

Research and Economic Development

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(DLR)

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An aerial photograph of a rugged, mountainous landscape. The terrain is characterized by deep, winding valleys and steep, rocky slopes. A narrow road or path is visible, snaking through the valleys. In the lower right portion of the image, there is a small, dark structure or building. The overall color palette is dominated by earthy tones of brown, tan, and grey, with some highlights from the sun.

Preface

The past year was an extremely successful one for DLR, with an immense range of projects and services in the focus areas of Aeronautics, Space, Energy and Transport making contributions to solving global challenges facing society. At the beginning of 2010, DLR established a new organisational unit, Program Coordination Defence & Security Research, which has a special focus on coordinating activities with the Federal Ministry of Defence. Economic development was also positive in the last year, with particular thanks to the various federal and state ministries who have supported the DLR in its combined capacity as research institution, space agency and project management agency.

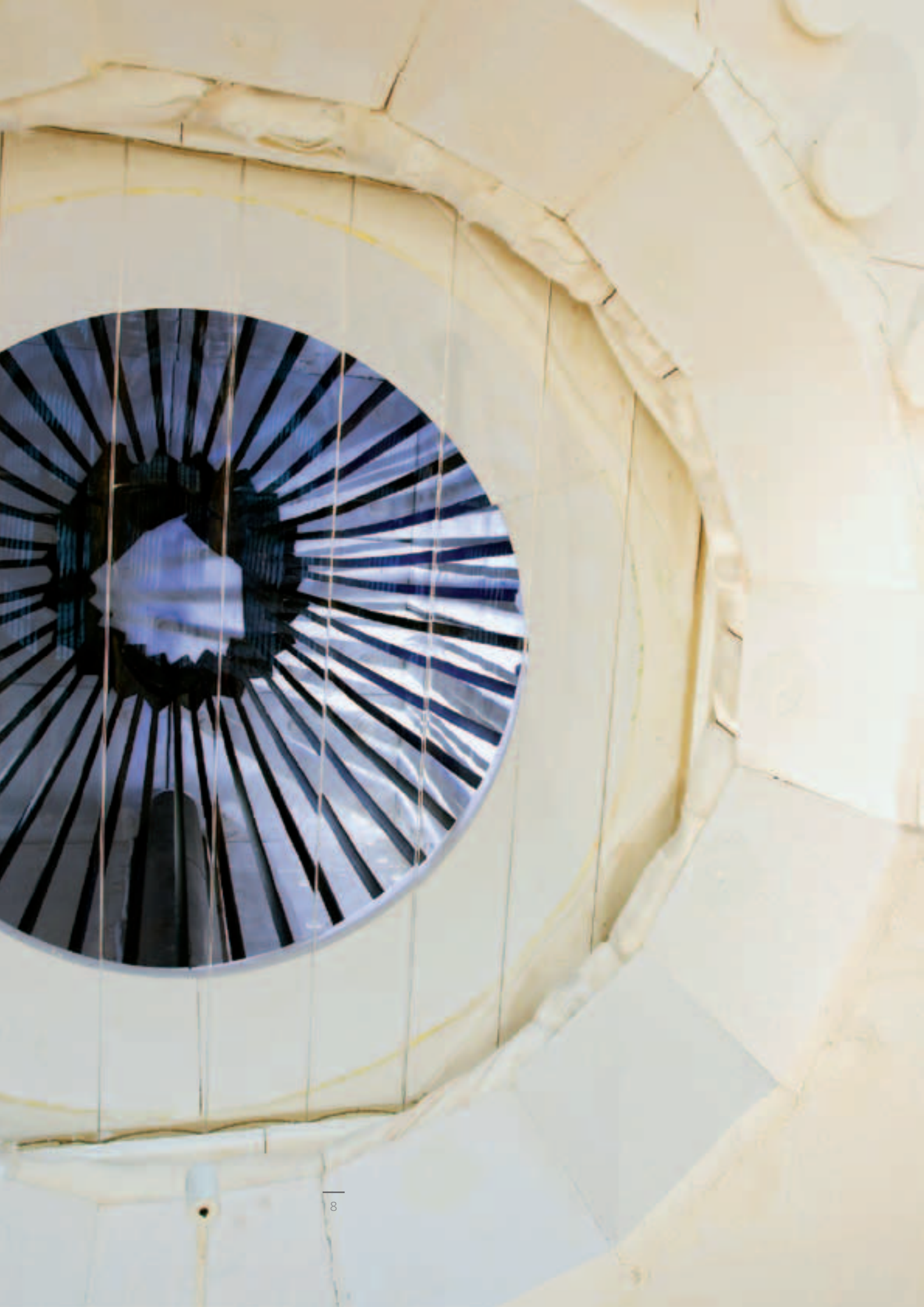
Regardless of our available budget, the success of the DLR stands and falls on the level of motivation of our employees. This motivation is the only way that we can secure the future of the DLR. Excellence and professionalism give a decisive competitive advantage in the effort to strengthen Germany as a center for industry and technology, especially at a time of competition with regard to new inventions and innovations within Europe and internationally. During the 2009/2010 reporting period I have witnessed many examples of excellence at DLR. I am delighted by the number of employees who take on responsibility, do their best for DLR, set high standards for themselves and provide mutual support for each other. I would like to take this opportunity to highlight a few representative examples that reflect the effectiveness and significance of the work done at DLR. These include the professionalism shown in gathering measurements of the ash cloud in May 2010, the first-rate launch and commissioning of the TanDEM-X and SatcomBW military communication satellites, the high quality of the groundwork done in preparing the concept of clean energy from the desert (DESERTEC) and the rich inventiveness shown in the field of electromobility research. The capabilities of DLR in all its guises were showcased to the public with an impressive style at the ILA Berlin Air Show 2010 and the COSPAR space research conference. More of our activities and projects are described in Part 1 of this annual report. Establishing the conditions under which DLR can further challenge and encourage the creativity and motivation of staff in the

organisation was a key goal in implementing the overall strategy for 2009: developing freedom to innovate. Meeting directly with employees is something I consider to be very important and as such I will again visit every one of the DLR sites during 2010. From developing an attractive employer brand to running a graduate programme for doctoral students, we have intensified our recruitment efforts, with particular focus on attracting young talent, in order to continue to meet the challenge of delivering high quality and excellence within DLR. In the Economic Development section of this report, we demonstrate how our work to develop a comprehensive infrastructure also extends to our third-party business activities, the personnel structure, the development of young talent, the quality assurance system and the management team. I hope that we have now aroused your curiosity to learn more about the highlights of our fascinating research programmes and the other activities of the organisation – and that you find our annual report to be an exciting read.



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





ANNUAL REPORT





Aeronautics

The years 2009 and 2010 represented a difficult period for the world of aviation. Following on the heels of the general global economic crisis, which hit cargo airlines particularly hard, came the eruption of the Eyjafjallajökull volcano in spring of this year. Although the duration of the eruption was limited, it had grave consequences for air transport, especially in Europe. Aviation has long been, and continues to be, sensitive to external influences, and this is something that this event highlighted in the public consciousness in particularly dramatic fashion. This sensitivity is also repeatedly evident, albeit less spectacularly, when extreme weather situations occur. The environmental effects both of and on aircraft are therefore quite intentionally given special significance in the research work carried out by DLR, with the consequences of aviation on the environment considered alongside the effects of environmental factors on air transport.

In the recent case of the disruption caused by the ash cloud, DLR was able to apply its impressive technical capabilities and expertise in a highly visible manner through the deployment of the Falcon research aircraft. Beyond this immediate response, experts from DLR continue to participate in various working groups that are concerned with finding ways to better manage the impact of similar events in future. In addition to this, it is necessary to improve not only our ability to forecast the dispersion and composition of ash clouds, but also the accuracy with which the actual risk to aircraft, especially their propulsion systems, can be assessed.

For DLR own flight operations, the most notable activities were the final preparations for and subsequent commissioning of the new HALO and ATRA research aircraft. Completing all the necessary steps for certification of the HALO atmospheric research aircraft proved to be a particular challenge. Of particular concern were the numerous attachment options on the wings and fuselage, which demanded very extensive investigations into factors such as aeroelastics and bird-strike resistance.

LamAiR

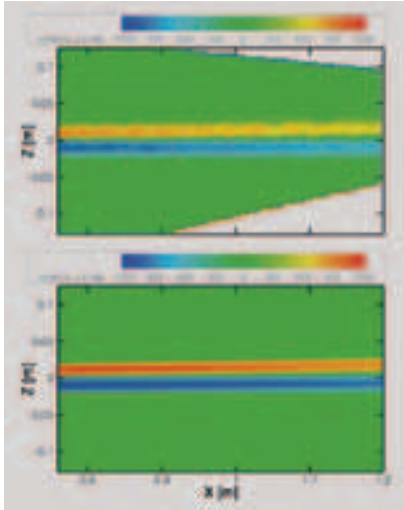
Reduction of aerodynamic resistance

There is no doubt that maintaining laminar flow at the boundary layer of aerofoils, tail units and engine nacelles is the area with the greatest potential for improving the aerodynamic qualities of transport aircraft. As such, this is one of the future technologies that is being investigated with a view to achieving the goals of ACARE and Vision 2020 for sustainable development in global aviation. With this in mind, DLR set up the internal LamAiR (Laminar Aircraft Research) project, which complements activities relating to the current national (LuFO IV – HIGHER-LE) and European (JTI-SFWA) projects. As with these other projects, the research work centres on two technology concepts, NLF (Natural Laminar Flow) and HLFC (Hybrid Laminar Flow Control). The NLF concept is particularly well suited for new short to medium haul aircraft, with the starting point for the DLR concept being a forward-swept laminar wing configuration. Using a new design methodology that takes into consideration the concavity of the wing at an early stage during design of the profile, it was possible to demonstrate that unlike with the rear-swept design for the JTI-SFWA, the cruising speed could be maintained at the previous level of $Ma = 0.78$. Building on this experimental work on the profiles, a sequence of corresponding preliminary design studies were conducted to investigate aerodynamics, structural mechanics and aeroelastics. For long haul aircraft, laminar flow can only be controlled through a combination of shape and boundary layer suction (HLFC). In preparation for demonstrating this technology in long-term flight tests on the DLR A320 D

ATRA, a vertical stabiliser with a simple boundary layer suction system is currently being designed as part of the LamAiR project. This work is multidisciplinary in nature and close attention has to be paid to matching aerodynamic requirements with the options available in terms of construction and design research. The initial concepts for construction of a leading edge for a vertical stabiliser with integral suction were prepared and perforated sheets produced that appear to be suitable for a porous outer skin. Thanks to a special flow meter constructed specifically for the task, researchers were able to measure their aerodynamic flow characteristics for the first time, particularly the pressure drop due to throughflow under the atmospheric conditions of free flight. A further major component of the LamAiR project is the evaluation of the laminar technology. An expert workshop was held to prepare scenarios that can be used as the basis for proving NLF and HLFC concepts in future.



Complete preliminary study of a short to medium haul aircraft with forward-swept NLF wing



Snapshot of the measured (top) and simulated (bottom) vortex density distribution in the wake of an oscillating aerofoil in a plane parallel to the flow

iGREEN

Numerical simulation technique

Various concepts for improving the performance, economy and environmental compatibility of new aircraft can even have an influence on the aeroelastic interaction between the aircraft structure and the airflow around it, and can therefore be safety-relevant. Such concepts include reduction of air resistance using laminar wings, load reduction through use of control surfaces, and use of large, efficient engines. In order to be able to consider these effects at an early stage of aircraft development, researchers must have a good understanding of the physical phenomena and be able to incorporate precise and reliable numerical simulations into the design process.

Such an approach is being pursued in the iGREEN (integrated Green Aircraft) project, which employs numerical simulations, wind tunnel experiments and a development process that reintegrates knowledge gained to bring about process improvement.

One of the main areas of focus for the project is the investigation of laminar wings at transonic speeds, with a view to possibly achieving different flutter characteristics to those of a conventional wing. To this end, tests were recently carried out on a simple wing model with

a laminar profile in the Göttingen transonic wind tunnel (TWG) at the German-Dutch Wind Tunnels (DNW) facility. These tests studied the movement-induced unsteady pressure distribution, which has a significant effect on flutter stability. The results are being used for validation of CFD simulations and other purposes. A second test using the flutter test rig is planned that will test the system with an elastically mounted, freely oscillating model.

A further major point of interest is the effect on the aircraft structure of the expected maximum non-steady-state loads due to wind gusts and flight manoeuvres, such as rapid emergency descent, which can also lead to instability caused by airflow separation (buffeting).

The brief, sudden elevated load peaks must be taken into account in the design of the wing by dimensioning the structure appropriately. It is possible to limit the mass of the structure, provided that the magnitude of the load peaks at the wing can be kept down by means of specifically controlled deflections of the rudder. To achieve this, it is necessary to be able to accurately predict the wind gusts and buffet loads. To test the prediction accuracy, a generic wind tunnel model was built for the TWG comprising two aerofoils mounted one behind the other. The front aerofoil generates unsteady gusts or, in the case of buffeting, highly dynamic regions of separated flows, which propagate downstream until they meet the second wing. Two different measurements were carried out, the first of which investigated the unstable flows behind the front wing. The unsteady distribution of vortex density produced in this region was measured optically and the results obtained corresponded well to those obtained by the CFD simulations, as shown in the illustration. The second measurement is to be carried out in the near future and will investigate the reaction of the elastic second wing as it is exposed to these fluctuations in the flow field.

MoJo

Modular construction of aircraft structures

A structural aircraft component with a CFRP-compatible construction has been developed as part of the European research project known as MoJo (Modular Joints for Composite Aircraft Components). The 1.4 metre long component is what is known in the industry as a flap track.

In a commercial aircraft this is a mounting inside the wing that acts as a guide for the wing flaps. By developing a new, modular construction and manufacturing technique and demonstrating its operational capability, it is hoped that in future structural components can be produced more cost effectively.

DLR has developed a continuous process for the manufacture of CFRP preforms for profiles that can be used to join the individual structural elements of the flap track. Preforms are semi-finished fibre products held in a fixed shape by a thermoplastic binder, making them easy to handle. Finished products are created by using a vacuum to inject resin in the fixed fibre preform. A flexible tooling concept for this process has been developed and the base plate for the flap track has also been manufactured.

The construction principles developed can be applied very flexibly throughout the entire structure of an aircraft and are suitable for an incredibly diverse range of modular components, for example freight and passenger doors, door frames, rudder fairings, and the ribs (also known as stringers) that are used to stabilise the aircraft fuselage longitudinally. During the course of the project, production techniques have been developed that pave the way for lighter-weight, and therefore cheaper and more environmentally friendly, aviation. In recognition of their achievement in successfully implementing the various construction techniques, the research consortium

received first prize in the Process category at the JEC Composites Show. Previously at JEC, in 2008, the MoJo project had been awarded second place in the Aeronautics category for their work on the topic of Continuous Inductive Preforming.

MOET

Model library and design tool

Electrification of on-board aircraft systems (More Electric Aircraft, Power-by-Wire) is a key aspect in the effort to achieve further reductions in fuel consumption and environmental pollution over aircraft that use conventional hydraulics and pneumatics to power systems such as actuators, de-icing and air conditioning.

In order to be able to use installed electrical power as efficiently as possible, systems for generating, distributing and utilising energy, which have previously generally been considered as separate entities, must be developed to the point where they form a highly integrated system.

The European Union's MOET (More Open Electrical Technologies) project has been established to advance the progress of the Power-by-Wire concept within the European aircraft industry. DLR is responsible for coordinating the development of new methods and tools that can help in designing the all-encompassing aircraft electrical system architectures of the future.



Guide rail for a rear flap (flap track) manufactured in CFRP

One important contribution from DLR was the development of a software environment known as ENADOT (Electric Network Architecture Design Tool), which can be used to automatically optimise the electrical system architecture with regard to energy characteristics, overall weight and reliability. This tool is now being used at AIRBUS. Another focus of the work at DLR is the development of the extensive NETCORE library, which facilitates detailed analysis of network stability and energy quality as well as health monitoring of complex high-voltage direct current on-board power systems. Both ENADOT and NETCORE are built using Modelica, a modern, object-oriented modelling language that allows multiphysics system modelling. Coordinated by DLR, the CleanSKy-SGO (Systems for Green Operations) project is currently working to establish standardised modelling processes and analysis tools for aircraft power systems.

CoSiCab+

Adaptronic CFRP panels

Noise levels within the aircraft cabin constitute a major factor affecting passenger comfort and one of the aspects addressed by the CoSi- Cab+ (Comfortable and Silent Cabin+) project. One of the most significant external sources of disturbance during a flight is the turbulent boundary layer (TBL), the undesirable effects of which are coupled to the aircraft structure via pressure fluctuations in the wall of the fuselage, from where they are transmitted to passengers in the form of unwanted noise. Low frequencies below 500 Hz have been

shown to be particularly problematic as there is no known passive solution that can provide effective attenuation at a sufficiently low weight. The goal in developing the adaptronic CFRP panel was therefore to produce a solution that can reduce the low-frequency cabin noise while also being compatible with lightweight construction. This would allow designers to fully exploit the weight advantages of a CFRP fuselage and avoid the need for heavy, bulky insulation material.

The CoSiCab+ project has developed a numerical design toolbox that will facilitate the design of noise-reduced, adaptronic lightweight structures. Utilising custom software modules in combination with standard ANSYS® and Matlab® software, this toolbox makes it possible to create Active Structural Acoustic Control (ASAC) process chains that model the significant physical processes involved in noise transmission, thereby permitting optimised design of the adaptronic structural system. After applying the ASAC process chain, the results provide specifications for the positioning of actuators and sensors in the passive system and an estimate of the operational performance of the uncontrolled (passive) and controlled (active) system.

In order to experimentally validate the software modules developed for the project, a flat, reinforced CFRP panel was designed using the ASAC process chain, then manufactured and tested in an enclosed measurement section in a closed-jet wind tunnel at mach 0.16. Pressure measurements were made in the TBL in order to characterise it and to allow a comparison with the turbulence data provided by the AVANTGARDE (Advanced Numerical Tools Graduation by Application in Aeronautical Research and Development) project. Vibroacoustic evaluation of the TBL-induced surface velocities of the structure was conducted using a laser scanning vibrometer (LSV) at 260 locations.

By filtering this data in the appropriate frequency range it was possible to analyse the form of the operational vibrations and the transmitted sound power. The open and closed loop control concepts implemented demonstrated a significant degree of vibroacoustic effectiveness, with vibration reductions of 12 dB and noise reductions of 6 dB(A) in third octave bands.

GOAHEAD

CFD validation of helicopters

Following a period of intensive development, URANS (Unsteady Reynolds Averaged Navier-Stokes) techniques are now available that have the potential to allow the aerodynamics of new helicopters to be simulated with such a degree of accuracy that no substantial aerodynamic modifications will be required after the maiden flight. Until recently, however, there was a lack of validation data to provide evidence of this potential.

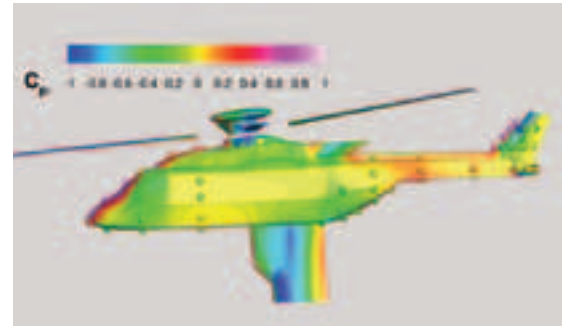
This gap was bridged by the European Union's GOAHEAD (Generation of Advanced Helicopter Experimental Aerodynamic Database for CFD code validation) project. Measurements were made of an NH90 main rotor-fuselage-tail rotor configuration under a diverse range of flight conditions. With its extremely comprehensive instrumentation (pressure sensors on the fuselage, rotors and walls of the wind tunnel, hot films, infrared images of the fuselage, PIV flow field measurement, measurement of the blade position and blade shape, micro-tufts), this was the most complex wind tunnel measurement ever carried out by the DLR team. A high number of CFD simulations were performed in prepara-

tion for the measurements and, particularly, during post-processing. These were necessary both for validation of the CFD procedures and for identification of inconsistencies in the measurement data through intensive comparison of the measurements with the simulation. Most of the inconsistencies were rectified by correction of the data. An evaluation programme was also implemented so that the measurement data and the results of the CFD could be compared quickly and conveniently. The outcome of this programme was a verified, user-friendly database that will allow significant advances in CFD techniques for helicopters to be made over the next few years.

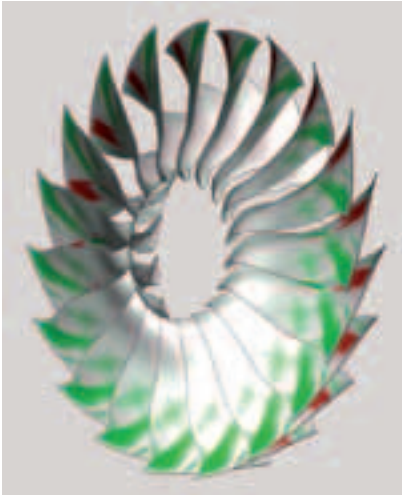
SIMCOS

Active flow control on main rotor profiles

Significant improvements in flight performance and fuel consumption have been seen since the introduction of modern transonic profiles for helicopter main rotors. These improvements are unfortunately accompanied by an intensification of dynamic stall effects under certain flight conditions, which in turn causes a very high variation in pitch torque. This phenomenon leads to increased vibration and greater loading on the swashplate actuators and control rods, which result in both increased wear and a limitation on the flight envelope.



Unsteady CFD simulation of the GOAHEAD complete helicopter model in the wind tunnel (DNW large low-speed facility, LLF: spheres = experimental pressure data; coloured areas = CFD simulation using the FLOWer CFD method from DLR)



Work output (green) and work input (red) from/into the AeroLight rotor

To address this issue, DLR and Onera established the Franco-German SIMCOS project with the aims of better understanding the complex flow phenomena that occur during dynamic stall and being able to manage these more effectively. Passive measures based on profile design and active methods are both considered. The SIMCOS programme places particular emphasis on active techniques for flow control, with the DLR investigating active blowing out. This work involved modifying the TAU code and evaluating 18 varied configurations of blower actuators. The best of these configurations achieved a reduction in pitch torque variation of about 85%, with it remaining possible to maintain a constant average lift. These outstanding numerical results must now be confirmed by conducting unsteady wind tunnel tests.

AeroLight

Aeroelastic investigations

Researchers working on the AeroLight project at DLR are developing, manufacturing and testing a single stage compressor demonstrator using new construction techniques to deliver excellent aerodynamic performance. Thanks to the possibilities opened up by the manufacturing technology used in the production of the blades, the Institute of Propulsion Technology enjoyed a high degree of design freedom in their optimisation of the blade geometry of the rotor, which uses a blisk construction. Developed jointly by the Institute of Structures and Design and the Institute of Materials Research, this technology is based on a blisk construction comprising three axial plates soldered together. MTU Aero Engines and the WTD 61 German air force test center are also participating in the project.

The Institute of Aeroelasticity investigated the flutter characteristics of the blisk at the end of the initial design phase using the TRACE CFD software developed by the Institute of Propulsion Technology. The aim of the aeroelasticity work was to evaluate the aerodynamic damping. This is necessary in order to be certain that vibrations that occur in the blades are damped under all operating conditions, in other words to ensure that there are no self-excited oscillations (flutter). The basis of the investigations is the natural mode shapes and the static aerodynamics at the relevant operating points. Simulations were carried out for each of the natural oscillations to determine the unsteady aerodynamic loads, from which it is possible to determine the work exchange between the blade and the fluid.

The decisive factor in the tendency to flutter is the integrated work input across the blading. Because this integrated global value is composed of large, localised instances of work inputs (both excitational and damping), it is very important to consider even the small details of the aerodynamics and vibration characteristics. Before operating the rotor it is necessary to ensure that all natural oscillations are damped, in other words that the overall work balance results in positive aerodynamic damping, something that has already been demonstrated for certain natural mode shapes.

MRO

Maintenance, repair and overhaul

In collaboration with Lufthansa Technik, the Institute of Propulsion Technology is conducting investigations on a CFM56 engine, used on aircraft such as the Airbus A340, with the goal of better managing and planning maintenance work on engine components.

Prolonged erosion during flight operations leads to typical wear marks, which generally occur at characteristic points on the engine fan blades. This means that shape of the blades deviates from the geometric ideal, thus leading to losses in performance. This effect is being studied both numerically and experimentally as part of the study.

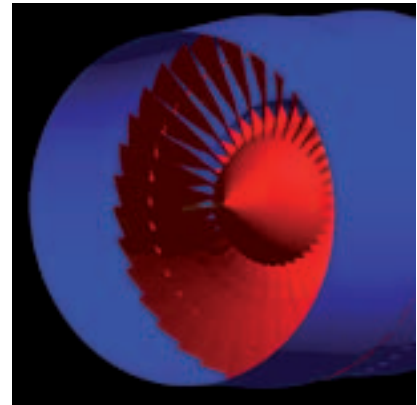
Various typical wear cases are being simulated using TRACE, the DLR flow solver software. Additionally, a selection of blade profiles is being measured aerodynamically in the Institute's cascade tunnel. As well as providing a detailed assessment of the modified fan aerodynamics, the results allow the most important factors affecting engine performance to be characterised in a targeted manner. This helps the industrial partner, Lufthansa Technik, to better understand the physi-

cal effects that lead to reduced performance and to take these into consideration to achieve optimal results when remachining the fan blades. The work combines many years of expertise in the field of numerical simulation of engines with the design expertise of the Fan and Compressor department.

Alternative Fuels

Behaviour in turbines

Synthetic fuels for aircraft propulsion are no longer some far-off utopia, rather aviation fuel obtained using GtL (Gas to Liquid) processes will in future be firmly rooted in the supply chain. This fuel is manufactured from natural gas using Fischer-Tropsch synthesis and can vary in its chemical composition. In order to optimise this innovative concept and provide a safe and effective method of implementing it in practice, the DLR Institute of Combustion Technology, in conjunction with partners from Qatar and the United Kingdom, is investigating the combustion characteristics of GtL fuels in gas turbine combustion chambers within the scope of a project financed by QSTP (Qatar Science & Technology Park).



3D view of fan blading in an engine fan



Experimental analysis of ignition process using high-speed cameras in a Rolls Royce test rig



Increasing automation is changing the capability requirements for pilots and air traffic controllers

Ignition characteristics are an important issue here, particularly their suitability for re-ignition of engines at high altitude. To this end, DLR employed a test rig at Rolls Royce in Derby, England, to analyse the ignition process under realistic conditions using high-speed measurement techniques. Comparison of five different GTL mixtures and Jet A-1 kerosene showed that as well as differences in ignition behaviour there was also a significant decrease in soot formation with the GTL fuels. Thanks to the high-resolution measurement technology, it was possible to capture the ignition process and flame propagation in such a high level of detail that the data could also be used for improving computer-based models. Overall, the results represent an important milestone in furthering the development and utilisation of these fuels.

Operational Monitoring

Central capability requirements

Human operators will continue to play a central role as managers and decision makers in the new European air traffic system under plans for the Single European Sky (SES). At the same time, however, substantial changes are anticipated with regard to the roles and tasks of those involved.

The central task of the interdisciplinary Aviator 2030 project was to clarify which changes will be made to the operator capability requirements as a result of SES. In order to investigate this issue, those aspects of the future air traffic concepts that have a bearing on career profiles were scrutinised and subjected

to simulation studies, with the involvement of pilots from Lufthansa and air traffic controllers from DFS (Deutsche Flugsicherung), the company in charge of air traffic control for Germany.

Based on the results of this work, monitoring with increased levels of automation is continually becoming more significant. It was possible to demonstrate that monitoring parameters are able predict understanding of the system. The corresponding simulation of free-flight scenarios showed an increase in capability requirements on pilots in several areas of attributes, whereas the demands on air traffic controllers remained largely at the same level.

All in all both operational monitoring is a key factor for of both professional categories regarding future ATM systems. Results from the first project are promising and will now be analysed in more detail in a follow-on project, Aviator II, which will also incorporate the results into new psychological test procedures.

Networking the Sky

Coordinated communications

Pilots and air traffic controllers will soon have a range of different communications channels available to them in addition to voice radio. These include data links in the VHF and L bands, a WiMAX-based standard for airports and new satellite connections. Until now however, there was no concept that could efficiently network these various data connections together, nor one that could integrate passenger applications. This problem was addressed by the Institute of Communications and Navigation in its vision of a "networked sky", which it pursued by initiating and managing the EU funded NEWSKY (NEtWorking the SKY) project.

In place of individual communication systems for different aspects of air traffic control and their associated applications, solutions are being developed for networking these systems through use of the Internet Protocol. A modular system architecture and standardised interfaces allow a high degree of synergy to be achieved. In addition to this, the use of widely available Internet technology helps deliver cost effective solutions for the aviation industry.

The networking concepts developed were unveiled to an expert audience in an impressive live demonstration at the close of the project in October 2009. SANDRA (Seamless Aeronautical Networking through integration of Data links, Radios, and Antennas) is the name given to the EU's follow-on project, which will see the NEWSKY concepts developed to a stage where they are ready for implementation.

Improving Airport Process Efficiency

Pooling information

At many airports, the limiting factors for air traffic are capacity and environmental regulations. In addition to this, journeys to the airport, passenger handling in the terminal and the airside processes leading up to take off make up a considerable portion of journey times within the air transport system.

DLR is making a contribution to solving these challenges and improving airport process efficiency as a member of the collaborative Airport2030 project, which is being run within the framework of the BMBF's (German Federal Ministry of Education and Research) Cluster of Excellence funding for the Greater Hamburg

Aviation Cluster. This work involves bringing together the existing expertise to be found in universities, major research institutions and industry in the Hamburg metropolitan region in the fields of air traffic management, logistics, aircraft design, system development and system simulation. In doing so, the aim is to improve selected airport processes, airport connections and compatibility between aircraft and the airport, as well as to evaluate the benefits of these improvements within the scope of the current project. In this respect, the focus at DLR is on management of airside processes, simulation of passenger flow in the terminal, compatibility of airports with revolutionary aircraft developments and technology evaluation.

One of the major foundation stones of the project, which is scheduled to run until 2013, is a specially prepared requirements catalogue detailing the technologies and processes to be developed by the project. This catalogue was prepared based on the outcomes of surveys of experts in the field and on three future scenarios prepared for Hamburg's medium-sized airport. Additionally, initial concept work has been carried out on the nature of the future workplace for apron controllers and ground handling dispatchers, with a view to providing the best possible working conditions.



Networking of aircraft using various data links for cockpit and passenger communications



Pressure chamber for human subject research. Rapidly changing pressure profiles can be achieved via high-volume pipes with computer controlled servo valves.

Protection Systems for Cockpit Crew

Hazard reduction in case of pressure loss

The pressurised cabin is a fundamental requirement for aircraft in fulfilling their role as a means of mass transport. Flying at altitudes of 10 km (33,000 ft) and more, which is a fundamental component in providing efficient air transport, means that occupants must be protected against the life-threatening conditions outside the aircraft.

In order to protect pilots against falling unconscious in the case of a sudden pressure loss, modern cockpits are fitted with what are known as quick donning masks. These deliver an oxygen-air mixture that varies according to altitude, starting at around 50% oxygen at typical cabin pressures. At and around maximum cruising altitude of 45,000 ft, the Pilot Flying must wear the mask at all times, in order to ensure that a sufficiently high proportion of oxygen is continuously maintained in the lungs. However, unlike in a military aircraft, in a large passenger aircraft the fastest possible loss of pressure takes between 10 and 20 s. This means that, provided oxygen is delivered quickly in the initial stages of the pressure loss, it is theoretically possible to achieve a sufficiently high proportion of oxygen in the lungs without pre-breathing oxygen by taking multiple breaths until the target altitude is reached.

In collaboration with representatives of the aviation industry, a series of tests were carried out in the pressure chamber facility at the DLR Institute of Aerospace Medicine with the participation of ten test subjects. The results demonstrated that when oxygen was delivered at 100% using an experimental oxygen mask within the first 2 s of a decompression event from 8,000 to 45,000 ft

in 20 s, pre-breathing of air was sufficient to prevent loss of consciousness. It is hoped that significant benefits in terms of weight and logistics can be achieved by developing a corresponding oxygen supply system that is suitable for real-world use.

CATS

Climate-compatible Air Transport System

The potential for minimising the impact of aviation on the climate is currently the subject of an interdisciplinary project known as CATS (Climate-compatible Air Transport System). This encompasses the operational side in terms of customised flight profiles as well as the technical possibilities offered by new technologies, propulsion systems and aircraft configurations.

An important area of focus is the reduction of the uncertainties that exist when modelling climatic impact. It is particularly important to properly understand the underlying processes and reciprocal effects between aircraft emissions and climatic impact. Researchers have now completed the construction of a multidisciplinary design and analysis chain for simulation and evaluation of the various options for reduction of climatic impact. To this end, various subject-specific models from the participating DLR institutes have been linked into an integrated CATS simulation chain.

This simulation chain will be utilised in the further work of the project to identify climate optimised mission profiles in the global route network. Investigations will then be conducted into the implications that simulation results have for aircraft design, with this work in turn feeding into the development and evaluation of a climate-optimised aircraft configuration that utilises new technologies and propulsion concepts.

The options investigated will be evaluated and presented on the basis of their contribution to reducing climatic impact, set against the change required in direct operating costs.

The participating institutes of the DLR all have an active role in interpreting the project outcomes, with each contributing their specialist knowledge towards a final set of substantiated conclusions by the DLR on how the environmental impact of aviation can be reduced in future.

Outlook

Scientific work has already begun on the first research projects at the previously mentioned Centre of Lightweight Production Technology (ZLP) and is running in parallel to the introduction of the necessary investments in plant technology. Funded by the federal states in which the DLR facilities are located, these projects will largely define the research programme at the ZLP until 2012. Work on the projects will be conducted at the various ZLP sites in close collaboration with equally committed partners from the worlds of research and industry.

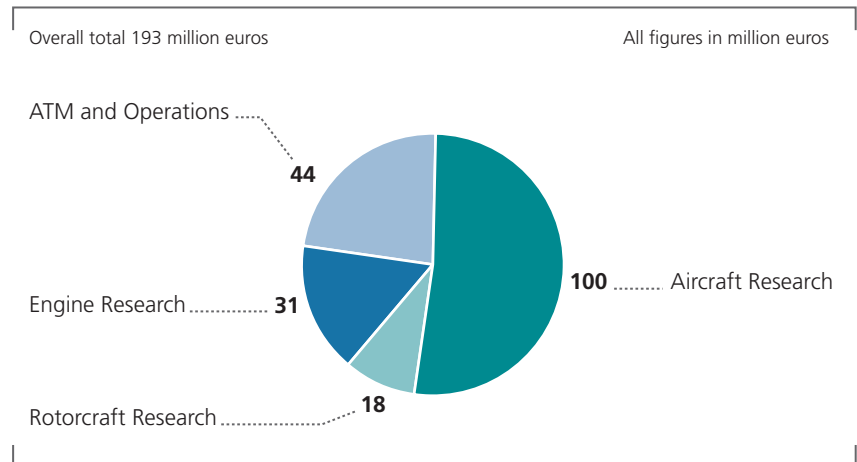
Alongside production technology, maintenance, repair and overhaul (MRO) is another new area of study that will become a firmly established part of DLR work over the coming years. This is an area of concern that has long represented a major problem for the aviation industry and engine manufacturers in particular. With increased use of fibre composite materials in aircraft primary structures, the problem is now taking on a new dimension, particularly for airframe manufacturers. Inspection and repair procedures used for metal structures will no longer be adequate here.

With its existing capabilities in the fields of flight systems engineering, materials and structures, DLR is very well placed to address a broad range of the issues surrounding MRO.

Aeronautics: revenues in million euros

	2009 actual	2010 planned	2011 planned
Basic funding	138	132	139
Third-party financing	66	61	71
Total revenues	204	193	210

Anticipated revenues for 2010





Space Administration and Space R&D

The German Aerospace Center (DLR) is where Germany's national and international space flight activities converge. Research work is carried out by the DLR Space Research institutes, whereas policy issues are the remit of the DLR as Space Agency, which is responsible for pursuing national and international space-related activities on behalf of the Federal Government of Germany. DLR own research institutes have the task of contributing to scientific, technological and operational activities. The integrated German space programme combines German participation in the European Space Agency (ESA) programmes, the EUMETSAT organisation, the national space programme, the DLR "Space" R&D programme and additional space related activities in science and industry. Through these activities, DLR is in a prominent position to demonstrate its expertise and capabilities in collaborations with 22 partners on

national and international space flight missions and research projects. The following examples provide a brief overview of successes and events during the past year in these areas.

Space Administration highlights

Galileo Testing

Satellite navigation for road and rail

In the near future, Germany will be able to boast satellite navigation test beds designed for every type of transport. DLR is funding the establishment of two additional Galileo Test and development Environments (GATEs). From spring 2012 these will provide facilities for the development of novel applications using the European global navigation satellite system, Galileo, even before it is fully operational. One of the new Galileo test environments is railGATE in Aachen, which will be used for rail transport, the other is automotiveGATE, which is for road transport. RWTH Aachen University is responsible for managing and implementing this project. Both test environments are designed to complement the existing German GATE facilities in the Berchtesgaden region (Galileo receivers and applications), SEA GATE in Rostock (shipping) and aviationGATE in Brunswick (aviation). Each test bed consists of a set of Galileo transmitters (pseudolites), each with its own monitoring and control station that can be used to monitor and configure the signals.

These two new GATE projects, which come under the funding umbrella of "Galileo above", were given the official go-ahead by the participating partners on 3 July 2009 at a kick-off meeting at the DLR Space Administration in Bonn.

eROSITA

X-ray telescope launch approval

From 2012, the German x-ray telescope, eROSITA (extended ROentgen Survey with an Imaging Telescope Array), will begin searching the skies for black holes and dark energy using its seven electronic "eyes". On 18 August 2009, members of the DLR Executive Board and the head of the Russian space agency Roskosmos signed a detailed agreement that defines all the organisational and technical constraints relating to the eROSITA mission.

eROSITA will be placed in orbit in 2012 on board the Russian Spectrum Röntgen Gamma (SRG) satellite, to be launched from Baikonur Cosmodrome. The German x-ray telescope comprises seven individual mirror modules, each containing 54 nested mirror shells, with incident light passing through apertures of almost 36 centimetres to allow the whole sky to be imaged simultaneously. eROSITA will survey around 100,000 galaxy clusters to measure radiation from the hot gases that become concentrated at their centers and is thus visible to its x-ray detectors. The distribution of these gases in space and the way in which they vary over time are the key to the further analysis. Using the data collected it is possible to derive information about the properties of dark energy, revealing, for example, if and how its contribution to the energy density of the universe, which today is a dominant 70 percent, has changed over the course of cosmic evolution.

ThermoLab

Experiment underway on the ISS

15 October 2009 saw the start of the ThermoLab experiment on board the International Space Station (ISS). Researchers from the Charité-Universitätsmedizin Berlin medical school will use this experiment to discover more about how weightlessness affects temperature regulation and circulation in humans. To achieve this aim, the experiment uses a novel sensor developed jointly by DLR, Charité and Drägerwerk of Lübeck.

When astronauts enter weightlessness they undergo a redistribution of bodily fluids, such as blood and lymph, from the lower to the upper half of the body. This is linked with changes in temperature regulation. In order to understand these changes more precisely and to counteract them, it is important to measure the temperature of the life-maintaining internal organs (the core temperature). ThermoLab is testing a new, non-invasive measuring technique using a dual sensor. This measures the flow of heat on the head and at the sternum. The heat flow values are then converted into body core temperatures using special mathematical techniques and, taken in conjunction with cardiovascular data, can be used to evaluate whether the subject is in a state of exhaustion. This means that people working in demanding situations – an astronaut carrying out an EVA for example – can be monitored to provide an early warning so that suitable countermeasures can be implemented.

The Space Administration provided financing for this project with funds from the Federal Ministry of Economics and Technology (BMWi). Developing and building the sensor and preparing it for use in space cost of the order of 400,000 euros.



Aerial view of RWTH Aachen's Aldenhoven Testing Center



SMOS satellite in orbit



Participants at the 2nd national SatKom conference

SMOS Satellite

Global survey of soil moisture and ocean salinity

SMOS (Soil Moisture and Ocean Salinity) was launched on its unique mission on 2 November 2009 from Russia's Plesetsk Cosmodrome, 800 km north of Moscow. The satellite mission is designed to deliver a full-surface survey of soil moisture and ocean salinity.

Both parameters are important to understanding global water circulation and climate change. Information from SMOS will be many times more accurate and meaningful than previous satellite data or point measurements carried out on the ground and at sea. This in turn means a improved ability to analyse and predict factors such as ocean circulation, water reserves and extreme weather events.

SMOS is the first mission to be specially designed to determine salinity at the ocean surface. Salt concentration in seawater is one of the most important parameters used in environmental monitoring. An unexpectedly rapid decline in salinity in a polar region may be a warning that the ice cap is melting more quickly. Beyond serving as an indicator, salinity is a major driving force underlying global ocean circulation, upon which the nature of the world's climate heavily depends. If there is any long-term disruption to the pattern of circulation, then this can have a dramatic impact on factors such as regional rainfall, wind systems and temperatures. As well as salinity, SMOS will survey the water content of the Earth's surface. Using the

data provided by the totally new measurement technology on board SMOS, it will be possible for the first time to provide a full-coverage map of the world showing soil moisture distribution. The measurements will help, for example, in improving forecasts of the likelihood of extreme events such as flooding and predicting how these will progress.

The total cost of the SMOS satellites amounts to 210 million euros, with both the French and Spanish space agencies providing additional financial contributions. In addition to funding research projects concerned with processing the data for use, DLR is also financing a German project office for SMOS at Universität Hamburg with funds from the Federal Ministry of Economics and Technology (BMWi).

National Satellite Communications Conference

Expert exchange forum

The future of the satellite communications sector from the German perspective was the subject of a two-day specialist conference that took place from 24 to 25 March 2010 in Bonn. Representatives from commercial organisations, ministries and research institutes joined delegates from the European Space Agency (ESA) to discuss ways of strengthening German competitiveness in this field. Topics on the table included the economic crisis and its impact on the satellite communications industry and the increasing level of competition from aspiring Asian space nations. This invitation-only event was hosted by the Space Administration. Attracting over 230 guests, participation was significantly up on the first conference two years earlier.

In his opening address to the conference, Professor Wörner, Chairman of the DLR Executive Board, emphasised that satellite communication is one of the key technologies for building a modern communication network. Other keynote speeches focussed on the following topics: the Heinrich Hertz and EDRS satellites; future applications of superconductivity in satellites; and the capabilities of small and medium sized enterprises (SMEs) in the field of satellite communications. Commercial service providers and the Federal Ministry of Defence (BMVg) also demonstrated which technologies will be important for future satellite communications applications. In total, the event featured nine keynote speeches, 39 specialist presentations and two podium discussions.

CryoSat-2

Polar mission launched

Europe's satellite mission to measure the ice fields at the North and South poles is underway. Launched from Baikonur in Kazakhstan on 8 April 2010 on board a Russian Dnepr launch vehicle, the CryoSat-2 Earth observation satellite is now in orbit around the Earth at an altitude of 717 kilometres. This launch is a particularly welcome success, as CryoSat-1, a practically identical predecessor to the recently launched satellite, was lost in 2005 as a result of a launch failure. It took just four years to build the replacement, CryoSat-2, and put it through its paces at the Industrieanlagen-Betriebsgesellschaft (IABG) space test center in Ottobrunn, Germany.

CryoSat-2 will research ice sheets in Antarctica and Greenland, as well as study sea ice. Researchers are expecting the mission to deliver new knowledge about the relationships between global warming, melting of the polar ice caps and changes in oceanic water and air circulation. DLR is facilitating the mission on

behalf of the Federal Government. CryoSat-2 is operated under the auspices of the European Space Agency's (ESA) Living Planet programme, in which Germany is the major stakeholder with a financial commitment of 24 percent. The overall cost of the mission is around 140 million euros.

„First Light“

Inaugural observation flight by SOFIA

The Stratospheric Observatory for Infrared Astronomy, a German-American partnership, completed its first in-flight observations of astronomic infrared objects during the night of 25–26 May 2010. This inaugural observation flight was given the name First Light.

The heavily modified Boeing 747SP is fitted with a 2.70 m reflecting telescope, constructed in Germany under the guidance of DLR. Take off was on 25 May at 21:45 local time from the aircraft's home base, NASA Dryden Aircraft Operations Facility in Palmdale, California. During the eight-hour flight, which reached altitudes of up to 11 kilometres, the 18-strong crew comprising scientists, engineers and technicians carried out extensive tests on the telescope and captured the first infrared images of test objects in the night sky, such as galaxy M82 and the planet Jupiter, at various infrared wavelengths.

This type of data is totally inaccessible using Earth-bound telescopes and the current generation of space telescopes. The "three-colour" image of Jupiter shows the heat that escapes through gaps in the planet's cloud layer. Images captured by the FORCAST instrument give a deep-reaching view of the interstellar dust cloud and portray several nodes, each of which is host to the birth of tens of thousands of stars.



Launch of CryoSat-2



SOFIA in flight with telescope door open



TanDEM-X dual polarisation image of Norwegian fjords

Space Administration: Research and Development Projects

Franco-German Climate Mission

Joint climate satellite

On behalf of the Federal Government, the DLR as Space Agency is planning a joint satellite project with France with the goal of observing the greenhouse gas methane (CH₄). An agreement to this effect was signed at the Franco-German Council of Ministers in Paris on 4 February 2010. This will be the world's first orbital methane LIDAR mission and will significantly improve our understanding of the global climate.

Methane is of particular significance because, after carbon dioxide, it is the gas that makes the second greatest contribution to global warming. The technologically and scientifically challenging mission therefore has the potential to play a major role in terms of internationally agreed climate targets.

With a substantial contribution from the DLR Institute of Atmospheric Physics, Germany is developing the measuring instrument that will sit at the heart of the satellite, a differential absorption LIDAR (DiAL) sensor. French space agency CNES is providing TanDEM-X dual polarisation image of Norwegian fjords the base station and the satellite bus, built on the MYRIADE microsatellite platform, which has been proven in service since 2004. Predicted overall costs for the mission are estimated at 120 million euros, to be shared equally by Germany and France.

The project was officially launched on 18 May 2010 at a kick-off event at the DLR Space Administration in Bonn, and by June, the Franco-German scientific advisory group had already held their first meeting in Paris.

TanDEM-X

Radar satellite launched

Germany's second national observation satellite, TanDEM-X (TerraSAR-X add-on for Digital Elevation Measurement) was successfully launched on 21 June 2010 from Baikonur Cosmodrome in Kazakhstan. Travelling on board a Russian Dnepr launch vehicle, the 1.3 tonne, 5 metre long satellite has now completed its journey into orbit. It took just half an hour after launch before first contact was made with the Troll ground station in Antarctica. After only 3 days and 14 hours, on 24 June 2010, the satellite sent its first images from space to Earth.

Various DLR institutes in Oberpfaffenhofen are responsible for controlling TanDEM-X via an Earth segment, overseeing the mission, and generating and using the scientific data.

The TanDEM-X mission is being implemented and financed as a public-private partnership between DLR and Astrium GmbH with funding from the Federal Ministry of Economics and Technology (BMWi). Infoterra GmbH, a subsidiary of Astrium, is responsible for the commercial marketing of TanDEM-X data. Astrium GmbH in Friedrichshafen built the satellites and has contributed to the cost of their development and utilisation. In total, the TanDEM-X mission costs are 165 million euros. DLR is contributing 125 Million euros, with European aerospace company Astrium making up the remaining 40 Million euros.

Together with its twin satellite, TerraSAR-X, which has been in space since 2007, the second German Earth observation satellite, TanDEM-X, flies at an altitude of 514 kilometres, from where it will comprehensively measure the complete land surface of the Earth – all 150 million square kilometres – many times. Currently, altitude models for large parts of the Earth remain imprecise, inconsistent or incomplete.

The gaps in the data will be filled in by the TandDEM-X mission, which will capture 3D digital mapping of the global landmasses in previously unheard of quality. To capture the data, TanDEM-X and TerraSAR-X fly in tight formation, separated by just a few hundred meters, thus forming the first ever synthetic aperture radar (SAR) interferometer of this type to operate in space.

Mars Exhibition

Presentation in Kobe

DLR held a Mars exhibition from 17 December 2009 to 31 January 2010 as a guest of the Kobe Science Museum in Japan. On show were fascinating, large-format 3D images of Mars in super high resolution taken by the German High Resolution Stereo Camera (HRSC) carried on board the European space probe, Mars Express. The exhibition was enhanced by the diverse information presented about Mars, its moon and the research into the Red Planet.

Mars Express is Europe's first independently executed mission to another planet. Since Christmas 2003, the Mars Express orbiter has been circling Earth's outer neighbour to discover new knowledge about its geology, mineralogy and atmosphere. The two main goals of the mission are the search for signs of water, which must have flowed in great quantities across the surface of Mars in its early history, and the global mapping of the planet with regard to its topography and mineralogy. Researchers from the DLR Institute of Planetary Research, the Freie Universität Berlin and other research establishments in Germany are all making major contributions to this work. The exhibition has already attracted half a million visitors in Germany, Austria, Japan and the United States.

Mars-500

Simulated flight to Mars

On 3 June 2010, six "astronauts" set off on a virtual journey to Mars. Over 520 days they will experience the hardship and isolation of an extended space flight, living in extremely cramped conditions in a sealed container at the Institute of Biomedical Problems (IBMP) in Moscow. This represents the main portion of the Mars-500 mission and will be the longest space simulation carried out to date. Scientists at the DLR Institute of Aerospace Medicine and other German research establishments, such as teaching hospital Berliner Charité and the universities of Erlangen, Munich, Mainz, Bonn and Cologne have all contributed experiments to the project.

The experiment simulates a journey to Mars. For the virtual outwards trip, the "astronauts" require 250 days, 30 days are then assigned to "visit" the planet, after which the crew must complete a 240 day return journey. As with its 105 day long predecessor study, carried out in 2009, the experiment is taking place in a special test facility at IMBP in Moscow. Apart from weightlessness and radiation, the simulated conditions are all as close as possible to those found in space. The crew experiences isolation, receives the same provisions as on an extended mission and must deal with emergency situations of the kind that could occur on a real flight to Mars.



Mars exhibition in Kobe



The Mars-500 „astronauts“ just before the start of the experiment



30-metre parabolic antenna at DLR Weilheim

Highlights from DLR Research and Development Division

Robotics and Mechatronics Center

ESA Reference Laboratory

DLR and the European Space Agency (ESA) concluded an agreement at the ILA Berlin Air Show 2010 that will see the new DLR Robotics and Mechatronics Center (RMC) serve as a reference laboratory for ESA. This is a good example of how DLR and ESA are continuing their successful ongoing partnership of 20 years. The aim of this collaboration is to establish an extensive network of international partners in the field of robotics and mechatronics, making best use of synergies between the partners and further expanding expertise in this field to ensure that it is fit for the future. Where possible, activities will be carried out at the RMC in Oberpfaffenhofen. The signatories to the contract were Prof. Wörner, Chairman of the DLR Executive Board, and Jean-Jacques Dordain, Director General of ESA.

Born out of the DLR Institute of Robotics and Mechatronics, the Robotics and Mechatronics Center will comprise several establishments and institutes working in the subject areas of robotics, mechatronics, system dynamics, control technology and optical information systems. The goal of this new center is to further cement and build on Germany's existing position as a world leader in the field of

robotics. This initiative is being supported by the Federal Ministry of Economics and Technology (BMWi) and the state of Bavaria.

New Navigation Signals

First analysis of next generation GPS

Researchers at the German Aerospace Center (DLR) have used the 30-metre antenna at the German Space Operations Center in Weilheim to receive and analyse signals from the first in the new generation of GPS satellites, known as IIF.

The satellite has been in space since 27 May 2010 and is initially sending a signal in the L5 frequency band, the third civilian frequency band, which should make the navigation service even more reliable and accurate. DLR has capabilities that are unique in the world for investigating signals of this type – knowledge and expertise that in future will make it possible to fine-tune and correct the satellites.

In future, the L5 signal will play a central role in satellite navigation, particularly safety critical navigation in aviation. Overall the L5 signal is the third civilian signal to be transmitted from GPS satellites, and the second to be in a frequency band that is approved for aviation. Like the standard L1 signal, this one lies in a frequency band that is protected for aviation use. Used together, the two signals can be processed in such a way as to cancel out the undesirable propagation error caused by the ionosphere. The ionosphere is an atmospheric layer that starts at an altitude of about 80 kilometres and contains large quantities of ions and free electrons. Radio signals, even those in the higher frequency

bands used for transmissions by GPS satellites, are delayed as they pass through this layer, which in turn leads to spatial errors during position determination.

Thanks to the availability of signals in two different frequency bands, these errors can be corrected to make positioning more precise and more reliable. Twelve next-generation IIF satellites will be placed in orbit over the next two or three years.

Signals from these navigation satellites will be beamed to Earth from an altitude of over 20,000 kilometres using no more power than a conventional light bulb. On arrival at the planet's surface the signal level is so low that it effectively disappears in thermal noise. However, using a special code, it is possible for GPS navigation receivers to detect the signals, correlate them out of the noise and amplify them.

With the 30-metre antenna at DLR location Weilheim, researchers are able to identify the signals within the noise without the need to filter them out using the code. This antenna has signal amplification factor of 150,000 and has the ability, if directed at a single satellite, to lift the signal out significantly above the noise. This allows researchers to conduct analyses that would not be possible using a conventional navigation receiver. In order to do this it is necessary to carry out laborious calibration of the equipment and extensive post-processing on the measurements. This expertise, nurtured within the DLR, will also be drawn upon in cooperation with the European Space Agency (ESA) for verification and optimisation of the navigation signals from the European satellite navigation system, Galileo. Additional joint measurements and analyses will be carried out within the framework of an international cooperation with Stanford University.

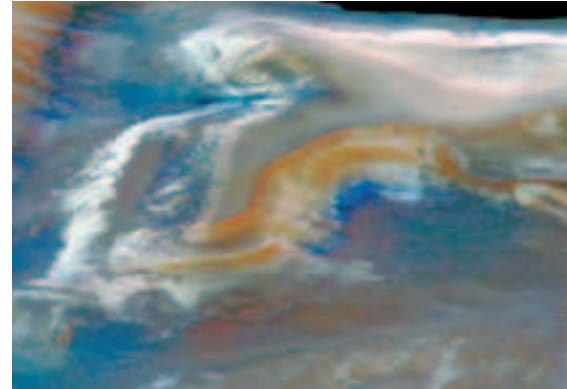
Cryobrines

Liquid salt solutions and life on Mars

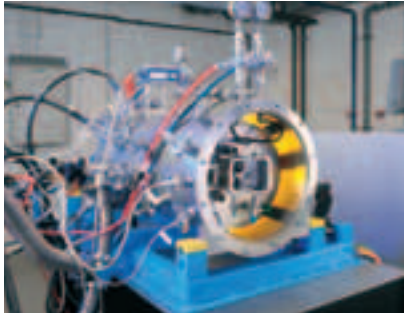
Are there salt solutions on Mars that retain their liquid form even at extremely low temperatures, so-called cryobrines? Theoretically yes, according to the results of research at DLR. Experiments and simulation models have shown that the necessary conditions do exist on Mars, particularly at high latitudes during the northern summer.

The research was initiated as a result of knowledge gained from NASA's Phoenix mission to Mars. In 2009 researchers used images of droplets of brine on the Phoenix probe to demonstrate that cryobrines could exist on Mars. Because liquid water is not present on the surface of Mars, it is possible that cryobrines, being a fluid medium, could be able to support life there. These liquid solutions could be responsible for flow processes, also known as rheological processes, on the surface of Mars. In the context of possible biological processes they could also provide a transport mechanism for nutrients and waste.

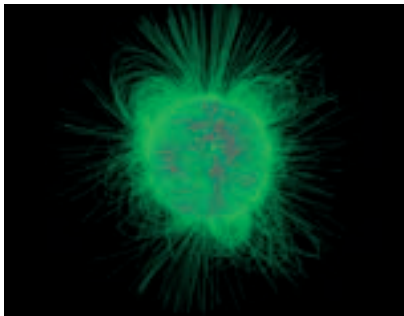
These are all processes that are otherwise only ascribed to water. If life were possible in this periodically liquid brine, then the definition of habitability would have to be expanded. Pure water would then no longer be the sole prerequisite for the formation of life.



Lightly coloured areas on the slopes of Mars



Process chamber high-temperature insert



Magnetic field lines around the Sun

Diffusion Laboratory Space Weather

Molten material design

On 18 December 2009, the completion of commissioning of the new diffusion laboratory marked the starting point for a series of innovative experiments on board the International Space Station. Understanding the basic process of atomic diffusion in molten materials is one of the keys to modelling how materials solidify. Through application of novel technologies for x-ray radiography, it is possible to observe the entire diffusion process in situ, from melting, through diffusion annealing to solidification. With the Materials Science Laboratory carried on board the International Space Station it is possible to carry out experiments under well-defined test conditions without any disturbance from convection effects. Constructed in a modular fashion, the design of the laboratory allows astronauts to swap between different experiment inserts. The experiments in both inserts will provide a new basis for our knowledge of fluid dynamics and the way in which molten alloys solidify, as well as provide a giant leap forward in the design of materials from the molten state.

Neustrelitz Information and Data Centre

On 2 September in Neustrelitz the first data was received from the US Advanced Composition Explorer satellite. This event marked the start of Europe's participation in an international space weather observation system. Intended as a long-running service, the space weather service will supply operators and users of modern telecommunications, navigation and remote sensing systems with important correctional information and warnings of disturbances. Operating under the leadership of the National Oceanic and Atmospheric Administration, the DLR receiver station is the only one in Europe. Additional receiver stations are located in the USA and Japan.

Space weather is determined on the basis of complex solar processes, which approximately follow an 11-year cycle. Currently we are in a period of minimum solar activity. Increased solar activity may cause substantial disruption to the infrastructure of our highly technologised society. Radio traffic is just as susceptible as the accuracy and reliability of navigation systems. The only way of providing timely warning of the possible hazards associated with the effects of space weather on satellite-based information and navigation systems is to use sophisticated observation and forecasting technology.

Outlook

For Germany, space involves research and development that directly benefits people while at the same time being our inspiration for the future. The major challenges facing humankind, such as globalisation, climate change, scarce resources and civil security, call for sustainable solutions. Space plays a crucial role in this respect.

Space also means pushing forward research to a completely new level. Space profoundly affects our vision of the Earth and the world beyond our planet. How did the cosmos come into being? Does life exist outside Earth? How does the space environment affect processes in the life sciences and materials science? These are all questions that affect people. Space offers unique new technical ways of answering these questions.

In the Helmholtz space programme, potential space applications are developed, work is carried out on technical solutions and specific scientific and application-related missions are prepared. All this happens in conjunction with partners from industry, research bodies, universities and government agencies and authorities, acting as a central link between all the key players involved in space and taking projects from an idea to executing an application in space.

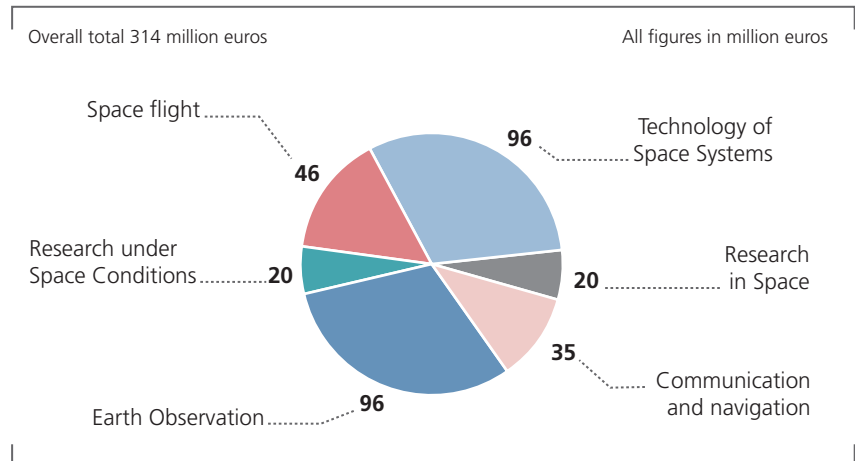
Space Administration: Revenues and funding budget in million euros

	2009 actual	2010 target	2011 target
Third-party funding (Management for Federal Ministries)	23.3	25.4	26.7
National programme (incl. proportionate management for BMWi)	231	243	242
ESA (total incl. BMVBS etc.)	648	642	713

Space Research: Revenues in million euros

	2009 actual	2010 target	2011 target
Basic funding	169	152	157
Third-party financing	146	162	132
Total revenues	315	314	289

Anticipated revenues for 2010





Transport

The transport sector is a major cornerstone of our industry-oriented society. It satisfies individual needs for mobility, generates employment, and represents a substantial proportion of value added in the economy. However, transport also has undesirable effects. Noise and exhaust emissions harm humans and the environment, countless people become the victims of accidents. These conflicting aspects have led to the necessity for intensive debate and action on the problems associated with the transport sector. The Transport programme at DLR aims to live up to this challenge. Our aim is to help shape a modern transport system that is sustainable over the long-term, both economically and in terms of its social and ecological impact. On the following pages, we will present a small selection from the diverse results of our research work during the period 2009–2010.

Electromobility

Quiet and sustainable on the move

After 100 years of history in the development of the internal combustion engine, there are signs that electromobility has put us on the cusp of a new era of transport technology and systems. In order to gain greater acceptance of the limited range compared to conventional vehicles, something that will remain a factor in the foreseeable future, and the increased time taken to „fill up“, it is not sufficient to focus solely on developing vehicle technology and special infrastructure for electromobility. Rather, there must be comprehensive, systemic research that considers both technical improvements to vehicles and the improved, intensified integration of electrical vehicles into both the transport and energy sectors. This research must look beyond vehicles and vehicle technologies to the world of transport in general, taking into account everything from demand for transport, through multi-modal transport management, to electricity and hydrogen generation and the means by which these are transported and stored. It will also be necessary to conduct an economic system analysis considering all relevant factors. DLR possesses a high level of systems expertise, a unique breadth of knowledge and many years of experience gained through close collaboration between energy and transport researchers.

In the field of novel vehicle structures, for example, work is being done to develop vehicle concepts optimised for electric power trains. This innovative approach takes into account both specific requirements, such as safety, weight reduction and driving dynamics, as well as new opportunities, for example replacing the mechanical power train with drive-by-wire technologies.

In parallel to this, researchers are also developing: safe, modular energy storage systems; hydrogen plants; efficient, environmentally friendly range extenders; and an optimised integral energy management system. Current research work in the field of transport systems includes the following: current and future transport demand trends; user behaviour and acceptance; utilisation models; the effects of electromobility on traffic flow; and urban mobility concepts. By investigating the environmental impact of transport and performing comparative evaluations of different technologies, the DLR is also active in paving the way for a system analysis that integrates the transport and energy sectors.

Motorway Accidents

Deduce measures, arrive safe

What causes serious traffic accidents on the motorway? How can these be avoided? These are questions that DLR has been concerned with in a study carried out for the state of Lower Saxony. Close to 9,000 accidents were investigated, all of which took place between 2005 and 2008 on the section of the A2 motorway that passes through Lower Saxony. This important east-west connection in northern Germany is not only heavily travelled, but also suffers a high number of accidents. According to the study, the regions around the conurbations of Brunswick and Hannover are particular accident black spots. Frequent triggers for both rear-end collisions and lane-change accidents were drivers not keeping their distance, unequal speeds and wet conditions. In cooperation with universities, DLR researchers developed an interdisciplinary method to establish a profile that allows tangible measures to be derived to allow safety on the motorway to be increased. For the first time,

this new approach takes into consideration all major factors that contribute towards accidents, such as road works, operational aspects as well as traffic psychology aspects.

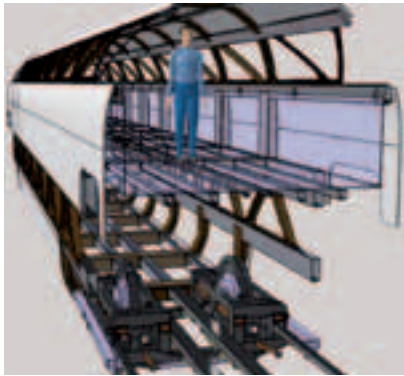
To arrive at this point, the researchers initially investigated accident factors using accident and load profiles. While using the DLR ViewCar more in depth analyses were also carried out in order to identify the impact of human behaviour on specific accident situations. The safety profile created shows that not only the specific safety levels of individual sections of a motorway could be quantified, but also starting points for targeted improvements could be identified. A comprehensive catalogue was produced detailing recommended measures for different motorway sections, with the aim of reducing the risk of accidents and thereby improving safety. Examples of these measures include the targeted introduction of dynamic traffic management systems for variable speed limits in wet conditions, banning overtaking for lorries and on slip roads, use of profiled edge markings and increased adoption of driver assistance systems.



Free-piston linear generator



The DLR ViewCar



A proposed design for the NGT high-speed rail carriage structure



Brunswick city, including the surrounding region, is being used as a laboratory for transport and mobility research

Next Generation Train

En route to the future

The demand for long-distance rail transport is growing around the world. This demand is founded on both a general increase in the demand for transport and the desire to replace short-haul flights with high-speed rail transport. Much faster, but more energy efficient, quieter and more comfortable than the ICE3 train – these are the requirements on which the DLR is basing its concept for the Next Generation Train (NGT). To complete Concept Phase I, a power train as well as a braking concept was included in the train set concept. A high degree of operational flexibility is guaranteed because of the single wagon principle. This supports simple maintenance and easy replacement of faulty wagons. Moreover, this system allows the possibility of dynamically coupling and decoupling on-the-fly.

The innovative NGT power train concept proposes contactless power pick-up from the tracks. Approximately 70% of drive power will be supplied by the traction units, with the remainder contributed by hub motors mounted on single-wheel-single-wheelset running gears. This results in above average acceleration of the train set. To decelerate the train, driver assistance systems will be used for an energy efficient freewheeling. If this is not sufficient, then at high speeds aerodynamic and recuperative braking will be used. At low speed magnetic brakes and finally mechanical brakes are used. The joining technology and types of con-

struction to be used for both the traction units and the intermediate carriages have already been defined. The carriage bodies will be built on metal structures, which will be fitted with synthetic material infills in different ways according to the load. As much functionality as possible will be integrated into the carriage body structure, in order to make best possible use of the restricted internal volume available due to the railway loading gauge. The largest components are the torque-controlled single-wheel-single-wheelset running gears. In terms of diversity, the most extensive amalgamation of features is to be found in the interior.

AIM

On the move with Brunswick

DLR, in collaboration with the state of Lower Saxony, the city of Brunswick and other partners, is building up the Application Platform for Intelligent Mobility (AIM). AIM uses the entire region and its real traffic infrastructure as an open and flexible platform for the latest mobility applications. From 2010 onwards this will provide a unique real-world opportunity for networking research, development and applications for intelligent transport and mobility services. AIM integrates and utilises the transport environment of the city and region of Brunswick. Around one million inhabitants are supplying important information for research into future mobility through their mobility behaviour, whether they are using a car, bus, tram, train or bicycle. AIM also incorporates special test routes and is using high performance equipment to simulate various aspects of mobility, from the smallest detail to the large-scale.

The combination of financial and technical resources brought together by AIM allows a broad range of methods and technologies to be applied, reducing both lead times and investment costs. Thanks to AIM, DLR researchers, together with their scientific, research, development and industrial partners, can now model and systematically investigate a previously unapproachable diversity of intelligent mobility services – both multi-modal and mode specific. The overriding goals of the project are to increase safety for all parties involved in transport, to achieve efficient traffic flows and to conserve resources. Five major focus areas are targeted by AIM: traffic flow optimisation; inter-modal mobility; future mobility concepts; mobility awareness; and introduction to market and migration, in other words the process of successively introducing new systems to the market and replacing existing ones. As an open and flexible research platform, AIM is designed for longevity and sustainability. The Helmholtz Association has allocated 8.7 million euros for setting up AIM. In addition to this, the state of Lower Saxony is providing 6.5 million euros in start-up funding.

Train-to-train Collision Warning System

Improved safety on secondary lines

Trains are considered to be a safe means of transport. Nonetheless, collisions do still occur. RCAS (Railway Collision Avoidance System) is a novel system developed by DLR researchers that aims to avoid accidents on the railways. The system functionality was demonstrated for the first time at the Siemens test centre in Wegberg-Wildenrath. This new system avoids collisions between trains

without relying on safety equipment installed along the route. Instead, the system utilises the latest in communications and sensor technologies, which allow direct communication from train to train. As soon as they come within range of each other, the trains begin to exchange information on position, speed, planned route and loading gauge. When the system detects that there is a threat of impact, a warning is given to the train drivers and possible solutions are also suggested.

RCAS is primarily intended for use on lines and in situations where no safety systems currently exist, for example on lines with very low traffic, dedicated industrial railways, construction sites and shunting yards. It is in no way intended to replace the universal European Train Control System, ETCS. RCAS is typically an add-on system – train control and safety systems already successfully prevent collisions. As such, RCAS can be used as a safety overlay to improve safety in those situations where conventional safety equipment is not used.



Test-train (Integral class) fitted with RCAS technology



Total Airport Management Suite – working together for improved efficiency

Total Airport Management Suite

Act cooperative, improve efficiency

Currently airport operators, airlines, authorities, air traffic control and security providers harmonise their activities at the airport mostly in a suboptimal manner. The various parties optimise their own areas of responsibility, however this very often happens without any knowledge or consideration of how this affects other stakeholders at the airport. This often results in higher costs for the parties involved and increased journey times for passengers. Total Airport Management Suite (TAMS) is being funded by the Federal Ministry of Economics and Technology (BMWi) as a flagship project until 2011. Working in collaboration with leading industry players, DLR is making an important step forward to a new type of airport management system that supports decision makers in taking a wider view in their approach to fulfilling their coordination and management roles. TAMS treats the airport as an integrated system comprising every process and corresponding interaction that relates to clearing passengers, baggage, air freight and aircraft, regardless of whether these are landside or airside. TAMS will create increased transparency and efficiency in airport operations. Beyond this, airports will become more flexible with regard to changing demand for air transport. Passengers will enjoy journeys that are more punctual, reliable,

comfortable and environmentally friendly. In addition to all this, significant CO₂ savings can be achieved by minimising waiting times for aircraft with running engines and reducing the overall amount of groundside vehicular traffic to a minimum. The total cost of the project, which involves Siemens, Inform, Barco, Atrics and Stuttgart Airport, amounts to 30 million euros, with DLR contributing around 7 million euros of research funding

Disaster Management Tool

A tool for the worst-case scenario

A Disaster Management Tool (DMT) has been developed as part of the European LIMES project, supported jointly by the DLR Transport and Space research programmes. This tool integrates satellite navigation, satellite communication and the latest mapping data from satellite-based Earth observation systems to create a portable, robust and functional information and communication tool for use in the field by international disaster response teams. The DMT was developed working closely with experts from the Monitoring and Information Centre (MIC), operated by the European Commission, who are responsible for providing assistance to international relief efforts. To ensure that the tool was geared to the needs of aid workers and systematically optimised to meet the demands of work in the field, the developers participated in several international disaster control exercises.

The EU experts rated the DMT technology as being already sufficiently mature that it should be deployed the next time an international disaster response is undertaken. For this purpose, the EU is providing training in the use of the tool. Beyond that, there are concrete plans of the EU to recommend the use or adapta-



DMT in action at an international disaster control exercise in Cyprus

tion of the DMT for deployment by the United Nations Disaster Assessment and Coordination organisation. The DMT and the expertise that it represents also have a major role to play at DLR in the context of developing a specialised transport management system for major events and disasters. This system will facilitate both interactive communication between response teams in the field and communication between response teams and the control center. In turn, this will mean the deployment of rescue teams and the evacuation of victims can be managed more effectively and efficiently.

Tangible Climate Change

Who, what, where, how much?

Transport is already a major contributor to global climate change today. Forecasts predict further increases in traffic volumes and the associated detrimental effects on the environment. Coordinated by the DLR since 2005, the European Union's QUANTIFY project conducted experiments and ran numerical simulations to quantify the contribution made by various forms of transport to climate change. Researchers examined the entire process chain, from the emissions source (gas and particulates), through local dispersion of emissions and regional and global changes in the composition of the atmosphere (including clouds), to actual climate change. In addition to this, the project also evaluated the contributions made to radiative forcing, which allowed a direct, quantitative comparison to be made between the various contributors to global warming. Taking IPCC consistent scenarios (IPCC = Intergovernmental Panel on Climate Change) as a

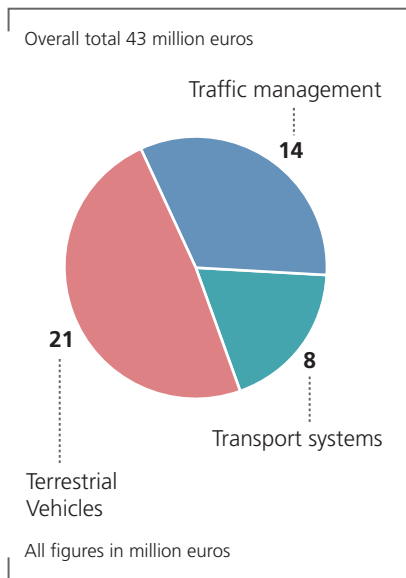
basis, simulations were performed to establish possible future trends in the contributions to climate change made by transport up to 2100. The project, which saw the participation of 41 international partners, concluded at the end of February 2010.

Because its expertise extends to every mode of transport, DLR was a major contributor to the success of QUANTIFY. For example, the FALCON research aircraft was deployed to measure the composition and dispersion of exhaust gases from large ships. Such measurements were needed because non-CO₂-related effects (e.g. ozone production due to nitrogen oxide emissions, vapour trails from aircraft, ship-induced cloud formation) are particularly significant in the case of transport emissions. The impact of this type of effect in terms of climate change differs significantly that of CO₂ emissions, which DLR was able to demonstrate using a simulated global climate model.



The DLR FALCON research aircraft, measuring dispersion of exhaust emissions from a container ship

Anticipated revenues for 2010



Outlook

Traffic jams with a combined length of 7,500 kilometres disrupt traffic daily on the major roads of Europe. European rail transport is pushing at the limits of its capacity on 16,000 kilometres of the network. Capacity bottlenecks, holdings and delays are commonplace in aviation. European transport routes guarantee everything but an unhindered journey, resulting in great expense for the economy. But that's not all. Noise and exhaust emissions from motor powered vehicles have a detrimental effect on the quality of life in urban agglomerations, as they do in other areas of heavy traffic, and hardly anyone doubts the negative effects on the climate any more. And, despite significant reductions in recent years, more than 35,000 people still die each year on Europe's roads, with countless more injured.

These significant problems in the transport sector are the result of a noticeable increase in passenger as well as freight transport, a pattern of increase that has been observed for decades now. As a transit country, Germany in particular is faced with the prospect of significantly increasing traffic in future too. This will only serve to further exacerbate the problems that exist today, as there appears to be little opportunity from either an economic or ecological perspective to extend the transport network sufficiently to meet demand. Rapid, reliable and safe transport connections are, however, a necessary prerequisite for stimulating economic growth and job creation. Mobility without bottlenecks is, on the one hand, a matter of economic concern to industry. It is also, however, an expression of individual desire that is characteristic for the lifestyle enjoyed by modern society.

The Transport programme focuses on addressing the problem areas described above and is oriented towards solving definite problems. By matching innovative ideas and specific expertises of our transport researchers with existing skills based in the fields of aviation, space and energy we are able to exploit synergies and develop novel solutions. It is precisely this focus on symbiotic relations, which is unique within Germany, combined with the use of innovative high technology that ensures our problem-oriented research delivers results for the transport sector. We tend to concentrate primarily on issues that require large-scale research for which system expertise and an interdisciplinary approach are indispensable. In combination with the extensive capabilities within the DLR for building and operating large-scale plants, this creates genuine added value for transport research in Germany. Our research focuses on road and rail vehicles, traffic management as well as on transport development and its environmental impacts. Because of the multi-modal alignment of our organisation, the permeability of our research focus areas, and the integration of all relevant internal players at the DLR, the Transport division is well placed to tackle systemic challenges, such as electromobility and urban mobility.

The majority of transport needs are met with terrestrial vehicles, particularly road vehicles, and this is a situation that is not going to change in the foreseeable future. The same applies to the major challenges associated with this situation, such as reducing energy consumption, noise emissions, CO₂, particulates and pollutants, increasing the use of alternative power trains and improving safety and comfort. In developing the corresponding solutions we give consideration to both road and rail transport, making use of the synergies that result.

In terms of road vehicles we focus on vehicle energy systems, novel vehicle structures and assistance systems for traffic participants. Our work in the rail sector is aimed at increasing performance, safety and reliability, as well as energy efficiency and comfort. The increasing demand for transport and the strain placed on infrastructures form the basis for the key challenges in traffic management: ensuring mobility whilst protecting the environment and conserving resources.

Our goal is therefore to use innovative approaches for traffic management to improve the effectiveness and efficiency with which resources are used, while at the same time reducing the burden on the environment. We consider road, rail and sea transport, plus airports in their role as transport hubs. As well as looking at transport specific issues, we also take inter-modal aspects into account. Our research into traffic management is specifically relevant to traffic management during major events and disasters. In this respect we develop solutions to support the police and emergency response teams. Beyond this we also hope to make it possible to take an integrated approach to transport development and environmental impact. To achieve this it is necessary to close the existing gaps in the process chain as a whole, from the origins of a transport concept, through its development, to its final impact, and to make this whole chain predictable.

The primary goal is to deepen our empirical analytical understanding of the origins of transport issues in passenger and commercial transport. In doing so, greater attention is paid to individual attitudes, preferences and lifestyles, alongside the traditional observation of external factors that do not take human nature into account. The results and data from the analysis of transport-related human be-

Transport: Revenues in million euros

	2009 actual	2010 planned	2011 planned
Basic funding	37	30	32
Third-party financing	11	13	14
Total revenues	48	43	46

haviour serve as inputs into models of passenger and commercial transport and allow the effects of measures taken to be evaluated. In addition to simulating the cause and effect relationships in passenger and commercial transport, we also bring together new and existing data for the purpose of analysing and evaluating the transport system at the regional, national and global scales.

Our goals also include predicting traffic noise and evaluating its effect on human beings, developing geographically distributed emissions inventories and emissions scenarios, and evaluating traffic emissions with regard to their impact on the climate. We will identify innovative ways to implement a sustainable transport system and to evaluate new vehicle concepts. We are also concerned with the question of how efficient multi-modal travel behaviour can be supported by suitable information and how potential traffic control measures can be evaluated through use of traffic information. By bringing together different, mutually complementary transport and environmental models we are able to provide forecasts at local, regional and global level as well.

Energy

Energy conversion and energy use play a key role in virtually all technical systems. The efficient handling of energy is therefore an important aspect of all of DLR fields of activity. For example, DLR optimises the energy efficiency of power plants, aircraft and vehicles, while efficient power supply is also of the utmost importance for space applications. Energy research at DLR is dedicated specifically to efficient and environmentally friendly energy supply, and concentrates its activities on stationary applications for the provision of electricity and heat at economically relevant scales. In this work, the Energy programme benefits from a wide range of synergies with the competences provided by DLR other fields of activity, and also shares the use of test facilities.

DESERTEC

Solar power from the desert

The scientific basis for the DESERTEC Industrial Initiative, founded in October 2009, was provided by the DLR Institute of Technical Thermodynamics in Stuttgart. The DESERTEC plans are based on three DLR studies that determine the potentials of renewable energies for the sustainable production of electricity and drinking water in 50 countries in Europe, North Africa and the Middle East, with particular consideration given to the option of solar thermal power plants. These studies showed that solar thermal power plants covering an area of less than 0.3% of the desert area of North Africa could produce enough electricity and desalinated water to meet the increasing needs of these countries and export solar power to Europe.

The MED-CSP (Concentrating Solar Power) study focuses mainly on sustainable power supply in the Mediterranean area. TRANS-CSP describes the restructuring required in Europe to create a sustainable electricity supply on the basis of local and imported energy sources such as solar power from the Sahara. The results gave rise to a further project to examine and model energy supply corridors in Europe, called REACCESS, which for the first time took solar power imports into account as a possible option for the future.

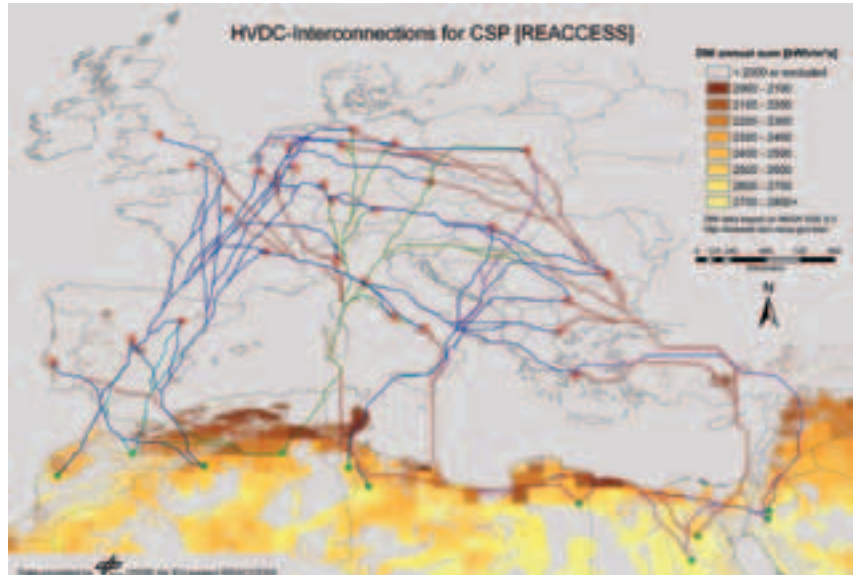
AQUA-CSP provided a concept for sustainable drinking water supply for the countries of North Africa and the Middle East. This project resulted in a further examination of five specific locations in

the Mediterranean region that would be suitable for implementing solar thermal power plants for combined power generation and seawater desalination (MED-CSD), which in turn led to two demonstration projects for power plants of this type, one on the Atlantic coast of Morocco as part of the Union for the Mediterranean, the other on the coast of the Red Sea in Egypt, both supported by the respective governments of those countries and the European Union.

Increased Fuel Flexibility for Combined Power Plants

Option for CO₂-free operation

In this project, the DLR Institute of Combustion Technology conducted the first examination worldwide of a reheat combustor with optical access using laser and high-speed measuring equipment at the high-pressure combustion test rig HBK-S. The reheat combustion concept used by ALSTOM in its largest gas turbine family for power plants features two sequential combustion chambers with an intermediate expansion stage in a single turbine, achieving greater overall efficiency compared to the conventional gas turbine process. The aim of the experiments carried out at HBK-S is to examine the auto-ignition and mixing of hydrogen-rich flammable gases (syngases) under typical conditions in a reheat combustor (high pressure, high temperature, fuel injection in exhaust gas). Such gases can be won for example by gasifying coal, wood, biomass or through solar processes. The experimental results deliver the basis from which design rules can be derived for developing a fuel-flexible reheat combustor that can be operated safely, reliably, and with low emissions using very different fuels



Map of possible corridors for solar energy imports from the Sahara superimposed on a map of solar energy resources in the Mediterranean area (source: REACCESS 2009)

(natural gas, syngases). Measurements on auto-ignition at the new reheat combustor test rig have already shown that a low proportion of natural gas in hydrogen of approximately 4% by volume can prevent auto-ignition in the mixing section.



Preparations for laser measurements at HBK-S



First operation of test rig to characterise SOFC under increased pressure: operation under increased pressure (1-8 bar)
Focus: electrochemistry at increased pressure/ operation of SOFC under increased pressure at system-relevant conditions

Hybrid Power Plant

Combining gas turbines with fuel cells

In this project, which aims to couple a high-temperature SOFC (solid oxide fuel cell) operating at high pressure with a gas turbine, the test rig for characterising SOFC at increased pressures was set up and taken into operation. SOFC behaviour under increased pressure cannot be derived directly from its behaviour under atmospheric conditions due to the complexity and interdependencies of processes within the SOFC. The use of data acquired in high-pressure operation is not an option, as to date only a small number of research institutions and companies worldwide conduct the corresponding analyses, and these institutions do not publish their data. The test rig was planned and built in the years 2008/2009. Similarly to other test rigs, it permits measurements of V(i) characteristics and impedance spectra, however at increased pressure. In addition, anode and cathode gases are analysed at the in- and output. Complex and precise pressure regulation allows differential pressures between anode and cathode environment of between 10 and 500 mbar to be applied at an absolute pressure of up to 8 bar. The increase in pressure results in an increased output in the range of 30%.

Numerical Design

Design tool for compressors

In recent years the DLR Institute of Propulsion Technology has developed the technology and expertise to design modern, especially efficient high-performance compressors. These include the high-precision simulation tool TRACE, which is used industrially, the extremely efficient optimisation system AUTOOPTI, and a fully integrated compressor design system. In the last two years, this design system was successfully used to redesign a performance-enhanced gas turbine for use in the fossil fuel power plants of a large international power plant manufacturer. Aerodynamics and mechanical strength of the compressor blading were designed in close cooperation with the DLR Institute of Structures and Design; the work was completed in early 2010. The project succeeded in achieving or even surpassing its ambitious aerodynamic design objectives in all points, in particular by drawing on previous experience in the field of automated optimisation of three-dimensional compressor blading. This involved developing for the first time an optimisation strategy to take into account both the base load operating point and several especially important partial load points, particularly in order to maximise performance at extreme underfrequencies and under unfavourable environmental conditions. It is to be expected that compared to the previous design the resulting product will set new standards in terms of efficiency at base load operation and stability under partial load.

SOLHYCO

Solar micro gas turbine

A solar hybrid micro gas turbine system was built and taken into operation on Plataforma Solar de Almería CESA-1 solar tower. In the SOLHYCO project, which was carried out jointly with 10 project partners and financially supported by the EU, an innovative solar receiver based on metal tube technology was developed at DLR and combined with a micro gas turbine (100 kW). After taking the system into operation with fossil fuels, solar tests have now begun with the aim of demonstrating cost-efficient energy generation by means of concentrated solar radiation for the application area of decentralised cogeneration units and solar cooling for industrial applications. The solar receiver test allows further insights into the potential of the innovative technology of profiled multilayer tubes, which is currently being developed at DLR.

CeraStore

Competence Center for Energy Research

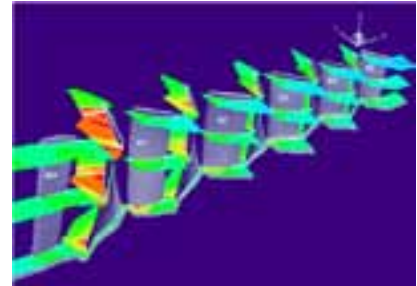
At its Cologne site, DLR is establishing a connection of two key areas that in this combination will provide DLR with a unique position in energy research: ceramic materials in energy research and thermal storage technologies. In order to utilise and emphasise the synergies between these two key areas, the two subjects will be brought together in a new competence center. A new building for this competence center will be financed largely with funds from the Economic Stimulus Package II of the state of North-Rhine Westphalia (Ministry of Innovation, Science, Research and Tech-

nology); in addition, several pieces of experimental equipment are intended for the two involved institutes. A joint proposal for the planned activities in the field of energy-related ceramics research has been submitted with the participation of industry and academic partners as part of the NRW competition "Mikro-Nano&Materials"; the preliminary project outline has already been positively assessed.

TEG 400

Transforming waste heat into energy

On the "TEG 400" project, the DLR Institute of Materials Research is working on developing a technology for thermoelectric generators that are to be usable at temperatures of up to approximately 400°C. Currently, state-of-the-art technology permits utilisation temperatures of approximately 250°C. New areas of application at which the current development is aimed are grid-independent heating systems and the transformation of unused waste heat in vehicles into electrical energy. There is significant interest in this technology on the part of industry, resulting in intensive cooperation. In the longer term, the project is already proposing to develop materials that can be used at up to 500°C.



Mach number distribution of the newly designed compressor blading (red: high Mach number, blue: low Mach number)

Modelling Combustion Processes

Exact understanding of chemical reactions

By calculating previously unknown reaction rates, an important contribution was made to modelling combustion processes with syngas (H_2 , CO), for example from biomass, and at low temperatures in atmospheric chemistry. For this purpose the rate of a key elementary reaction was for the first time predicted using methods of theoretical reaction kinetics.

Chemical reactions involving highly reactive gases or substances can often not be experimentally examined at combustion-relevant temperatures, as a result of which their pressure- and temperature-dependent reaction rates are not experimentally accessible. Reactions such as $CO + HO_2 \Rightarrow CO_2 + OH$ however play key roles in "flameless oxidation" as well as in lean combustion and especially at higher pressures because they transform the "stable" radical HO_2 into the more reactive radical OH , thus directly affecting ignition processes. Therefore the rate of the aforementioned reaction was for the first time calculated and very precisely predicted at the DLR Institute of Combustion Technology in collaboration with working groups in the USA using quantum chemical and statistical methods of theoretical reaction kinetics. The estimated reaction rates previously used in chemical reaction models were found to be too high by a factor of more than 10, as a result of which the ignition point of hydrogen, carbon monoxide and hy-

drocarbon mixtures for example with methane or ethane at high pressures was predicted to occur far too early.

Outlook

The foreseeable shortage of affordable fossil fuels and the clearly apparent environmental effects of their use are creating significant pressure on policymakers and industry to adopt new and innovative technical solutions. The speed of innovation must therefore be significantly increased in the energy industry and in energy research. Despite the successes of the Federal Government, considerable further efforts and additional resources will be required here.

Three overriding objectives must be pursued:

the demand for energy must be drastically reduced by means of higher utilisation efficiency, if possible without limiting the standard of living;

energy transformation for the provision in particular of electricity must become more efficient;

and fossil fuels must be replaced to the greatest possible extent by the introduction of renewable energies.

Energy research at DLR is guided by these objectives and works on topics relating to the efficient provision of electricity, to thermal, electrochemical and chemical energy storage, and to developing the energy system as a whole.

Optimising stationary gas and steam turbines is one of the main focus areas of DLR energy research. Its experimental and numerical work in the fields of compressors, combustors and turbines and

its systems competence serve to significantly increase the efficiency of energy generation; in addition, DLR examines and prepares for the use of alternative fuels. Work is also being carried out on optimising specific procedures for CO₂ separation and storage.

Research into fuel cell systems serves to improve their reliability and longevity for future use in energy supply. Combining high-temperature fuel cells and gas turbines into hybrid power plants can be expected to deliver an increase in electricity generation efficiency of approximately 10 per cent compared to these components used individually.

Concentrating solar technologies present the option of generating electricity in an economical and environmentally friendly manner on a large scale, as well as the potential to provide hydrogen in the longer term. Not least the DESERTEC industrial initiative has been internationally publicising this technology and its potential since 2009. DLR covers a broad technical spectrum in this field, from optimising the current parabolic trough technology to new designs for solar towers with innovative energy generation techniques.

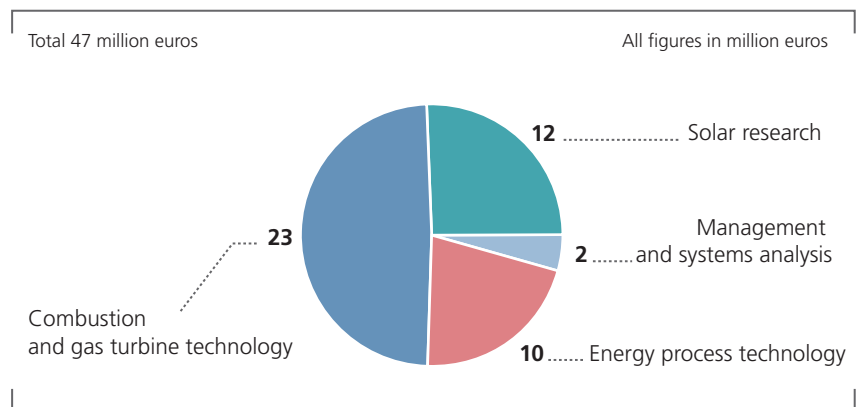
The growing proportion of renewable energies in energy supplies is drastically increasing the need for storage. DLR has for years been working on developing high-temperature heat storage devices for a wide range of uses in solar thermal processes and energy-intensive industries. Chemical storage devices are being developed on the one hand based on solar hydrogen generation, on the other hand by exploring reversible chemical reactions that may have potential uses in low-loss storage.

Expertise in electrochemistry acquired through working on fuel cells has recently also been used to develop high-

Energy: revenue in million euros

	2009 Actual	2010 Planned	2011 Planned
Basic funding	22	20	20
Third-party funding	37	27	37
Overall revenue	59	47	57

Expected revenue for the year 2010



performance batteries on a lithium basis. Finally, cross-disciplinary systems analysis aids the provision of policy advisory services and underpins the thematic orientation of energy research in DLR and in the Helmholtz Association.

In 2010, three topics were newly identified that are currently being examined for their potential: firstly the use of aerodynamic, aeroacoustic and structural mechanical knowledge gained in aeronautics to optimise wind power plants; secondly the use of cyclical processes to generate energy from low-temperature heat; and thirdly the development of robust and versatile aerogels as highly effective insulation materials.



Defence and Security Research

The Defence and Security programme of the German Aerospace Center plans and controls research and development activities relating to defence and security in coordination with partners from government, academia and industry. Defence and Security is an interdisciplinary remit that comprises all activities of the Aeronautics, Space, Energy and Transport programs in terms of their security-relevant utilisation. It covers both innovative organisational concepts and corresponding strategies for

action, focusing on multi- and interdisciplinary projects that connect the research areas of DLR. In the course of these projects DLR contributes to developing, testing and evaluating technologies and to assessing and consulting on security-relevant applications with the aim of supporting and protecting people. DLR is active for example in the areas of airport security (Aeronautics/Transport), satellite based crisis management (Space), decentralised energy supply (Energy) and in transportation management for large-scale public events and disasters (Transport), to each of which DLR brings expertise in significant system areas such as Earth observation, robotics and communications. The following results are examples from the Security and Defence programme that were achieved in the previous year.

UCAV-2010

Technologies for highly agile partially and fully autonomous aircraft

Highly agile uncrewed aircraft are already an indispensable component of military scenarios, and gaining increasing importance in civil security. The future tasks of partially and fully autonomous aircraft are diverse and range from monitoring critical infrastructures to autonomous exploration and reconnaissance missions. In addition to challenges relating to autonomous flight and partially autonomous flight with other crewed systems in controlled airspace, the development of the platform itself places highest demands on a number of aeronautics disciplines. On the UCAV-2010 project DLR is contributing to designing, analysing and evaluating the handling qualities and configurative properties of highly agile partially and fully autonomous aircraft.

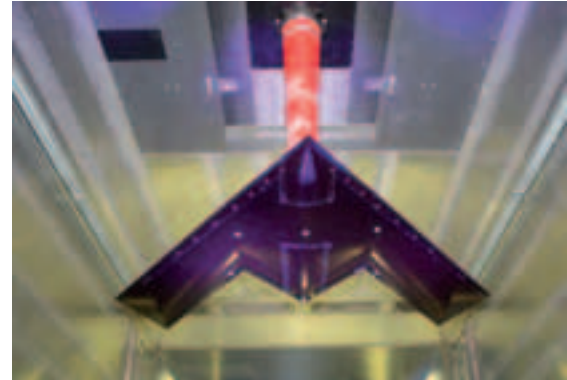
In particular, DLR has enhanced the preliminary design processes of a multi-disciplinary simulation environment for highly agile partially and fully autonomous aircraft. Its main focus was on validating multi-disciplinary methods for simulating aerodynamics and the structural behaviour of flying wing configurations with the aim of achieving a compromise between high agility and long flight times. A further key area of activity was designing adapted propulsion concepts and alternative control concepts. Technologies considered crucial to the design of such configurations are those that affect radar or infrared signatures. An adapted shape can for example render the aircraft almost undetectable by radar. In addition, radar and infrared signatures influence the choice of structural properties for the outer skin. Extensive aerodynamic experimental tests were carried out in order to better understand flow physics and aerodynamic behaviour. Basic research into alternative control concepts and engine intake aerodynamics completed the project's range of

tasks, which will contribute to allowing partially and fully autonomous aircraft to be operated highly agilely and with minimal signatures in future.

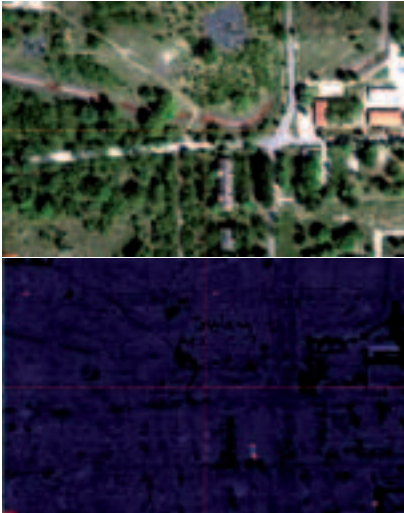
Hyperspectral Remote Sensing

Detecting booby traps and contamination

Landmines and booby traps represent a danger to life and limb not only of soldiers, but also of the civilian population. In the last 30 years, landmines have caused the death of approximately one million people, 80% of whom were civilians who often fell victim to these mines only after the conflict had ended. In a joint project with the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation, the Department of Optical Information Systems at the DLR Institute for Robotics and Mechatronics has developed camera systems featuring innovative automated image evaluation processes that can be used to explore material properties in overflight and thus to detect landmines and booby traps, but also to discover contaminations of the Earth's surface.



Experimental examination of the DLR-F17 configuration in DNW-NWB



Test area (high-resolution, top) and objects identified by means of automated image evaluation processes (bottom)

Camera sensors can record material-specific properties of liquids or solid bodies in many ranges of the optical spectrum. Typical applications today are the recording of oil spills on ocean surfaces by aircraft or the search for important mineral resources (for example precious metals) in remote areas of the Earth by means of satellites. Sensors that use very many spectral ranges on the optical spectrum simultaneously – also known as hyperspectral systems or imaging spectrometers – are currently used in combination with other high-resolution optical matrix cameras in order to better identify objects from aircraft or helicopters for environmental and security-relevant applications. Detecting dangerous objects, such as landmines or booby traps, and discovering contaminations of the Earth's surface by hydrocarbons (e.g. oils or chemical solvents) are just a few examples of how hyperspectral systems can be employed to protect human beings. By pictorially recording and combining spectral channels from the visible to the mid-infrared range, imaging spectrometers capture spectral characteristics typical of certain materials that provide information on specific component substances (e.g. plastics or metal oxides), like a "fingerprint".

In the course of the project a test area was overflown by DLR with a sensor combination consisting of a camera system and a hyperspectral sensor, and the measured data subsequently evaluated. Contaminations of the Earth's surface with oil films and small objects made of plastic were identified by their typical spectral characteristics and then isolated in the image and classified using appropriate automatic image evaluation processes. Thanks to stereo evaluation, these high-resolution procedures are also suit-

able for creating 3-D representations, which are the next step to ensuring significantly further improved interpretation of the data.

Measuring the Volcanic Ash Cloud

Safe air travel

Following the eruption of the Eyjafjallajökull volcano in Iceland on 14 April 2010, the ash cloud drifting across Europe caused an extraordinarily extensive closure of European airspace. From 15 to 20 April 2010, 75% of European airspace was closed. In total, 10 million passengers were affected; more than 100,000 flights were cancelled in April and May 2010. A natural phenomenon and its consequences: experts estimate the damage to the European economy to be in the billions.

The rules of the International Civil Aviation Organisation (ICAO) require that flights through volcanic ash clouds generally be avoided. These rules have subsequently been amended to state that flights are permitted at ash concentrations under 2 mg per cubic metre. In order to support decision-makers in closing or partially opening airspace throughout Europe, the Institute of Atmospheric Physics at DLR carried out a total of 17 data collection flights with the DLR research aircraft Falcon 20 E in April and May 2010 on behalf of the Federal Ministry of Transport, Building and Urban Development, the German weather service Deutscher Wetterdienst and the German Airline Association. Both the Light Detection And Ranging (LIDAR) measuring system developed by DLR and in situ measuring equipment for measuring ash and gases from the volcano were used in the course of these data collection flights. The measurements

helped German and European aviation authorities assess the situation, served to review the model predictions of the Volcanic Ash Advisory Centre of the British National Weather Service and led to the adjustment of its input data regarding the ash emission rate at the volcano.

The evaluated measured data are now available for scientific research, and will also form the basis for decisions in the event of future volcanic eruptions. This improved basis for decision-making will allow economic damage to be kept to a minimum in future without endangering the safety of passengers.

Center for Satellite Based Crisis Information

Satellites help relief workers

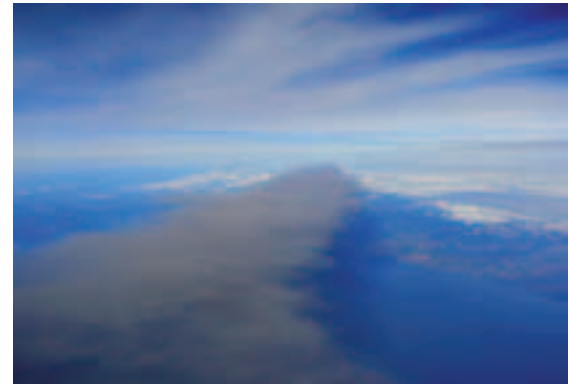
Due to the worldwide increase in natural disasters and crisis situations, the associated humanitarian relief efforts, and an ever expanding level of global networking, the need for timely and extremely precise disaster information is growing rapidly. This applies not only to emerging and developing countries, but also to highly developed industrial nations.

In applied research projects funded in the DLR Space and Transport programs, the German Aerospace Center develops methods and algorithms to quickly and efficiently utilise satellite image data and geo information to assist in crisis management and the provision of humanitarian aid. The aim of this work is to develop faster and better analyses and visualisations of crisis information for use in the day-to-day business of decision-makers and relief workers, and thus contribute significantly to civil security. Sat-

ellite data evaluations of this kind are used in a wide range of crisis management scenarios – for example in flooding situations, during forest fires, for recording and planning refugee camps, to manage large-scale public events, or for detecting drug cultivation or illegal diamond mines.

An example where current research issues and scientific work resulted in specific support for relief workers was the recording of earthquake damage in Haiti in January 2010. The DLR Center for Satellite Based Crisis Information (Zentrum für Satellitengestützte Kriseninformation, ZKI) in Oberpfaffenhofen supplied relief workers in the crisis area with emergency maps derived from satellite images and geo data, and thus directly helped save human lives. In addition, the maps provided by ZKI were used to optimise logistics on the ground and to enable the rapid transport of people, materials and relief goods.

DLR is constantly expanding the field of satellite based crisis information in a wide range of project activities with the aim of enabling up-to-date satellite analysis and precise evaluation of the situation for any type of disaster or crisis only 24 hours after an alert. A technological challenge of this magnitude necessitates research and development work on all partial aspects of the alert, satellite recording and analysis chain. In future, DLR will continue to strive to combine current research and development work with data evaluation and the provision of up-to-date information.



Volcanic ash cloud from Eyjafjallajökull



Rapid damage assessment based on emergency maps derived from satellite data; here: Haiti 2010

Project Management Agency

Project Management Agency for Aeronautics Research

Long-term funding of aeronautics research

The Project Management Agency for Aeronautics Research (PT-LF) supports the Federal Ministry of Economics and Technology (BMWi) in implementing the federal Aeronautics Research Program (LuFO), as well as providing support to the states of Bavaria, Hamburg, Brandenburg and Rhineland-Palatinate in running their own development programs and projects to complement the federal program.

With its third call for proposals for the fourth Aeronautics Research Program (LuFo IV), the Federal Government has

further intensified its commitment to civil aviation research, which had already increased significantly in recent years.

With additionally assigned funds of 140 million euros from 2010 to 2013, LuFo IV has now reached a total volume of just under 600 million euros. During the reporting period, all projects submitted under the third call for proposals to LuFo IV began on schedule. In 2009, a total of 128 new federal technology projects were launched in addition to the approximately 400 ongoing projects at federal and state level.

Through this program, the Federal Government is providing a stable basis for sustainable research in the aeronautics sector and enabling industry, large-scale research facilities and higher education institutions to continue urgently required research work in a currently difficult economic climate. As a result of the economic crisis, which also affected the major players in the aviation industry during the reporting period, no significant new research activities were launched. With the beginning economic recovery, sufficient resources will again become available to the research partners to take up new lines of development.

Like the Federal Government, the federal states were also able to stabilise their efforts in the area of aeronautics research during the crisis. The increase in funding from the federal states planned for the coming years is expected to remain untouched by the effects of the crisis. PT-LF manages the vast majority of regional aeronautics research activities. In the federal states of Bavaria, Brandenburg, Hamburg, Lower Saxony and Rhineland-Palatinate, a total of 80 projects were funded by PT-LF in 2009.

The aeronautics research activities of the Federal Government and the federal states are integrated into the European Framework Programme for Research and Technological Development. In order to ensure coordinated activities at regional, national and European levels, PT-LF has on behalf of the Federal Ministry of Economics and Technology assumed the role of national point of contact for the field of aeronautics research in the 7th EU Framework Programme for Research and Technological Development.

Due to the technological skills acquired through the federal and state aeronautics research programs, German companies and research institutions are highly sought-after partners in European research consortia. It was therefore possible to maintain the high return flow of funds from the European Framework Programme to Germany at over 20% at the beginning of the 7th Framework Programme for Research and Technological Development.

A contributing factor was the ERANet "AirTN-Air Transport Net" EU project managed by PT-LF as a coordinator, where initial cross-border research associations have meanwhile been formed in order to specifically combine expertise from the various member states and make it mutually available in the respective national programs. The coordination of national programs and funding mechanisms has also met with great interest

**Project Management Agency for Aeronautics Research:
revenue and funding volume in million euros**

	2009 Actual	2010 Planned	2011 Planned
Revenue			
Third-party funding	3	4	4
Funding volume			
Federal Ministry of Economics and Technology	90	126	136
Ministry of Economics of the Free State of Bavaria	8	10	10
Ministry of Economics Brandenburg	5	5	5
Ministry of Economics Hamburg	9	5	3
Ministry of Economics Lower Saxony	25	25	25

outside AirTN. Due to the successful first phase of AirTN, a second phase with now 28 partners from 18 European countries has meanwhile been initiated. As the research activities of our European partners have also significantly increased in recent years, effective coordination of national research efforts is becoming increasingly important. The aim of AirTN is to develop the funding mechanisms necessary for this purpose.

As Project Management Agency for the Federal Ministry of Economics and Technology, PT-LF has been able to further extend its central role as a service provider and source of knowledge in the area of aeronautics research at EU, national and regional levels and is therefore in a position to support the Federal Ministry of Economics and Technology in its efforts to provide coordinated and efficient support for aeronautics research in Germany and to prevent duplicate funding. This special role is unique among comparable institutions in the European partner countries.

Funding planning: revenues in million euros

	2009 Actual	2010 Target	2011 Planned
Third-party funding*	62	69	74
of which project management tasks	33	38	41
of which special projects	29	31	33
Funding volume	795	987	1,000

* without Profi

Project Management Agency in DLR

The Project Management Agency in DLR, PT-DLR for short, has positioned itself as a specialist provider of services in the areas of research and education funding and research management. PT-DLR operates at both national and international levels. Its clients include the Federal Ministry of Education and Research, the Federal Ministry of Economics and Technology, the Federal Ministry of Health, the Federal Ministry of Family Affairs, Senior Citizens, Women and Youth, the EU Commission, numerous state ministries and various private entities. At the end of 2009, PT-DLR employed approximately 750 people and managed ap-

proximately 795 million euros in research funding, added to which were further funds from a number of special projects; this represents an increase of approximately 10% compared to the previous year. Plans for 2010 and 2011 project further significant increases; whether these are realistic ultimately depend on whether the currently planned developments in government spending for education and research are actually implemented.

The range of subjects represented by PT-DLR portfolio is extraordinarily broad and covers the majority of today's most important scientific and technological areas of interest as well as education. They include health research, environmental research, sustainability research, information technology, new media in the economy, research into the development of work and services, education research and gender research. The Project Management Agency also incorporates the national contact points for EU programs and the European research initiatives COST and EUREKA, as well as the EU Bureau of the Federal Ministry for Education and Research (BMBF). The International Bureau of the BMBF at PT-DLR oversees international cooperation in research and education throughout the world. The Public Auditors of the Federal Ministry of Education and Research for projects co-financed by the ESF is also part of the Project Management Agency. Due to its many years of experience in the areas of research and education funding as well as project management, PT-DLR maintains excellent contacts with research agencies and institutions, professional committees and proven experts in the national and international research community.

In 2009, PT-DLR was again able to strengthen its position as Germany's largest project management agency for research, development, education and innovation and successfully expand its

teams in all funded areas. The DLR teams provide technical and specialist expertise in order to support their respective clients in making Germany fit for innovation. They do the same at international and EU levels, as both the internationalisation strategy of the Federal Ministry of Education and Research and the significance of the European dimension for Germany have substantially gained in importance in the last year. Examples include the year of the German EUREKA Presidency and the preparations for the new EU Framework Programme for Research and Technological Development with many new instruments and key areas. The support that PT-DLR has provided and will continue to provide for the High-Tech Strategy of the Federal Government and the various comprehensive programs in education goes almost without mentioning. That this often involves breaking new ground, be it in the form of Excellence Clusters or by collaborating with foundations on the "Local Learning" initiative, has presented significant challenges to PT-DLR, as has the "marketing" of education offerings and research results in all fields of research. It should further be noted that following its successful organisation of "Year of Science 2009 – Research Expedition Germany", PT-DLR has received a further follow-on request from the Federal Ministry of Education and Research and is organising the "Year of Science 2010 – The Future of Energy".

A detailed description of PT-DLR programs and our work can be found in our annual report for 2009, available from www.pt-dlr.de under "Service & Links/Publications" (German only).

Allocation of budget resources 2009 in thousand euros

	Number of projects (2009)	2009 in th. euros
Health Research/Human Genome Research	1,873	241,000
Information Technology	1,446	200,800
Environment, Culture, Sustainability	1,290	122,400
New Media in the Economy	383	75,000
Development of Work and Services*	708	43,300
Humanities and Social Sciences	264	32,200
Integration*	172	19,800
Empirical Education Research	197	19,200
International Bureau	7	15,900
New Media in Education*	212	14,800
Gender and Equality	243	12,800
Education Research*	61	8,000
Innovation-oriented Research	32	6,500
Years of Science Bureau	24	5,800
Eurostars	42	3,500
Total	6,954	821,000

* Co-financed with funding from ESF (European Social Fund)



JAHRSHAUPTVERSAMMLUNG
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DLR Deutsche für Luft-
2009

DLR



ECONOMIC DEVELOPMENT



Future Development of DLR

Last year, prompted by the Executive Board, discussion took place with employees from all levels of DLR concerning DLR general focus and technical strategies. The in-house view was broadened through interviews with representatives from other research bodies, ministries and industry, a process resulting in a harmonised general focus. The objective over the next few years will be to implement the strategic objectives posted, pursuing their achievement via results-oriented criteria. The following nine strategic objectives are to be pursued for 2010 and thereafter. The key strategic goal is fulfilment of the high requirement for quality and excellence in all areas of DLR. The flow of information between all sites will be improved through enhanced horizontal communication within DLR. DLR collaboration in training programs and study courses will

be made possible by the contribution of specialist skills to the world of universities. The introduction of consistent principles for central processes will promote reproducibility in processes and structures, thus facilitating efficiency gains. Through operational support and the provision of appropriate infrastructure DLR can influence research beyond its own facilities. DLR will in the future increasingly strengthen its position as a source of technology in business thanks to active technology marketing and knowledge transfer. The optimisation of internal cycles should make the balance between research and ancillary processes possible. It is our intention to promote DLR driving and shaping role in its main centers of interest by virtue of its intended proactive role in the forming of national and international networks.

Parallel with discussion of the general focus, strategic goals for individual focuses will be developed. The evaluation of individual components of the programme for the process of programme-oriented support under the umbrella of the Helmholtz Association have been supplemented by investigation into the research portfolio in conjunction with the Federal Ministry of Economics and Technology (BMWi) and other external research and industry bodies. New topics have been identified whose financing for coming years has to be clarified.

Third-party Funding

There was a further considerable increase in 2009 in revenue from third-party funded projects for the core process of research & development (third-party revenues). With an increase of 73 million euros compared to 2008, third-party revenues reached a record level of 381 million euros. This makes the third-party share of overall proceeds 49%, and as such it remains approximately at the previous year's level. The reason was the parallel increase in institutional support occurring in 2009, by virtue of special financing from BMWi, the effects of Economic Stimulus Package I and the funding for the Bremen site.

Essentially it can be said that in the overall picture almost every sponsor contributed to the increase in third-party revenue. Thus in the case of direct Federal project funding for example, a significant new increase can be observed. For example we would cite the 6.9 million euros increase in support from BMWi, of which the main beneficiaries were projects from the ongoing aerospace research programme (Lufo IV), together with larger spaceflight projects such as EnMap. In the case of the Federal Ministry for Education and Research (BMBF), it has been possible especially to increase the number of newly launched projects. Speaking of direct project funding from regional authorities, overall there has been a slight downturn; however, in some regions such as Lower Saxony and North Rhine-Westfalia, a significant increase over the previous year is seen.

Revenue from public projects has also generally increased, together with the revenue from projects with both domestic and foreign commercial companies. Profitability from domestic financial proceeds of R&D activities was at 12%. Proceeds from foreign clients (revenue volume) made a 25% contribution to the final result, representing a 4% increase on the previous year. Income from ESA

Third-party funding	2007	2008	2009
Total third-party revenue	€ 294 M	€ 308 M	€ 381 M
Growth in profitability compared to previous year, domestic commercial revenue from R&D activity	26%	11%	12%
Proportion of overall revenue from third-party sources	52%	51%	49%
Proportion of revenue from foreign clients (volume of revenue)	22%	21%	25%
Success rate for EU applications over last three years (accepted/ submitted)	47%	46%	37%
Revenue from EU funding	€ 19,9 M	€ 19,7 M	€ 21,7 M
Co-ordinator/total ratio (EU projects)	13%	14%	22%

projects more than doubled relative to the previous year, increasing by 21.6 million euros to the present level of 39.6 million euros. The two largest projects are Galileo, at 16.6 million euros and the test rigs in Lampoldshausen at 6.7 million euros, together with further major projects from the CAF cluster and space operations.

The average success rate in EU projects over the last three years at 37% shows a 9% downturn relative to the previous year. The number of new applications in 2009 remained at the level of previous years, but the number of commissions/awards fell by around 40. Revenue however remained at a sustained, high level compared with previous years and once again rose by some 2 million euros to 21.7 million euros.

There was a 22% increase in the ratio between EU co-ordinator projects and the total volume of EU projects, accompanied by a decline in the number of projects ongoing in 2009. During the same period however it was possible to achieve an increase in the number of co-ordinator projects.

Research-related results	2007	2008	2009
Publications in referred journals	511	442	577
Referred publications in proceedings, books etc.	568	593	460
Presentations to scientific conferences, workshops, lectures*	1,639	1,634	1,688
Appointments to universities	13	12	13
Lectureships	204	248	244
Diploma projects	326	384	396
PhD theses	83	94	105
Postdoctoral qualifications	4	2	4

* per scientific associate engaged by the institutes and facilities

Technology Marketing

The political, social and industrial goals of domestic and international innovation policies, with the associated strengthening of technology transfer from publicly-funded research & development, are increasingly being reinforced in the longer term as a significant success factor in the competitiveness of the domestic economy. Shortening the time-to-market of research results to market-ready products, processes or services is here a vital prerequisite. Through its outstanding research results and technological developments, DLR is able to provide complete value added chains that extend from basic 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 determining the requirements in every sector of the market, developing and implementing ideas by means of technology transfer projects, and turning DLR expertise into something of commercial benefit.

The main goals are collaboration with industry already at the "front end of innovation" in the generation of new product/service/process concepts and – based on these, and so aligned with demand – the development of DLR technologies for the deployment of products with partners from business and the acquisition of new customers, the management of property rights and support for company start-ups.

Research-Related Results

The quality of science is one of the most important criteria in the DLR Research Centre. Alongside the third-party funding procured, significant indicators of this are the scientific results made public in publications, presentations and courses. Their volume varies from year to year, attributable mainly to project work, staffing fluctuations and activities relating to proposals.

The appearance of a total of 1,037 referred publications in the reporting period means that for practical purposes there were precisely as many as in the previous year, with a noticeable increase however in the proportion of journal articles. The trend of many years towards an increasing number of completed diploma papers and PhD theses continues unabated.

In order to achieve this goal Technology Marketing had by the end of 2009 set up a comprehensive ideas management within DLR. This includes firstly software support, in the sense that all DLR employees can enter their own ideas at their workplaces which then are promptly assessed against transparent criteria and, if appropriate to industrial application, are easily implemented into corresponding development projects financed by Technology Marketing from the cross-transfer corridor. Secondly, Technology Marketing offers ideas workshops and, in collaboration with personnel development, continuous-training events on the topic of innovation.

Furthermore, the "strategic innovation partnerships" model has been further extended. This includes not only the acquisition of new partners but also intensification of collaboration with partners already in place in the sense of specific development projects having the goal of developing new products/services/processes in collaboration between research and industry, followed by easy transfer to the marketplace via the industrial partner.

Additionally, Technology Marketing initiated the "DLR innovation campaign" project. In this project, within the framework of implementation of DLR new overall strategy and its own in-house principles to improve DLR innovation performance, and also via an awareness-raising campaign and "face-to-face communications", the profile of DLR as a technology provider for business has been raised and reinforced.

DLR Technology Marketing was re-certified to DIN EN ISO 9001:2008 in April 2009.

Examples of successful Technology Marketing

In the "AWFS II + III" projects, the "FireWatch" ground-based forest fire early warning system – which is marketed by IQ Wireless GmbH and can already claim 190 installations in Europe – was extended to include night-time fire detection, and work on the possibilities of extension to applications in mountainous areas with no sight line to the horizon is currently underway. These further developments have strengthened the position of IQ Wireless in the marketplace, enabling its industrial partner to install over a hundred more systems in Europe and worldwide and bringing corresponding licence revenues for DLR.

A small fuel cell system for the mains-independent operation of pallet strapping machines has been developed in conjunction with ERGOPACK GmbH, the global market leader in these machines. A similar system derived from DLR patents is marketed by DMT produktentwicklung AG as a stand-alone unit. Cooperation/licensing agreements are in place with both companies.

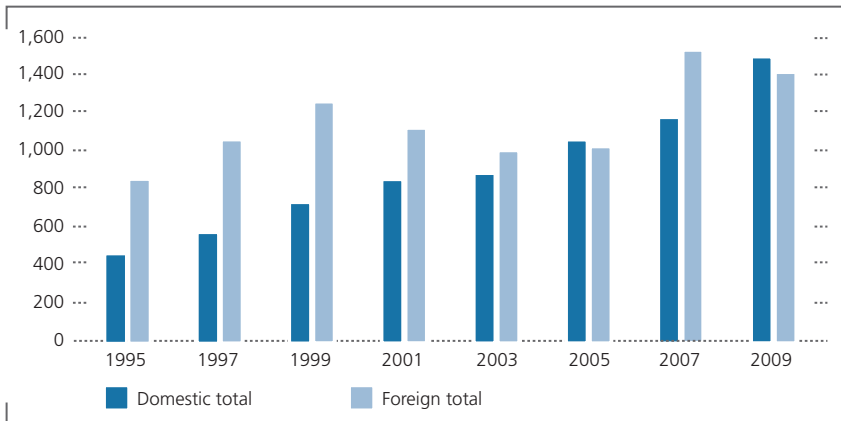
In the VECTOR21 project, in collaboration with Deutsche Post DHL – a strategic innovation partner – there has been technical/economic evaluation of vehicle models against DLR VECTOR21 model, and scenarios were evaluated for selected vehicles from DHL's fleet. The goal of the project was to adapt the VECTOR21 vehicle technology scenario model for the prospective evaluation of a logistics

company's vehicle fleets, taking as an example selected and representative DHL fleet vehicles, in order to optimise costs and cut the fleet's CO₂ emissions subject to prevalent conditions.

A follow-up project is planned in light of the quality of results and their benefits to DHL.

Under the "DMT" transfer project, a disaster management tool is being developed. DMT is an integrated position and guidance system for international disaster rescue teams. Users benefit from the bringing together of satellite communication, navigation and earth observation with real-time access to up-to-date geoinformation and technical data on the local infrastructure.

Proprietary rights in Germany and abroad



DMT represents practical structures and processes in European crisis management in a framework of input screens enabling procedures to be standardised, simplified and accelerated should a mission arise. A decisive advantage compared with a conventional GIS (Geo-Information System) is the simplicity of operation by assessment experts who have no in-depth IT background, and who are provided with a tailor-made and authoritative tool.

The system's uniqueness is based on DLR core skills: DMT brings together into a single integrated solution the three core elements of communications, navigation and satellite-based earth observation. At the same time the instrument is compact and modular, operates autonomously in the field and may be flexibly expanded for additional tasks and wider user groups.

Proprietary rights

In the field of "Proprietary rights and licenses" DLR portfolio of proprietary rights is being expanded and looked after, and covers all commercial marketing agreements including the granting of licences. DLR stock of proprietary rights now numbers just under 2,900 (domestic and foreign patent registration and patents including EP and PCT registrations), the highest level ever attained in the history of DLR. With 225 registrations in 2009, around 20% more invention disclosures were submitted than in the previous year.

The graphic shows how the number of domestic proprietary rights has been rising continually over several years, now standing at just under 1,500 (patents, utility models and their registrations).

Each year the German Patent and Trademark Office publishes a list of the 50 most active patent applicants in Germany, and in 2009 – as in the previous year – DLR held 28th place. The only other research body to appear on this list is the Fraunhofer Society in Munich (in position 13). The most active patent applicants are Bosch in first place (with 3,213 patent registrations) and Daimler in second (with 1,756 patent registrations). If however you look at these figures in terms of the number of people employed by the above, a completely different story emerges: seen this way, DLR (with around 5,000 employees in R&D) registered one patent per 29 employees, whilst Fraunhofer (with some 15,000 employees) registered only one per 37 employees. This ratio must surely count as evidence that DLR has the capability to significantly further the state of technology in its research areas.



Licenses

The granting of licences in 2009 resulted in a turnover of around 3.9 million euros, putting income from licensing at the level of the previous year.

Company start-ups

Technology Marketing supports spin-off companies originating from DLR institutes and facilities. Employees keen to establish a start-up are prepared for independence with appropriate advice on technology selection and maturation, partly through projects from the technology transfer fund, and receive help in developing their business plan. With these young companies, DLR secures market access for its technology. The companies are set up with licenses to use the technology, and create applications in the form of profitable products or services which, in addition to the licensing income expected in the long-term, may also in the short term produce third-party income for the respective institutes through R&D commissions.

Support from institutes is provided through the targeted commissioning (by Technology Marketing) of services, accelerating technology transfer from research to companies under the corresponding development projects.

For commercial added value these small start-ups represent an important stage in the innovation process, since such innovations are only of interest to large companies once risks have been clarified and the market sounded out. From the industry's viewpoint, stakes in such companies represent investments in a technology in which they are collaborating or in which they may subsequently acquire a majority share.

This support system – in addition to the pure commercial impact on DLR business activity – represents an attractive career option for the employees involved. Both the entrepreneurial activity and collaboration with a new company based on DLR technology represent a forward-looking basis for career development, particularly from the viewpoint of staff on a fixed term employment contract.

Companies have the option of obtaining financing from the high-tech start-up fund, which was set up to provide financing for companies via the BMWi and big name companies. Also private stakeholding options are made available increasingly. The Kreditanstalt für Wiederaufbau (Reconstruction Loan Bank) and regional funds from Landesbanken (state banks) also maintain financing options for the mentioned companies.

Technology Marketing supports DLR institutes and facilities in the compilation of business plans and the preparation of proposals and, together with the Legal department, the structuring of contracts with these companies covering collaborative work and licensing issues. DLR takes holdings in companies whose activity extends the scope for application of DLR research outcomes and so strengthens research activity into a given topic, or opens up further knowledge regarding the scope of applications of these outcomes in other fields. Thus for example in materials research from industrial applications, experience has been gathered concerning the damage characteristics of materials that require extensive qualification processes for their approval in high-performance aerospace applications

which just go along with industrial applications. Through these companies' activities DLR can access new knowledge, such as in the field of medical technology, which lies outside DLR main research activity. In this way both sides benefit from the synergy, with technology transferring into DLR as well.

In the 2009 business year two further companies were founded that were built on the basis of DLR technology. The development of companies founded in recent years has been monitored; they collaborate closely with the institutes as the technology continues to develop, allowing them to also expand their fields of operation.



Structure and Organisation

Development of the Research Centre

Administrative infrastructure

An external evaluation of DLR Administrative and Technical Infrastructure (ATI) was conducted in November 2009. The evaluation was in two parts: the evaluation of Administrative infrastructure (AI), whose results are described below, and evaluation of the technical infrastructure (please see the Technical Infrastructure Report). The main issues for the evaluation of administrative infrastructure were:

- Implementation of goals and strategies
- Improvement of effectiveness of commercial process management
- Appropriately matching commercial information systems to internal customer requirements (institutes/facilities).
- Managing the development of project tasks; procurement; planning & management of resources and management of personnel.

The assessors (information on the assessors can be found in the Management Report of the 87th Senate meeting) drew a positive conclusion from their assessment of the Administrative infrastructure. They regard AI as having overall moved closer toward being a successful process company.

- The implementation of DLR strategy via employee goals and projects within AI is both strict and transparent.
- Actions are aligned to goals.
- The principle of profitability is pursued.
- Customer and employee alignment is clear. Customer and employee satisfaction is regularly surveyed.
- Processes are well matured.
- Great emphasis is placed on thinking in processes, which can be seen as exemplary compared with others. Further development since the previous evaluation is clearly discernible.

The Administrative infrastructure is proactive in its role as service-provider. Service philosophy is based on a high degree of customer alignment. The guidelines of AI, which are specifically formulated for both senior management and employees, come from both sides.

In addition to overall assessment the 2009 evaluation provided useful information on the further development of the processes and business information systems. These were evaluated by the process owners and those responsible for the business information systems, and are now being implemented.

The consensus and the positive input impressively underline the practical value of the AI process model, which is further backed-up by the 4% saving of AI costs relative to DLR overall financing.

For some years AI has employed the EFQM self-evaluation model for improving processes and organisation. This positioning within the framework of the continuous improvement process should now be supplemented by external assessment.

Thus in 2010 AI is to submit itself to external assessment in competition with other organisations under the Ludwig-Erhard award initiative. The Ludwig-Erhard award stands as a recognised national distinction for the proven sustainable excellence and competitiveness of companies and organisations. Applications are submitted in May and on-site assessments take place in September.

The success of administrative processes is built not only on innovative ideas in process management but also, to a significant extent, on qualified and highly-motivated employees who shape and successfully implement processes.

Technical Services

A major milestone was achieved by Technical Infrastructure (TI) with the assessment at DLR Oberpfaffenhofen site from 16th to 20th November 2009, which was conducted jointly with Administrative Infrastructure. The evaluation produced valuable indicators from in-house and external assessors and led to a comprehensive appraisal of their performance capability.

The focal points for TI's evaluation were the development of goals & strategies and the further development of the supporting processes of "Developing and realising technical systems" and "Facilities management" in the context of a comprehensive management system. The presentation of the newly formed "Facilities Management" process had particularly high priority for TI, since this process is the basis for the first comprehensive life cycle study of buildings and plants within DLR. In their conclusions the assessors confirmed that for the support processes examined, the prerequisites for working towards common goals had been created and that there was recognisable adherence to customer alignment and enhancement of effectiveness & efficiency, and that further development of the management system was on a well-planned, future-proof basis, specific to DLR. In respect of both processes, the assessors attached great significance to customer communications and customer alignment. Consequently they recommend regular measurement of customer satisfaction.

On the basis of the assessors' consensus and decision by the proper commercial management, structural changes have been implemented within Technical Infrastructure since February 2010. In this context the transfer is taking place of all facility management functions – both buildings-related and non-buildings-related - into a centrally responsible and co-ordinated process organisation. DLR FM (Facility Management) comprises the provision for institutes and facilities of building services and material/site related services, so contributing towards the efficiency and productivity of research operations within DLR. Wider challenges include the ever-faster changing requirements, both internally and externally, for efficient facility management within DLR. Currently, all facility management functions are being transferred into an integrated, life-cycle oriented facility management process: Economic Development > Structure and Organisation. Since the

beginning of 2010 the "Facility Management" process, which is aligned to properties' life cycles, has been part of Technical Services and is integrated into a property management function.

The goal is to extend the scope of application of the existing integrated Technical Services management system to processes in the field of property management. This includes quality and environmental management to DIN ISO 9001 and 14001 and supplementary tools & methods such as the Balanced Scorecard and EFQM. Technical Services have extended their integrated management system, which was re-certified in March 2010, in terms of methods and functionality. The goal-definition process and the scorecard system had been structured according to the Balanced Scorecard (BSC), and the management assessment (review) to ISO 9001 and 14001 was based on the quantified nine-criterion report from the EFQM model (European Foundation for Quality Management). Improvements ascertained from the 2009 EFQM self-assessment are now being flowed incrementally into the management system. The continuous improvement process (which has the German-language acronym KVP) had been extended to all areas of Technical Services in 2009, with the introduction of a fault-reporting system including reporting of accidents and environmental damage.

A further change in Facility Management relates to the bundling of responsibility, decision-making and resources. This is a prerequisite for rapid and customer-aligned implementation of requirements and is achieved by the introduction of the "Contact person model" within a regional structure, enabling to establish contacts having decision-making abilities and responsibilities for, the resources at all regional and site levels. This culmi-

nates in faster and better fulfilment of customers' requirements and the more efficient use of resources, since decision-making processes are reduced. The inclusion of employees and customers into the change process is here an important prerequisite for successful implementation.

As for 2009 there were around 230 employees in Technical Services, this figure rising in 2010 to around 480 as property management functions were taken over. The main Building Management Department workforce was increased in 2009 and 2010 to be able to handle the sharp increase in building work. The further training of particular target groups, such as new talent representing up-and-coming management, continues to attract high priority.

Contingent on government economic stimulus programmes special funds were also made available to Technical Services within DLR, which are to be used promptly. Under the Federal government's "Fundamental and energy remediation of buildings" subsidiary programme within Economic Stimulus Package II, there are grant awards for 2 small and 2 major building programs subject to the milestone procedure (<0.3 or > 4 million euros). In a further step DLR achieved the deadlines, but no notification has yet been received. Rejections have been received concerning seven building programs allocated under the first-come first-served process (> 0.3 < 4 million euros). The other five programs are on the waiting list.

Financial strategy is steered by the goals of DLR, by customers' requirements and by the strategic objectives of a Technical Services. Since 2007, the main Technical Systems Building has functioned as a profit center with 'mid-term result planning. Building management and DLR Safety are managed via corridor planning (planning of costs of personnel and overheads). In all three areas, controlling is done by reporting and annual accounts. The IT tool described as the building monitor for control and supervision, and also for overall planning of all building programs within DLR, is still being developed in 2010 and will evolve from the prototype version into an operational system within DLR IT landscape. DLR building management holds great respect to use environmental and resource friendly technologies for creation of new buildings and in the context of extensive repairs. In 2010, the bonus/penalty point rule has been used in building management in which an important consideration is the establishment of a costing framework.

In Technical Services, consumptions and costs are allocated specifically to originators and users. This is optimised through the use of new, customer-aligned energy-saving technologies. An important example of the use of highly innovative technologies is the Rapid Prototyping production process, introduced in the Technical Systems Building in 2009 following consultation with customers. By

simultaneous cutting of components this reduces production times and enhances precision, and offers an expanded range of capabilities for very complex components.

An IT tool has been developed for the Technical Systems Building, in collaboration with Berlin's Beuth University, for the management of tasks with respect to timeframe, quality and costs.

Risk management with respect to the financial resources of Technical Services is embedded within DLR overall risk management. Consistent resource management for the whole of Technical Services is still practised.

Science competitions within DLR

Work by the winners of the third round of the "Visionary Projects" had begun in January 2009 and will be completed in the first quarter of 2011. The competition was commissioned by the Executive Board of DLR and is directed at all employees, with young researchers in particular to be encouraged to present their innovative and inventive ideas for the technologies of the future. In January 2009 the best nine were selected from a pool of around 50, including the energy topic "Fuel from the Sun", the material topic "Agents in resin" and the propulsion topic "Laser drives in space". These topics are currently sponsored with 90,000 euros/year for 2 years. Six more are receiving smaller funding of 10,000 euros/year for two years. After these two years of funding, researchers will present their results to the Management.

The topic of "Satellite navigation" was selected in the second DLR in-house science competition "DLR-Center of Excellence

2010 – 2012" (DLR-CoE). Within the CoE competition, services are assessed that have already been provided over the last three years. This competition was also commissioned by the Executive Board. The distinction of "DLR-Center of Excellence" carries a grant of 500,000 euros over three years. The topic receiving this year's award was particularly distinguished by numerous publications and the active training of diploma and doctorate candidates, it was possible, as a partner recognised worldwide in science and industry at the same time, to acquire third-party funds with corresponding expansion in applied skills. This shows very clearly (shows) the bridging function DLR performs between university research and industrial applications.

Two of the DLR Centers of Excellence that had already been running for three years underwent internal evaluation in 2009. By virtue of the positive results and achievement of goals, funding for these two DLR Center of Excellence awards – "SURFACE - Schicht- und Oberflächentechnologien für fortschrittliche Anwendungen im Hochtemperaturbereich von Luftfahrt bis Energie" (coating and surface technologies for advanced applications in high-temperature areas from aeronautics to energy") and "SAR – Advanced High-Resolution and 3D SAR Technologies and Applications" was extended until 2012 with funding in each case of 100,000 euros over three years. No further extension will be possible thereafter.

The "DLR-Center of Excellence" competition is commissioned annually and the selection for 2010 will be announced at the end of the year.

Quality Management, Standardisation and Environmental Protection

Quality management

Excellent scientific expertise, high third-party revenues and our growing number of employees are just some of the indicators for the success of DLR customer relations. DLR operates an integrated and established quality management system to support the senior management of DLR and to continue to successfully form and build upon their customer relations. The management process designed by the Executive Board's Quality Board provides the institutes and facilities with a framework that enables them to establish and operate their management systems independently. In March 2009 the management process was for the second time successfully re-certified to ISO 9001.

By the end of 2009 21 institutes and facilities had introduced quality management systems with a total of 25 certificates, some sector-specific. A further 11 institutes and facilities are in preparation. A growth against the period in the previous year has been achieved, with a 64% deployment rate (systems introduced and in preparation). Comprehensive (i.e. 100%) qualification for certification to the minimum ISO 9001 standard should be attained by 2013.

This fully integrated quality management system is one of the unique characteristics that sets DLR apart in the Helmholtz Association of German Research Centres.

The existing system is now being further developed into an integrated management system. As such, the quality management process is a driving force behind the establishment of the system,

Quality management	2007	2008	2009
Existing certifications & accreditations	19	25	28
Number of DLR auditors	15	15	10
Implementation of audit	29%	32%	38%

since it integrates environmental issues and occupational health and safety. DLR quality policy already combines quality, safety, environmental protection and sustainability. The DLR Code of Conduct lays down the principles of ethical behaviour for DLR and its partners.

The organisation of representatives within the Safety system has been integrated into DLR management system by means of a standing working group which reports to the standing working committee of quality representatives. Work is currently underway to define how to extend the quality management system to the aspects of safety and environmental protection. The corresponding quality-control processes for auditing within DLR are currently being developed. Since autumn 2009 DLR internal auditors have been qualified by training courses on audits in integrated management systems.

Individual subsystems are already in the process of development up to (and beyond) the ISO 9001 minimum standard, working toward sector-specific certificates such as EN 9100, ISO 14001 and ISO 27001.

The Quality Board has approved the top level of the DLR process landscape and integrated it into the framework system. The core processes are "Research and development in aeronautics, space, energy and transportation" and "Managing national astronautics activities" and "delivering services to support research and training." The leadership and support processes approved by Manage-

ment are mandatory. They are now to be incorporated by the facilities as component parts of the corresponding subsystems.

Within the Materials Testing Laboratory for Fire Behaviour at Trauen, in the Institute for Propulsion Technology, the JES 314 test rig was successfully certified in July 2009. The integrated management system within the Institute for Rocket Drives (quality, environmental and safety) was re-certified in August. The management system of the Cluster for Applied Remote Sensing was confirmed as part of the outcome of the second supervisory audit in October 2009. The simulation and software technology test laboratory has been accredited to DIN EN 17025. The re-certification audit to ISO 9001 and VDA 6.2 in the Institute of Transportation Systems and Vehicle Control in December 2009 was successful in both Brunswick and Berlin, as were the supervisory audits for the Institute for Flight Control and for the Space Agency's QM system. Administrative Infrastructure was successfully re-certified in December. In the period February to March 2010 the Institute of Aerospace Medicine in Hamburg and in Cologne, and the Space Operations Centre in Oberpfaffenhofen, Cologne and Weilheim, were re-certified. Within the framework of the supervisory audit for the facility, the Microgravity User Support Center in Cologne was included in the ISO 9001 certification. In March, there was confirmation of the second



Certifying authority supervisory audit of the management system focusing on transportation took place. The Technology Marketing supervisory audit took place in March 2010. The Gesellschaft für Raumfahrtanwendungen (GfR – Institute of Space Applications) was successfully certified for the first time in April.

DLR is a member of the European Foundation for Quality Management (EFQM). The EFQM assessor training offered in DLR internal training programme last year was found popular with DLR employees in the last year. This year DLR again participated with an assessor in selecting the winner of the 2009 Ludwig Erhard prize.

Activities focusing on business excellence are underway within five facilities actively operating a QM system. The first evaluations and assessments have provided good points of reference for further improvement of systems. Self-evaluation of the Administrative Infrastructure processes confirmed a high degree of maturity.

At DLR New Year reception in Berlin DLR quality prize was awarded for the seventh time to the quality officers of the Cluster for Applied Remote Sensing, to a project manager from the Institute of Flight Guidance and to the Quality and production safety manager of OHB-System AG in Bremen. Employees demon-

strating sufficient specialist knowledge and knowledge of the processes applicable within DLR have since September 2004 been appointed as DLR auditors. Caused to fluctuation the number of auditors has fallen to 10 Efforts are being made to significantly increase this number in order to achieve comprehensive, reciprocal monitoring within institutes and facilities. During the reporting period these auditors were able to achieve 38% of the planned system audits within DLR.

Revision of the procedure for ascertaining in-house and external customer satisfaction, and for integration of recommendations for project management with cross-facility collaboration into the project gateway, are still underway.

The standing working group of quality representatives is tasked with anchoring the identified procedures for quality assurance in scientific work into the management system.

Standardisation

Competent standardisation work as a strategic Management tool has achieved competitive advantages. One per cent of Germany's gross national product can be saved annually through standardisation measures, with an economic benefit amounting to around 16 million euros annually.

DLR actively collaborates in the authoritative standardisation organisations, such as DIN, CEN/CENELEC and ISO, at national, European and international level. Together with other spaceflight agencies in Europe and partners from European spaceflight industries, DLR is compiling consistent standards for spaceflight projects within the European and international associations of ECSS, CCSDS,

ESCC and IAQG. More than 300 standards and over 1,000 specifications have already been developed.

The "Innovation with Norms and Standards (INS)" project initiative launched in 2006 by the Federal Ministry of Economics and Technology was supplemented at the end of 2009 with the funding program "Transfer of research and development results (R&D) by normalisation and standardisation".

Standardisation of research results within DLR is carried out alongside research and development work at the various institutes and facilities, coordinated and supported by the Standardisation department.

The three standardisation projects approved by DIN in 2009 have been successfully completed. Project results have led to a proposal for an international ISO standard and a revision of a European EN standard used within DLR. The third project made apparent the need for standardisation, and its proposals for further standardisation projects are currently being evaluated.

For the 2010 project year DLR has received the go-ahead for four normalisation projects within the INS project:

- Expansion of up/downlink data structures in spaceflight for safety-related information;
- Lightweight construction for railway rolling stock;
- Qualification of optical components for concentrating solar power technologies;
- Optical communications technology for data downlinks from low-flying earth survey satellites.

Eight proposals for both project initiatives were submitted from DLR Space, Transport and Energy departments for the 2011 project year.

- Digital speech communication/voice data structures;
- Expansion of digital speech communications for ground stations in manned and unmanned spaceflight;
- Verification of spacecraft monitoring & control standards by a prototype;
- Identification of future needs for standardisation and research for the pan-European S-Band MSS system;
- Preparation of a standardised procedure for the concurrent engineering approach for national, European and international spaceflight projects;
- Definition of a test standard for the implementation of dynamic tests with angular projectiles to simulate stone/ballast strike on high-speed trains;
- Development of standards for the qualification of laser optics in spaceflight;
- Surveying and assessment of the surface form of mirror components for solar concentration technology;
- Jointing technologies for railway rolling stock.

Qualification of EEE components for spaceflight

EEE components comprise both active and passive electronic, electrical and electromagnetic components ("EEE") which during spaceflight are subject to particular demands on reliability, service life, vibration-resistance, radiation-resistance and temperature fluctuations and must be qualified accordingly. EEE components represent as much as 30% of the hardware costs for a spaceflight system. Sixty per cent of the strategic components whose functioning is key to performance capability and reliability of spaceflight equipment or systems are manufactured in the USA and subject to

US export restrictions. This leads to a significant constraint on the availability of EEE components in national space flight projects.

In a procedure harmonised at European level, DLR, within European Space Components Coordination (ESCC), is compiling joint standards and specifications for the qualification, procurement and use of EEE components in spaceflight. The specialist department for EEE component qualification defines and implements the national technology development and qualification programme for EEE components on behalf of DLR spaceflight agency. Components are developed and qualified together with national component manufacturers. Thus, in collaboration with European partners, it has been possible in recent years to reduce dependency on US exports from 70% to 60%. In order to increase the availability of EEE components, DLR collaborates with China, Russia and Japan, and promotes the qualification of commercial components within the framework of a national assembly and test house.

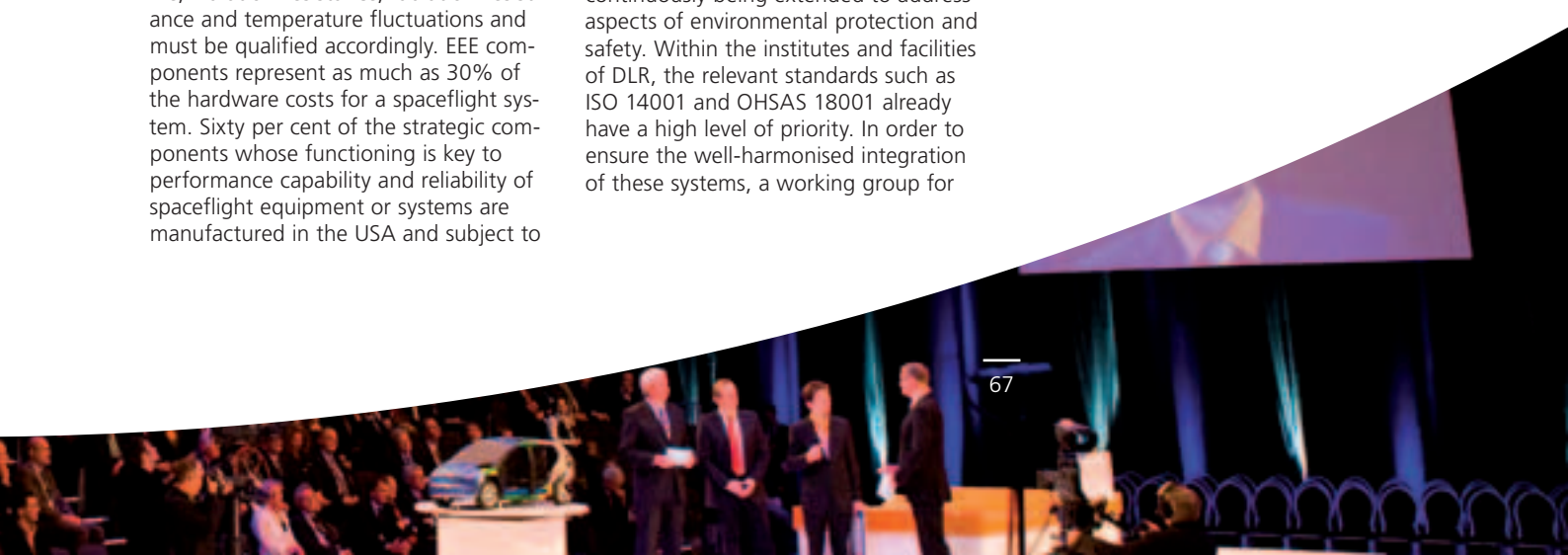
In 2010 DLR conducted nine evaluation and qualification projects in the EEE components department with a total budget of 2.5 million euros.

Environmental protection and safety

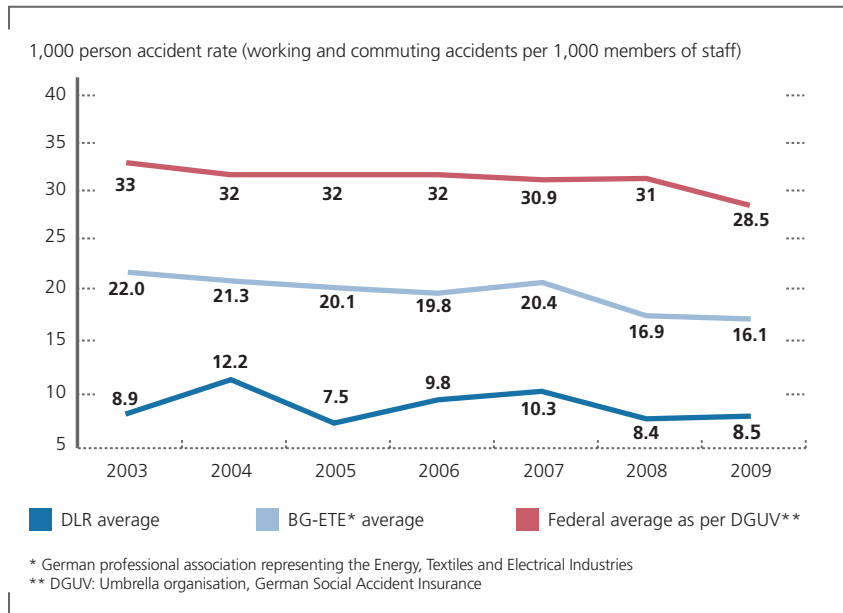
Among other interests, DLR researches environmental protection and safety: the sparing use of resources and protection of employees' health are high-priority goals in a research establishment that promotes sustainable operation such as DLR. DLR quality framework system is continuously being extended to address aspects of environmental protection and safety. Within the institutes and facilities of DLR, the relevant standards such as ISO 14001 and OHSAS 18001 already have a high level of priority. In order to ensure the well-harmonised integration of these systems, a working group for

the integrated management system has been established to train auditors for internal and external audits and to organise the implementation of audits with partners and suppliers. DLR Safety for the first time submitted itself for a special audit by the expert VDSI association (Verband deutscher Sicherheitsingenieure (Association of German Safety Engineers) e.V.), in the context of which the Association's own Gesellschaft für Qualität im Arbeitsschutz (GQA – Company for Quality In Industrial Safety) presented a professional report to the DLR Safety staff Department.

Alternative technologies are used at DLR and substances hazardous to the climate are avoided. In the field of energy production and recycling the focus is on low-CO₂ technologies, examples of which include the use of heat pumps and thermal insulation solutions in new and converted buildings that greatly surpass the legal guidelines. Energy-saving concepts have been initiated as part of the masterplan to reduce energy consumption within DLR. In its building activities DLR considers an holistic view of individual projects, and subsequent energy savings by the operator will, among other aspects, have already been addressed at the preliminary planning stage. Very high priority is given to consideration of every activity throughout the building's life cycle in the terms of supporting economic and ecological management of the building's sustainability.



Accident trends at DLR



DLR is distributed over 13 sites, requiring a high level of communication. In order to minimise work travel and all of the entailed economic and ecological impact, video conferencing is increasingly employed. For this purpose conferencing systems have been set up in meeting rooms and at workplaces, allowing the number of face-to-face meetings to be reduced. With a particular focus on safety and environmental protection, reconfiguration of intranet applications has enabled further optimisation for users of communications via IT media (www.dlr.de/dlr-sicherheit) to be achieved in 2009. In addition newsletters on environmental and safety topics are regularly sent out to interested target groups within DLR and HGF. Specialist networks, for example with universities and new talent, are maintained in

the field of environmental protection and safety. The results on safety-related topics commissioned and completed within DLR will be flowed into representatives' safety and environmental protection activities.

Information events for employees have been offered at individual DLR sites, such as days on environmental protection and healthcare, including personal health checks, fitness and nutrition advice and flu vaccinations. Also included have been ergonomics for desktop working and content covering travel medicine. In the field of risk communications one focus was preventions against pandemics. Numerous activities were conducted in this context in the framework of collaboration within the Helmholtz Association. For example the conduct of a regularly-convened crisis panel, the further development of the pandemics Handbook with information on the intranet and the preparation of emer-

gency measures. Employees within DLR will thus receive extensive guidelines on prevention and on actions in case of an incident.

Following publication of the 2009 accident figures by Deutsche Gesetzliche Unfallversicherung (DGUV – German mandatory accident insurance) on 24 June 2010, fewer notifiable industrial accidents occurred in Germany last year. Presumably the 40-hour annual reduction in working time will have played a part in reducing the number of accidents. DLR was unaffected. Accident figures here are well below the German average (see graphic) due to the extensive preventative work and our employees' high level of awareness. DLR, with a rate in 2009 of some 8.5 accidents per 1,000 employees, was consistently between eight and 10, which is well under the Federal value (28.5). The DLR figure was also almost half the average figure for the DLR professional association (BG-ETE of 18 May 2010) of 16.1. Within the Helmholtz Association, structured performance indicators for large-scale research facilities have been compared since 2008. There the rate, of almost 11 per 1,000 persons, is just above DLR figures.

DLR reported 55 notifiable accidents, approximately half of which occurred not at the workplace but on the way to work. The majority of injuries were from falls, trips, sprains, cuts and puncture injuries. There were no fatal accidents during the period reviewed. Although this relative indicator has fallen, days off per accident have risen by 5 to 32 and the costs entailed have accordingly risen by around 18%. This indicates a greater severity of accidents. In this context, the HGF average is approximately 22.

Helmholtz Association of National Research Centers (HGF)

Programme development

The research areas “Energy” and “Aeronautics, Space and Transport” are in the first or second year of implementation within the second funding period. “Energy” had additional resources awarded to the topic of Energy storage in view of the future importance of this research topic. Correspondingly increased support for the topic of Electromobility in collaboration with other centers belonging to the Helmholtz Association is being discussed.

Initiative and networking fund

DLR has received funding from the Association’s budget allocation for new topics, networking and new talent for a lecture course on the subject of safety-related technologies. Young scientists thus obtain the cross-programme opportunity of further training for safety-related research over and above DLR own topics. In addition, two young managers will receive funding for the setting-up of research groups into the topic of the impacts of aerosols on the atmosphere and climate, and on the topic of modeling and diagnostics of fuel cells.

National and European Networks	2007	2008	2009
DFG participations	27	33	34
Sponsorship agreements	45	49	41

National and European Networks

Collaborations with universities

Collaboration with universities is a strategic goal within DLR corporate policy. Collaborative projects in almost every area of activity ensure the optimal utilisation of available resources in programmed research. Similarly the training of highly qualified new talent for industry and science benefits from working with others, and such collaboration is equally beneficial to DLR and to the universities. For the universities, the infrastructure available in DLR scientific and technical areas is in many cases a prerequisite for a wide range of research projects, while DLR gains access to up-and-coming new scientists and new research topics.

Each year the institutes of DLR oversee around 700 postgraduate students working on their PhD theses, with another 400 or so students completing their final year theses at DLR facilities. The number of DLR scientists with lectureships has increased significantly in the last few years. In 2009, around 250 scientists were tasked with delivering lectures, tutorials, seminars etc. at universities and colleges.

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. In the last reporting year two initiatives

were launched which go far beyond the form of co-operation with universities described above. The DLR@Universität Stuttgart institution collaborative programme opened with a kick-off meeting in autumn of 2009. By bundling together the scientific skills of DLR and Stuttgart University and through collaboration on new joint research areas combined with joint teaching events, the goal is to jointly shape the future and strengthen their leading national and international positions. As a further institutionalised form of collaboration with universities DLR founded the Munich Aerospace e.V. joint faculty in collaboration with Munich Technical University, the Universität der Bundeswehr München (University of the Federal Armed Forces Munich) and Bauhaus Luftfahrt. As the joint research, development & training department for aerospace, Munich Aerospace e.V. is to bring together the partners' diverse scientific and technical expertise to collaboratively identify new research goals and raise Munich's science landscape to the status of an attractive European aerospace training center.

Participation in DFG programmes

Integration into the programs of the Deutsche Forschungsgemeinschaft (DFG - German Research Foundation) is an important measure of the quality of DLR research work. DFG's "co-ordinated programmes" support extensive interdisciplinary networks of researchers dedicated to a broader range 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 high-calibre young scientists. During the reporting period DLR participated in Collaborative Research Centres fourteen times, Priority Programmes seventeen times, and Research Training Groups three times.

Sponsorships

Sponsorships are a successful tool for rapid technology transfer through individuals and also enable highly qualified young talent to be secured for research and development in science and economics. This involves companies taking over half the costs for the training of 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. A total of 41 sponsorships were overseen within DLR in 2009.

Collaboration within ACARE

DLR held a national ACARE workshop on 10 September 2009 as part of the German Aerospace Congress at Aachen. Following an overview of current developments in European aerospace research and ACARE (Advisory Council for Aeronautical Research in Europe), representatives of the German universities, industry and research exchanged experiences in the 7th framework program and discussed possible approaches for the way forward in Europe.

Following the publication of the addendum to the strategic research agenda a year ago ACARE analysed current devel-

opments around aeronautics and air transport research, summarising this in a document. The “background document” was presented, together with the results of the EU projects AGAPE (analysis of achievement of the goals of Vision 2020) and MEFISTO (analysis of impact of previous aeronautics projects in the 5th and 6th framework programs) in an ACARE workshop held during ILA on 10 June 2010. ACARE thus laid the foundations for new vision and strategy processes in European aeronautics research.

Collaboration with the EU

In the calls to tender for the 7th framework program published on 30 July 2009, completed at end last year/beginning this year, which included the topics of transport (including aeronautics), space-flight, energy and safety, DLR once again participated successfully in a wide range of project applications. Expert opinion regards DLR as the most successful single participant from Germany in space-flight, participating in 15 projects with total funding of more than 4 million euros (out of a total for tenders of 111 million euros) and acting as co-ordinator on two of these.

DLR secured over 9 million euros in aeronautics, participating successfully in 23 projects (acting as co-ordinator in 5) and in the process increased its share of the total available tender amount from the previous 5% or so to around 8% (out of a total for tenders of 108 million euros). With a success rate of just below 50%, DLR is well above the average success rate – of around 20% – in aeronautics.

Through N.ERGHY, the European association of research facilities, DLR continues to participate actively in the constitution of tenders under the fuel cell and hydrogen joint technology initiative (FCH JTI). In June 2010 the 3rd call from FCH JTI was published with a tender volume of approximately 90 million euros. As in previous years DLR will again participate in project applications for these tenders.

The negotiation phase for last year’s FCH JTI is in its closing stages with the third quarter of 2010 being envisaged as the project start for successful applications with DLR participation.

In parallel, as in previous years, DLR participated through its membership of the European groups (EREA, ECTRI, ...) in the preparation of the next tenders, to be published at the end of July 2010.

While the 7th framework program is exactly halfway through, the preparatory activities of the Commission and the various players in preparation of the 8th framework program are being finalised. DLR participates here both by virtue of its own positions in the context of European consultations (e.g. on the EU 2020 Strategy on the future of transport) and also indirectly through contributions to the positions of the Federal Government, HGF and other groups such as EREA, ECTRI and N.ERGHY.

On 3 September 2009 DLR, in collaboration with the German Embassy in Belgium and the Brussels city authorities, opened the exhibition “What a Sight: Space looking out for world heritage” in a small but excellent event. In the exhibition, displayed from 3 September to 8 October 2009 on the park railings opposite the Royal Chateau in Brussels, 30 panels were exhibited showing photographs produced from remote sensing data of selected UNESCO World Heritage Sites. With these DLR wishes to use artistic images to raise public awareness – in Brussels but primarily in Europe as a whole – of the capabilities of remote sensing technology and in particular of DLR technology, to raise awareness of the need to protect the environment,

and to highlight the political need for rapid implementation of GMES (Global Monitoring for Environment and Security).

On 2 February 2010 DLR held its traditional New Year reception in Brussels representing the state of Lower Saxony, with aeronautics being the technical focus this year. Following a welcome address by Prof. Wörner and Secretary of State Dr. Liersch, a discussion was held before around 160 guests between Andras Siegler, Director of Transport in European Commission’s Directorate-General for Research, and Prof. Szodrich in his role as Co-Chairman of ACARE and senior aeronautics representative for DLR, concerning the future strategic direction of aeronautics research in Europe. The technology platform of ACARE (Advisory Council for Aeronautical Research in Europe), as the leading European technology platform, was

highlighted as an example for joint European strategy planning to be followed by individual implementation by all partners. Director Siegler explained the Commission's general transport policy goals for low-carbon transport. In addition to the development of alternatives to road transport and improved integration of transport networks, the technological contribution of aeronautics research must also play its part. The examples put forward by DLR management illustrated how well placed DLR is in this area and how it will continue to contribute substantially in the future to the development of sustainable air transport.

European groups (EREA, EERA, ECTRI)

On 23 September 2009 the Association of European Research Establishments in Aeronautics (EREA) organised for the first time a comprehensive seminar on the preparation of competitive EU applications. The EREA concept was based on the DLR internal information events which are held regularly on DLR sites within the framework of the DLR training programme by DLR Brussels office, Administrative Infrastructure, and the national contact offices for aerospace based within DLR. In the EREA seminar participants received practical tips and experience gained by the Brussels representatives of EREA belonging to DLR, INTA and ONERA, together with information from European Commission scientific officers regarding tenders currently on the table. This event was attended by around 40 potential applicants from EREA member facilities.

On 1 December 2009 on the 15th anniversary of EREA the EREA board held discussions in a high-level policy seminar with senior representatives from industry, the European Commission, member states, SESAR, and Clean Sky, covering joint undertakings experience and the expectations of EREA. The contributions made clear that EREA has developed into one of the key players in European aeronautics research. Future expectations of EREA in the area of pioneering are high, particularly on the part of the Commission.

In the subsequent annual reception D. Maugars, the departing EREA chairman, welcomed around 140 guests from the European Parliament, the European Commission, industry, research and member states. Together with Director J.-R. Smits, he awarded the EREA Best Paper Award of 2009 to a team from CIRA who won by a considerable margin.

At the EREA Board Meeting of 2 December 2009 M. Peters, succeeding Prof. F. Abbink as CEO of NLR, was elected the new EREA chairman. D. Maugars will, as in previous periods, also serve as vice-chairman in the interests of a smooth handover and to provide support. The Board of EREA also approved the modification to EREA's strategy discussed in early 2009. Accordingly EREA's focus will continue to be on representing joint interests in relation to politics and industry. An important prerequisite for this is however collaboration throughout the EU and also in bilateral or trilateral projects which should strengthen the effectiveness and transparency of EREA both internally and externally, and in individual cases potentially lead to further links between institutions.

DLR membership of the European Conference of Transport Research Institutes (ECTRI) continues to develop very successfully. Dr. Piehler, Program Director for Transport, represents the Association as elected secretary and Board member. His sphere includes strategic development of the Association, optimisation of leadership processes and improvement of public perception. DLR is correspondingly playing an intensive role in the relevant working groups (strategy, preparation for the 8th research framework program, etc). In addition a weekly newsletter prepared by DLR Brussels office keeps ECTRI members up-to-date with current information on transport-related developments and decisions in Brussels. At specialist level DLR is meanwhile represented in working groups in every topic, in some cases with several Institute members.

Analogously with EREA in aviation and ECTRI in surface transportation, EERA (the European Energy Research Alliance) was founded to better represent the interests of the national energy research facilities. EERA is part of the European Commission's "Strategic Energy Technology Plan (SET-Plan)", of which official membership is restricted to one facility per country. The German place is filled by HGF, currently represented by Dr. Fritz of Karlsruhe. A guiding principle here is the analysis of existing programme activities with regard to a better and more efficient programme organisation. DLR is represented both in technical working groups relevant to DLR and in administrative/legal working groups. Furthermore DLR supports HGF in the co-ordination of an EU project to develop the EERA Secretariat in order to be able to shape the development of EERA centrally.

Collaboration with NLR

Although SESAR's administration board had decided to set up an associate membership of the SESAR Joint Undertaking it had not yet been possible to secure the membership of AT-One. for research facilities amongst others, in contrary to previous announcements. Because SESAR focuses mainly on implementation of the master plan, it is currently unclear how mid- to long-term research in the field of ATM (air traffic management), which transcends SESAR concepts, can be facilitated at European level. For this purpose a working group was set-up within ACARE to identify the need and any potential shortfalls. Both DLR and NLR are represented on this working group in order to pool shared interests and capabilities.

In parallel SESAR, in the framework of a workshop in Brussels, has presented the tenders planned for this year with regard to longer-term advanced ATM research. DLR and NLR will be participating and leading these tenders in the framework of the AT-One joint subsidiary.

Collaboration with ONERA

Both at the DLR/ONERA steering committee and on the occasion of the Joint Executive Board Meeting there was discussion on the now virtually extinct exchanges between in particular younger scientists. As the first step towards the strengthening of such scientific exchange two joint workshops for younger scientists – one in France, the other in Germany – are planned for 2010.

Collaboration with CNES

The DLR-CNES working group, tasked with producing a proposal for a joint climate observation mission, has developed the concept of a Franco-German mission to observe the greenhouse gas methane (CH₄), with a launch scheduled for 2014 onward. On 4th February 2010 the Franco-German Council of Ministers explicitly approved the joint construction of a methane observation satellite under the 2020 Franco-German agenda.

Germany is developing the instrument payload, an Integrated Path Differential Absorption (IPDA) LIDAR. France is leading the development and operation of the satellite based on the French Myriade platform.

In order to intensify collaboration between DLR and CNES under the European spaceflight policy, a working group on launcher development has been created. Under the strategic objective of guaranteed European access to space, this working group has to investigate further development of the ARIANE 5 rockets and the prospects for a new generation of launchers. The results should be presented by the end of 2010.



ESA summer school in Alpbach with German students, sponsored by DLR and German consultants

International Collaboration

USA

In the USA discussion of spaceflight was shaped by the re-alignment of NASA and President Obama's new Space policy. Although the modified structure and re-tasking of NASA are not yet finalised, a clear trend can be seen towards greater openness and internationalisation in US spaceflight policy. This was underpinned in the summer of 2010 by the Space policy announced by President Obama which explicitly highlighted the importance and prospects of international cooperation.

Relations with NASA were intensified and extended by reciprocal visits. Thus in August 2009 Prof. Wörner met the new NASA Administrator, Mr Bolden, who in turn visited DLR in Stuttgart, together with a delegation, in February 2010. In order to provide structure and support for cooperation with NASA it was decided at a meeting held between Prof. Wörner and Lori Garver (Deputy Administrator of NASA) during ILA 2010 in Berlin to establish a framework agreement between DLR and NASA. The new collaboration is expressly intended to cover not only spaceflight but also aeronautics, such as the cooperation discussions currently in progress in the fields of Air Traffic Management, Rotorcraft and Climate & Aviation.

Collaboration with the Air Force Research Laboratory (AFRL) has been specifically extended. The cooperation agreement for collaboration in DLR SHEFEX (Sharp Edge Flight Experiment) research program was able to be signed on that occasion, together with the agreement on data

exchange regarding UAV (Unmanned Aerial Vehicle). Cooperation with AFRL has great potential since AFRL, just like DLR, is aligned towards long-term technology development. Collaboration with AFRL has already been in place for many areas, such as in laser research for over 25 years.

In the summer and autumn of 2009 the relationship with the US National Oceanic and Atmospheric Administration (NOAA) in the field of Space weather was also intensified. Space weather is of great importance for example for accurate navigation on earth using GPS signals, and is extensively conditioned by solar activity. The meetings and negotiations culminated in an MoU on Space Weather between DLR and NOAA signed in Washington in December 2009 on the festive occasion of the DLR Christmas reception. Cooperation with NOAA is also to be extended in other areas in the future.

Energy research plays an ever-increasing role in collaboration with the USA. To address this development Prof. Wörner visited the US National Renewable Energy Laboratory (NREL) in Golden, Colorado in December 2009. NREL and DLR are conducting joint research in the field of solar thermal systems.

Canada

Construction of the satellite receiver station at Inuvik in the north-west of Canada stands clearly at the forefront of collaboration with Canada. DLR constructed the antenna in August 2009, and this was prepared for TanDEM-X reception in autumn 2009. This cooperation however extends far beyond mere data reception, and DLR is collaborating very closely with the Canada Centre for Remote Sensing (CCRS) and the Canadian Space Agency (CSA) in joint analysis of radar satellite data. This cooperation was also expanded to include commercial data and data service providers such as Infoterra (Germany) and MDA (MacDonald Dettwiler, Canada).

Japan

Thanks to a strategic dialogue between DLR and JAXA the collaboration between Japan and DLR received strong support in Tokyo in August 2009. In the context of this dialogue an agreement for greater collaboration on catastrophe protection was signed. In addition numerous discussions were agreed upon covering potential cooperation, for example in the field of combustion research or other areas of earth observation. Long-standing cooperation, such as in planetary research and aeronautics, was extended further.

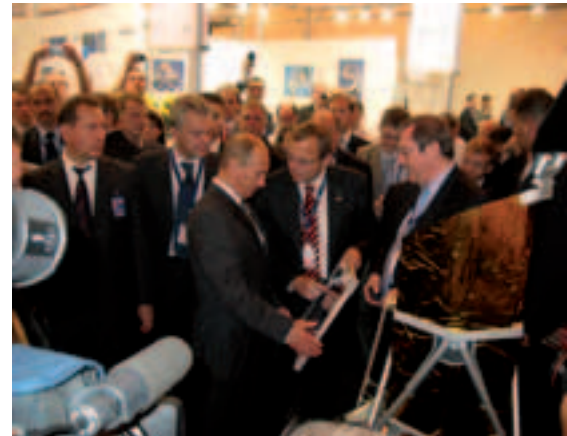
Russia

On 14th July 2009 the 105-day space flight simulation experiment in the "Mars-500" framework, with german contributions was completed at the Institute for Biological/Medical Problems (IBMP) of the Russian Academy of Sciences. Accompanied by prominent representatives of Roskosmos and ESA, Prof. Wörner welcomed the international composition of the crew as they left the research laboratory at the Institute for Biological/Medical Problems in Moscow. The event was recognized with an international Press conference. The crew of six included Federal Army serviceman Oliver Knickel. The question at the heart of the Mars-500 study is: how can a person's physical and mental performance be maintained under the extreme conditions of a long-term Space mission? The Deutsche Zentrum für Luft und Raumfahrt (DLR, German Aerospace Center), in common with IBMP and ESA, the European Space Agency, contributed substantially to Mars-500 with DLR research institutes contributing to several experiments. In addition DLR provided financial support for the project in its role as national space agency on behalf of the German Federal Government.

For the third time since 2005, DLR participated with its own exhibit in MAKS, the Moscow Aerospace Fair (MAKS

2009 from 18th to 23rd August 2009). The majority of exhibits were selected for their significance to German/Russian cooperation. The main event was the signature of the "Agreement between the Russian Federal Space Agency and DLR for collaboration on the Russian/German "Spektrum-Röntgen-Gamma" astrophysics space observatory". The German contribution accounts for the main payload: the X-ray telescope eROSITA (extended Roentgen Survey with an Imaging Telescope Array). The development & construction of this telescope was led by the Max Planck Institute for Extraterrestrial Physics, located in Garching. This project is sponsored by DLR in the framework of the German national Space program. In parallel, the first "Young scientists' seminar" was held with young specialists from the Zentralen Aero-Hydrodynamischen Institut (ZAGI, Central Aero Hydrodynamics Institute) and aeronautics institutes from within DLR. A follow-up seminar was held as part of the aeronautics program at ILA 2010. The goal of the seminar was to develop a network of young scientists as part of DLR-ZAGI cooperation.

In the course of ILA 2010 a framework agreement was signed by Prof. Perminow, the leader of the Russian Federal Space Agency, and by Prof. Wörner together



Vladimir Putin, Prime Minister of the Russian Federation, at the DLR stand seen here with a model of the eROSITA telescope. Prof. Wörner and Professor Morfill, Director of the Institute for Astrophysics (left to right) are handing over a picture of the ATV produced in Bremen.



Prof. Hua Jun, the new deputy CEO of CAE, seen here with Prof. Szodruch, DLR Board member during the meeting in Peking

with Mr Hohage for a long-term cooperation programme for scientific research under zero-gravity conditions in "FOTON-M" and "BION-M" type space vehicles.

On 14th June 2010 at the Russian General Consulate in Bonn, already the 4th German/Russian spaceflight conference was held. These have been arranged by the General Consulate of the Russian Federation in Bonn, by the Russian spaceflight agency (ROSKOSMOS) and by DLR spaceflight management. The theme of the conference this year was "Researching the universe: latest technologies in the service of science". The main thrust of presentations have been reports on respective projects in this scientific sector and presentations on results so far achieved in shared projects. The focus of Russian spaceflight research and technological development is on solar system research, with particular reference to the Moon, using electrically operated probes.

Ukraine

Under the keen gaze of the regional media, on 15th March 2010 in Kiev the closing meeting of the twinning programme "Boosting Ukrainian Space Co-operation with the European Union" was held. "Twinning" is an EU neighbourhood policy tool, and in this instance was financed to the tune of 1.5 million euros. The contract partner on the Ukrainian side was Ukraine's national spaceflight agency, and on the European side a consortium of CNES-DLR/ BMWi in which ADETEF (the French association for the development of economic and financial exchange in technology) and GTZ (German Society for Technical Co-

operation) also participated. The goal of the program was to promote European/ Ukrainian collaboration in the field of spaceflight.

Over the past two years, a total of 42 experts from DLR and CNES have worked on more than 80 missions. 45 seminars and conferences have been held, with more than 300 presentations. The programme has included three study trips and three practical events extending over several weeks at the premises of DLR, CNES and ESA. In total more than 1,600 specialists from the spaceflight sector were involved from the Ukrainian side. DLR was represented at the closing event by a delegation led by Dr. Schmidt-Tedd, the head of the legal department in spaceflight management. The hard-working employees of CNES, DLR and the Ukrainian spaceflight agency were commended for the work they had done over the previous two years.

China

On 12th April 2010, in the course of a delegation visit by DLR led by Board member Prof. Szodruch, the 24th "Joint Committee Meeting" (JCM) was held with the "Chinese Aeronautical Establishment" (CAE). German/Chinese collaboration celebrates a particular anniversary this year. Thirty years ago on 15th April 1980 the "Special Agreement" was signed between DFVLR e. V. and the CAE. This was followed in Peking on 19th October 2005 by an extension to the existing agreement. The main content of this extended agreement was participation by the European and Chinese aeronautics industries in the future projects of both organisations.

The Chinese aeronautics industry has been greatly centralised over recent years, and from the two divisions of "Aviation Industries of China" (AVIC I

and AVIC II) a centralised state corporation (AVIC) has emerged. In the course of this merger process CAE has been completely reconfigured and now represents with its institutes the research basis for the greater part of the Chinese aviation industry.

An important goal of the China visit was to achieve a stronger relationship with the new senior management of CAE. At the joint committee meeting in Peking there was reporting on the development of joint research projects over the past three years, and options for new projects were discussed.

Kazakhstan

During the meeting in Bremen in May 2009 between the chairman of the Kazakhstan Space agency "Kaskosmos" and Prof. Wörner it was agreed to work towards greater depth of collaboration between the two organisations. This was particularly prompted by growing demand for earth observation capabilities in Kazakhstan, for which the resources of DLR and of the German spaceflight industry are building the foundations. A DLR delegation travelled to Astana and Almaty in October to conduct the meetings necessary to the negotiation of a framework agreement and to assure themselves of the possibilities offered by Kazakhstan space research in the context of a start-up seminar. The "Agreement for collaboration in the exploration and exploitation of Space for peaceful purposes" was prepared ready for signature at ILA 2010.

Mexiko

Mr Reiter and a delegation from DLR and the German spaceflight industry visited Mexico City in May to present German spaceflight technology in research and applications to a selected audience of scientists, politicians and the military. There is great demand currently in Mexico for applications in navigation, tourism,

urban and rural planning and in particular in safety and environmental management. Visits were made to potential users of remote sensing data such as for example the national crisis prevention center. In the course of a two-day workshop organised by the local German Embassy, specialist topics could be discussed in detail. This workshop was very well received. Mr Reiter visited high-ranking political representatives. Both members of the DLR party and representatives from industry had a very positive view of the visits.

India

From 20th to 23rd July 2010 Dr. G. Madhavan Nair, Chairman, High Powered Committee-National Civil Aircraft Development (HPC-NCAD), CSIR and Dr. A.R. Upadhyya, Director National Aerospace Laboratories (NAL), visited the Stuttgart, Brunswick, Göttingen and Cologne sites for meetings on bilateral collaboration. Prof. Szodruich welcomed the delegation to Brunswick and expressed his appreciation for the many years of successful collaboration between DLR and the Indian aeronautics research organisation. The visit followed an invitation given during the 1-week workshop in January 2010 in Bangalore. The intention of the workshop was to achieve greater collaboration with NAL for mutual benefit. The workshop resulted in both sides declaring their intention to conduct joint projects in the future for mutual technological gain. The high point of the visit was the signature of an MoU whose purpose is joint research & development of a concept for the design of a regional aircraft and joint wind-tunnel testing. During the site the existing research in-



Prof. Szodruich and Dr. Upadhyya during the signing of the MoU

frastructure, such as wind tunnels, aircraft from DLR fleet and the laboratories could be shown to the delegation. The guests appeared impressed by the infrastructure.

Brazil

Dr. Ganem, chairman of the Brazilian Space agency AEB, attended the COSPAR conference from 19th to 23rd July 2010 going on to visit various DLR sites. In the course of talks within the framework of COSPAR Prof. Wörner and Mr Reiter welcomed the delegation and expressed their appreciation for the many years' of successful collaboration between DLR and the Brazilian spaceflight research organisations. Dedicated technical talks were consequently held with DLR experts at the Oberpfaffenhofen, Lampoldshausen and Bonn sites to discuss details



Photo: Niklas Hedman of the United Nations Office for Outer Space Affairs (UNOOSA), Prof. Johann-Dietrich Wörner (DLR), S.E. Ciro Arévalo-Yepes (Chairman UNCOPUOS), Dr. Christoph Becker and Andreas Wolke

of the topics for collaboration. Particular objectives of the talks included collaboration in research under space conditions, especially research rocket technology. Brazil has for many years supplied reliable rocket motors for the TEXUS science program as part of the national programme, as well as for ESA's high-altitude research programmes. Long-term availability of the Brazilian contribution is of great value to German zero-gravity research. Ways in which DLR and the German spaceflight industry could support the Brazilian partners in further development of motors were discussed.

Turkey

A Turkish delegation visited three DLR sites in September 2009. Thirteen delegates from the Turkish TÜBITAK research organisation and leading Turkish spaceflight companies were able to gain an impression of the capabilities of German spaceflight research through visits to Cologne, Bremen and the Munich area. At all three sites the scientists and experts met not only DLR researchers but also representatives of German spaceflight companies, and visited the premises of their respective companies. Great interest in achieving fuller collaboration was confirmed on both the German and Turkish sides.

Following the success of this initial contact, another visit was planned to allow both the personal exchange of knowledge between scientists and experts from research and industry and also for the German specialists to extend their knowledge of the Turkish spaceflight sector. DLR organised a delegation visit to Turkey for this purpose in February 2010 when 14 delegates from Germany

visited institutions and research organisations in the Turkish spaceflight sector in Ankara and in Istanbul. The contacts made and the knowledge and experience exchanged during the visits have laid excellent foundations for future joint projects.

Poland

Central and Eastern European states are becoming increasingly significant to European space flight collaboration. DLR is eager to establish trusted collaboration with these countries even before the entry of some of these to the European Spaceflight Agency ESA, one example being Poland.

Contacts and joint projects with PAW, the Space Research Centre within the Polish Academy of Sciences, have existed for several years. Mr Reiter, DLR Board representative for spaceflight research & development, took a DLR delegation to visit Warsaw in November 2009 at the invitation of the chairman of PAW. In the course of several meetings with representatives of PAW and from universities and specialist authorities from across Poland numerous areas of shared interest and research, such as flood prevention, were identified and further collaboration agreed.

Romania

In May 2010 Prof. Szodrucl, DLR Board representative for the aeronautics field, visited the Romanian National Institute for Aerospace Research "Elie Carafoli" (INCAS) in Bucharest. During the visit there were talks with representatives from the Romanian Academy of Sciences, presentations on Romanian aeronautical research and a visit to the Institute that has a wind tunnel. Finally, a cooperation accord between DLR and INCAS covering aeronautics was signed.

United Nations and international organisations

A New Year reception was held on 1st February 2010 at the residence of Germany's permanent representative to the United Nations for the Vienna-based UN establishments and multilateral organisations, together with a "working lunch on sustainable energy supply in particular through solar power systems", at which high-ranking representatives from UNIDO (UN Industrial Development Organisation), the OPEC Fund and ambassadors from countries rich in solar energy held an intensive discussion on the rising demand for energy. On the same day DLR also visited UNOOSA, the United Nations Office for Outer Space Affairs. A range of DLR research results were given to the COPUOS meetings in the form of a technical presentation for the International Space Association.

UNESCO (United Nations Educational, Scientific and Cultural Organization)

The DLR-UNESCO exhibition "What a Sight: Space Looking Out for World Heritage" took place in autumn in Brussels and at the UN building in Bonn. These satellite pictures of world heritage sites provide unique views of the Earth, and also show the marks left there by mankind. At the end of November 2009 at the German permanent mission at the United Nations in Vienna, a presentation took place on the DLR/UNESCO collaboration for the protection of world heritage sites using satellite data. Many of the 33 embassy representatives from 25 countries expressed keen interest in this initiative, which is also supported by DUK (Deutsche UNESCO-Kommission, the German UNESCO Commission, Bonn). This event again made clear that the DLR/UNESCO venture for remote sensing of world heritage sites and biosphere reserves is excellently suited to raise the wider public's awareness of the benefits of modern remote sensing satellites.

UN-SPIDER (United Nations Platform for Space-based Information for Disaster Management and Emergency Response)

From 21st to 23rd October 2009 in collaboration between UNOOSA and DLR and with support from the United Nations Convention to Combat Desertification (UNCCD), the 3rd International UN SPIDER workshop was organised on the United Nations campus in Bonn for 150 attendees. For the first time, UN SPIDER also targeted precautionary measures ahead of catastrophes.

"We look forward to a successful collaboration between DLR and UN SPIDER in the provision of satellite data for disaster areas and in the conduct of technical advisory missions for developing countries", Prof. Wörner emphasised in his speech. "Thanks to intensive exchange of information and specialist knowledge, the foundation for further cooperation in the future has been laid". His Excellency Neville Gertze, the Namibian ambassador to Germany, welcomed this support for his country which in recent years had been increasingly affected by flood disasters. The guest speaker was Rüdiger Lüdeking, the head of the German permanent mission to the United Nations in Vienna, who took the opportunity to visit DLR on this occasion and gleaned extensive information on German space-flight skills and their place in the international environment.

The regional UN SPIDER workshop in Ecuador also concerned itself with space-flight-supported applications relating to disaster management. This took place from 29 September to 2 October 2009 with support from ZKI (Center for Satellite-based Crisis Information), amongst other bodies, in Quito and was attended



UN-SPIDER Workshop 2009: Prof. Johann-Dietrich Wörner (DLR), Dr. Robert Backhaus (UN-SPIDER), Dr. Annette Froehlich (DLR) and His Excellency Rüdiger Lüdeking, Germany's standing delegate at the United Nations, Vienna

by more than 60 participants from 17 countries. ZKI had already attended the 18th cartographic UN regional conference for south-east Asia in Bangkok, held 26-29 October 2009, which looked at the expansion of national and regional geo-data infrastructures and their efficient utilisation for crisis management.

Communications

DLR Communications is responsible for all aspects of DLR portrayal to the outside world: press communications work, cross-media activities, fairs, exhibitions and other events, publications (DLR magazine, echtzeit, company brochures), audiovisual media and visits. It also ensures that DLR presents a consistent image (CD/CI) to the public.

Last year it was possible to achieve a marked increase in DLR profile in relevant areas such as the media and the broader public as well as decision-makers in politics, science and business. This is reflected in the increasing visits to DLR web portal, in its positive media image and in reactions to its latest trade show appearance. The closer relationship between the sites and DLR Communications department has also helped improve the efficiency of public relations. DLR has positioned itself as a determining element in shaping opinion in the media landscape and in the minds of the public, especially in aerospace. This is shown by the new quarterly qualitative media analysis.

Communication with the public via DLR web portal is a key task of cross-media activities. The introduction of new editorial formats such as web news, reportage, interviews and webcast has decisively enhanced the information provided. The portal receives 160,000 visits monthly, generating on average over 1 million page views. The DLR blogs introduced in January 2010 produced

great interest, with the TanDEM-X mission blog in particular yielding a high response, together with that of DLR Board Chairman. The English-language content of the reporting on DLR activities around the volcanic ash cloud flights in April 2010 helped retain a high international profile for these.

The introduction of a quarterly qualitative media analysis made it possible for the first time to observe and technically assess media attitudes to DLR in the press, and with it in the public eye. DLR space research and development receives most coverage in the media, with around 1,000 articles. There was however already a positive perception of the energy and transport areas, conditioned by the structural changes within DLR Public Relations in 2009.

The media role played by DLR was shown during the activities around the volcanic ash cloud in April and May. The co-ordinated approach and the concentration of Press activities together with extremely high personal input from all involved gave DLR, as a research institution whose scientific work also yields economic benefit, a consistently positive image with all target groups.

The over 70 fairs and exhibitions attended last year through the Events Department elevated the outside world's perception of DLR to a new level. One of the major points was DLR keenly observed presence at ILA 2010 (the International Aerospace Exhibition). The new stand concept was presented for the first time in Berlin together with a re-designed image.

Some highlights :

- Flights by DLR Falcon 20E research aircraft began on 19th April following the closure of major sections of European airspace after the eruption of Iceland's Eyjafjallajökull volcano. Media interest was focused on DLR from day one, with positive reporting on DLR throughout the mission in around 900 articles from all media sources.
- Another major point was the commencement of the TanDEM-X mission on 21st June, with the launch event being very well received by both guests and by employees. High media attention was attained by virtue of the mission blog, which had already been started ahead of the event.
- Thanks to the focused appearance by DLR at ILA 2010 – in the spaceflight hall, on its own stand and in the static display – DLR clearly demonstrated its leading aerospace position in Germany.

Political and Economic Relations

"Politics is an important area of objectives for DLR". These were the words of Prof. Wörner, chairman of the executive board of DLR, in 2010 in an in-house strategy meeting; as early as 2008, he had set up an organisational unit devoted to "Political and economic conditions".

Correspondingly, this department held countless background and information discussions with the Chairman of the Board and other Board members and members of DLR management, as well as members of the government and delegates from the Federal and state governments and the European Parliament, or organised these for the Board.

Accordingly, at the fringes of the “DLR in dialogue” discussion platform newly called into existence by the Department, there were extensive talks between the chairman of the Board and leading politicians, such as Vice Chancellor Dr. Westermelle, Federal minister Brüderle who was responsible for dealings with DLR, and the chief parliamentary director of the SPD, Mr. Oppermann, covering topics such as DLR focal points of research and strategic objectives. These and similar activities between DLR and politics serve to maintain and to deepen the excellent relationship between DLR, which is predominantly a State-funded major research establishment and agency, and its “stakeholders” at Federal and regional level.

The following high points can be selected as examples within the reporting period:

- Departure of the chairman of many years’ standing of the Aerospace parliamentary group (“PGLR”), MdB Kurt Rossmanith and the support of his successor, MdB Klaus-Peter Willsch
- Exhibition within the Federal parliament “A country grows together”: the first exhibition following the constitution of the 17th German parliament and presentation of “One DLR” to the MdB
- Support for the European Inter-parliamentary Space Conference (“EWK”), for the International Astronautical Federation (“IAF”) and for ILA, the International Aerospace fair in Berlin
- Information trips concerning DLR “products” and international spaceflight events for politicians and business leaders (high altitude parabolic flights, Shuttle launches).
- Thorough political consultation, for example on parliamentary budget procedures, on topics such as the robotics performance center, the science leisure initiative, preparation of the new German spaceflight strategy, sustainable energy research (DLR concept for the

Desertec initiative) and topics from the fields of safety research and transportation research;

- Special events taking in political circles concerning current affairs, e.g.: “volcanic ash problem” and possible repercussions on research policy
- High-profile events for politics and business, such as the one held at the Speyer Museum of Technology on the occasion of the 40th anniversary of the first manned Moon landing
- Preparation of support for the 20th anniversary of German unification with joint activities between DLR, the Bremen Senate and the Office of the President of the Federal Republic of Germany
- Design of a publication for politics and business covering German spaceflight centers and their relationship with politics and business
- Introduction of Prof. Wagner, the new DLR representative for energy and transport research, at parliamentary level
- The extension of support at DLR sites on high-level issues of political and economic relations.

According to Prof. Wörner the purpose of DLR “relations with politics and business” is – in particular – to be seen as “one DLR”. To that extent, the organisational unit’s political communications with relevant economic decision-makers consolidates DLR position both as an organisation of excellence within Germany’s research infrastructure, and as the national spaceflight agency.



People

Gender Equality and Work Life Balance

To mark the 10th anniversary of gender equality within DLR a corporate brochure on this topic has been released, presenting women within DLR who work in particularly unusual roles in aerospace. The successful development of measures established over the years to strike a family / work balance is documented by various awards under the work and family audit and the "Total E-Quality" principle. Employees report on their experience of opportunities for a balanced lifestyle within DLR. The broad compass of the subject of equal opportunities is addressed, from a report looking specifically at women's personal development through to hierarchically targeted promotion of new intake.

The future promotion of new talents will be addressed particularly toward girls and young women. Thus in August 2009 DLR joined the German national "Komm mach MINT" initiative ("Come on and

do Mathematics, IT, Natural sciences and Technology"), a BMBF project intended to win more girls over to careers in these fields. This initiative has been embraced in DLR by DLR_School_Labs. Individual young but experienced female scientists are put forward as role models and provide events such as the "Science first hand" girls' day for schoolgirls. Many female DLR scientists participate as mentors in a large number of mentoring programs operated by higher education colleges and universities. These activities are co-ordinated by the Equal Opportunities Department.

Family Consultation is a new focal point. DLR employees are generally supported and advised in their search for childcare options or the care of needy dependents. One particular task here however is the provision of childcare for the very young. This project "closing gaps" can demonstrate some initial successes, permanent allocation of places in the Cologne and Bremen sites are arranged and consultations for other sites are in progress.

Since 2009 all DLR employees starting young families receive a card with good wishes from the board and a baby romper suit bearing the DLR logo to emphasise to them the genuinely family-friendly nature of the organisation. This initiative is a great success, as is shown by the wealth of positive feedback.



Human Resources

Qualification and promotion measures for human resources development are planned according to need and demand. There was again a significant rise in the level of take-up for in-house training programs in 2009: 460 training and re-training events in all were held for employees, management, and young management talents (excluding mandatory events for management concerning the introduction of performance-related pay). The dropout rate in training programs was able to be kept consistently below 20% (18% in 2009). 75 events were planned at short notice to cope with demand from users at the time.

The number of team workshops (events tailored to specific organisational units) was increased from 56 (2008) to 68. This underlines the increasingly close relationship between the development of personnel and that of the organisation.

Further, eight mentoring pairs from the previous year were continued. Due to personnel changes it was not possible to announce the new mentoring program until the end of 2009.

57.2% of employees participated at least once during 2009 in training programs, personnel development opportunities for management or in team workshops. On average, 2.1 days per year per employee was spent on personnel development activities (retraining events or team workshops) which, for the whole payroll, comes to 13,854 days in 2009.

The prime goal of personnel development is to promote new scientific talents. For the sixth time, a moderated forum was held between up-and-coming management talents and the board of DLR. More than 70 potential candidates were able to discuss with the highest management levels and learn about

Personnel	2007	2008	2009
Employees	5,627	5,880	6,485
Scientific associates (total)	3,046	3,295	3,677
Permanent /fixed-term contracts	3,104/2,523	3,148/2,732	3,229/3,256
Proportion of women			
- total	30%	30%	30%
- in management positions	13%	14%	14%
- scientific associates	12%	16%	17%
Young scientists	93	86	63
Doctoral candidates (internal/external)	607	670	734
Trainees	247	252	252

major strategic developments and decisions. This overcomes hierarchical barriers, promoting corporate identity.

The DLR_Graduate_Program was launched at 1st July 2009, a new qualification program open to all DLR Ph.D. students. In addition to professional qualifications, the programme covers important methodological, management and social skills that can be used directly during the promotion period and that boost the career in the long term as essential skills. Key areas include scientific presentations and publications, project management and third-party acquisition, conflict management and conducting negotiations, team leadership and intercultural skills. In addition, participants have the opportunity to network with doctoral candidates throughout DLR, to present their topic at international conferences and publish it in professional journals. A team page with an integrated database of abstracts promotes the specialised but informal exchange of information between participants.

The DLR institutes profit from the doctoral candidates' increased knowledge

and abilities. Moreover, DLR presents itself as an attractive employer to the next generation of scientists. By June 2010 applications had already been received from 180 Ph.D. candidates. 46 training courses and workshops were held within the framework of the cross-institute qualification program. These events are continuously evaluated and conceptually redeveloped in accordance with the feedback and needs of participants.

HR development and mobility	2007	2008	2009
Training days per employee	1.7	1.8	2.1
Mentoring pairs	7	8	8
Assignments abroad (months)	586	545	487

Project management is a key competence of DLR employees. The number of participants in the four-day intensive training course has been gradually increased to 99 in 2009. Additional eight participants have attended specific training events to prepare for PMP® certification, the world's most widespread and accepted qualification in project management.

In addition Personnel Development department has taken over the sub-project management for implementing projects career path - comparable to the management career path in DLR. New requirement profiles based on knowledge, experience and skills are currently being generated for project managers at various levels. In collaboration with external higher education institutions, qualification programmes will be devised based on this, extending to graduate level.

The concept linked to talent management, with systematic follow-up planning, falls under the responsibility of the Deputy Chairman of the Board. Eight of 17 applicants were accepted to the programme after an extensive evaluation of their potential. Individual human resource development plans will be generated covering two years and bindingly agreed with all parties.

Human Resources Development

The "Profiling the DLR Employer Brand" project, created in the first half of 2009, was completed as planned in December 2009 with the development of employer brand positioning that was fully meshed with DLR own brand. Following approval by the board in the first quarter of 2010 the measures devised were assessed and suitably prioritized. Their successive implementation was initiated. The focal points for implementation are (1) internal communication of the new employer brand and its implications, (2) reviewing and/or optimising the personnel recruiting process (in particular recruitment/on-

boarding processes) and (3) preparing to supplement DLR external communications image with the new components now required for specific employer communication, focused on the particular requirements of the defined target group. The goal here is the embedding across all media of the target group's perception of DLR as an attractive employer.

The presence at trade fairs was also continuously expanded during the reporting period by Human Resources Marketing. Building on the first very positive feedback (both internal and external) from the first "Fair season" in the New Year, DLR was present at a total of 11 higher education fairs between July 2009 and June 2010. The department takes over the entire organisation and co-ordination of appearances at fairs in this context, ensuring a consistent image in the sense of DLR employer brand identity. It also ensures that institute representatives attend fairs able to act as direct contacts, with specific job opportunities. It has already thus been possible for contacts made at fairs to directly fill vacancies and to increase the number of qualified applications received. At the "Aerospace day" in Cologne and the "50 years of Lampoldshausen" open day Human Resources Marketing also provided visitors at its careers stand with information on the subject of working with, and entry opportunities at, DLR.

A further focus of activities lay in securing a regular presence in media specific to target groups. Ideally this is in the form of editorials in which employees talk first-hand about their exciting projects and positive experiences working for DLR.

German Staff at ESA

At the end of 2009, ESA retained a total of 2,122 employees in the salary brackets commensurate with "high-level employment". The proportion of German employees at that time was 18.8%, so well below Germany's funding contribution of 23%. By contrast, France and Italy, in terms of their respective funding contributions, are markedly over-represented. There are two main reasons for the under-representation of German personnel within ESA. Firstly, there is an attractive remuneration structure within Germany's domestic aerospace industry. Secondly there is a noticeably low inclination to work abroad for extended periods. Over the years this has led to a consistently low rate of applications, below 10%. Despite these difficult conditions, DLR has succeeded, through various tools such as an advisory service for applicants or a relocation program agreed with ESA, in achieving an average rate of 20% for new appointments.

GTP, the German Trainee Programme, is a new tool for German personnel development within an international organisation. This program supports new German academic intake and new employees with ESA as they take up their employment, and helps with their career options. The purpose of this in the mid- and long-term is to improve the German share of personnel, and as such accords with the objective of the Federal government and Parliament of increasing the proportion of German personnel within international organisations – such as in this instance ESA. GTP receives funding from BMWi and is financed under the national spaceflight program, in the first instance until 2011. For program purposes, GTP reports to DLR Management office. The programme is managed by the trans-departmental DLR working group, which was set up for ESA's own recruiting purposes.

German staff at ESA – a comparison

Member state	Number of employees	Employees [%]	Financial contribution [%]
Germany	417	19,0	24,0
France	531	24,2	20,4
Italy	384	17,5	14,0
GB	219	10,0	10,5
Spain	169	7,7	6,8

Only 25% of participation in the launcher programme is taken into account for the calculation of the respective financing contributions.

GTP envisages that 10 trainees annually be placed for one year in activity and programme areas, to be selected by Germany, within ESA, or for two years where dictated by employment policy and programme needs. All information and job offers are accessible on DLR GTP web page.

GTP trainees selected by the DLR working group began their first placement in summer 2010 at ESA ESOC, ESTEC and ESRIN sites. Together with their ESA colleagues they worked in the fields of earth observation, technology, manned spaceflight/launchers, science, satellite operation, robotics, navigation and mission analysis. In this context Germany, along with Spain, Portugal, Greece and most recently the Czech Republic, have put into practice their own new talent programmes with ESA. DLR next objective will be to provide long-term funding for GTP in order to ensure its sustained capability.

Commendations and Awards

In-house awards 2009

DLR Science Prize

- Heiko Hirschmüller Ph. D.,
Institute of Robotics and Mechatronics
- Dr.-Ing. Marc Röger,
Institute of Technical Thermodynamics

DLR Research Semester

- Dr. rer. nat. Axel Amediek,
Institute of Atmospheric Physics
- Dr.-Ing. Jens Baaran, Institut für
Institute of Composite Structures
and Adaptive Systems
- Dr. rer. nat. Johannes Bosbach, Institute
of Aerodynamics and Flow Technology
- Dr. phil. nat. Norbert Fürstenau,
Institute of Flight Control
- Dipl.-Ing. Gundolf Kopp,
Institute of Vehicle Concepts
- Dr.-Ing. Heinrich Lüdeke, Institute of
Aerodynamics and Flow Technology
- Dr. rer. nat. Andreas Minikin,
Institute of Atmospheric Physics
- Dipl.-Phys. Ulf Tapken,
Institute of Propulsion Technology
- Dr. rer. nat. Christiane Voigt,
Institute of Atmospheric Physics
- Dr. rer. nat. Martin Weissmann,
Institute of Atmospheric Physics

DLR Senior Scientist

- Dr. rer. nat. habil. Veronika Eyring,
Institute of Atmospheric Physics

Prizes awarded by the Society of Friends of DLR (SoF)

Otto Lilienthal Research Semester
- Dr.-Ing. Gerhard Krieger, Institute of
Microwaves and Radar received the
Otto Lilienthal research semester. A
research visit to the Jet Propulsion Lab-
oratory in Pasadena, California, USA
is planned on the topic of "New radar
technologies for systematic earth
observation by satellites".

Hugo-Denkmeier Prize

- The prize was awarded to Dr. rer. Nat.
Susanne Lisinski (formerly of RWTH
Aachen) as the youngest doctoral can-
didate to be awarded a doctorate with
distinction in aerospace.

Fritz-Rudorf Prize

- In recognition of their services towards
the foundation of the DLR Institute
for aerospace systems in Bremen, this
year's Fritz-Rudorf prize went to
Dr. Alfred Saltzmann, DLR Bonn and
Dr. Ludger Fröbel, DLR Köln-Porz.

Chairman's Prize

- Mr. Ulf Noyer, Institute of Transporta-
tion Systems, DLR Berlin-Adlershof, re-
ceives the prize awarded by the Chair-
man of the Society of Friends of DLR in
recognition of being the youngest pat-
ent applicant during the year.

Franz-Xaver-Erlacher Prize

- GvF member Mr Franz-Xaver Erlacher
from Starnberg has funded the Society
of Friends for 2009 and 2010 for a
prize to promote fresh intake (grant aid
for doctorate projects), which this year
was awarded to Mr Peter Vogt, of the
German Remote Sensing Data Center,
DLR Oberpfaffenhofen. DLR and the
Society of Friends thank Mr Erlacher for
his funding of this prize.

Innovation Prize

- For their successful teamwork on the project "Tools for qualification and optimisation of concentrating collectors for solar thermal power stations", the prize for innovation was awarded to Dr. Eckhard Lüpfer, Dr. Klaus Pottler, Dr. Steffen Ulmer, Dr. Marc Röger and Dr. Björn Schiricke, of the Institute of Technical Thermodynamics, DLR Köln- Porz.

DLR_School_Lab

- DLR_School_Lab Lampoldshausen/ Stuttgart was awarded the DLR_School_Lab prize. The eight-strong prize-winning team is made up of pupils from the Johannes Häußler school, GHWRS Neckarsulm, who devoted themselves with great commitment and success to the topic of "Secondary school rockets".

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 2009 Quality Prize to:

- Mrs Sabine Engelbrecht, quality officer for the Cluster for applied remote sensing in Oberpfaffenhofen;
- Mr Florian Piekert, certified Project manager within the Institute of Flight Guidance, Brunswick and
- Mr Jürgen Mathes, head of quality and product control with OHB-System AG, in Bremen.

Selection of external awards in 2009

Award	prize winner
Borchers Medal from RWTH Aachen	Dr. Susanne Lisinski
Richard-Pohl medal from Universität Göttingen	Dr. Matthias Sperl
Fellowship of the Zukunftscolleg from the University Konstanz	Dr. Thomas Voigtmann
Albrecht-Meydenbauer medal from DGPF	Dipl.-Ing. Frank Scholten
Erich-Krautz prize	Dr. Sabine Wüst
Therese von Bayern prize from LMU Munich	Dr. B. Weinzierl
Best European PhD Award from the Geoscience and Remote Sensing Society	Dr. M. Esselborn
D.Q. Kern Award (AICHE)	Prof. Dr. Hans Müller-Steinhagen
Solar PACES Technical Innovation Award	Dr. Lüpfer, Dr. Ulmer, Dr. Pottler, Dr. Schiricke, Dr. Röger
Hellmuth-Fischer medal 2009 (DECHEMA)	Prof. Dr. Andreas Friedrich
Innovation prize for telemedicine from the German Telemedicine Society	Dr. Thomas Weber, Dr. Christian Juhra, Dr. Frank Ückert, Maximilian Ataian, Prof. Dr. Michael Raschke



Compilation of Performance Indicators

Third-party funding	2007	2008	2009
Overall revenue from third-party funding	294 M euros	308 M euros	381 M euros
Proportion of overall revenue from third-party funding	26%	11%	12%
Revenue growth in comparison to preceding year, commercial revenues from domestic R&D activities	52%	51%	49%
Proportion of revenue from foreign clients (revenue volume)	22%	21%	25%
Success rate of EU proposals in the last three years (accepted/ submitted)	47%	46%	37%
Revenue from EU funding Euro	19.9 M euros	19.7 M euros	21.7 M euros
Ratio of EU projects as coordinator vs. all projects	13%	14%	22%

Research-related results	2007	2008	2009
Publications in peer-reviewed journals	511	442	577
Peer-reviewed publications in proceedings, books etc.	568	593	460
Presentations for scientific conferences, workshops and lectures*)	0.76	0.55	0.55
Appointments to universities	13	12	13
Lectureships	204	248	244
Diploma theses	326	384	396
PhD theses	83	94	105
Postdoctoral qualifications	4	2	4

* per scientific associate engaged by the institutes and facilities

Technology marketing	2007	2008	2009
Revenue from licenses	3.6 M euros	3.9 M euros	3.9 M euros
Start-up companies	4	2	2
New "in-house" technology transfer projects	10	8	11
Investments in technology transfer projects	2.44 M euros	3.5 M euros	2.8 M euros

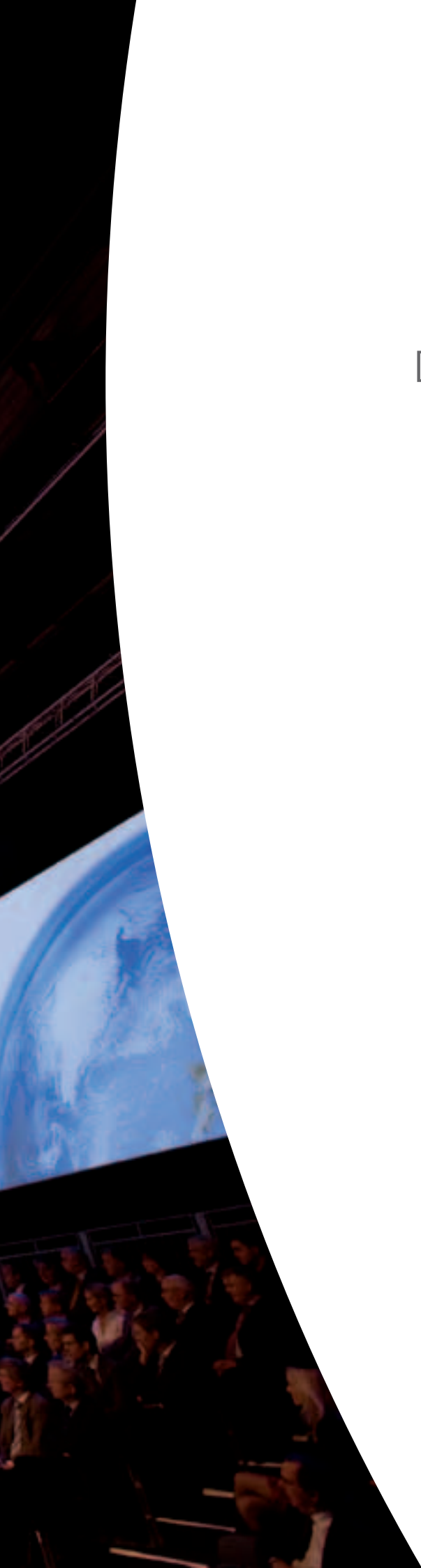
Management instruments	2007	2008	2009
Total project work	73%	72,8%	73,1%
Quality management	2007	2008	2009
Existing certifications & accreditations	19	25	28
Number of DLR auditors	15	15	10
Implementation of audit	29%	32%	38%
National and European networks	2007	2008	2009
DFG participations	27	33	34
Sponsorship agreements	45	49	41
International collaboration	2007	2008	2009
International visiting scientists*	7.4%	7.9%	3.3%
* staying > 1 month referenced to scientific associates in institutes			
Personnel	2007	2008	2009
Employees	5,627	5,880	6,485
Scientific associates (total)	3,046	3,295	3,677
Permanent /fixed-term contracts	3,104/2,523	3,148/2,732	3,229/3,256
Proportion of women			
- total	30%	30%	30%
- in management positions	13%	14%	14%
- scientific associates	12%	16%	17%
New talent	2007	2008	2009
Young scientists	93	86	63
Ph.D. students (internal/external)	607	670	734
Trainees	247	252	252
HR development and mobility	2007	2008	2009
Training days per employee	1.7	1.8	2.1
Mentoring pairs	7	8	8
Assignments abroad (months)	568	545	487



Wissen für Morgen

Wissen für Morgen

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 Center
- 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, 2010, DLR had 47 sponsoring members in addition to honorary members, scientific members and ex officio members.

Honorary Members

- The Honourable Daniel Saul Goldin, Washington, USA
- 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 50,000 euros 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
- The Free State of Bavaria, represented by the Bavarian State Minister of Economics, Transport, and Technology, Munich
- State of Berlin, represented by the Senator for Education, Science and Research for the State of Berlin, Berlin
- State of Bremen, represented by the Senator for Education 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, societies and associations with no legal capacity

- Aerodata AG, Braunschweig
- AIR LIQUIDE Deutschland GmbH, Düsseldorf
- ALSTOM Power Systems GmbH, Mannheim
- AOPA-Germany, Verband der Allgemeinen Luftfahrt e. V., Egelsbach
- Arbeitsgemeinschaft Deutscher Verkehrsflughäfen (German Airports Association), Berlin
- Robert Bosch GmbH, Berlin
- Bundesverband der Deutschen Luft- und Raumfahrtindustrie e. V. (BDLI) (German Aerospace Industries Association), Berlin
- CAE Elektronik GmbH, Stolberg
- CAM Systems 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) (German Aerospace Society), Bonn
- Deutsche Gesellschaft für Ortung und Navigation e. V. (German Institute of Navigation), Bonn
- DFS Deutsche Flugsicherung GmbH, Langen
- Diehl Aerospace GmbH, Überlingen
- 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, Munich
- Snecma Groupe SAFRAN, Vernon
- Stadt Braunschweig, Braunschweig
- Tesat-Spacecom GmbH & Co. KG, Backnang
- Volkswagen AG, Wolfsburg
- ZF Luftfahrttechnik GmbH, Calden

Scientific Members

- Prof. Dr.-Ing. Philipp Hartl, Munich
- Prof. Dr. Hans Hornung, Pasadena, California, USA
- Prof. Dr. rer. nat. Joachim E. Trümper, Garching

Ex Officio Members

- Prof. Dr.-Ing. Manfred Aigner, Stuttgart
- Dipl.-Kfm. Uwe Baust, Düsseldorf
- Jürgen Breitkopf, Munich
- Prof. Dr.-Ing. Hans-Jörg Bullinger, Munich
- Bernhard Conrad, Hamburg
- 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
- Prof. Dr.-Ing. Peter Horst, Braunschweig
- Prof. Dr.-Ing. Matthias Kleiner, Bonn
- Prof. Dr.-Ing. Jürgen Klenner, Bremen
- Prof. Dr.-Ing. Uwe Klingauf, Darmstadt
- Dr.-Ing. Reinhold Lutz, Munich
- Dr.-Ing. Rainer Martens, Munich
- Peter-Michael Nast, Stuttgart

- Dr.-Ing. Norbert Rüdiger Ninz, Überlingen
- Dr.-Ing. Manfred Peters, Cologne
- Dipl.-Ing. Thomas Reiter, Cologne
- Dr. rer. pol. Rainer Schwarz, Berlin
- Prof. Dr.-Ing. Joachim Szodruch, Cologne
- Prof. Dr.-Ing. Ulrich Wagner, Cologne
- Prof. Dr.-Ing. Johann-Dietrich Wörner, Cologne
- Prof. Dr. Gunter Zimmermeyer, Berlin

Senate

As of June 30, 2010, the following persons were members of the senate:

From the scientific sector

- Prof. Dr.-Ing. Manfred Aigner
- Prof. Dr.-Ing. Hans-Jörg Bullinger, ex officio
- Prof. Dr. rer. nat. Ursula Gather (Deputy 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. Uwe Klingauf
- Peter-Michael Nast
- Dr.-Ing. Manfred Peters

From the economics and industrial sector

- Dipl.-Kfm. Uwe Baust
- Jürgen Breitkopf
- Bernhard Conrad
- Marco R. Fuchs
- Dipl.-Ing. Rainer Götting
- Prof. Dr.-Ing. Jürgen Klenner
- Dr.-Ing. Reinhold Lutz
- Dr.-Ing. Rainer Martens
- Dr.-Ing. Norbert Rüdiger Ninz (Deputy Chairman)
- Dr. rer. pol. Rainer Schwarz
- Prof. Dr. Gunter Zimmermeyer

From the State sector

- Under Secretary Erwin Bernhard
- Under Secretary Dr. rer. pol. Gerd Gruppe
- Secretary of State Jochen Homann (Chairman)
- Secretary of State Dr. Hans-Gerhard Husung
- Under Secretary Günther Leßnerkraus
- Privy Counsellor Carl Othmer
- Ministerial Director Gerold Reichle
- Ulrich Schüller
- Under Secretary Andreas Schneider
- Secretary of State Dr. jur. Michael Stückradt
- VLR I Joachim Freiherr von Marschall

(without voting rights in 2010)

- Secretary of State Dr. phil. Josef Lange

Senate Committee

As of June 30, 2010, 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. nat. Ursula Gather (Chairman)
- Prof. Dipl.-Ing. Rolf Henke
- Prof. Dr.-Ing. Reinhard Niehuis
- Prof. Dr.-Ing. Heinz Voggenreiter

From the economics and industrial sector

- Christa Fuchs
- Prof. Dr. Jürgen Lehold
- Dipl.-Ing. Georg Rayczyk (Deputy Chairman)
- Dr. Artur Redeker
- Dr. Helmut Richter
- Dipl.-Phys. Berry Smutny

From the state sector (with voting rights in 2010)

- Chief Deputy Assistant Under Secretary Dr. jur. Reinhard Altenmüller
- Deputy Assistant Under Secretary Ronald Else
- Under Secretary Helge Engelhard
- Deputy Assistant Under Secretary Dr. jur. Axel Kollatschny
- Deputy Assistant Under Secretary Rainer Krug
- VLR I Joachim Freiherr von Marschall

(without voting rights in 2009)

- Dr. Walter Dörhage
- Senate Counsellor Bernd Lietzau
- Under Secretary Dr. Dietrich Nelle
- Dipl.-Ing. Josef Schiller
- Deputy Assistant Under Secretary Dietmar Schneyer
- Deputy Assistant Under Secretary Dr.-Ing. Ulrich Steger

Executive Board

(As of June 30, 2010)

- Dipl.-Kfm. Klaus Hamacher
(Vice Chairman)
- Dipl.-Ing. Thomas Reiter
- Prof. Dr.-Ing. Joachim Szodruch
- Prof. Dr. Ing. Ulrich Wagner
- Prof. Dr.-Ing. Johann-Dietrich Wörner
(Chairman)

Scientific-Technical Council

Members of the Scientific-Technical Council (As of June 30, 2010)

- Prof. Dr.-Ing. Alberto Moreira (Chairman)
- Prof. Dr. rer. nat. Hansjörg Dittus
- Prof. Dr.-Ing. Cord-Christian Rossow
- Prof. Dr.-Ing. Dirk Kügler
- Prof. Dr.-Ing. Karsten Lemmer
- Prof. Dr. Dr.-Ing. Hans Müller-Steinhagen
- Dr. rer. nat Marina Braun-Unkhoff
- Dipl.-Ing. Frank Kocian
- Dr.-Inform. Florian Piekert
- Dr. rer. nat. Reinhold Busen
- Prof. Dr. rer. nat Thomas Holzer-Popp
(Deputy Chairman)
- Dr. rer. nat Stephan Ulamec

Space Committee

(As of June 30, 2010)

- Ministerial Director Jürgen Meyer,
AL VII Technology politics, Federal
Ministry of Economics and Technology
- Under Secretary Dr. Dietrich Nelle,
UAL 42, Federal Ministry of Education
and Research
- Joachim Freiherr von Marschall, Head
Ref. 405, Ministry of Foreign Affairs
- VA Wolfgang Reimer, UAL 5,
Federal Ministry of Food, Agriculture
and Consumer Protection
- Ministerial Director Gerold Reichle,
AL LR, Ministry of Transport, Building
and Urban Affairs
- Norbert Weber, Ref. Rü IV 4,
Federal Ministry of Defence
- MinDirig Dr. jur. Peter Müller
AL ZG
Federal Ministry for the Environment,
Nature Conservation and Nuclear
Safety
- MinDirig Dr. Gabriel Kühne
UAL I C
Federal Ministry of Finance
- RegDir Frank Wetzel
RefL 421
Industrial Policy; Federal Chancellor's
office
- MinDir Beate Lohmann
AL O
Federal Ministry of the Interior



Affiliates and Joint Ventures

DLR Joint Ventures Gesellschaft mit beschränkter Haftung (DLR Joint Ventures Limited Liability Company), Bonn, Germany

100%

The purpose of this company is 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 (DLR Company of Space Applications mbH), Weßling, Germany

100%

The purpose of this company is provision of services relating to space applications.

DLR GfR mbH, together with Italian company Telespazio S.p.A., has a 50% stake in the founding of spaceopal GmbH, based in Munich. The main function of the company - subject to the award of contract by ESA - is the management of operations of the European satellite navigation system Galileo, including the two control centers in Fucino (Italy) and Oberpfaffenhofen.

Stiftung Deutsch-Niederländische Windkanäle (DNW) (German-Dutch Wind Tunnels Foundation), Noordoostpolder, The Netherlands

50%

DLR established this foundation as a non-profit organisation on an equal basis together with its Dutch partner organisation, NLR. Its object is to operate, maintain and continue to develop the low-speed wind tunnel in Noordoostpolder owned by the DNW foundation as well as wind tunnels owned by DLR and NLR. (www.dnw.aero)

European Transonic Windtunnel GmbH (ETW), Cologne, Germany

31%

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

TeleOp Gesellschaft mit beschränkter Haftung (TeleOp Limited Liability Company), Weßling, Germany

25%

This company was founded in collaboration with T-Systems, EADS and LfA Förderbank of Bavaria. Its object is to conduct negotiations within the framework of the GALILEO project, as may be required to participate in the construction and operation of the European satellite navigation programme, GALILEO. (teleop.de)

Anwendungszentrum GmbH (Incubation Centre for Applications GmbH) Oberpfaffenhofen, Gilching, Germany 25%

The Incubation Centre was established as a public-private partnership and is receiving start-up funding until the end of 2009 from funds provided by High-Tech-Offensive Bavaria. Since its launch, more than fifty companies have either passed through this start-up and entrepreneurial incubation centre in the field of satellite navigation initially funded by DLR alone, or have settled permanently at the Oberpfaffenhofen site as a result of its activities. (www.anwendungszentrum.de)

Europäische Akademie zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen Bad Neuenahr-Ahrweiler GmbH, Bad Neuenahr-Ahrweiler, Germany 25%

The European Academy 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 of processes that are influenced by the natural and engineering sciences and medical disciplines. As an independent scientific institution, the European Academy pursues a dialogue with the world of politics and society at large. The state of Rhineland-Palatinate is the further shareholder. (www.europaeische-akademie-aw.de)

ZFB Zentrum für Flugsimulation Berlin GmbH (Centre for Flight Simulation GmbH), Berlin, Germany 16.67%

The purpose of this company is to provide flight simulators for applied research in the fields of flight control and flight management, particularly for research and education purposes, system simulation and manipulation and associated areas of technology, instruction and training for aerospace engineers and training for flight crews. (www.zfb-berlin.de)

WPX Faserkeramik GmbH (WPX Fibre Ceramics GmbH), Cologne, Germany 10%

WPX Faserkeramik GmbH is a start-up company ensuing from the DLR Institute for Materials Research, which is built upon DLR expertise in structural materials. The purpose of the company is to provide product development, sales and service for the technical applications of WHIPOX – DLR technology. (www.whipox.com)

Dualis Medtech GmbH, Bernried, Germany 10%

Dualis MedTech develops, produces and markets novel medical implants for patients with severe heart conditions. The central product is the DUALIS-VAD implantable heart support system with the DUALIS-TET wireless energy transfer system. The technology is based upon technology from the Institute of Robotics and Mechatronics, DLR Oberpfaffenhofen. (www.dualis-medtech.de)

Zentrum für Angewandte Luftfahrtforschung GmbH (Centre for Applied Aeronautics Research GmbH), Hamburg, Germany 10%

The purpose of the company is to promote applied aeronautics research at the Hamburg site. The company is tasked to contribute to developing the research infrastructure, combining existing research skills, improving collaboration between the industrial sector, suppliers, large-scale research and the scientific community and implementing a stronger national and international network. (zal-gmbh.de)

Innovationszentrum für Mobilität und gesellschaftlichen Wandel (InnoZ) GmbH (Innovation Centre for Mobility and Demographic Change GmbH), Berlin, Germany 9.8%

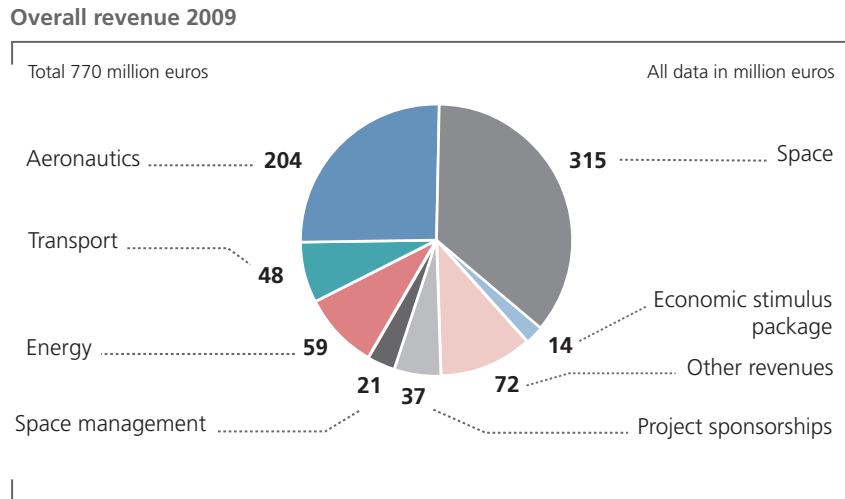
InnoZ researches the complex interactions at the interface between mobility and social change, developing innovative solutions to new challenges arising and to be faced by players in the transport and infrastructure sector. To this end, InnoZ combines a wide range of interdisciplinary skills under one roof. Sociological, geographical and economic expertise is equally included as are the perspective of applied transport economics. (www.innoz.de)

ZTG Zentrum für Telematik im Gesundheitswesen GmbH, Krefeld 6%

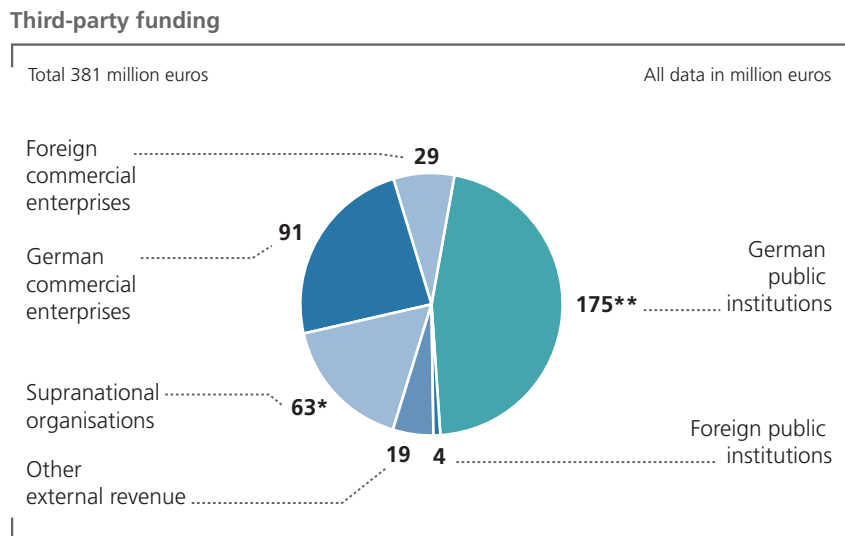
The aim of the competence centre is to introduce, develop and disseminate modern information and communications technology within the healthcare sector. Major focus areas include providing neutral advice and project management services for customers from industry and healthcare, implementing interoperable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

Use of Funds

Overall Revenue 2009 (Third-party and Basic Funding)



Third-party Funding according to Origin and Institutional Funding 2009

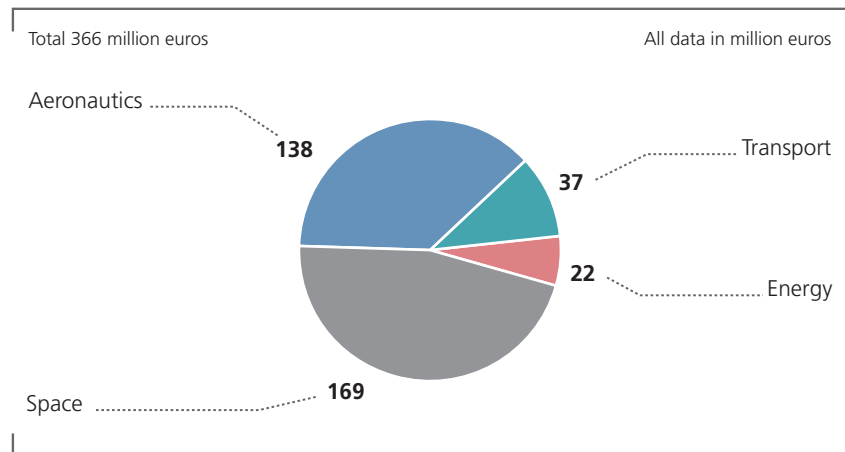


* including: ESA 40, EU 22, other 1

** including: national public institutions 94, project sponsorship 57, other R & D third-party funding 24

Third-party Funding Related to Institutional Funding 2010*

Third-party funding related to institutional funding 2010*



* without other revenue



List of Abbreviations

ACARE	Advisory Council for Aeronautical Research in Europe	DFG	Deutschen Forschungsgemeinschaft
ADETEF	Association pour le Développement des Échanges en Technologies Économiques et Financières	DFS	Deutsche Flugsicherung
AEB	Agência Espacial Brasileira	DGUV	Deutschen Gesetzlichen Unfallversicherung
AeroLight	Aeroelastische Untersuchungen des Rotors	DiAL	Differentielles Absorptions Lidar
AFRL	Air Force Research Laboratory	DIN	Deutsches Institut für Normung
AFRL	Air Force Research Laboratory	DLR	Deutsches Zentrum für Luft- und Raumfahrt
AGAPE	ACARE goals progress evaluation	DMT	Disaster Management Tool
AI	administrative Infrastruktur	DUK	Deutsche UNESCO-Kommission
AIM	Anwendungsplattform Intelligente Mobilität	DWD	Deutscher Wetterdienst
AirTN	Air Transport Net	ECSS	European Cooperation for Space Standardization
AQUA-CSP	Concentrating Solar Power for Seawater Desalination	ECTRI	European Conference of Transport Research Institutes
ASAC	Active Structural Acoustic Control	EDRS	European Data Relay Satellite
ATI	administrative und technische Infrastruktur	EEE	elektronische, elektrische und elektromagnetische Bauteile
ATM	Air Traffic Management	EERA	European Energy Research Alliance
ATRA	Advanced Technology Research Aircraft	EFQM	European Foundation for Quality Management
AutoOpti	Automatischer Optimierer	ENADOT	Electric Network Architecture Design Tool
AVANTGARDE	Advanced Numerical Tools Graduation by Application in Aeronautical Research and Development	EnMap	Environmental Mapping and Analysing Program
AVIC	Aviation Industries of China	ERANet	European Research Area Network
AWFS	Automatisiertes Waldbrandfrüherkennungssystem	EREA	Association of European Research Establishment in Aeronautics
BDF	Bundesverband Deutscher Fluglinien	eROSITA	extended ROentgen Survey with an Imaging Telescope Array
BG-ETE	Berufsgenossenschaft Energie Textil Elektro	ESA	Europäischen Raumfahrt-Agentur
BMBF	Bundesministerium für Bildung und Forschung	ESCC	European Space Components Coordination
BMVBS	Bundesministeriums für Verkehr, Bau und Stadtentwicklung	ESF	European Science Foundation
BMVg	Bundesministerium für Verteidigung	ESOC	European Space Operations Centre
BMWi	Bundesministeriums für Wirtschaft und Technologie	ESRIN	European Space Research Institute
BSC	Balanced Scorecard	ESTEC	European Space Research and Technology Centre
CAE	Chinese Aeronautical Establishment	ETCS	European Train Control System
CAF	Cluster Angewandte Fernerkundung	ETW	European Transonic Windtunnel GmbH
CATS	Climate compatible Air Transport System	EU	Europäische Union
CCRS	Canada Centre for Remote Sensing	EUREKA	European Research Coordination Agency
CCSDS	Consultative Committee for Space Data Systems	EWK	Europäischen Interparlamentarischen Weltraumkonferenz
CEN/CENELEC	Comité Européen de Normalisation Electrotechnique	FuE	Forschung und Entwicklung
CeraStorE	Competence Center for Ceramic Materials and Thermal Storage Technologies in Energy Research	FCH JTI	Fuel Cells and Hydrogen Joint Technology Initiative
CESAR-1	Central Termosolar de Almería - 1	FM	Facility-Management
CFD	Computational Fluid Dynamics	FM	Facility Management
CFK	Kohlenstofffaserverstärkter Kunststoff	GATE	Galileo-Test- und Entwicklungsumgebung
CIRA	Centro Italiano Ricerche Aerospaziali	GfR	Gesellschaft für Raumfahrtanwendungen
CNES	Centre National d'Études Spatiales	GIS	Geoinformationssystem
CoE	Center of Excellence	GMES	Global Monitoring for Environment and Security
COPUOS	United Nations Committee on the Peaceful Uses of Outer Space	GOAHEAD	Generation of Advanced Helicopter Experimental Aerodynamic Database for CFD code validation
CoSi- Cab+	Comfortable and Silent Cabin+	GPS	Global Positioning System
COSPAR	Committee on Space Research	GQA	Gesellschaft für Qualität im Arbeitsschutz
COST	European Cooperation in Science and Technology	GtL	Gas to Liquid
CSA	Canadian Space Agency	GTP	German Trainee Programme
		GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
		GvF	Gesellschaft von Freunden des DLR
		HALO	High Altitude and Long Range Research Aircraft
		HBK-S	Hochdruckbrennkammer-Prüfstand Stuttgart
		HGF	Helmholtz-Gemeinschaft Deutscher Forschungszentren
		HIGHER- LE	High-Lift Enhanced Research Leading Edge
		HLFC	Hybrid Laminar Flow Control
		HPC-NCAD	High Powered Committee-National Civil Aircraft Development
		HRSC	High Resolution Stereo Camera
		IABG	Industrieanlagen-Betriebsgesellschaft
		IAF	International Astronautical Federation

IAQG	International Aerospace Quality Group	RCAS	Railway Collision Avoidance System
IBMP	Institut für Biomedizinische Probleme	REACCESS	Risiko der Energieverfügbarkeit: Gemeinschaftliche Korridore für Europas Versorgungssicherheit
ICAO	International Civil Aviation Organization	RMC	DLR-Robotik und Mechatronik-Zentrum
iGREEN	integrated Green Aircraft	ROSKOSMOS	Russian Federal Space Agency
ILA	Luft- und Raumfahrtausstellung	RWTH	Rheinisch-Westfälische Technische Hochschule
INCAS	Nationales Institut für Luft- und Raumfahrtforschung	SANDRA	Seamless Aeronautical Networking through integration of Data links, Radios, and Antennas
INS	Innovation mit Normen und Standards	SAR	Synthetic-Aperture Radar
INTA	Instituto Nacional de Técnica Aeroespacial	SES	Single European Sky
IPCC	Intergovernmental Panel on Climate Change	SESAR	Single European Sky ATM Research
IPDA	Integrated Path Differential Absorption	SET-Plan	Strategic Energy Technology Plan
ISO	International Organization for Standardization	SGO	Systems for Green Operations
JAXA	Japan Aerospace Exploration Agency	SHEFEX	Sharp Edge Flight Experiment
JCM	Joint Committee Meeting	SIMCOS	Advanced Simulation and Control of Dynamic Stall
JTISFWA	Joint Technology Initiative Smart Fixed Wing Aircraft	SMOS	Soil Moisture and Ocean Salinity
Kaskosmos	Kasachische Raumfahrtagentur	SOFC	Solid Oxide Fuel Cell
KMU	Kleine und mittlere Unternehmen	SOFIA	Stratosphären-Observatorium für Infrarot-Astronomie
KVP	kontinuierliche Verbesserungsprozess	SOLHYCO	Solar-Hybrid Power and Cogeneration Plants
LamAir	Laminar Aircraft Research	TAMS	Total Airport Management Suite
LIDAR	Light Detection and Ranging	TanDEM-X	TerraSARX add-on for Digital Elevation Measurement
LIMES	Land and Sea Monitoring for Environment and Security	TBL	Turbulente Grenzschicht
LSV	Laser-Scanning Vibrometers	TEG	Thermoelektrische Generatoren
LuFO	Luftfahrtforschungsprogramm	TEXUS	Technologische Experimente unter Schwerelosigkeit
Ma	Mach	TI	Technische Infrastruktur
MAKS	Moskauer Luft- und Raumfahrtsalon	TRACE	Turbo machinery Research Aerodynamic Computational Environment
MDA	MacDonald Dettwiler	TRANS-CSP	Trans-Mediterranean interconnection for Concentrating Solar Power
MED-CSP	Concentrating Solar Power for the Mediterranean Region	TÜBITAK	Scientific and Technological Research Council of Turkey
MEFISTO	Methodology for framework programmes' impact assessment in Transport	TWG	Transsonischer Windkanal Göttingen
MINT	Mathematik, Informatik, Naturwissenschaften & Technik	UCAV	unmanned combat air vehicle
MOET	More Open Electrical Technologies	UNCCD	United Nations Convention to Combat Desertification
MoJo	Modular Joints for Composite Aircraft Components	UNESCO	United Nations Educational, Scientific and Cultural Organization
MOU	Memorandum of Understanding	UNOOSA	Büro der Vereinten Nationen für Weltraumfragen
MRO	Maintenance, Repair and Overhaul	UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
N.ERGHY	New European Research Grouping on Fuel Cells and Hydrogen	URANS	Unsteady Reynolds Averaged Navier-Stokes
NAL	National Aerospace Laboratories	VAAC	Vulkanasche-Vorhersagezentrums
NASA	National Aeronautics and Space Administration	VDSI	Verband deutscher Sicherheitsingenieure e.V.
NEWSKY	NEtWorking the SKY	VECTOR	Vehicle Technologies Scenario Model
NGT	Next Generation Train	VN	Vereinte Nationen
NLF	Natural Laminar Flow	WiMAX	Worldwide Interoperability for Microwave Access
NLR	Nationaal Lucht- en Ruimtevaartlaboratorium	ZAGI	Zentrales Aero-Hydrodynamisches Institut
NOAA	National Oceanic and Atmospheric Administration	ZKI	Zentrum für satellitengestützte Kriseninformation
NREL	National Renewable Energy Laboratory	ZLP	Zentrum für Produktionstechnik
ONERA	Office National d'Études et de Recherches Aérospatiales		
ÖPNV	Öffentlicher Personennahverkehr		
PAW	Polnischen Akademie der Wissenschaften		
PE	Personalentwicklung		
PGLR	Parlamentsgruppe Luft und Raumfahrt		
PMP	Project Management Professional		
PT-DLR	DLR-Projektträger		
PT-LF	Projektträger Luftfahrtforschung		
QM	Qualitätsmanagement		
QSTP	Qatar Science & Technology Park		
QUANTIFY	Quantifying the Climate Impact of Global and European Transport Systems		

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