

A STRATEGY FOR THE FUTURE

As nations compete for scientific recognition, Germany is boosting its fight. Over the past few years, the Bundesministerium für Bildung und Forschung (BMBF)—Germany’s ministry of education and research—has upped the science budget and encouraged initiatives that require universities and scientists to be more innovative. The intention is to promote competition to improve the nation’s science reputation. **By Gunjan Sinha**

Last year the federal and state governments announced the first winners of the Excellence Initiative—a measure introduced by the Deutsche Forschungsgemeinschaft (DFG) and the Wissenschaftsrat, a scientific commission that advises political decision makers. For the first time in decades, universities and collaborative research groups have a chance at winning substantial extra funding if they prove worthy.

“My view on the development of the science system in Germany is not to have a flat field but a picture of the Alps,” says **Matthias Kleiner**, president of the DFG, Germany’s primary science funding agency.

Germany’s “flat field” is its university system. For decades the notion of equality in education has driven the nation’s science funding strategy. Until last year, all universities received the same lump sum from state and federal governments, regardless of quality. But while all universities are similarly prestigious, they haven’t been able to compete internationally and lure in top talent.

The Excellence Initiative offers €1.9 billion in additional funding through 2011. Last year the DFG and the Wissenschaftsrat doled out €873 million of that sum in the program’s three categories: 12.7 percent went to support graduate schools, 63.4 percent went to research clusters (projects involving scientists from several institutions), and 23.9 percent was awarded to universities for devising strategies for future development.

Federal and state governments plan to announce a second round of winners this October. Overall 40 graduate schools and 30 research clusters will win the coveted extra funds after a lengthy application process. In addition, universities will also receive a supplementary allowance of 20 percent of the funding to cover indirect expenses.

Universities aren’t the only science research centers to get a financial boost. BMBF also promised a 3 percent per year increase in funding through 2011 to Germany’s nonuniversity research institutes: the Hermann von Helmholtz Association of National Research Centers, Max Planck Society, Fraunhofer Society, and Gottfried Wilhelm Leibniz Science Association. The total science budget increase amounts to an additional €6 billion over five years.

German research is striking back in other ways too. Construction of a new European X-ray laser facility in Hamburg is slated to begin this year—it will be the only one of its kind in Europe. And the Deutsches **continued »**



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Krebsforschungszentrum (DKFZ)—German Cancer Research Center—recently launched The National Center for Tumor Diseases in Heidelberg with the goal of translating basic research into better treatments for cancer patients.

Germany isn't the only nation within the European Union to strengthen its scientific prowess. The nation's efforts are the manifestation of the European Council's decision in 2000 to transform the European Union into "a competitive and dynamic knowledge-based economy" by 2010. The so-called Lisbon Strategy calls on all member states to increase spending on research and development to 3 percent of GDP by 2010.

But instead of keeping the status quo, Germany wants to shake up the system by requiring institutions and scientists to compete for those extra funds. Germany isn't alone in this regard. The French government has a bill pending that would also give French universities, which are government controlled, more freedom to manage budgets, investments, and real estate. Italy and Spain are also moving in similar directions. But while they continue to debate the pros and cons of a competitive system, in Germany the idea is no longer controversial.

"No one talks anymore about equal funding and possibilities for everyone," says **Thomas Vogt**, spokesperson for the Leibniz Association. "This [initiative] is to strengthen the strong."

The Winners

While Germany's research institutes such as Max Planck, Leibniz, and Helmholtz have strong reputations, its university research has been lackluster. In the 2006 list drawn up by the *Times* Higher Education Supplement, for example, the University of Heidelberg came in at number 58—that was the best rank of any German university.

"Germany was one of the leading nations in science," says Kleiner.

Helmholtz Association
www.helmholtz.de

Leibniz Association
www.wgl.de

Max Planck Institut für Eisenforschung
www.mpie.de

Nationales Centrum für Tumorerkrankungen
www.dkfz.de/en/nct

Technische Universität
portal.mytum.de/welcome

Universität München LMU
www.uni-muenchen.de

University of Karlsruhe
www.uni-karlsruhe.de



Current (bottom) and future (top) National Center for Tumor Diseases (NCT) building in Heidelberg.

"But the loss of science during the Second World War has been long lasting. There must be a movement toward excellence in science again."

Toward that goal, DFG and the Wissenschaftsrat implemented the Excellence Initiative in 2005 that introduces competition into the system to improve the quality of research. Last year, reviewers selected 22 universities to receive additional funding; a few came out ahead of the class. Technical University Karlsruhe (TUK), the University of Munich (LMU), and Technical University Munich (TUM) won in all three categories—future development, graduate programs, and cluster participation—making the city of Munich the program's biggest winner.

TUK's future strategy centers on its longstanding cooperation with the Forschungszentrum Karlsruhe, an institute governed by the Helmholtz Association. The two propose to create the Karlsruhe Institute of Technology, modeled on the Massachusetts Institute of Technology in the United States.

TUK also won funds for its proposal to establish a department of optics and photonics and for collaborating with the DFG Center for Functional Nanostructures, which will form the epicenter of a nanotechnology research cluster.

The Karlsruhe School of Optics and Photonics graduate school, which the university intends to establish in collaboration with three other research institutions, is intended to plug a hole in graduate study. The optics and photonics industry grows annually by about 20 percent according to the Association of German Engineers. However, optics and photonics are not distinct disciplines at German universities.

LMU's future strategy is a concept it refers to as "working brains – networking minds – living knowledge." It plans to introduce student recruitment, conduct more fund raising—a rarity in **continued »**

Focus on Germany

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Germany—and use peer evaluation to improve and update teaching quality.

LMU also intends to launch a graduate school of systematic neurosciences and participate in three research clusters: the Munich Center for Integrated Protein Science, the Munich Center for Advanced Photonics, and the Nanosystems Initiative Munich.

The third university to take top honors was TUM. It proposed to transform itself into an “entrepreneurial university” by adopting a

series of measures that ensure greater information exchange between the university and industry, selectively recruiting students and professors, and conducting more fund raising. It also plans to further develop its new Institute for Advanced Studies, modeled on the one in Princeton, New Jersey, which will free some of its top professors from part of their teaching loads.

“Both universities in Munich are really outstanding,” comments Kleiner. “But there are no losers in this competition, he adds. Working on proposals to apply for the additional funds has helped universities focus on the future—a task they were never encouraged to do. Even the universities that don’t win Excellence Initiative funding, Kleiner says, profit from the exercise of applying.

Nonuniversity Research

Established within the past 60 years, German nonuniversity research centers such as Max Planck, Leibniz, and Helmholtz already have reputations for conducting strong science. Contributing to their success, says Leibniz’s Vogt, is the fact that they are relatively new and that they function independently. Moreover, scientists can pursue research without the constraints imposed by teaching.

“We have pretty modern equipment,” says **Anke Pyzalla**, director of the Max Planck Institut für Eisenforschung in Düsseldorf. “That gives us the possibility to pursue science that is really new.” The institute for

iron research is one of the very few that are financed partly by the Stahlinstitut VDEh, she adds, an industrial partner. The collaboration helps the institute conduct projects that would be of interest to the steel industry that are potentially profitable. It’s a model that many institutes and universities would like to emulate.

To bring university research up to par, one explicit aim of the Excellence Initiative is to foster more collaboration between universities, nonuniversity research centers, and industry when possible—an effort that has so far been fruitful. Seventy percent of the 17 research clusters thus far awarded funding as part of the Excellence Initiative are being driven by Max Planck Institutes, says **Bernd Wirsing**, spokesperson at Max Planck. Among them are the Frankfurt cluster on macromolecular complexes and the clusters of astrophysical science and cellular networks both centered at the University of Heidelberg.

The Leibniz Association participates in four clusters and the Helmholtz Association participates in six—collaborations that have greatly benefited university scientists and graduate students who have access to the better infrastructure that exists at research centers. But the research centers benefit too, says Wirsing, because cluster participation and the accompanying financial resources enable them to branch out into new areas. Leibniz, for example, has broadened its research to include ocean science, nanotechnology, and cellular biology.

Collaboration among researchers across institutions and industry participation is the norm in the US. But inertia within the system has prevented such collaboration from becoming widespread in Germany. Funding that promotes research clusters will establish a framework for collaboration, says Kleiner.

Just as beneficial, say experts, is the 3 percent annual funding increase promised by BMBF. It’s the first time that the research centers can count on at least a 3 percent annual increase, perhaps indefinitely, says Vogt. Leibniz has mostly put the extra funds toward salary increases and internal costs.

Helmholtz Association, however, has taken a slightly different tack. It has used much of the funding to launch a number of initiatives that mirror the Excellence Initiative. In 2002, for example, Helmholtz introduced the President’s Initiative and Networking Fund that has so far doled out €150 million toward three types of projects: collaborative research that includes different Helmholtz centers, universities, international partners, and industry; financial packages to support young scientists and graduate schools; and establishing a framework to improve working conditions for researchers.

After a scientific review process, the president can distribute the additional funds at his discretion, says **Korinna Bauer**, project officer for the Helmholtz **continued »**

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Focus on Germany

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—Christof von Kalle



Alliances scheme, which funds the collaborative research projects. For very large clusters, the senate must also give its consent. Still, it's a much less complicated process than doling out institutional funds, which requires a lengthy review process, she adds.

Two collaborative projects approved earlier this year, for example, are Physics at the Teraskala and Mem-Brain. Physics at the Teraskala aims to investigate the nature of matter and the forces operating directly after the Big Bang. Particle physicists from two Helmholtz Centers, Deutsches Elektronen-Synchrotron (DESY) and Forschungszentrum Karlsruhe, have joined forces with colleagues from 17 universities and the Max Planck Institut für Physik in Munich. This alliance will receive a total of €25 million over the next five years.

The Mem-Brain project pools scientific talent from four Helmholtz centers, universities, industry, and research institutions both in Germany and abroad. The goal is to develop ceramic membranes to lower pollutant and carbon dioxide emissions in coal-fired power plants. This alliance will receive €11 million over the next three years.

The fund has been so successful that Helmholtz plans to more than double it next year to €57 million. But the extra funds won't necessarily go into the same programs.

“The idea is to do some structural innovation,” Bauer explains. “Our goal is not only to do excellent science, but also to do things that will last beyond the research itself.” Reaching out to young, talented scientists, for example, ensures a steady supply of fresh talent that will be interested in working with Helmholtz long into the future, Bauer adds.

Other Projects

Earlier this year, BMBF officially launched the construction of the European X-ray laser facility (XFEL)—a particle accelerator that will send electrons hurtling down a 3.4 km underground tunnel to generate pulses of brilliant X-ray light.

Expected to provide bursts of light that are orders of magnitude brighter than any existing light source, XFEL will enable researchers to film at atomic detail the precise sequence of events in chemical reactions, material deformation, and biological processes.

The XFEL will be built in Hamburg and Schenefeld and is scheduled to be complete by 2013. The project is a pan-European effort but Germany is funding the bulk: Twelve countries will contribute at least 25 percent of the estimated €1.082 billion cost; German federal and local governments will finance the rest.

The facility's closest rival is across the Atlantic, where engineers

are working on the US Department of Energy-funded Linac Coherent Light Source—a machine that will produce X-rays in a manner similar to XFEL, emitting pulses a thousand times shorter than existing instruments. It is scheduled to be complete by 2009.

Less grand but equally important is Germany's new National Tumor Center in Heidelberg. For the past 40 years DKFZ has carried out basic cancer research and cancer patients have been treated at the nearby University of Heidelberg hospital. But the collaboration between basic and clinical researchers has been limited, explains **Christof von Kalle**, director of the new center. The new center aims to translate basic research into new therapies. In 2004, the Helmholtz Association gave DKFZ a startup grant to support the project with €13 million over five years.

“That's not a huge amount,” von Kalle acknowledges. But the DKFZ, Heidelberg University, and two neighboring hospitals have agreed to split the remaining costs 50/50, he adds.

Right now the center is operating out of Heidelberg University hospital. But in two years, it will occupy its own space and become the first comprehensive cancer clinic in Germany. Deutsche Krebshilfe, a nonprofit cancer aid society, has agreed to foot the bill for a new facility scheduled to be complete in 2009. The new facility will occupy 5,500 square meters of space, five times the space the center presently occupies. The society has also agreed to finance the building for 10 years, after which Heidelberg University Hospital and DKFZ will take over. The center's primary goal will be to take promising basic research from DKFZ and put it into clinical trials conducted at the center.

Measuring Success

Overall the changes and additions in the German science landscape bode well for scientists—more money means more jobs. But whether they go far enough to achieve their intended goals is anybody's guess. And Germany has other issues that some say hold back the nation's science. One problem echoed by many is the salary system.

The German government still considers scientists civil servants and fixes their salaries via a tariff system. “It has been very difficult to offer internationally competitive salaries because of the mandatory tariff,” von Kalle complains. Recent changes do offer a scheme whereby institutions can top up salaries based on performance, but at the same time the government has reduced base salaries and even cut university funding in several areas, says von Kalle.

Gender is also an issue. Only 14 percent of professors are female in Germany—about half the percentage in other nations. But change is afoot. There's lots of discussion over initiatives that keep women in science. Several universities that won additional DFG funding, for example, plan to actively recruit more female professors.

In fact, the Excellence Initiative has been so successful, says Kleiner, that he has been discussing extending it beyond its scheduled five-year life span, perhaps indefinitely. “This isn't a process that will be finished in five years. We want to make it permanent and the response from politicians so far has been very positive.”

Gunjan Sinha is a freelance writer living and working in Berlin, Germany.

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