REGIONAL REPORT

Baden-Württemberg

Baden-Württemberg is one of Europe's most inventive and innovative regions. Here in the southwest of Germany, 4.2% of the gross domestic product is invested in research and development, equal to €14 billion per year. Four of the nine best German universities have their home in Baden-Württemberg. Some 80 extramural research institutions work together with the higher education institutions located in the region. Baden-Württemberg and the international companies headquartered in the state generously support research projects with third-party and external funding. Baden-Württemberg develops specifically focused programmes to promote important fields of research and technology, such as the life sciences, nanotechnology, microsystems technology, new and novel materials, aerospace research, and energy and environmental research. It also offers a broad range of funding opportunities for young scientists and researchers.

RÜDIGER BUHL

FORWARD-LOOKING BY TRADITION: BADEN-WÜRTTEMBERG, LAND OF INVENTORS AND NOBEL LAUREATES

Automobiles and the Zeppelin, airbags and anti-lock braking systems, SAP software: groundbreaking inventions were made in Baden-Württemberg. This is why it is one of the leading states in the Federal Republic of Germany. Global players such as Daimler, Bosch and SAP have their global headquarters here, IBM and Hewlett-Packard their German headquarters. Besides automotive engineering, other key branches of industry include mechanical and electrical engineering.

Industry's technological lead is closely interwoven with the region's long tradition in science and research. Germany's oldest university lies in Heidelberg. Numerous Nobel Laureates either come from Baden-Württemberg or once worked there. Besides the author Hermann Hesse, other leading figures deserving mention are Prof. Dr. Christiane Nüsslein-Volhard, Prof. Dr. Georges Köhler, Prof. Dr. Bert Sakmann, Prof. Dr. Klaus von Klitzing and Prof. Dr. Harald zur Hausen.

MWK

The state's economic success has led to income levels well above the German average. Baden-Württemberg is not only a safe and friendly place to live and work, but also enjoys a very high standard of living. The countryside between Lake Constance, the Swabian Alb and the Black Forest, as well as important historical buildings such as Heidelberg Castle or Hohenzollern Castle, attracts countless tourists. The wines from Baden and Württemberg enjoy a good international reputation, while many gourmet restaurants are to be found here. The region has more than 100 theatres and over 1,000 public and private museums.

RESEARCH POLICY GUIDELINES IN BADEN-WÜRTTEMBERG

Germany's federal system gives the 16 federal states the freedom to set their own priorities in research and science. Baden-Württemberg has adopted a policy of steady and continual funding coupled with a long-term philosophy of appointing excellent professors so as to set the right course for recruiting the world's very best minds. Baden-Württemberg supports the universities with a guaranteed core budget of over €2 billion per year. This is topped up with external and third-party funding amounting to a total of €430 million. Project funding comes from the German Research Foundation (DFG), the German Government and the European Union, together with funds provided by various foundations. Baden-Württemberg's own foundation, the Landesstiftung Baden-Württemberg, has alone spent around €100 million on research funding since its establishment in 2000. Further funds are raised through industrial research contracts. Selected projects even include an allowance for infrastructural costs, such as equipment or facilities.

Rather than distributing its research funding indiscriminately, Baden-Württemberg attaches importance to sharing out funds on the basis of performance. The creation of clusters and centres of excellence at the universities is one of it's higher education policy priorities. In their capacity as strategically important fields

of research and technology, the life sciences, nanotechnology and microsystems technology, new and novel materials, aerospace research plus energy and environmental research are promoted through special programmes. The Ministry of Science, Research and the Arts of Baden-Württemberg supports cooperation between universities, extramural research institutions and industry.

Baden-Württemberg's higher education institutions were recently given the opportunity to establish professorships with a focus on either research or teaching. Professors with a focus on research are relieved from some of their teaching duties and vice versa. This provides more flexibility as far as tasks and responsibilities are concerned, while also giving greater consideration to individual strengths or interests.

UNIVERSITÄT TÜBINGEN

RESEARCH IN BADEN-WÜRTTEMBERG – A SUCCESS STORY

The Innovation Index 2008 shows that Baden-Württemberg is the most inventive and innovative region in Europe. Baden-Württemberg spends 4.2% of the gross domestic product on research and development, placing it at the top of the international league. Baden-Württemberg accounts for the highest proportion of staff working in high-tech industrial fields in the EU. More than 130,000 people at universities and companies work in fields of research and development.

In terms of patent applications, Baden-Württemberg is Germany's most successful federal state. One quarter of all patents registered in Germany were developed here in the region. Many of these patents were produced by efficiently transferring technology from the universities and extramural research institutions into business and industry.

National rankings prove that Baden-Württemberg's higher education institutions regularly top the rankings. Under the Sixth Research Framework Programme of the EU, they raised more than €200 million of third-party funding — more than the universities in any other German federal state. A similar success story is beginning to emerge in the current Seventh Research Framework Programme. The new programme has a much greater volume of €50.5 billion in total; basic research will be funded for the very first time.

SCIENTIFIC LANDSCAPE

Baden-Württemberg has one of the world's most tightly knit networks of universities. The region boasts some 80 public or private higher education institutions, with a total of 260,000 students. The nine universities among them stand out by being the most active in research. The 23 universities of applied sciences (*Fachhochschulen*) are particularly close to industry and offer very good applications-orientated education and training, while the Baden-Württemberg Cooperative State University (*Duale Hochschule*) is the first university in Germany to combine academic studies and work experience in companies. There are also six Universities of Education (*Pädagogische Hochschulen*) plus ten Universities of Music, Art, Design and Film. In addition, some 80 extramural research institutions have settled in Baden-Württemberg. These include 11 Max Planck Institutes for Basic Research, 14 Fraunhofer Institutes for Applied Research, seven Leibniz Association Institutes and two major research facilities of the Helmholtz Association. A further 13 research institutes are affiliated to companies.

UNIVERSITIES AS THE FOCUS OF RESEARCH

Three universities — Heidelberg, Freiburg and Tübingen — were founded as early as the 14th and 15th centuries and offer the whole spectrum of academic education.

The University of Heidelberg enjoys a reputation that extends far beyond Germany's borders. Besides its broad range of studies in the arts and humanities, it has set the natural and life sciences as one of its priorities. Heidelberg collaborates closely with the German Cancer Research Centre and the European Molecular Biology Laboratory. The University of Freiburg is also internationally acclaimed. A particular strength lies in its scientific centres, where cross-faculty research is performed. These centres include the neurosciences, materials sciences, medicine, history and law, among others. Freiburg also has its own Faculty of Engineering. The University of Tübingen fosters a transdisciplinary focus in all major fields of science and research, ranging from archaeology, linguistics and empirical education research to quantum physics and astrophysics as well as geo-environmental research, and from the molecular biology of plants, oncology and immunology, to the neurosciences.

The universities in Karlsruhe and Stuttgart were technical universities in the 19th century. And even today, they still have their core research areas in the natural sciences and engineering.

The Universität Karlsruhe and the Forschungszentrum Karlsruhe are currently merging to form the Karlsruhe Institute of Technology (KIT). The aim is to overcome the separation between university and extramural research. The merger will create an institution with 7,000 staff, more than 300 professors and an annual budget of €700 million. The core research areas at KIT are energy and environmental engineering, nanotechnology and microtechnology as well as elementary and astroparticle physics. The distinct profile of the University of Stuttgart includes networking the natural sciences and engineering with the humanities and social sciences. Core research areas include, among other fields, modelling and simulation technologies, new and novel materials, complex systems and communication, technology concepts and assessments, plus mobility. The underlying vision is one of comprehensive exploration the whole product development and product life cycle.

The universities in Konstanz and Ulm were founded in the late 1960s as reform universities. Konstanz is a modern campus university whose particular strength lies in its interdisciplinarity. Its 'Zukunftskolleg' jointly fosters and supports young and junior scientists and researchers from the natural sciences, arts and humanities, and social sciences. Ulm, too, engages in intensive, cross-disciplinary collaboration. The university has four key research areas: life sciences and medicine, information and communications technology, nanomaterials and biomaterials, and financial services.

The University of Mannheim's profile is shaped, above all, by its internationally acclaimed work in economics and the social sciences. By closely dovetailing subjects together, this relatively small university creates strong synergies and so, in terms of research performance, surpasses much larger universities.

The University of Hohenheim to the south of Stuttgart was founded in the 19th century as a School of Agriculture. Its strengths lie especially in the agricultural sciences and economics. The Centre for Agriculture in the Tropics and Subtropics pools the skills and competences of agricultural scientists, biologists and food technologists.

THE GERMAN EXCELLENCE INITIATIVE

The real quality behind Baden-Württemberg's universities is also highlighted by the results of the Excellence Initiative. In this purely science-driven competition, a total of €1.9 billion have been awarded so far to universities in Germany. The prize at stake included funding for Excellence Clusters and Graduate Schools as well as Institutional Strategies to Promote Top-Level Research and so advance the universities. Successful Institutional Strategies also won the coveted title of an "University of Excellence".

Baden-Württemberg was the most successful federal state in the Excellence Initiative. Of the nine German Elite Universities, four lie in Baden-Württemberg: Freiburg, Heidelberg, Karlsruhe and Konstanz. Seven Excellence Clusters and nine Graduate Schools were also awarded to universities in Baden-Württemberg.

The Excellence Initiative produced numerous new jobs for scientists and researchers. The universities also gained a non-materialistic benefit from the programme. The interdisciplinary focus of the Excellence Initiative made it possible to overcome disciplinary and institutional borders and so widen and extend the universities' scope and range.

The Excellence Initiative is to be continued. As from 2010, universities will be able to submit their proposals for the second round. Some €2.5 billion have been earmarked for continuing existing and establishing new Excellence Projects. This second round will again create jobs for scientists and researchers, including in new Graduate Schools.

SELECTED RESEARCH PRIORITIES

Baden-Württemberg's universities and extramural research institutions offer numerous distinguished core research areas in medicine, the natural sciences and engineering, as well as in the humanities and social sciences. The following presents some selected Excellence Clusters, Collaborative Research Centres and Graduate Schools.

Life sciences

The Universities of Freiburg, Heidelberg and Tübingen are studying communication within and between cells. All three core research areas are Excellence Clusters. Ulm also won a Graduate School in this topic area.

The Centre for Biological Signalling Studies (bioss) at the University of Freiburg is working on a new interdisciplinary research approach. It will contribute decisively to explaining the molecular principles of biological signal processing and to understanding the signal processes that maintain the body functions but can also lead to pathological changes. The focus is on a dialectic research process to which signal scientists are contributing with analytical and synthetic methods. The bioss strategy is supported by a resource centre for signal engineers, the 'bioss toolbox', the development of two new machines for signal synthesis and image information processing, and by a technical platform for gene and protein synthesis.

At the 'Cellular Networks' cluster of the University of Heidelberg, scientists from all fields of the life sciences are looking to explain the function, structure and evolution of networks within and between cells. They aim to analyse the components and dynamic changes of such networks so that they can develop an overarching understanding of their regulation and interaction. No longer are complex phenomena to be studied solely *in vivo* or *in vitro*, but also and increasingly *in silico*, in other words with the help of computer programmes, for example simulation or modelling.

KIT

The Werner Reichardt Centre for Integrative Neuroscience (CIN) at the University of Tübingen is exploring how the brain generates functions such as perception, memory, communication and actions. Researchers from the field of integrative neurosciences are studying the brain mechanisms underlying these functions and their disturbances – from their genetic basis to the processing of information in neuronal networks. CIN is made up of working groups from six faculties at the university and collaborates with the Max Planck Institute for Biological Cybernetics in Tübingen and the Fraunhofer Institute IPA in Stuttgart

The Graduate School for Molecular Medicine in Ulm offers clearly structured, interdisciplinary doctoral training in one of the university's key research topics. The priorities set in the modular training programme are 'signal networks in molecular and cellular development and degeneration', 'signal networks in the blood-forming system and carcinogenesis' and 'signal networks in cardiovascular and metabolic diseases".

Simulation technology

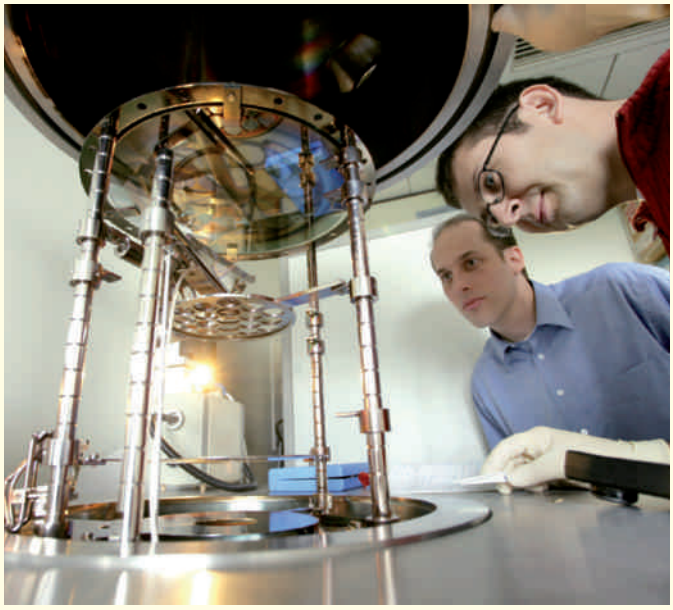
The fields addressed by the Excellence Cluster on Simulation Technology (SimTech) at the University of Stuttgart extend from molecular dynamics and modern mechanics via numerical mathematics and systems analysis through to data management, plus interactive visualisation and high-performance computing. This is complemented by a platform of reflection, technology impact assessment and evaluation. For example, scientists and researchers are drawing up methods that lead to the simulation-based design of new materials with tailor-made high-tech properties, through to the completely virtual development of prototypes and factories, as well as solutions in the field of systems biology and medicine.

Nanosciences

The DFG Centre for Functional Nanostructures (CFN) in Karlsruhe, also an Excellence Cluster, is one of Europe's largest nanosciences research institutions with more than 250 scientists. The spectrum

of research topics extends from metamaterials via molecular-electronic components through to the transport of nanoparticles in cells. The scientists aim to develop functional nanostructures for optical, electronic and biomedical applications. They are working on more than 80 projects, including nanophotonics, nanoelectronics, nanobiology and molecular nanostructures.

UNIVERSITÄT KARLSRUHE



Humanities

The Excellence Cluster on the 'Cultural Foundations of Integration' at the University of Konstanz examines integration at all levels of society, from family to world community. It transcends the ages from antiquity to the present. The work focuses particularly on those 'locations' where processes of integration and disintegration intersect, where culture becomes both a contact zone and a place for addressing differences. Building on the available empirical research, more than 100 scholars from the humanities and social sciences are working on a new theory of culture that understands culture as a constituent element of integration.

The Excellence Cluster 'Asia and Europe in a Global Context: Shifting Asymmetries in Cultural Flows' at the University of Heidelberg studies relations between Asia and Europe. These have always been intensive, tense and exciting, but generally asymmetric. The scientists do not see this as a flaw, but rather as the normal state of cultural relations. The cluster is divided into four research areas: governance and administration, public spheres, health and environment, historicities and heritage. The cluster combines theoretical approaches with the study of original sources and field research. In so doing, it incorporates previously-neglected (for instance, audiovisual) material.

Agricultural Science

The Collaborative Research Centre on 'Sustainable Land Use and Rural Development in the Mountain Regions of Southeast Asia' at the University of Hohenheim aims to contribute to preserving natural resources and to improving people's living conditions. The scientists are studying complex land-use systems, thereby applying methods that take the interactions between ecosystems, ethnic diversity and various institutional frameworks into consideration. Their interdisciplinary and participative approach also incorporates the general population. The scientists show the decision-makers where a need for action exists as well as the options that are available, and assess the efficiency of technical changes and innovations.

OPPORTUNITIES FOR YOUNG RESEARCHERS

Future successful research in Baden-Württemberg depends essentially on whether the young scientists and researchers are able to work under good conditions and develop freely. This is why Baden-Württemberg offers a broad range of funding sources and opportunities for graduates and postdocs.

A well-developed system of scholarships and grants enables young graduates to produce their doctoral thesis in good time. The new Graduate Promotion Act of Baden-Württemberg places the decision on how much and for how long graduates receive funding in the hands of the universities, making flexible arrangements possible.

Structured doctorates or PhD programmes, such as those offered by research training groups and research schools, for example, are to be expanded, because they contribute particularly to promoting interdisciplinary and international collaboration. research training groups (*Graduiertenkollegs*) are approved by the German Research Foundation (DFG) in a strict review process. The universities in Baden-Württemberg currently have a total of 37 DFG research training groups. The Federal State has earmarked a total of €7.7 million per year for funding graduates.

The Landesstiftung Baden-Württemberg is a private foundation in which the State of Baden-Württemberg is the sole shareholder. It invests its resources in forward-looking projects in the fields of research, education and social responsibility. Its measures include promoting postdoctoral students in its Elite Programme, from which infrastructural resources are allocated for outstanding research projects. Since 2002, more than 120 young researchers have been funded with up to €80,000 each.

The State of Baden-Württemberg has a new programme which awards 'research seed capital' to young scientists and researchers who have bright new ideas for research projects. The funding — up to €100,000 — enables them to do preliminary work that can later provide a basis for raising further research funding. The programme aims to encourage scientists to address truly new 'high-risk' research beyond the mainstream.

Junior professors at Baden-Württemberg's universities are able to conduct research and teach autonomously and can then qualify for a tenured professorship, even without the postdoctoral habilitation, the *venia legendi*. They can also take a tenured professorship at the same university, without needing to submit a further application (tenure track). The universities in Baden-Württemberg have a total of 750 positions available for junior professors. The Federal State promotes junior scientists and researchers in a special programme worth €2.6 million per year. This opens up greater financial freedoms for junior professors and enables them to carry out innovative research projects. They can receive up to a total of €150,000 over a maximum of three years.

Baden-Württemberg attaches importance to the equal opportunity of men and women in science and spends around €3.8 million per year on numerous programmes to support this objective. A special childcare programme for research staff helps them combine their scientific career and family duties. The 'Schlieben-Lange-Programme' awards grants to mothers so that they can continue their scientific or artistic career even with children. The 'Margarete von Wrangell Habilitation Programme for Women' specifically provides funding to promote young women. Its goal is to increase the proportion of women among the professors. The women scientists are employed at universities, through which they have full social security cover.

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