and international engagement; in-house networking; and relevance to other fields of research. The guiding principles here are the core and supporting goals that form the “DLR Goals and Strategies”.

Since 2005, five of the larger inter-institute research groups have been named “DLR Centres of Excellence” and received the accompanying funding bonus of 500 thousand euros for three years in recognition of their first-class research over the preceding years. Two of these are still to be evaluated in 2008 at the end of the period of additional funding and have the opportunity of gaining an additional, albeit smaller, bonus over the next three years.

The promotion of the renamed “DLR Centre of Excellence, Robust and Reliable Communication” competition began in the first quarter of 2008. This is mainly concerned with the application of communications technologies in safety-critical areas, such as air-traffic management (ATM), the control of unmanned aerial vehicles (UAVs), and collision avoidance for rail and road traffic. The particular challenges here are the provision of guaranteed data transmission, even under difficult conditions, the robustness of the data transmission against various type of fault, and the rapid delivery of information in real time. In Germany, the new DLR CoE is already a leader in aviation communication and an internationally reputed partner that is in great demand.



Antenna assembly in Jakarta

Quality Management and Environmental Protection

The quality of its research results, products and services is fundamental to the performance and competitiveness of DLR. The highest of demands are made of research, management, and infrastructure. This is expressed in the motto: DLR – Our research enables the future

Increasing third-party revenues and our growing number of employees speak for the success of our customer relationships. DLR operates a management system designed to support the management team and to continue the successful development of these customer relationships into the future through excellence in research results and high quality scientific and technical services and products.

The new, integrated DLR quality policy combines quality, safety, environmental protection and sustainability, thereby defining the framework for the development of the DLR management system and the pursuit of the idea of excellence. A central element of this is the DLR Code of Conduct, which lays down the principles of ethical behaviour for DLR and its partners. The Code of Conduct details DLR's approach to ethical issues and promotes the following: ethics in scientific work; support for the United Nations Global Compact; compatibility of work and family life; health and safety for all personnel; acceptance of responsibility for the environment; and DLR's regional and international social relations.

Quality Management

DLR maintains a management system in order to assure the long-term success of its customer relations. The core processes are "Research and development in aeronautics, space, energy, and transport" and "Managing national astronautics activities, delivering services to support research and training."

The principle of self-responsibility applied to the institutes and facilities provides scope for each of these to structure itself and assign priorities according to its specific requirements. The management system is an integral part of DLR's "Goals and Strategies, 2006 to 2009".

As of the middle of 2008, quality management systems had been introduced and certified at a total of 20 institutes, facilities and organizational units. This process is underway at a further eleven institutes and facilities. The deployment rate achieved represents an increase of 5% over the performance level of the preceding year at 58% (systems implemented and under development).

The development priority for the quality management system was again based on the extension of existing systems through the expansion of its scope of application. This was achieved both through the assimilation of additional workflows into the management system and by extending the demands placed on the management system. The trend continued towards integrated management systems based on the management of quality, supplemented by occupational health and safety and environmental protection. As such, the QM process is a driving force behind the establishment of the management system, since it integrates environmental issues and occupational safety and health. Having a consistent quality

management system across the entire organization is one of the unique characteristics that sets DLR apart from other large research organizations. June 2008 once again saw a successful audit to DIN EN ISO 9001 of the management processes employed in both the DLR quality management system and the quality and product assurance system by Bureau Veritas Certification.

The Applied Remote Sensing Cluster introduced a management system that was awarded DIN EN ISO 9001:2000 certification in November. The certifiers recognized the management system used by the administrative infrastructure in February, with the Project Management Agency and the Institute for Space Propulsion being re-certified. The Institute of Transportation Systems has extended the scope of validity of its DIN EN ISO 9001:2000 certification to its site in Berlin; the Braunschweig site achieved re-certification to VDA 6.2. In March 2008, the management of the Transport business division successfully passed the certification audit. Technical Services were able to broaden the coverage of their integrated quality and environmental management system to all locations. DLR Technology Marketing reached its first milestone, Committed to Excellence, in June 2008. The validation was carried out by a senior advisor from the German Society for Quality.

DLR is a member of the European Foundation for Quality Management (EFQM). Once again, DLR participated in the 2007 Ludwig-Erhard Prize with one assessor, and also provided a further assessor for the European Excellence Awards (EEA) in 2007 and 2008.

For the fifth time, the DLR Quality Prize was awarded to three employees and one service provider during the annual general meeting.

The demand from our customers and partners to assess DLR as a whole and/or the individual institutes and facilities by means of audits or by the production of a certificate remained at a high level. In a few instances, customer demands already extend beyond ISO 9001, for example Airbus and Rolls-Royce require EN 9100 and EADS requires ISO 14001.

In certain cases, it was also possible to tap into additional acquisition potential during 2008, which would not have been possible had the facility not had a QM system.

Since September 2004, members of staff who are able to demonstrate sufficient technical expertise and a knowledge of standard processes at DLR have been given the title of DLR Auditor. These thirteen auditors carried out 29% of planned system audits during the reporting period. June saw the third auditor's conference at DLR, which provided the 25 participating auditors with the opportunity for mutual exchange of ideas. The guidelines on protecting investments in software development have been integrated into the management system. Occupational health and safety standards were published at the start of the year using the integrated system.

It is planned that all DLR facilities will be subject to a systematic, full-coverage audit process in order to create a solid foundation for the continuous development of the complete QM system. This process will also involve inspecting and taking an inventory of all the product-relevant measurement and test equipment used by DLR. Important outstanding tasks to be completed are: embedding of scientific quality assurance into the management system; implementation of the audit, measurement, and test databases; establishment of a space product assurance network; and the harmonization of the process landscape at DLR. The total num-

Quality Management	2005	2006	2007
Existing certifications and accreditations	15	16	18
Number of DLR auditors	13	14	15
Proportion of audits conducted	60%	24%	29%

ber of audits has risen due to the decision to audit all institutes and facilities (with and without QMS).

Environmental protection and safety

Along with the numerous and varied research activities and developments in the fields of environmental protection, conservation of resources and emissions reduction, operational environmental protection is firmly anchored in organizational policy as a goal of equal importance to the success of the business. The first environmental management system to be included in the DLR infrastructure was successfully certified in 2000. This continuous improvement process was then pursued further by systematically integrating related areas such as occupational safety and health and by creating links into the quality system.

There have been deep-reaching changes to the infrastructure of DLR, which are complemented by a structured target definition process for Technical Services that uses the Balanced Scorecard methods to develop common goals, strengths and values. Following on from these changes, the facilities managed by Technical Services were examined by means of a matrix audit and in March 2008 were successfully certified as complying with the ISO 9001 and 14001 standards. Technical Services' policies include: guiding principles, unified processes, and a programme designed with economic, ecological and social goals in mind. These policies convinced the auditors of the high level

of professionalism delivered by Technical Services, which they confirmed as being on a par with that found in the aviation industry, industrial research organizations, and major infrastructure service providers. In the medium term, the subject of "sustainable economics" will play an important role for Technical Services.

Environmental and safety standards, such as ISO and OHSAS, already have significant importance for the certification activities undertaken in the various institutes and facilities run by DLR. One of the major areas of work over the last year was the introduction of overarching safety and environmental protection standards in the form of in-house standards, guidelines, and recommendations, which interpret and concretise the legal requirements applicable to the research enterprises at DLR. These have been published on the DLR intranet and represent a further important step towards an organization-wide, integrated management system; they are also incorporated within the DLR General Manual.

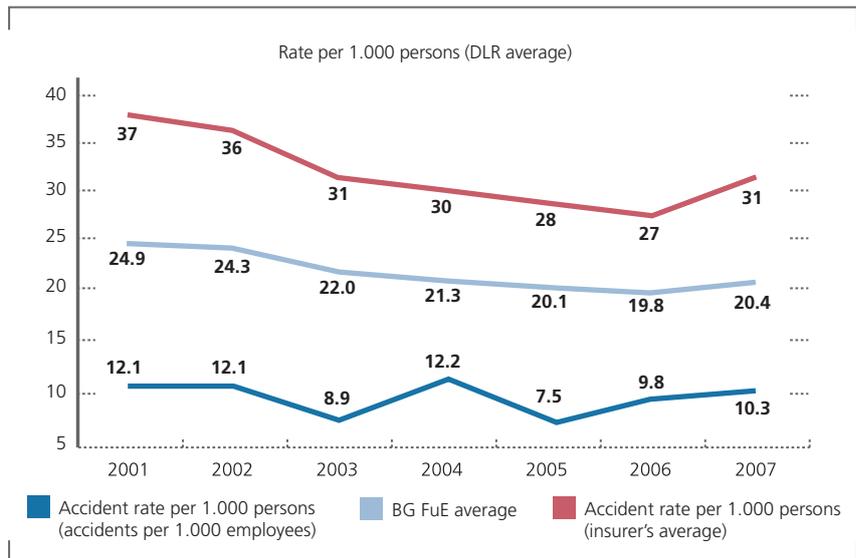
Fire prevention and building preservation were also a focus area during the last period of interest. The fabric of the older buildings was audited and additional optimisation measures taken as required. Additional restoration activities were also undertaken to protect the environment. Drainage systems were renewed and legacy waste was removed from building structures, both above and below ground. To improve the efficiency with which resources are used, thermal insulation

was fitted to buildings in an effort to save primary energy. Use of waste-heat exchangers, water-saving washroom facilities, and energy-saving lamps is also a necessary part of the resource conservation measures taken by DLR.

Another focus area for safety and environmental protection was internal communication, which was further improved through ongoing development of the Internet application (www.umwelt.dlr.de) and further training of selected target groups, partly in cooperation with the employers' liability insurance associations. As a member of the Helmholtz Association, DLR was involved in producing an Employer's Liability Insurance Association Information Document (BGI 5096). This guideline, "Forschungsinstitute – sicher, gesund und erfolgreich" ("Research Institutes – Safe, Healthy and Successful"), was published in order to ensure predictable and safe working practices. Information events for employees, such as the "Environment, Health and Safety" days in Oberpfaffenhofen and Göttingen, and special training for management, were offered and delivered.

The number of accidents at DLR was significantly lower than the national average as a result of the comprehensive preventative measures (see illustration). With an incident rate of 10.3 accidents per 1000 employees during 2007, DLR was well below the national average of approximately 31. DLR had only half the average number reported by the employers' liability insurance associations of 20.4. In 2007, DLR recorded 57 notifiable accidents, of which almost half occurred away from the workplace, either while travelling on business or commuting between home and work. The majority of workplace accidents fell into the categories of falls, trips, sprains, cuts and skin

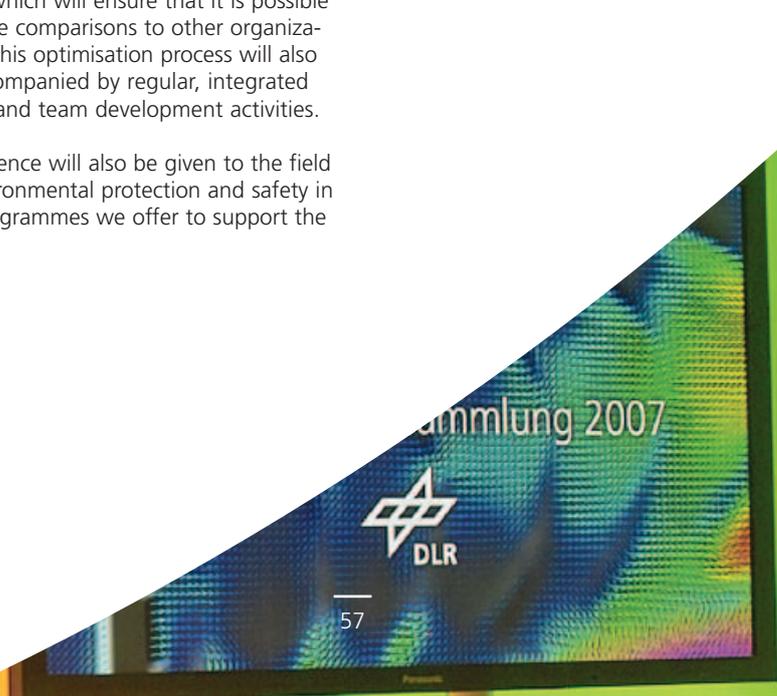
Accidents at DLR



penetrating injuries. No fatal accidents occurred in 2007. The continuous improvement process for environmental protection and safety is being systematically progressed at DLR. Service providers, suppliers and other partners are being evaluated and integrated into these activities. Performance figures will be further extended by making use of the Balanced Scorecard method to improve the data basis, which will ensure that it is possible to make comparisons to other organizations. This optimisation process will also be accompanied by regular, integrated audits and team development activities.

Prominence will also be given to the field of environmental protection and safety in the programmes we offer to support the

next generation of academics. Student projects covering safety-relevant topics, such as fire prevention and law amendment, will be offered and supervised by DLR at both bachelor's and master's level. The results of this initiative will feed into the work of the personnel responsible for occupational health and safety and environmental protection.



Relations

Helmholtz Association of German Research Centres

Programme development

A major feature of the past year was the evaluation of the programmes within the "Aeronautics, Space and Transport" research area. The superb results achieved by all three programmes pay tribute to the outstanding scientific performance of the employees. It seems that DLR is very well positioned to meet the upcoming challenges over the next five years of the programme-oriented funding scheme. In the field of "Energy" research, DLR, along with other centres in the Association, is preparing for the second round of programme-oriented funding. The evaluation for this field of research is scheduled for the first half of 2009. It is intended that the activities that make up the system analyses in the "Energy" and "Key Technologies" research areas will be audited together. The hope is that this will demonstrate strengthened synergies and reinforce networking.

Initiative and Networking Fund

Development funding was obtained for a new young investigators group in the field of material physics in space. The collaboration with the University of Konstanz in this field is now firmly established. Four new proposals, which

included collaborations with universities in Stuttgart, Braunschweig, Munich, and Bochum, were submitted to the offices of the Association. Over the next five years, universities and non-university partners at home and abroad have the opportunity to work together in the field of space research thanks to financing provided by the "Planetary Evolution and Life" research alliance. Cooperative ventures were initiated with Canadian institutes in the field of energy.

National and European Networks

Collaborations with further education establishments

Cooperation with universities and colleges is one of the strategic goals of the DLR's organizational policy. Joint projects in practically every sector of industry ensure optimal utilization of existing resources in programmatic research. At the level of the individual, these collaborations provide a boost to the training of highly-qualified young talent for industry and research. Similarly, both DLR and the higher education institutions benefit from working together. For the educational establishments, the scientific and technical infrastructure available at DLR is indispensable for numerous fields of research. For DLR, these schemes ensure access to young scientific talent and new topics of research.

Each year the institutes of DLR oversee more than 500 postgraduate students working on their PhD theses, with another 300 students completing their final year master's projects at DLR facilities. The number of DLR scientists with lecture-ships has increased significantly in the last few years. This meant that around 200 scientists were tasked with delive-

ring lectures, tutorials, seminars, etc. at universities and colleges during the last year.

Combined appointments form a central element of the links that individual employees have to higher education. All heads of DLR institutes must also accept an appointment to a position in higher education, meaning that alongside their positions in the institutes, the DLR heads of institutes take on a university professorship with all the rights and duties to the university this entails. Combined appointments based on the qualification criteria of both partners ensure that positions are filled by the best candidate and give the scientist appointed increased potential for research and teaching.

Participation in DFG programmes

The "Coordinated Programmes" of the German Research Foundation (DFG) provide support for numerous networks of researchers who apply themselves as interdisciplinary teams to a large group of topics. The Foundation supports Collaborative Research Centres that focus on excellence in research, Priority Programmes designed to develop pools of expertise, and Research Training Groups for training of high-calibre young scientists. During the reporting period, DLR participated in Collaborative Research Centres seven times, Priority Programmes seventeen times, and Research Training Groups three times.

Sponsorships

Securing highly qualified young talent for research and development is an essential matter for both science and the economy. Sponsorships combine development of young talent with the goal of rapid technology transfer through individuals. This involves companies taking on half the costs of training young scientists, who are engaged by DLR for a period of between three and four years to work in areas of equal interest to DLR and the company. A portion of this time is spent at the company.



National and European networks	2005	2006	2007
DFG participations	30	27	27
Sponsorship agreements	54	53	44

Forty-four sponsorships were supervised in 2007. This, although being a significant reduction when compared to the remarkably high level seen in the two preceding years, is still considered a very good number.

Collaborations with NLR/EREA

On December 12, 2007 the EREA board welcomed more than seventy representatives from Parliament, the Commission, national and regional ministries, and the industrial and research sectors to the customary annual gathering in Brussels. Guest speaker Philip Busquin, Member of the European Parliament and former Commissioner for Research, reasserted his support for research, and aeronautics research in particular. Following his address, Prof. Abbink (NLR Director General) took the opportunity to present the first ever EREA Best Paper Award to a team from ONERA. He then handed over the chairmanship of the EREA to D. Maugar, president of Onera. The chairman will be supported in his work over the next two years by Prof. Abbink in the role of vice-chairman and Mr. A. Junior (DLR) as EREA Secretary.

During this year's ILA air show, DLR was represented as part of the EREA stand and the events organized around it. A series of presentations showcased the special expertise of various European aeronautics research establishments to a focused public, covering themes such as large test facilities and research into helicopters, materials, wake turbulence, and noise. Particular attention was given to bilateral and trilateral collaborations within the ERA, such as the Aero Testing Alliance (ATA), which is a cooperative

venture involving the DLR, NLR and ONERA wind tunnels, and the bilateral Onera-DLR work in the field of helicopter research.

Collaboration with the EU and Onera

DLR submitted 186 proposals, including 24 as coordinator, in response to the first call for proposals for the Seventh Framework Program (FP7). With a success rate of around 29%, DLR again came in significantly above average. Viewing this critically, however, it should be noted that the success rate with FP7 has fallen heavily compared to FP6. Given the costly and time-consuming application process, it would be beneficial for the Commission, member states, and research players to come together to consider how success rates can be kept at an acceptable level. DLR is prepared to actively guide this discussion, both as an individual organization and in its role as a member of European technology platforms (ACARE, ERRAC, ISI, etc.) and special interest groups (EREA, ECTRI, etc.).

This notwithstanding, DLR has contributed numerous proposals in response to the second call for the Seventh Framework Programme. Due to the lower success rates, in this case DLR concentrated on resubmitting proposals that were successful in the first round, but which no longer had sufficient funds available. Following the political decision by Council and Parliament to establish the Clean Sky Joint Technology Initiative, the Commission is now working on completing the detail of the implementation documentation (Grant Agreement, Stakeholder Agreement). DLR officially declared its participation as an associate in the Clean

Sky project, confirming it as member of the three Integrated Technology Demonstrators (Fixed Wing, Helicopter and Systems) and the Technology Evaluator. A representative of DLR has now taken part for the first time in a meeting of the Clean Sky Governing Board, representing the Fixed Wing ITD. Beyond this, discussions are currently underway to determine how the research infrastructures at DLR and its partners (wind tunnels: DNW; research aircraft: ATRA, FHS) can be integrated into the JTI. DLR also plans to respond to calls for proposals from the other ITDs.

With regard to the participation of DLR in the Fuel Cells JTI, which was passed by the politicians in Spring 2008, DLR has taken a major role in the formation of the N.ERGHY Research Grouping, which will become a member of the Fuel Cells JTI as the representative of research. The initial meeting to this purpose took place in March 2008. In accordance with the decision of the N.ERGHY plenary meeting, DLR has assumed the role of administration office for N.ERGHY.

Collaborations with CNES

Head of CNES, d'Escatha, accepted the invitation to participate in the Senate and in turn invited Prof. Wörner to the meetings of the CNES board. This allows a better mutual insight into the management and processes employed by the organizations.

This exchange and the coordination of activities between CNES and DLR will continue to be pursued at various levels.

Bilateral discussions on the subject of European space policy are planned within the context of France's presidency of the EU.

Progress has been particularly good on collaboration in the field of carrier technology:

The Aldebaran project has the goal of developing a micro-launch vehicle demonstrator. Aldebaran will initially investigate various concepts for the transport of payloads up to 300 kg into LEO, based on a cooperation agreement between CNES, DLR (research) and CTDI.

Currently the industrial and research partners have more than ten suggested concepts on the table, which must now be reduced to a maximum of three concepts by the end of the year by means of an evaluation process. Phase A is due to start in the coming year.

Manned space flight – DLR and CNES will hold an informal workshop to compare and discuss the various concepts for a European space transport vehicle to carry astronauts, initially into near Earth orbit. The concepts for a workable European solution and the positions taken will be documented in the form of an executive summary.

International Collaboration

The headline event for DLR in terms of international cooperation was once again the International Air Show (ILA) in May 2008. The ILA provided the forum for the "Earth Observation: Solutions for Decision-Making" conference hosted in conjunction with the German Aerospace Industries Association (BDLI), which showcased German remote sensing expertise in areas ranging from satellite construction to data products. The central application themes for national and international experts and decision makers were disaster assistance and climate and environmental management. At the invitation of Prof. Szodrich, a meeting of high-ranking representatives of international research institutions took place in the immediate run up to the International Air Show (ILA). The goal of this meeting was to stimulate an international dialogue on the contributions made by international research to the subjects of aeronautics and climate change.

The Singapore Airshow and the Dubai Airshow held during the reporting period offered additional opportunities for discussions with partner organizations from Asia and the Arabian Peninsula. For the second time since 2005 DLR also took part in the Moscow International Aviation & Space Salon, "MAKS 2007" (August 2007). At the invitation of the ESA, the DLR presentation in the European Space Agency's chalet included both European and national projects. Featured topics were the Mars Express mission, which carries the German HRSC (High-resolution Stereo Camera), the cooperation between

satellite control centres on the ISS project, and the German TerraSAR-X radar satellite. DLR also had a trade stand presence at the International Astronautical Congress, which was held in the Indian city of Hyderabad in September 2007.

USA

The launch of Columbus in February 2008 on board the US Space Shuttle Atlantis and its subsequent successful coupling to the International Space Station (ISS), as well as the launch of the ATV just one month later, were not only without doubt the outstanding highlights of the transatlantic space flight collaboration, but also of German-American cooperation. Alongside these impressive milestones in human space flight, NASA and DLR continued to hold discussions on other subject areas covered by their bilateral cooperation. In January 2008 a delegation from NASA visited the Cologne and Bonn sites in order to agree the next steps for the bilateral SOFIA (Stratospheric Observatory for Infrared Astronomy) project. In the meantime, the Boeing 747 carrying the infrared telescope delivered from Germany has successfully completed its first flight tests. The integration of additional instruments is now proceeding.

In March, bilateral expert consultations took place in Washington, D.C. to determine the possibilities for collaboration in the field of exploration. Particular emphasis was given to the fields of radar, robotics, planetary research and optical communication. The first outcome from these discussions was the participation of DLR in NASA field tests in November 2008. The exchange was strengthened back in April through a visit to DLR by the head of the JPL (Jet Propulsion Laboratory), Dr. Charles Elachi. Agreement was reached to work together with the JPL on the options for a possible radar mission (L-band).



Berlin Summit of international aeronautics research institutes in the run up to the ILA in Berlin, May 2008

During his visit to Berlin on the occasion of the ILA, the head of the US Air Force Research Labs (AFRL), General Major Bedke, met with the DLR Executive Board and toured selected DLR sites. This meeting confirmed the considerable potential for collaboration on aerospace projects and further visits are planned to give shape to the ideas.

Canada

The central theme of the bilateral relationship with Canada is Earth observation, particularly in the field of radar technology. To this end, a delegation from the Canadian CSA visited the DLR site at Oberpfaffenhofen at the start of February 2008. Among the items agreed was the decision to continue the mutual exchange of data for research purposes. DLR visited the Canadian Space Agency, CSA, on the occasion of the COSPAR conference in Montreal. The main topic of discussion was the construction of a DLR receiving

station in Inuvik in the Canadian North-West, which is being supported by the CSA and the Canadian government.

Russia

During the Moscow International Aviation & Space Salon, ROSKOSMOS director Prof. Perminow and the Chairman of the DLR Executive Board signed a Memorandum of Understanding (MoU) relating to the "On Orbit Verification" (OOV) programme. This will allow innovative technologies to be verified under real space conditions and prototype functionality to be demonstrated with the assistance of Russian launch options.

Following on from an MoU of March 2007, in October an agency agreement was initialled in Garching to seal the German contribution of the eROSITA (Extended Roentgen Survey with an Imaging Telescope Array) x-ray telescope to the Russian Spectrum-X-Gamma

(Spektr RG) satellite mission. The telescope is being developed by the Max Planck Institute for Extraterrestrial Physics with support from the DLR Space Agency.

In April, RKK Energiya hosted the first "Soyuz Upgrade Initiation Meeting" of the German space industry, under the leadership of DLR, in Moscow. The content of the discussion was the provision of German technologies from the European ATV programme for Russian human space flight. A follow-up meeting was held during the ILA in Berlin in May 2008.

The ILA also provided the opportunity for an exchange with the director of the Russian space research institute, Tsagi. Building on many years of cooperation and in reaction to the restructuring of the Russian aeronautics sector, it was agreed to intensively examine new Russian suggestions for collaborations and to resume the discussions in fall 2008.

Ukraine

Within the framework of the European Neighbourhood Policy, DLR, CNES (Centre National d'Etudes Spatiales), and other partners are participating in a twinning programme with Ukraine under the leadership of the National Space Agency of Ukraine (NKAU). The goal of the two-year scheme is to support NKAU in the reorientation of national policies on astronautics and the space industry. In this context, a framework agreement was signed off by the DLR and NKAU agencies at the ILA covering their collaboration on activities in the space sector.



Strategy dialogue with JAXA

Japan

In November 2007, Berlin played host to the annual consultation between DLR, their French sister organization, ONERA, and the Japanese agency, JAXA, on the subject of trilateral cooperation on aeronautics research. The goals of the meeting were to analyse the status of existing projects and to agree new fields of collaboration, which were successfully identified in several subject areas.

On a bilateral level, the so-called strategy dialogue between DLR and JAXA facilitated an exchange on the programmatic focus of the two space programmes. For the first time, an industrial forum was held in parallel to meeting, which allowed German companies the opportunity to present themselves to the Japanese sister organization. May 2008 saw a visit by a delegation of the Japanese Ministry of Economy Trade and Industry (METI) to the DLR's Oberpfaffenhofen and Bonn sites to gather information on the possibilities for closer collaboration in the field of Earth observation.

China

In November 2007, Prof. Yu-Long Tian led a delegation of high-ranking officials from the China National Space Administration (CNSA) to DLR in Oberpfaffenhofen. The discussions laid the groundwork for the first Joint Committee Meeting between DLR and the CNSA in October 2008. Agreement was reached on closer information exchange with the Chinese CASC China Aerospace Science and Technology Corporation (CASC) and their space technology manufacturing centres.

Brazil

The 26th meeting of the Scientific-Technical Cooperation Commission took place in Brazil in November 2007. Under discussion was the extension of cooperation in the field of sounding rockets for scientific experiments between German, European and Brazilian research institutes. In addition to this collaboration with the CTA, DLR is cooperating with the Brazilian space institute INPE on the MAPSAR project. Currently in the study phase, the goal of this project is to examine the technological developments required to use an L-band SAR satellite to assist in the protection of the Brazilian rainforest.

India

As a prelude to the ILA in Berlin, which this year featured India as the partner country, in February 2008 Prof. Szodruch visited the National Aerospace Laboratories, the Indian Institute of Science, and Hindustan Aeronautics Ltd. (HAL) in Bangalore. This trip identified subject areas for possible cooperative projects in the future, as well as producing an agreement to intensify the exchange of scientific staff.

Algeria

In the field of energy research, DLR and the Algerian renewable energy agency, New Energy Algeria (NEAL), concluded a cooperation agreement. This agreement gives DLR direct access to the first solar-thermal power plant in Algeria, near Hassi R'mel. In return for the opportunity to scientifically evaluate the operating experience gained there, it was agreed that there would continue to be further exchanges of scientists and doctoral students studying topics in the field of solar research.

Israel

Israeli Minister for Science, Culture and Sport Mr. G. Majadle paid a visit to DLR in December 2007 in order to gain an overview of its activities. The visit took place within the context of an official visit of the minister to the BMBF.

EU

Meetings were held with Swedish and Austrian partner institutions relating to bilateral collaboration with European space nations. The current theme of the Swedish-German partnership is the joint construction of the receiving station in Inuvik, Canada. A visit by Prof. Wörner to the Austrian Research Promotion Agency (FFG) facilitated the discussion of deeper ties between German and Austria.

Press and Public Relations

Over the last financial year, DLR has become a recognized, central source of information on the fields of aerospace, energy and transport research as a result of its presence across the whole spectrum of press and public relations channels – media communication, events, Internet and multimedia. The close inter-

action between the core areas of the Press and Public Relations department gave DLR a voice in shaping the image and public perception of Germany as a centre of high technology.

The highlights during the reporting period were:

- Columbus mission: Europe took up a permanent presence in space with the delivery of the European Columbus laboratory to the International Space Station (ISS). Along with the European Space Agency (ESA), DLR was the first port of call for comprehensive information about the mission. More than 1000 journalistic articles referencing DLR were published over a period of just 14 days. Particularly important contributions were made by DLR's comprehensive Internet offering, which included constantly updated information, a blog, and multimedia content, and the establishment of the press centre at the Oberpfaffenhofen Control Centre.
- JAnnual general meeting 2007, Göttingen: The culminating event of the annual meeting calendar used the excellent research results as a vehicle to convey the DLR brand into the spotlight.
- New Year's reception, Berlin: At the first annual press briefing held in conjunction with the New Year's reception, journalists had the chance to learn about the highlights to be expected over the coming year. This measure had a positive effect on the coverage given to DLR.
- ATV: It was possible to carry over the successful communication achieved on the topics of ISS and Columbus to the ATV mission.
- C²A²S²E²: The DLR Press and Public Relations department supported the start-up of the largest computer to be used for aerospace research by providing press relations and organizing and hosting events. T-Systems was the collaboration partner.

- ILA 2008: As in previous years, the DLR presence at the International Aerospace Exhibition proved especially popular with visitors, press, and partners alike. DLR showcased its work to an international audience through its contribution to the Space Hall, with the additional stand demonstrating the activities of DLR nationwide, particularly in the fields of aviation and technology transfer. With the combined presence of the research aircraft fleet, DLR was able to command particular notice. The first public outing for the A320 ATRA in its guise as "Fuel Cell Demonstrator", implemented in collaboration with Airbus, drew a lot of additional attention. The closely maintained multimedia counterpart to the ILA on the DLR web portal attracted great interest from the general public.

- Oberhausen Gasometer: The "Eye in the Sky" exhibition, a joint promotion of the Oberhausen Gasometer and DLR, has to date broken all records for visitor numbers at this venue. Due to this enormous success a follow on project is already in the pipeline for 2009.

Political and Economic Relations

As part of the restructuring of the second level of executive management, a new organizational unit, "Political and Economic Relations (VO-PW)", has been established under the authority of the Chairman of the DLR Executive Board and is now in the set-up phase.

One of the main tasks included in the remit of the VO-PW will be to further intensify communication with the political establishment, that is with parliament and government at state and national

levels. Alongside the traditional political counselling activities of DLR on aerospace themes, the intention is that advisory services will now be intensified in the transport and energy research sectors as well, with stronger interaction between all the various fields of action.

The construction of a network of economic leaders and key figures from professional associations will be another focus area for the new unit. It will be important in this regard to ensure that deliberate efforts be made to include small and medium-sized enterprises (SMEs). The results of activities in the field of economic relations will extend far beyond the existing contacts and collaborations with the aerospace industry – above all in the context of the work of Technology Marketing and the numerous projects that the DLR institutes and DLR Space Agency are already involved in.

The main objective of the measures introduced by the new "Politics and Economic Relations" communications unit will be commitment to the general political goal of sustainability, that is to entrench the innovative and synergetic potential of DLR research and development and the work of the Agency even more deeply into the consciousness and long-term strategic manoeuvres of politicians and economists.

People

Equal Opportunities and Work-Life Balance

DLR acknowledges the importance of family and strives to provide equal opportunities for all. Having received a TOTAL E-QUALITY award in 2007 for the second time, the measures implemented focused on the work and family audit (audit beruf-undfamilie®). The aim here was to successfully pass a second re-audit. Following a preparatory workshop and the actual audit in March 2008, the Executive Board approved the new objectives in April.

DLR has already established a wide range of family-friendly practices such as: flexible working hours and models; teleworking, particularly in conjunction with working part-time temporarily to facilitate the return to work after parental leave; and access to family services. In future, childcare solutions tailored to specific locations will enhance these services. This HR policy is underlined by concerted measures in human resources development to advance women and raise management's awareness of these issues.

A separate department with responsibility for equal opportunities has been

created and now reports directly to the Chairman of the Executive Board. These tasks were previously handled within human resources.

Human Resources Development

Human resources development at DLR forms part of HR management as a support process. HR development is designed to assist institutes and facilities in reaching their goals by continually improving the performance of employees, teams, and organizational units, while also boosting motivation and job satisfaction.

With regard to employees, it is crucial to harmonize qualifications, skills, development needs, and achievement potential with the demands of the job on an individual basis. At management level, HR development supports the recruitment, selection, integration, development and advancement of staff as required in terms of each organizational unit's objectives. Corresponding team workshops support strategic and structural change processes.

Services and tools in HR development

The illustration highlights the demand-orientated nature of HR development services at DLR based on strategic discussions at management level, structured employee interviews, individual requests regarding in-house further training, and harmonization with corporate objectives. Skilled HR developers create customized HR and organizational development concepts with these aspects in mind. They advise on issues, support the implementation of various HR development measures ("one face to the

customer"), and evaluate their efficiency.

As well as general consulting activities, HR development also encompasses issues relating to further training, personnel management and support, plus the following primary services:

- Education programmes, both at individual site level and across the organization, focusing on language and computer training, soft skills, management skills and promoting better health
- Differentiated development for management personnel and next-generation leadership talent
- Management feedback to optimise leadership and collaboration
- Team workshops on organizational development (e.g. change management, strategy development, leadership and collaboration, customized training seminars for teams)
- Support with regard to the recruitment, selection, and induction of new employees
- Coaching for managers, employees, and small groups
- Mentoring, particularly to nurture the next generation of scientists
- Central coordination of training programmes (250 trainees)

In 2007, 43.3% of employees participated in at least one training programme, or took part in a management course or team workshop offered under the HR development remit. Each employee spends an average of 1.7 days per year on HR development activities (training events or team workshops) and this added up to 9,506 days in 2007 across the organization.

Overall, the number of training events was up significantly on the previous year (369 compared to 324 events in 2006). This can be attributed to an increase in the headcount (approx. 300 more employees than in 2006) and a reduction in the number of seminars cancelled due to a lack of participants. The cancellation rate was reduced to 17%, highlighting the way training programmes increasingly respond to demand at the different sites.

The number of team workshops (38) was maintained at the same level as the previous year. This is evidence of greater interaction between HR development and organizational development.

In 2007, a total of eight mentoring pairs were supported following on from the previous year and seven new tandem arrangements were formed. DLR also directs a mentoring project within the Helmholtz Association that extends beyond the individual centres (cross-mentoring).

HR development and mobility	2005	2006	2007
Training days per employee	1.5	1.7	1.7
Mentoring pairs	9	8	7
Postings abroad (months)	485	564	568

To cultivate the next generation of scientists, moderated dialogue between young management professionals and the DLR Executive Board was established in 2005. In 2007, over 90 emerging leaders at DLR had the opportunity to exchange ideas with management at the highest level and to stay informed about key strategic developments and decisions.

A special focus in 2007 was the development of employees' intercultural skills, as well as extending the four-day intensive project management-training course. Dealing with journalists and the media and the ability to communicate scientific topics to the public in a clear, concise

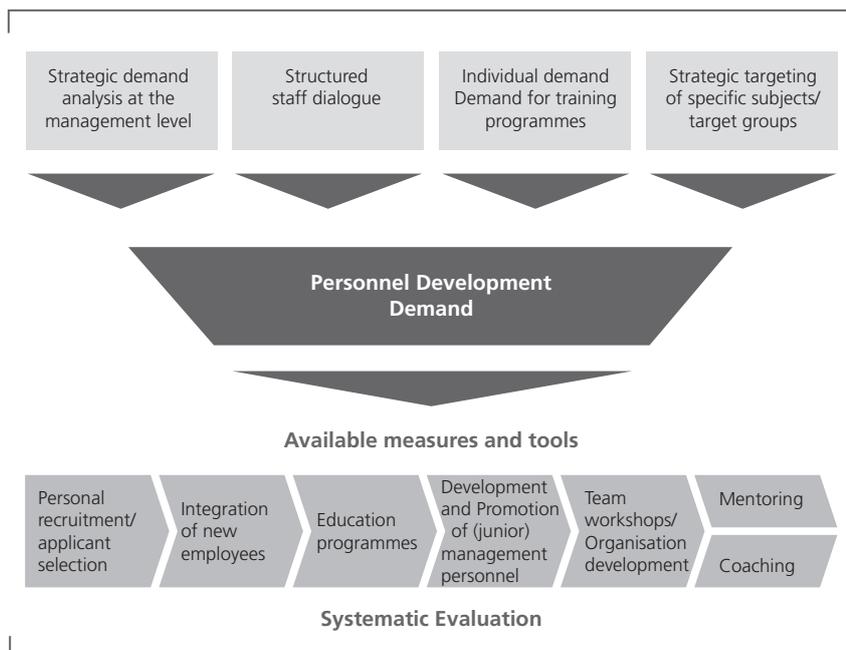
way is strategically important skills for managers. Participants found two pilot events on media training exceptionally effective and more training courses of this type will be provided.

New developments/projects

As part of a postgraduate programme, the recruitment of doctoral candidates is to be optimised together with the qualification process and support for this group. HR development is designing a support programme for this purpose comprising both mandatory and optional elements, which also systematically integrates existing supervisory structures. A dedicated intranet portal and specific symposia for doctoral candidates are also set to boost networking in this area. Incorporating modern learning methods via e-learning programmes and virtual classrooms is crucial. The HR development programme is divided into phases to meet growing requirements. This ensures that content is conveyed at each stage that is relevant to doctoral candidates' day-to-day work, as well as when preparing their doctoral theses or other publications.

The first steps have now been taken to make the concept of talent management part of the Vice Chairman of the Executive Board's portfolio. The goal is to identify, support, and develop employees with high potential, encourage them to remain loyal to the organization and to enable them to take on key management tasks. A requirement profile for those with leadership potential has now been compiled covering twenty different competencies.

**Personnel Development:
Demand orientation and measures/tools**



This concept is associated with systematic succession planning. Managers and employees in key functions who will be leaving DLR in the foreseeable future are identified in good time. The profiles of DLR employees with high potential are then checked to see whether they can be considered as a replacement and what help they would need to prepare them for these key roles.

Based on integrated process understanding in the field of HR management, HR development has proposed a new central service for HR marketing. Needs analyses within the institutes show that in some cases recruiting enough young scientists of the right calibre is proving difficult. DLR also lacks organization-wide concepts on adapting to the Bologna Process, recruiting and integrating graduates with bachelor's degrees, and supporting employees studying for a master's degree. At present, the employees responsible for the processes governing HR management, talent management, and press and public relations are liaising with customers to define a service that will span the whole organization.

The project plan for the implementation of performance-related pay with regard to compensation for public service jobs (TVöD) is currently being put into practice. HR development at DLR will coordinate all training events for managers, communicating information on management instruments and soft skill competencies in particular. The aim here is to develop management culture at DLR further by using structured interviews with employees to implement systematic performance reviews and agreements on targets. The key objectives are to leverage the motivational opportunities presented by new instruments and to avoid staff becoming frustrated or demotivated. Performance reviews must be conducted on the basis of transparent and explicit criteria, with feedback provided effectively in discussions with employees and necessary HR development measures

Employees	2005	2006	2007
Headcount	5,125	5,344	5,627
Total scientific staff	2,603	2,749	3,046
Permanent/fixed-term contracts	3,064/2,061	3,043/2,301	3,104/2,523
Proportion of women			
- in total	28%	29%	30%
- in management positions	12%	12%	13%
- scientific associates	12%	13%	12%
Young scientists	113	110	93
Doctoral candidates (internal/external)	519	538	607
Trainees	256	243	247

agreed. Managers and employees alike must therefore be familiar with the procedures and strategies required to deal with different assessments of performance (self-assessment versus third-party assessment) productively without disputes escalating.

Employee surveys with feedback from managers were completed in 2007 as a key element of the project to develop the entire administrative culture within DLR. This data provides key insights into progress made on implementing process organization and the leadership and work culture this requires. The findings on job satisfaction represent important figures, which are determined and reflected on continually in a two-year cycle. The implementation of measures agreed to date within the respective organizational units will be evaluated in a second wave and synchronized with the objectives of the process for shaping corporate culture. The second survey is currently being prepared.

HR administration

Instruments regarding performance-related pay at DLR were an important topic during the past year. Following tough negotiations, a collective agreement on compensation with a performance-related element was signed in June 2008. The relevant legislation (LeistungsTVBund), which became effective in August 2006, has thus been implemented at DLR. Performance-related pay is a management instrument designed, with the understanding of all parties, to boost employee motivation and fulfilment of objectives and results. The collective agreement is therefore based on a shared understanding that contractual obligations are covered by standard pay. Performance-related pay encourages and rewards performance that goes beyond this.

The goal is the annual payment of a performance-related bonus. Initially the performance element will represent 1% of the annual salary, gradually rising to 8%.

The level of individual performance-related pay is based on the results of a clear appraisal of performance, which each supervisor must carry out for each member of staff, either individually or on a group basis (team). The assessment is conducted either according to levels of performance (systematic performance review) or the extent to which objectives have been met. In both cases, points are assigned to assess performance, which are then converted into monetary amounts on completion of the annual appraisal cycle.

The model used at DLR comprises four levels ranging from zero points (requirements not met or not fully met) to three points (requirements exceeded considerably). A systematic performance review takes into account the quantity and quality of work, customer focus, cost-effectiveness, teamwork, flexibility/further training; for managers, leadership is also considered.

The first period for which performance will be assessed commences on April 1, 2009. The first performance reviews and subsequent payment of performance-related bonuses are therefore scheduled to take place in spring 2010. Over the next few months, managers and employees will receive further information on the details, with extensive training and information events also being held.

Furthermore, an arrangement has been negotiated with the Central Staff Council to enable further financial incentives and remuneration for employees in the field of research and research management based on the system being put in place for performance reviews and outcomes. This instrument will also allow pay increases to be made to this group to attract talent or dissuade specific personnel from leaving. Unfortunately talks with the funding bodies regarding similar arrangements for administrative staff at DLR have proved inconclusive.

German staff at ESA – a comparison

Member state	No. of employees	Employees (%)	Financial contribution (%)
Germany	379	19.2	22.1
France	481	24.3	21.3
Italy	348	17.6	14.7
UK	193	9.8	12.7
Spain	146	7.4	5.9

German staff at ESA

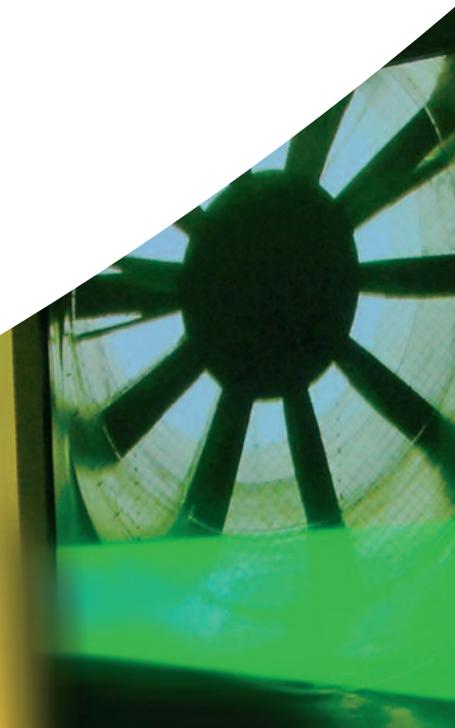
At the end of 2007, ESA employed a total of 1976 people in salary brackets A1 to A6 and HC (comparable with senior public servants). As in the previous year, the proportion of German employees stabilized at 19.2% (379 people), but continues to fall short of Germany's financial contribution of 22.1%. In contrast, France and Italy are significantly overrepresented.

In 2007, Germany accounted for the most new appointments compared to all member states at 21.9% (2006: 27.8%). It should be taken into account here that once again very few German citizens applied to ESA in 2007: they comprised 9.8% of applicants compared to 33.6% for Italy. It should also be noted that a disproportionate number of German employees left ESA to retire, which means that the average age of German employees is falling.

The proportion of German staff varies significantly across the different directorates. While Human Space Flight and the ESOC in Darmstadt exceed the ideal figure, there is a need to catch up in all other areas, particularly in the fields of launchers, navigation/telecommunications, and human resources/finance.

Overall, the proportion of German staff at ESA continues to grow satisfactorily as, following an increase in 2006, new appointments in 2007 (21.9%) were once again up on the prior year figure of 19.2%. It is impressive that this figure of 21.9% could be achieved despite the low proportion of applicants at 9.8%. The main reasons for this are as follows:

- Setting up a DLR working group to advise German applicants extensively and recommend them to ESA
- Since the end of 2004, preference has been given to applicants from underrepresented member states when recruiting at ESA



- DLR-ESA secondment programme that involves five young DLR employees each year spending at least one year working at ESA. The aim is for DLR employees to be taken on at a later date.
- Promotional events at German universities (DLR in conjunction with ESA, AA, BDLI)
- DLR and ESA attendance at job fairs in Germany

The following reasons are given for the low proportion of German staff (19.2%) in view of the country's financial contribution:

- Germans are less mobile than other nationalities
- Salaries at ESA are not attractive enough for young German dual-income families or couples who then have to manage on a single salary at an ESA site
- Pension gap: ESA employees typically retire at 60 or 62 but only receive a full pension in Germany from 65 onwards at the earliest

Although DLR cannot influence these general conditions, we will develop further instruments to improve the proportion of German staff. This includes introducing a grant programme for young German scientists seconded to ESA and financed by DLR for a maximum of two years. DLR will also work more closely with the German space industry to boost the proportion of German staff at ESA.

Commendations and Awards

In-house awards, 2007

DLR Science Prize

- Dr.-Ing. Alin Albu-Schäffer, Institute of Robotics and Mechatronics
- Dr. med. Mathias Basner, Institute of Aerospace Medicine
- Richard P. Dwight, Ph.D., Institute of Aerodynamics and Flow Technology

DLR Research Semester

- Dr. rer. nat. Volker Grewe, Institute of Atmospheric Physics
- Dipl.-Geol. Klaus Gwinner M.A., Institute of Planetary Research
- Dr.-Ing. Holger Hennings, Institute of Aeroelasticity
- Dipl.-Ing. Volker Krajenski, Institute of Composite Structures and Adaptive Systems
- Dipl.-Ing. Christoph Sickinger, Institute of Composite Structures and Adaptive Systems

DLR Senior Scientists

- Alan W. Harris Ph.D., Institute of Planetary Research
- Dr. habil. Phys. Math. Andrey Osipov, Microwaves and Radar Institute
- Prof. Dr.-Ing. Martin Otter, Institute of Robotics and Mechatronics
- Dr. rer. nat. Thomas Streit, Institute of Aerodynamics and Flow Technology

Prizes awarded by the Society of Friends of DLR

Hugo-Denkmeier Prize

- The Hugo-Denkmeier Prize was awarded to Dr. Raymond Wittmann (formerly of TU Munich) as the youngest doctoral candidate to be awarded a doctorate with distinction.

Fritz-Rudolf Prize

- Dr. Ingo Baumann, DLR Cologne-Porz, and Dr. Nicolaus Hanowski, DLR Space Operations and Astronaut Training, Oberpfaffenhofen, received this year's Fritz-Rudolf prize for their outstanding management achievements in winning the contract for the SATCOMBw project.

Innovation Prize

- Oliver Eiberger, Alexander Beyer, Manfred Schedl, Dr. Alin Albu-Schäffer, Georg Plank, Institute of Robotics and Mechatronics, DLR Oberpfaffenhofen, and Dr. Günter Schreiber of the company KUKA Roboter Technik, Augsburg, were awarded the Innovation Prize for their successful teamwork on the "DLR Light-weight Robot" project.

Otto-Lilienthal Research Semester

- Dr. Martina Heer, Institute of Aerospace Medicine, DLR Cologne-Porz, was presented the Otto-Lilienthal Research Semester. She plans to spend her time at the ANZAC Research Institute/University of Sidney/Australia researching the topic "Comparison of musculoskeletal changes during the aging process between humans on Earth and astronauts on extended space missions".

DLR_School_Lab

- The DLR_School_Lab prize went to the DLR_School_Lab, Göttingen. The 13-strong prize-winning team comprised school students from Years 5 and 6 drawn from various secondary schools across Göttingen, who applied themselves with great enthusiasm and success to the topic "On the trail of Ludwig Prandtl – Can the 'Göttingen profiles' be applied to model aircraft?". They were supported in this endeavour by Mr. Kai Notholt, who is in charge of the school's workshop.

Chairman's Prize

- Mr. Lars Ebrecht, Institute of Transportation Systems, DLR Braunschweig, receives the prize awarded by the Chairman of the Society of Friends of DLR in recognition of being the youngest patent applicant during the year.

RUAG Prize

- RUAG Aerospace Deutschland GmbH once again awarded a prize for research into environmentally-friendly aviation, which this year was presented to Mr. Harry Hemmer, Institute of Propulsion Technology, DLR Cologne-Porz. DLR and the Society of Friends of DLR would like to extend their thanks to the management of RUAG for the donation of this prize.

Selection of external awards in 2007

Award	Winners of prizes
Bavarian State Prize for Innovation in Manual Trades	Prof. Dr. Lorenz Ratke
BMBF competition "Bionics – Innovation Inspired by Nature"	Dr.-Ing. Jörg Melcher
EU Descartes Prize	Projekt Hydrosol Dr. rer. nat. Sattler et al.
EEefCOM Innovation Prize	Dr.-Ing. Andreas Lehner, Dr.-Ing. Alexander Steingaß
EuMC Microwave Prize	Dr.-Ing. Lukasz Greda, Dr.-Ing. Achim Dreher
Euron Technology Transfer Award	Dr. H. Liu, Prof. Dr. G. Hirzinger, P. Meusel u.a.
IEEE Field Award 2007: "Kiyu Tomiyasu" for the development of new radar concepts	Prof. Dr. Alberto Moreira
IEEE Field Award Robotics and Automation	Prof. Dr. Gerd Hirzinger
IF Product Design Award	Peter Meusel
Lewis Fry Richardson Medal 2007 of the European Geosciences Union	Prof. Dr. habil. Ulrich Schumann
Lilienthal Prize	Dr. Heinz-Wilhelm Hübers
Non-Automotive 2007 innovation competition	Frederik Blumrich
RUAG Prize 2007: "Emissions Reductions for Aircraft"	Dipl.-Ing. H. Hemmer
"Thurn und Taxis" Advancement Award 2007 for Forestry	Dr. Tobias Mette
Tycho Brahe Award 2007	Dr. rer. nat. habil. Oliver Montenbruck
ZARM Advancement Award	Bernd Wagner



DLR-School_Lab award ceremony

DLR Quality Prize

The Vice Chairman of the Executive Board, Mr. Klaus Hamacher, and the Head of Quality Management, Ms. Marion Scheuer-Leeser, presented the 2007 Quality Prize to:

- Ms. Heidrun Orlicek, member of the Administrative Infrastructure team at DLR Cologne. She received the award on behalf of the whole team.
- Dr. Stefan Buckreiß, research associate at the Microwaves and Radar Institute in Oberpfaffenhofen
- Mr. Wolfgang Balzer, research associate at the Remote Sensing Technology Institute in Oberpfaffenhofen
- Mr. Achim Kern, Hagen Consulting & Training GmbH in Siegburg, a trainer representing the DGQ (German Society for Quality).

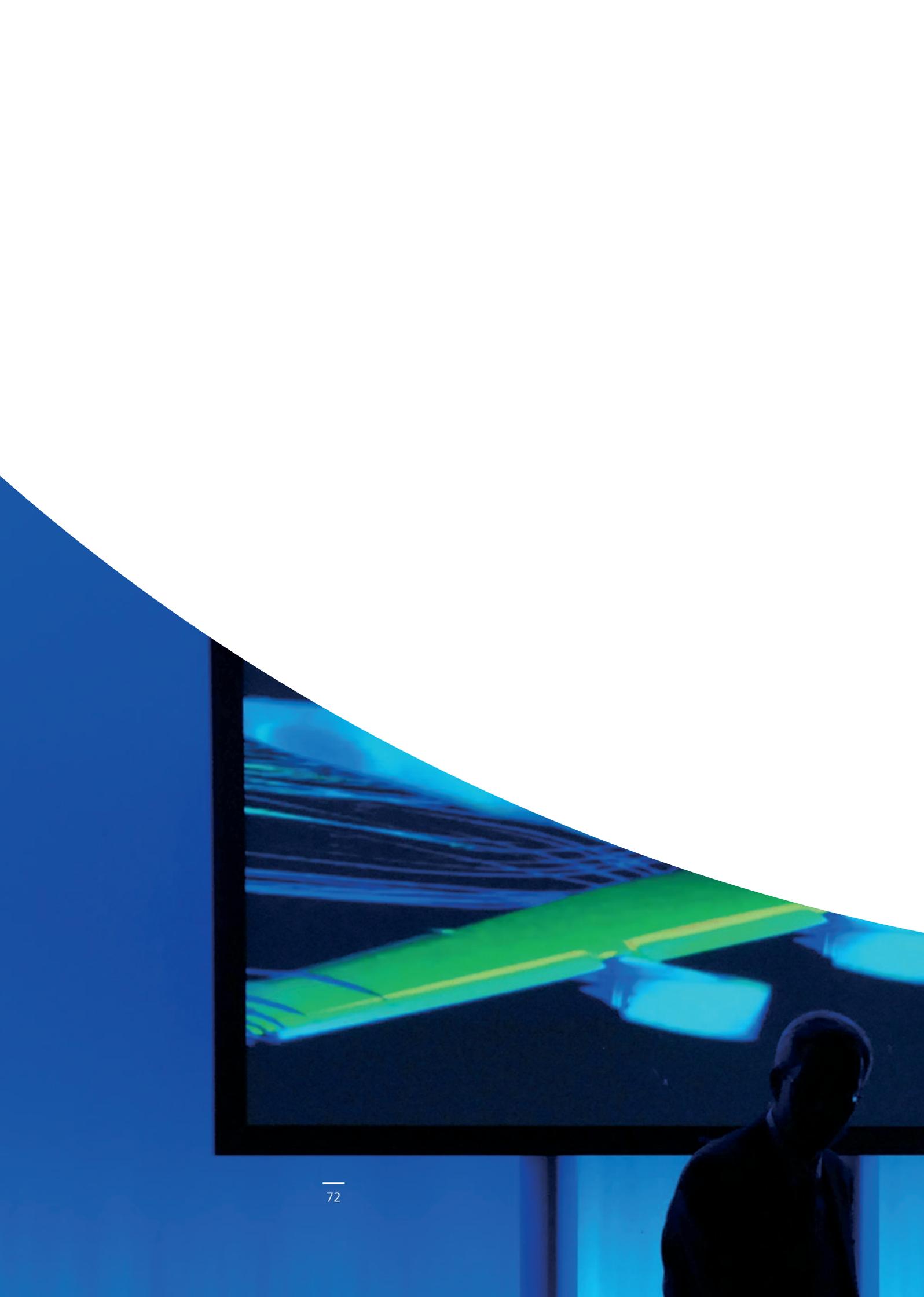
Compilation of Performance Indicators

Third-party funding	2005	2006	2007
Total revenue from third-party funding	Euro 275 m	Euro 255 m	Euro 294 m
Revenue growth over preceding year, commercial revenues from domestic R & D activities	1%	41%	26%
Proportion of overall revenue from third-party sources	52%	48%	52%
Proportion of revenue from foreign clients (revenue volume)	31%	29%	22%
Success rate of EU proposals in the last three years (accepted/ submitted)	40%	54%	47%
Revenue from EU funding	Euro 15.6 m	Euro 17.3 m	Euro 19.9 m
Ratio of EU projects as coordinator vs. all projects	21%	16%	13%

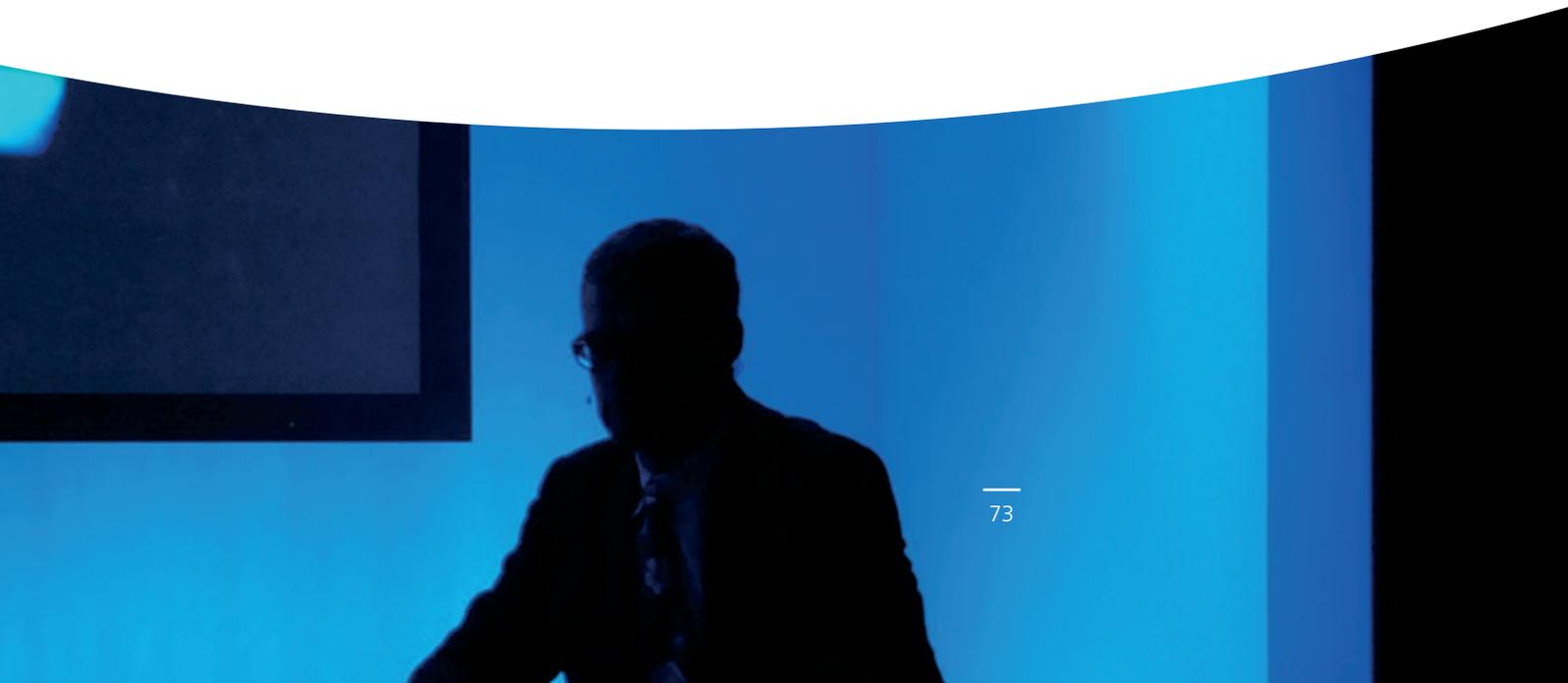
Research-related results	2005	2006	2007
Publications in peer-reviewed journals	561	495	511
Peer-reviewed publications in proceedings, books, etc.	566	536	568
Presentations to scientific conferences, workshops, lectures *	0.81	0.85	0.76
Appointments to universities	9	8	13
Student projects	264	318	326
PhD theses	71	78	83
Postdoctoral qualifications	5	4	4

* per scientific associate engaged by the institutes and facilities

Technology Marketing	2005	2006	2007
Revenues from licenses	Euro 2.7 m	Euro 4.1 m	Euro 3.6 m
Start-up companies	1	2	4
New in-house technology transfer projects	15	13	10
Investments in technology transfer projects	Euro 3.5 m	Euro 2.8 m	Euro 2.44 m
Management instruments	2005	2006	2007
Total project work	63%	66%	73%
Quality Management	2005	2006	2007
Existing certifications and accreditations	15	16	18
National and European networks	2005	2006	2007
DFG participations	30	27	27
Sponsorship agreements	54	53	44
International collaboration	2005	2006	2007
International visiting scientists (staying > 1 month) referenced to scientific assoc's in institutes	7.9%	6.6%	7.4%
Employees	2005	2006	2007
Employees	5,125	5,344	5,627
Scientific associates (total)	2,603	2,749	3,046
Permanent/fixed-term contracts	3,064/2,061	3,043/2,301	3,104/2,523
Proportion of women			
- in total	28%	29%	30%
- in management positions	12%	12%	13%
- scientific associates	12%	13%	12%
Youth promotion	2005	2006	2007
Young scientists	113	110	93
Doctoral candidates (internal/external)	519	538	607
Trainees	256	243	247
HR development and mobility	2005	2006	2007
Training days per employee	1.5	1.7	1.7
Mentoring pairs	9	8	7
Postings abroad (months)	485	564	568



DATA & FACTS



Institutes and Facilities

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

Members and Committees

As of June 30, 2008, DLR had 46 sponsoring members in addition to honorary members, scientific members, and ex officio members.

Honorary members

- The Honourable 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
- 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
- State of Berlin, represented by the Senator for Science, Research and Culture for the State of Berlin, Berlin
- State of Bremen, represented by the Senator for Training and Science, Bremen

- State of Lower Saxony, represented by the Lower Saxony Minister for Science and Culture, Hanover
- State of North Rhine-Westphalia, represented by the Minister for Innovation, Science, Research and Technology for the State of North Rhine-Westphalia, Düsseldorf

Natural persons, legal persons, and societies and associations with no legal capacity

- Aerodata AG, Braunschweig
- AIR LIQUIDE Deutschland GmbH, Düsseldorf
- 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. (BDLI), Berlin
- CAE Elektronik GmbH, Stolberg
- CAM Computer Anwendung für Management GmbH, Unterföhring
- Carl-Cranz-Gesellschaft e. V., Weßling/Obb.
- Commerzbank AG, Großkundencenter Region West, Düsseldorf
- 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 Defence Holding GmbH, Überlingen

- Dornier GmbH, Friedrichshafen
- Dresdner Bank AG, Cologne
- EADS Deutschland GmbH, Munich
- ESG Elektroniksystem- und Logistik GmbH, Fürstenfeldbruck
- Fraport AG, Frankfurt/Main
- GAF AG, Munich
- Gemeinde Weßling, Weßling/Obb.
- HDI-Gerling Industrie Versicherungs AG, Hanover
- Industrieanlagen-Betriebsgesellschaft mbH (IABG), Ottobrunn
- Kayser-Threde GmbH, Munich
- KUKA Roboter GmbH, Augsburg
- LIEBHERR-AEROSPACE LINDENBERG GmbH, Lindenberg
- 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, München Snecma Groupe SAFRAN, 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, Grünwald
- Prof. Dr. rer. nat. Joachim E. Trümper, Garching

Ex officio members

- Prof. Dr.-Ing. Manfred Aigner, Stuttgart
- Dr. rer. pol. Ludwig Baumgarten, Bonn
- Jürgen Breitkopf, Munich
- Prof. Dr.-Ing. Dr. h. c. mult. Bullinger, Munich
- Marco R. Fuchs, Bremen
- Prof. Dr. rer. nat. Ursula Gather, Dortmund
- Prof. Dr. Reinhard Genzel, Garching
- Dipl.-Ing. Rainer Götting, Heidelberg
- 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, Düsseldorf

- Prof. Dr.-Ing. Matthias Kleiner, Bonn
- Prof. Dr.-Ing. Wolfgang Kubbat, Darmstadt
- Dr.-Ing. Reinhold Lutz, Munich
- Dr.-Ing. Norbert Rüdiger Ninz, Überlingen
- Dr.-Ing. Manfred Peters, Cologne-Porz
- Dipl.-Kfm. Gerhard Puttfarcken, Hamburg
- Dipl.-Ing. Thomas Reiter, Cologne-Porz
- Dr. rer. pol. Rainer Schwarz, Berlin
- Prof. Dr.-Ing. Klaus Steffens, Munich
- Prof. Dr.-Ing. Joachim Szodruch, Cologne-Porz
- Uwe Teegen, Braunschweig
- Prof. Dr.-Ing. Johann-Dietrich Wörner, Cologne-Porz
- Prof. Dr. Gunter Zimmermeyer, Berlin

Senate

As of June 20, 2008, the following persons were members of the DLR senate.

From the scientific sector

- Prof. Dr.-Ing. Manfred Aigner
- Prof. Dr.-Ing. Dr. h. c. mult. Hans-Jörg Bullinger, ex officio
- Prof. Dr. rer. nat. Ursula Gather (Vice Chairman)
- Prof. Dr. 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
- Dr.-Ing. Manfred Peters
- Uwe Teegen

From the economics and industrial sector

- Jürgen Breitkopf
- Marco R. Fuchs
- Dipl.-Ing. Rainer Götting
- 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
- Prof. Dr.-Ing. Klaus Steffens
- Prof. Dr. Gunter Zimmermeyer

From the state sector

- Ministerialdirektor Dr. rer. pol. Gerd Gruppe
- Staatssekretär Jochen Homann (Chairman)
- Staatssekretär Dr. Hans-Gerhard Husung
- Staatssekretär Dr. Josef Lange
- Ministerialdirigent Günther Leßnerkraus
- Vortragender Legationsrat 1. Klasse Joachim Freiherr Marschall von Bieberstein
- Ministerialdirektor Thilo Schmidt
- Ministerialdirigent Andreas Schneider
- Staatssekretär Dr. Michael Stückradt
- Ministerialdirektor Dr. Christian D. Uhlhorn
- Ministerialrat Hendrik Zillinger

Senate Committee

As of 30 June, 2008, the senate committee comprised six members from the scientific sector, six members from the economics and industrial sector, and five members from the state sector.

From the scientific sector

- 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)
- Prof. Dr.-Ing. Heinz Voggenreiter

From the economics and industrial sector

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

From the state sector (with voting rights in 2008)

- Ministerialdirigent Helge Engelhard
- Vortragender Legationsrat 1. Klasse Joachim Freiherr Marschall von Bieberstein
- Ministerialrat Karl Schumacher
- Ministerialdirektor Dr. Christian D. Uhlhorn
- Ministerialrat Hendrik Zillinger

(without voting rights in 2008)

- Leitender Ministerialrat Dr. jur. Reinhard Altenmüller
- Ministerialrat Dr. jur. Axel Kollatschny
- Senatsrat Bernd Lietzau
- Dipl.-Ing. Josef Schiller

Members of the Board

(As of June 30, 2008)

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

Space Committee

(As of June 30, 2008)

- Ministerialdirektor Detlef Dauke, Federal Ministry of Education and Technology
- Ministerialdirektor Dr. C. D. Uhlhorn, Federal Ministry of Education and Research
- Joachim Freiherr von Marschall, Ministry of Foreign Affairs
- VA Wolfgang Reimer, Federal Ministry of Food, Agriculture and Consumer Protection
- Ministerialdirigent Thilo Schmidt, Federal Ministry of Transport, Building and Urban Affairs
- LBDiR Gerhard Brauer, Federal Ministry of Defence
- Ministerialdirigent Dr. Rainer Sontowski, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- Ministerialdirigent Dr. Gabriel Kühne, Federal Ministry of Finance
- Regierungsdirektor Frank Wetzel, Office of the Federal Chancellor

Scientific Technical Council

Members of the Scientific-Technical Advisory Council
(As of June 30, 2008)

- Prof. Dr. Stefan Dech (Vice Chairman)
- Dr. Georg Eitelberg
- Prof. Dr. Horst Friedrich
- Prof. Dr. Karsten Lemmer
- Prof. Dr. Alberto Moreira
- Prof. Dr. Cord-Christian Rossow
- Dr. Marina Braun-Unkhoff
- Dr. Reinhold Busen (Chairman)
- Dipl.-Ing. Frank Kocian
- Dr. Thomas Holzer-Popp
- Dipl.-Ing. Uwe Teegen
- Dr. Stephan Ulamec

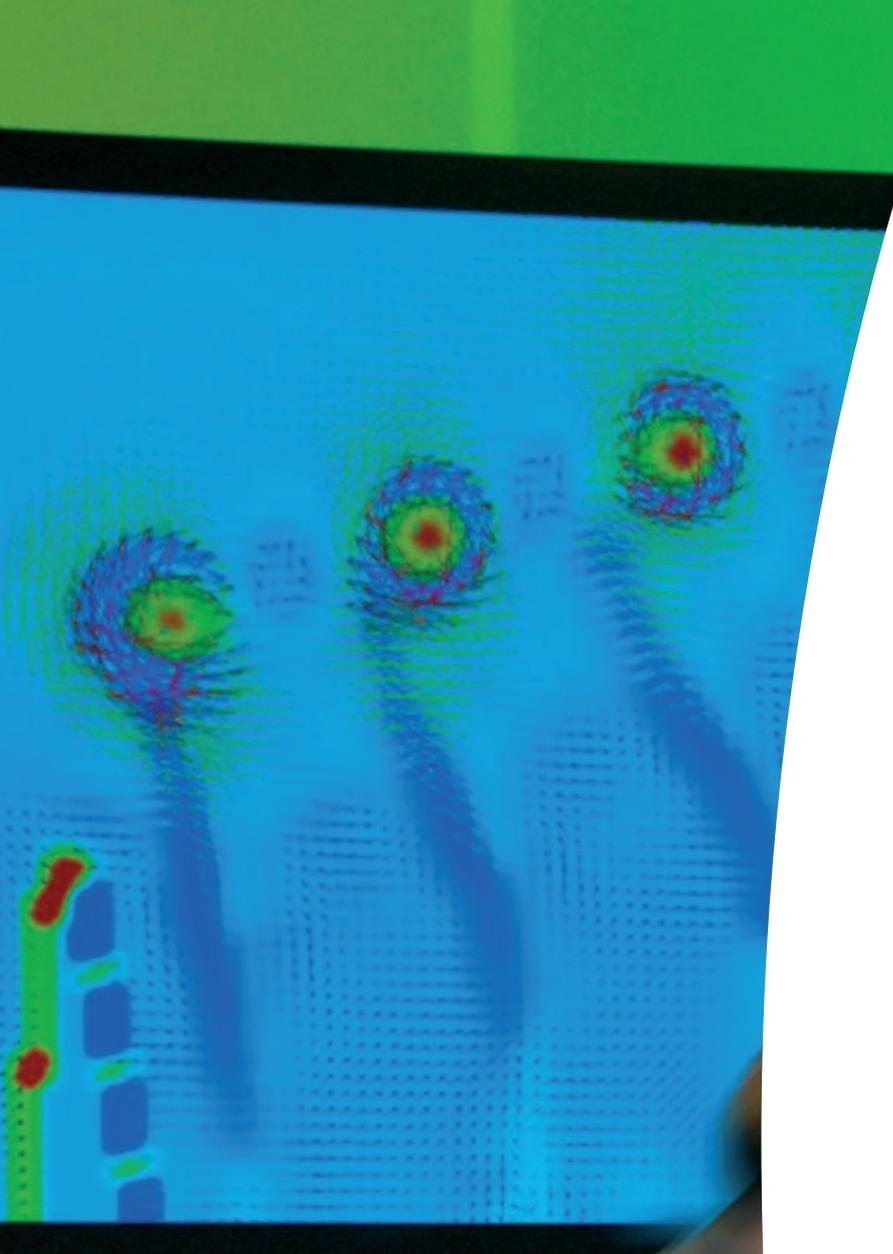
Affiliates and Joint Ventures

DLR Joint Ventures Gesellschaft mit beschränkter Haftung, Bonn
100.00%

The purpose of this company is the participation in European Economic Interest Groupings (EEIGs) within the framework of the statutory tasks of the German Aerospace Center. The company holds interests in the European project management agency EDCTP-EEIG and AT-One EWIV, an enterprise founded in 2007 to support and organise the collaboration between DLR and NLR in the field of air traffic management.

DLR Gesellschaft für Raumfahrtanwendungen (GfR) mbH, Weßling
100%

The purpose of this company is provision of services relating to astronautics applications. The company was entered into the commercial register on May 06, 2008.



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

DLR established this foundation as a non-profit organization on an equal-share basis with its Dutch partner organization, NLR (www.nlr.nl). Its remit is to operate, maintain and continue to develop the foundation's own low-speed wind tunnels in Noordoostpolder as well as wind tunnels owned by DLR and NLR. (www.dnw.aero)

**European Transonic Windtunnel
GmbH (ETW), Cologne
31.00%**

ETW, the European Transonic Windtunnel, built and operated by four nations, Germany, France, the United Kingdom, and The Netherlands, is the most modern wind tunnel anywhere in the world. The ETW will be used to test and optimise new aircraft designs using scale models under realistic flight conditions. The knowledge gained will play a decisive role in the success of the aircraft projects. (www.etw.de)

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

T-Systems Solutions for Research – a joint company of DLR and T-Systems Enterprise Services GmbH – provides long-term IT partnerships to scientific and research customers. In 1999, DLR integrated its “central data processing” into the joint venture. (www.t-systems-sfr.com)

TeleOp GmbH, Weßling
25.00 %

This company was founded in collaboration with T-Systems, EADS and LfA Förderbank Bayern. Its remit is to conduct negotiations within the framework of the GALILEO project, as required to meet the objective of obtaining an interest in the construction and operation of the European satellite navigation programme, GALILEO.
 (www.teleop.de)

Anwendungszentrum GmbH, Oberpfaffenhofen, Weßling
25.00%

The Application Centre was established as a public-private partnership and will receive start-up funding until the end of 2009 from funds provided by High-Tech-Offensive Bavaria. Since the launch of this start-up and relocation incubator, which was initially funded by DLR alone, over fifty companies from the field of satellite navigation have either passed through its gates or settled permanently at the Oberpfaffenhofen site.
 (www.anwendungszentrum.de)

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

The Europäische Akademie deals with the scientific study and evaluation of the consequences of scientific and technological advances for individuals and society, as well as for the natural environment. The main focus is on the examination processes that are influenced by the natural and engineering sciences and the medical disciplines. As an independent scientific institution, the Europäische Akademie pursues a dialogue with the world of politics and society at large. The state of Rhineland-Palatinate is also a shareholder. (www.europaeische-akademie-aw.de)

ZFB Zentrum für Flugsimulation Berlin GmbH, Berlin
16.67%

The purpose of this company is to provide: flight simulators for the fields of applied research into flight guidance and flight procedures, particularly for research and teaching purposes; system simulation and manipulation and associated areas of technology; education and further training for aerospace engineers; and training for flight crews.
 (www.zfb-berlin.de)

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

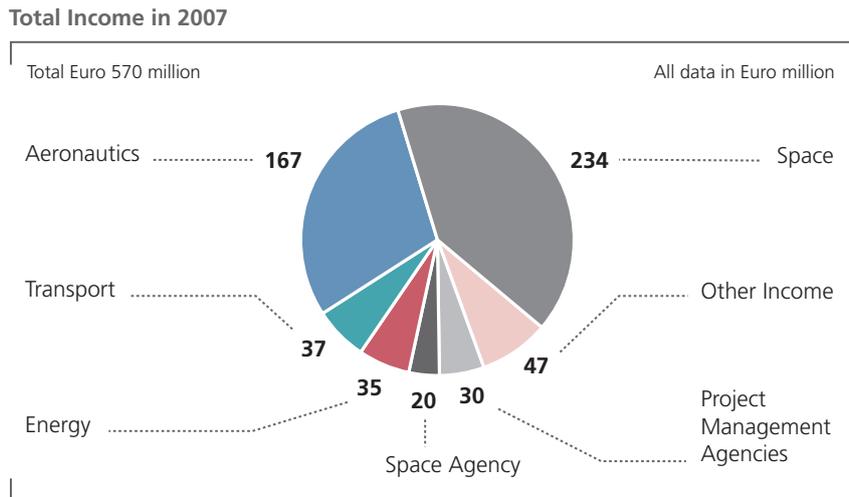
InnoZ researches the complex interactions at the interface between mobility and social change, developing innovative solutions to newly arisen challenges faced by players in the transport and infrastructure sector. InnoZ therefore has to combine a wide range of interdisciplinary skills under one roof. Sociological, geographical and economic expertise has equal weight to the practical perspectives of the transport economy.
 (www.innoz.de)

ZTG GmbH (Competence Center for Healthcare Telematics), Krefeld
6.00%

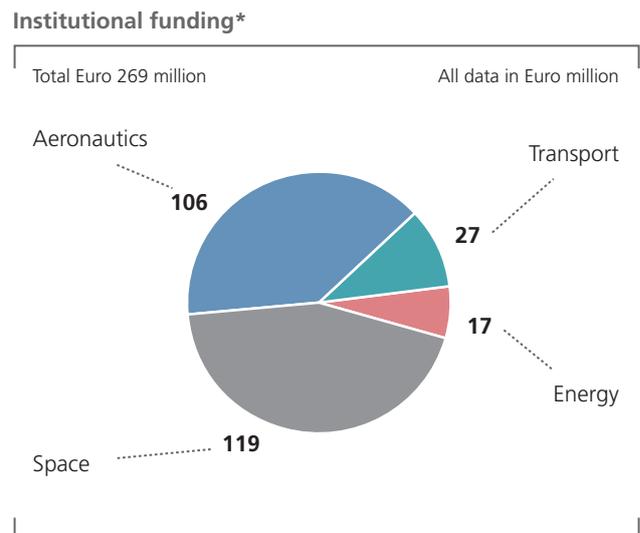
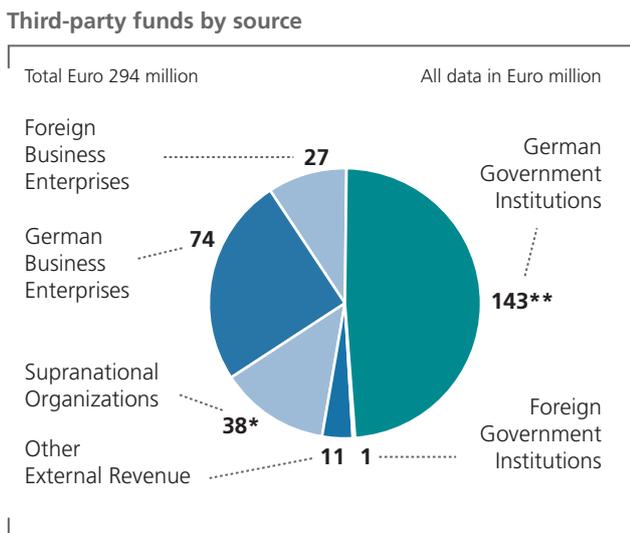
The aim of the Competence Center is to introduce, develop, and disseminate modern information technology and communications technology within the healthcare sector. Major focus areas include providing neutral advice and project management services for customers from industry and healthcare, implementing interoperable solutions to facilitate integrated provision, and promoting knowledge transfer between the healthcare sector, science, politics, and the wider economy.
 (www.ztg-nrw.de)

Use of Funds

Total income in 2007 (third-party funding and basic financing)



Third-party funds by source and institutional funding in 2007

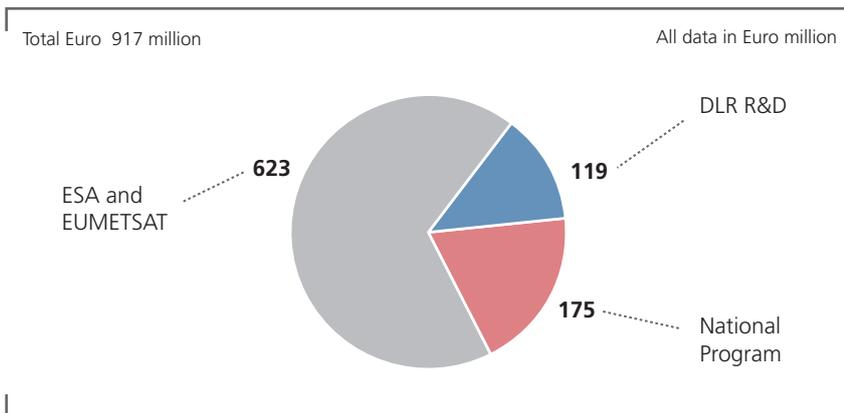


* of these: ESA 17, EU 20, Others 1
 ** of these: Project Management Agencies 49, National Government Institutions 75, Other German government R&D third-party funding 19

* without other income

German public funding for space in 2007

Public funds for Space



In 2007, approximately 917 million of public funds were put into civilian space activities. Of this figure, around 68% was committed to the German contributions to the ESA (BMW i and BMWBS) and EUMETSAT, approximately 19% to the German national space programme, and 13% being used for astronautics research and development by DLR.



List of Abbreviations

ACARE	Advisory Council for Aeronautical Research in Europe	CIRA	Italian Aerospace Research Centre
ADV	German Airports Association	CNES	French National Space Agency
ATM	Air Traffic Management	DFD	German Remote Sensing Data Centre
BDLI	German Aerospace Industries Association	DFG	German Research Foundation
BG	Professional association	DFS	German Aviation Safety
BMBF	Federal Ministry of Education and Research	DGAC	French aviation authority
BMFSFJ	Federal Ministry of Health, the Federal Ministry of Family, Senior Citizens, Women and Youth	DIN	German Institute for Standardization
BMG	Federal Ministry of Health	DLR	German Aerospace Center
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety	DNW	German-Dutch Windtunnels
BMVBS	Federal Ministry of Transport, Building and Urban Affairs	DQS	German Society for Certification of Management Systems
BMWi	Federal Ministry of Economics and Technology	EADS	European Aeronautic Defence and Space Company
BWB	Federal Office of Defence – Technology and Procurement	ECSS	European Cooperation of Space Standardisation
CAE	Chinese Aeronautical Establishment	ECTRI	European Conference of Transport Research Institutes
CCSDS	Consultative Committee for Space Data Systems	EEA	European Excellence Award
CEN	European Committee for Standardization	EEF-Fonds	Helmholtz funding programme to assist start-ups originating in research institutions
CENELE	European Committee for Electrotechnical Standardization	EFQM	European Foundation for Quality Management
CERTH/CPERI	Centre for Research&Technology, Hellas/Chemical Process Engineering Research Institute	EOS	Earth Observation System
CFD	Computational Fluid Dynamics	ESA	European Space Agency
CFK	Carbon fibre reinforced plastic	ESCC	European Space Components Coordination
CIEMAT	Spanish centre for research into energy, the environment and technology	ESTEC	European Space Research and Technology Centre
		EWIV	European Economic Interest Grouping
		FAA	Federal Aviation Administration

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

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 5,700 people are employed at thirteen locations in Germany: Koeln (headquarters), Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stuttgart, Trauen and Weilheim. 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.**
in der Helmholtz-Gemeinschaft

German Aerospace Center

**Corporate Development and
External Relations**

Linder Hoehe
D-51147 Cologne

www.DLR.de