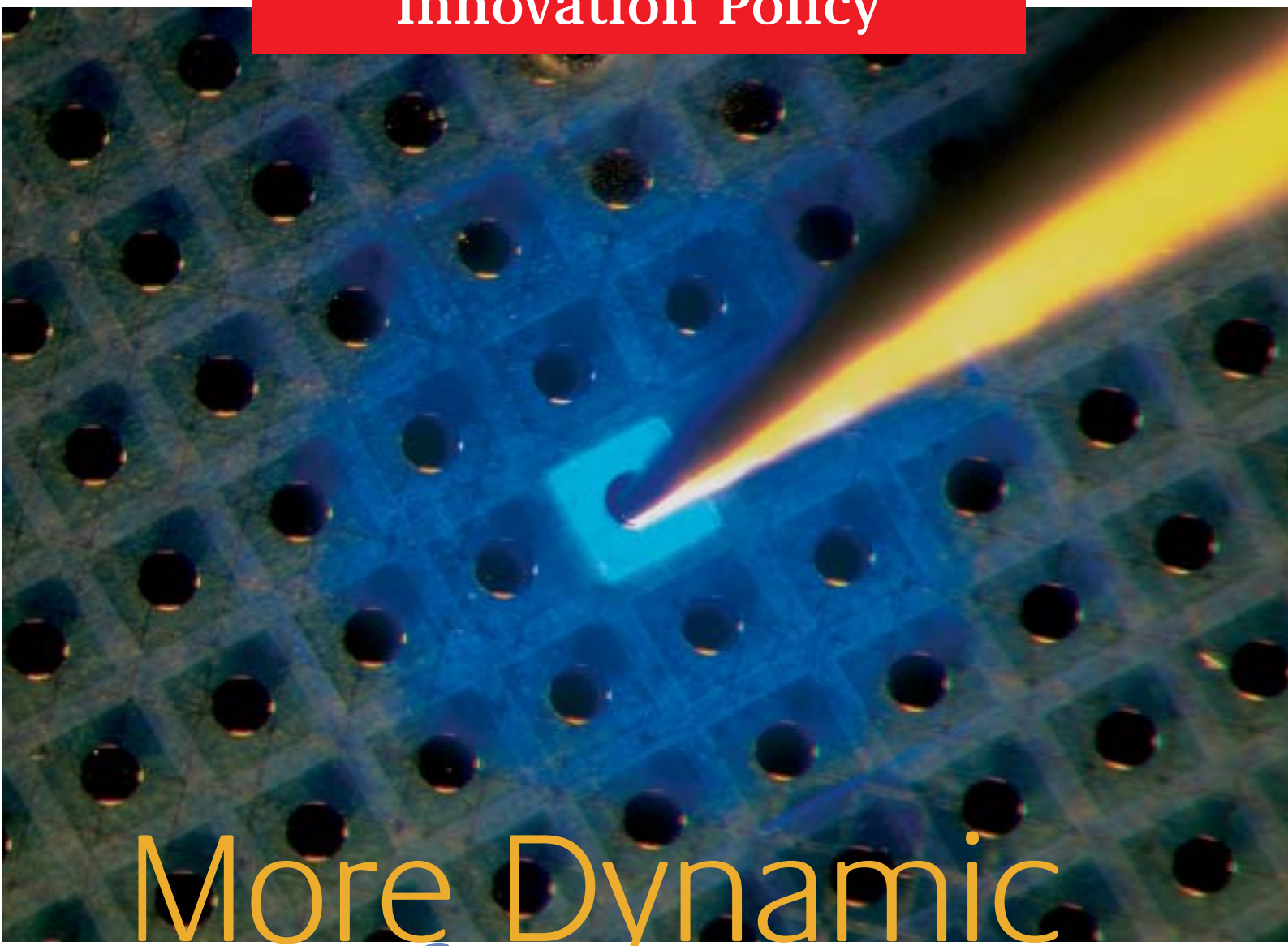
Federal Ministry
of Economics
and Technology

Federal Ministry
of Education
and Research

Innovation Policy



More Dynamic for Competitive Jobs

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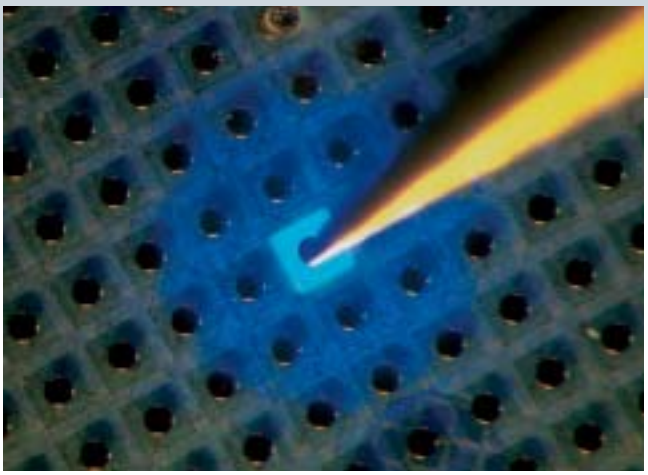
Contents

Foreword



TO OUR READERS,

Innovation secures the future. New products, services and processes make companies more competitive in the global markets and so secure jobs for the future in Germany. That is why innovation policy is a central component of a forward-looking policy for more growth and employment.

Germany is well placed for this. We have efficient and highly motivated people, innovative companies and an excellent scientific and technical infrastructure. But only the rapid introduction of new technologies to the markets of the future will decide whether we can keep pace with the ever shorter cycles of innovation and products – even more, whether we can help to decide the tempo of development.

Important signals have already been set. Within its areas of competence the German Government has taken far-reaching steps to modernise our education and training system. For first of all, and above all, we need highly qualified personnel if we are to remain a top league player in the global knowledge society. Research and innovation have again been accorded priority. Incentives have been given for better cooperation between universities, research institutes and companies, particularly small and medium-sized companies – and now they need to be vitalised. Moreover, the innovation networks need to involve more international partners.

This brochure has been produced jointly by the Federal Ministry of Economics and Technology and the Federal Ministry of Education and Research to show the challenges we face and the innovation policy measures the German Government has taken and will take to accompany our progress into the global knowledge society. The measures taken by each of the Ministries are clearly presented here in a unified concept, to give the general public full information on the German Government's innovation policy.

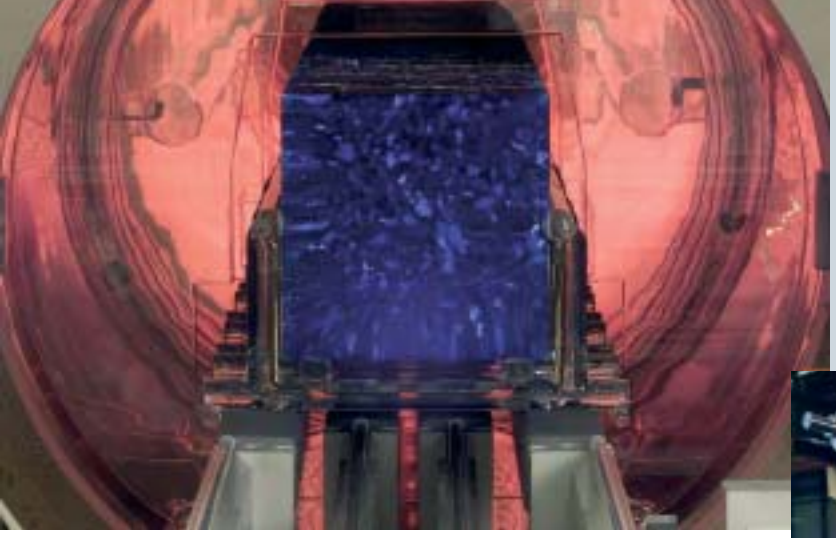
Innovation is the result of the wealth of ideas produced by our scientists and workers. But innovations also need resourceful entrepreneurs who can develop the ideas into marketable form. And they need a society that is open to new ideas. Hence innovation for jobs for the future is a subject that matters to all of us. We invite the universities, the research institutes, companies and all the men and women in our country to play an active part in helping to meet the challenges, above all to help create new and viable jobs for the future. That also means dialogue and critical discussion. This brochure is also intended to encourage these.

Federal Ministry of Economics and Technology
Federal Ministry of Education and Research

April 2002

Innovation and Employment

Germany´s
Competitiveness on Innovation



INNOVATION CREATES POTENTIALS FOR GROWTH AND SO CREATES NEW JOBS

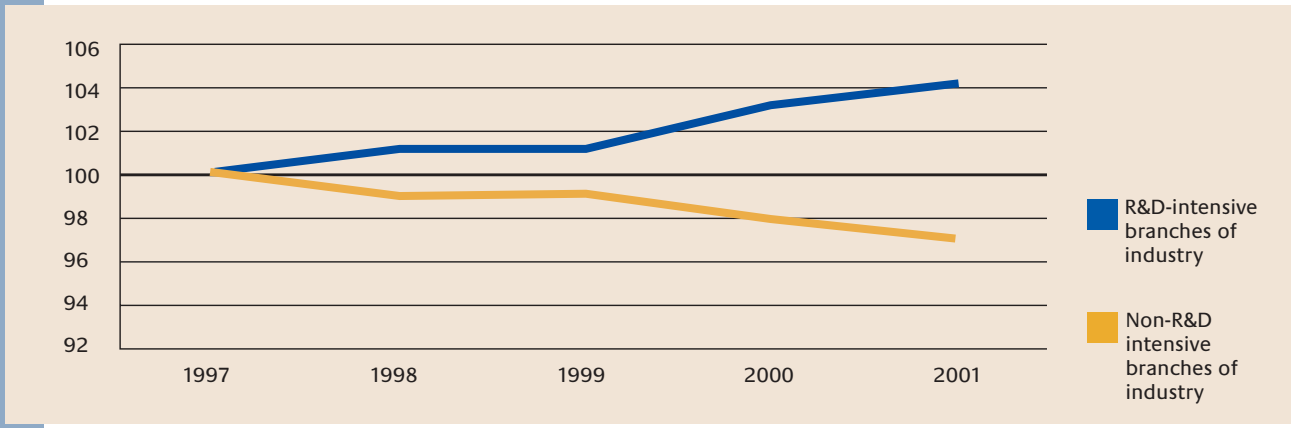
INNOVATION CREATES NEW JOBS

Germany needs innovation more urgently than ever before. Innovation prepares the way for prosperity in our society. Above all, innovation creates new jobs that will also be viable for the future. New staff are appointed firstly by companies that are successful in marketing new products or new services born of innovative ideas. Behind new and successful products there is generally a long process of innovation inside the firm, and a large number of highly qualified staff are needed. Not without reason are companies that invest in research and development (R&D) more successful on the market.
On balance the sectors that are highly innovative and research-intensive create most of the new employment. Between 1997 and 2001 about 92,000 new jobs were created in the R&D-intensive branches of industry, while during the same period about 110,000 jobs were lost in the sectors of the manufacturing industry that are not R&D-intensive.

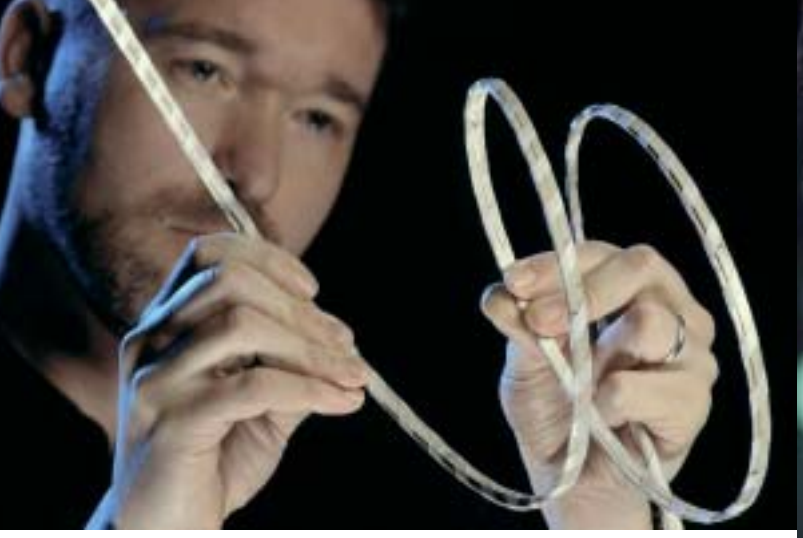
New technological developments from the research-intensive sector also lead to many new jobs in the services sector. For it is often only the accompanying bundle of services, like software, marketing and maintenance, that makes the introduction of a new product really successful. During the same period more than half a million additional jobs were created in knowledge-intensive services firms. A policy for more innovation is thus always also a policy for more growth and employment.

The connection between research, innovation and employment is particularly impressive in the automotive industry. The vehicle construction firms have clearly expanded their research in the last twenty to thirty years, far more than most other sectors, and far more than the automotive industry in other countries. These efforts have paid off. Nearly every second patent registered at the European Patent Office for vehicle construction comes from Germany. We have one fifth of the world market in this sector. Vehicle construction is also

THE TREND IN EMPLOYMENT IN R&D-INTENSIVE BRANCHES OF INDUSTRY IN GERMANY (1997 = 100)



Source: Niedersächsisches Institut für Wirtschaftsforschung (NIW), Hanover



STABLE CONNECTIONS LIKE HIGH-TEMPERATURE SUPRA-CONDUCTORS EXEMPLIFY INNOVATION IN ENERGY TECHNOLOGY

NEW INSIGHT INTO THE FUTURE BRINGS COMPETITIVE ADVANTAGES

one of the very few industrial sectors that has achieved a growth in employment in the last twenty years – and that is not including the many jobs in components firms or services in other branches to accompany the innovations.

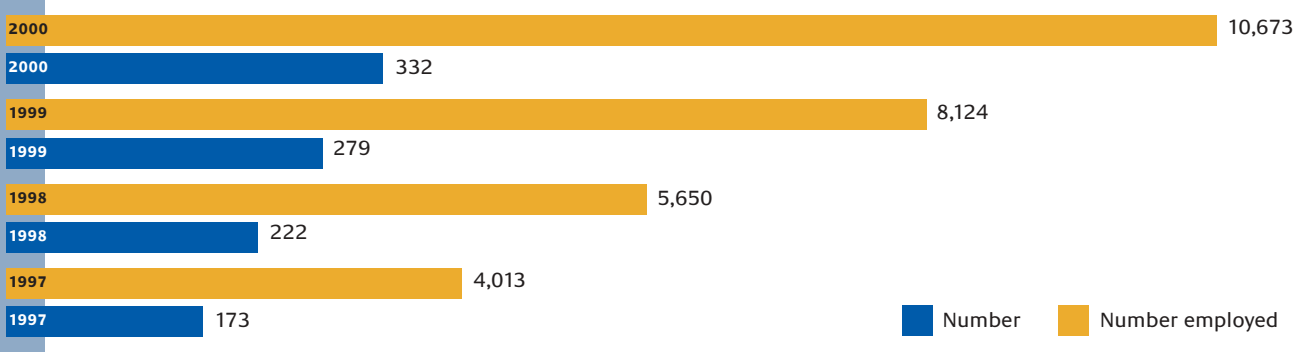
New jobs are not only created in existing fields, they are created particularly in **new branches with a high potential for growth.** The biotechnology sector in Germany is a striking example. According to a study by Ernst & Young in 2001 the number of new jobs in the core biotechnology companies alone rose by 31 % from 1999 to 2000. Since 1999 Germany has had the highest number of biotechnology firms in Europe, but the influence of this sector extends further. Altogether around 200,000 jobs in the pharmaceutical and chemicals industry, in agriculture, in food processing and the environment in Germany depend on biotech know-how – and the trend is upward.

INTERNATIONAL INNOVATION COMPETITION NEEDS FURTHER EFFORTS

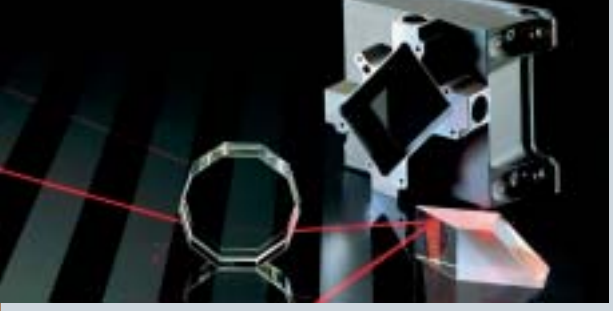
Germany is facing **fierce international competition** with its innovative products and services. In the globalised world of the 21st century national advantages in innovation are relativised worldwide in ever shorter times by new products and processes or imitations. The newly developed countries are increasingly penetrating the traditional technology markets of the industrial countries as well. Knowledge is stopping less and less at national borders. The big companies that have grown up on regional basis are increasingly developing into global players and directing their research and innovation activities to international markets.

Nevertheless, Germany is in a **good position.** We are the technological leader in Europe. We are the second largest exporter of research-intensive goods in the world and actually the world market leader in vehicle construction, mechanical engineering and environmental technologies. Among the big European countries Germany has the highest density of innovative compa-

THE NUMBER OF CORE BIOTECHNOLOGY FIRMS IN GERMANY

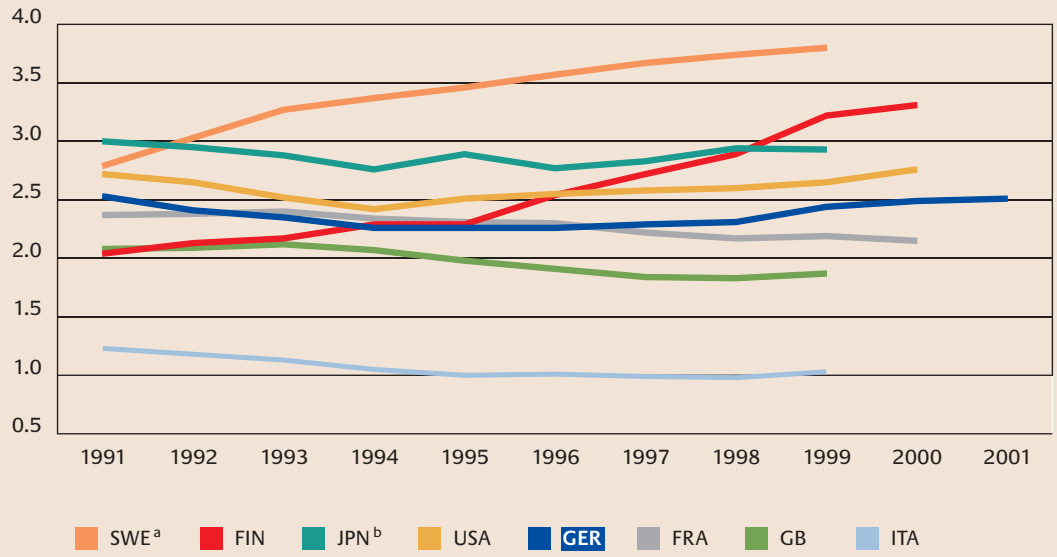


Source: Ernst & Young, Europäische Jahresberichte (1998–2001)



LASER OPTICS – A COMBINATION OF THE KNOW-HOW IN OPTICS, AND SENSOR AND LASER TECHNOLOGY

R&D INTENSITY IN SELECTED OECD COUNTRIES 1991 TO 2001*



*) Total R&D expenditure in percent of GDP.
a) Structural break in the survey method 1993/1995.
b) R&D expenditure in Japan slightly overstated up to 1995.

Source: BMBF: Bericht zur technologischen Leistungsfähigkeit Deutschlands 2001

nies and they are producing more and more new products. The share of market innovations in German industrial firms' turnover has doubled since 1996 and in 2000 was just under 8 %. Other countries have advantages in the acknowledged high tech fields like information and communications technology and segments of electrical engineering. In these fields Germany's strength is mainly in taking up technological developments and integrating them in the innovation activities of other sectors, like vehicle construction or mechanical engineering.

Germany's successes in worldwide innovation competition are based primarily on a good education and training for our personnel. However, the high level of skills could deteriorate in future if steps are not taken to

ALWAYS LOOKING AHEAD - THANKS TO WELL TRAINED PERSONNEL

THE SPEED OF INNOVATION DEPENDS ON THE INCENTIVES

prevent this. In Germany only 16 % of school-leavers complete a university course; that is not enough for a modern industrial nation like ours, if the OECD average is 25 %. An international comparative study by the OECD, "Programme for International Student Assessment " (PISA), also showed considerable shortcomings in German schooling.

But precisely the new jobs in the growth fields require growing levels of skills. Our economy's need for highly skilled personnel is growing. If these people are not available innovation activities will be slowed down or actually prevented. A high level of education for our people is thus both a condition and a consequence of an innovative economy and society. The German Government therefore clearly stated the priority it would accord to better education and training when it took office, and it has greatly increased investment for the future in these fields within the areas of its competence.

Another area also requires particular attention. Germany has a good international reputation in basic research, but the results of the publicly funded research are still insufficiently translated into innovations for the market. There is considerable potential for improvement in cooperation between research and industry. Hence in March 2001 the German Government launched a programme of action entitled "Knowledge creates Markets" with a number of additional promotional measures to give new impetus to knowledge and technology transfer in Germany.

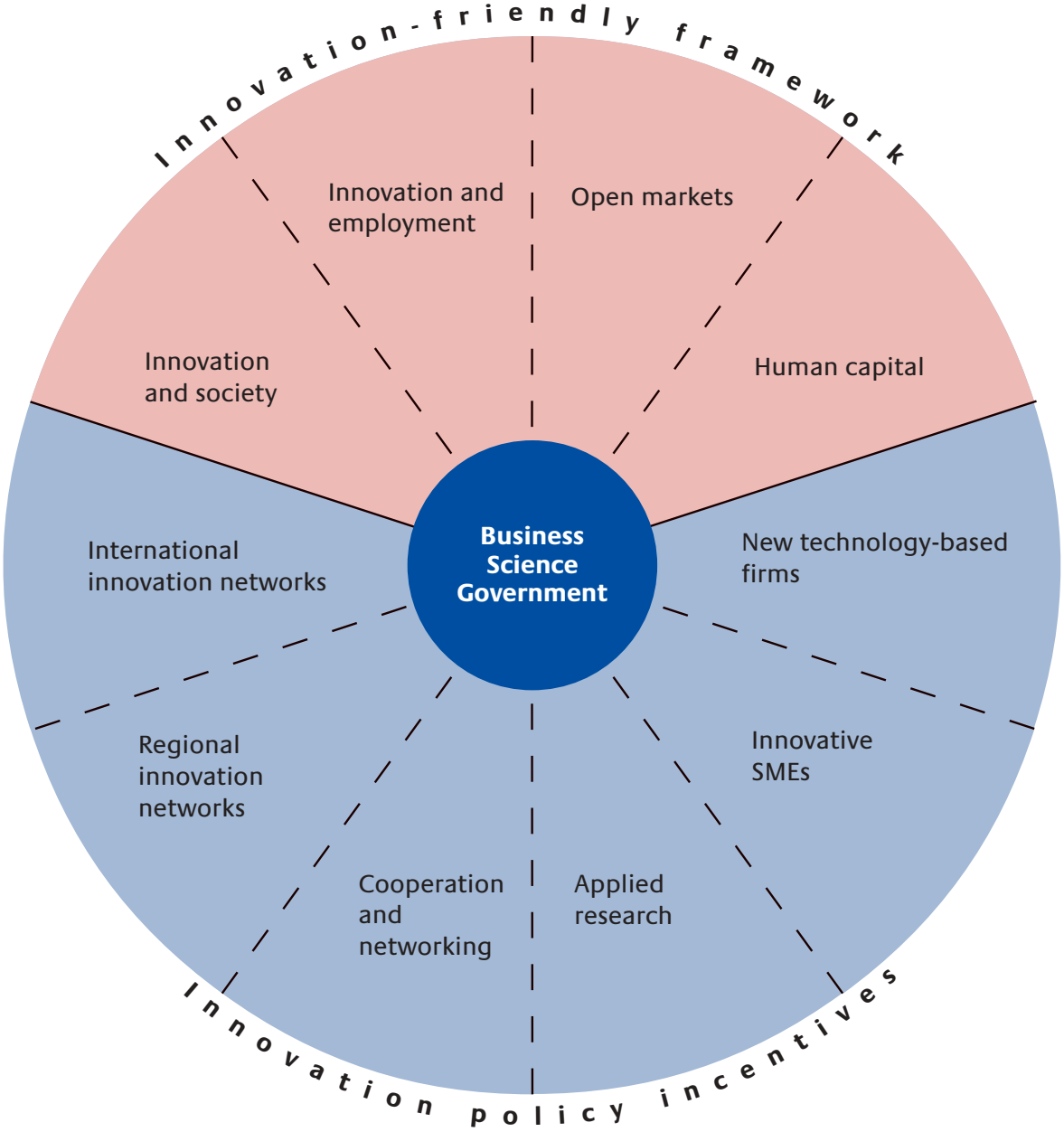
With its "Innovation Concept" the German Government is supporting innovative work by companies and society

To stimulate innovation in companies and society and also make an essential contribution to more jobs for the future the German Government has combined its innovation policy measures and coordinated these better. This "Innovation Concept" is presented here in an overall survey for the first time.

The activities range from the general conditions to promote innovation, like liberalising hitherto regulated markets and improving the systems of education and training, through promotional measures for new businesses, the SME sector, the universities and research institutes to technology transfer and social dialogue. Not least, this policy is also directed at the men and women in our society, for innovations can only become established if they are also accepted and supported by the majority of the people.

INNOVATION NEEDS THE RIGHT CONDITIONS

THE GERMAN GOVERNMENT'S INNOVATION POLICY



Opening Markets

Stimulating and Promoting Innovation

OPENING MARKETS WIDENS HORIZONS

Competition on open markets is a crucial driving force for innovation. As the economist Schumpeter said, it is competition that releases the creative force of innovative entrepreneurs who want to gain advantages on the market with their new products and processes. To enable competition to develop its full innovative force new competitors must have free access to the market. Not only will the new companies profit from this, the consumers of the products will benefit as well, indeed primarily. Opening former monopoly markets (especially for postal services, telecommunications and energy) in Germany brought tangible advantages in the form of new and better products and lower prices.

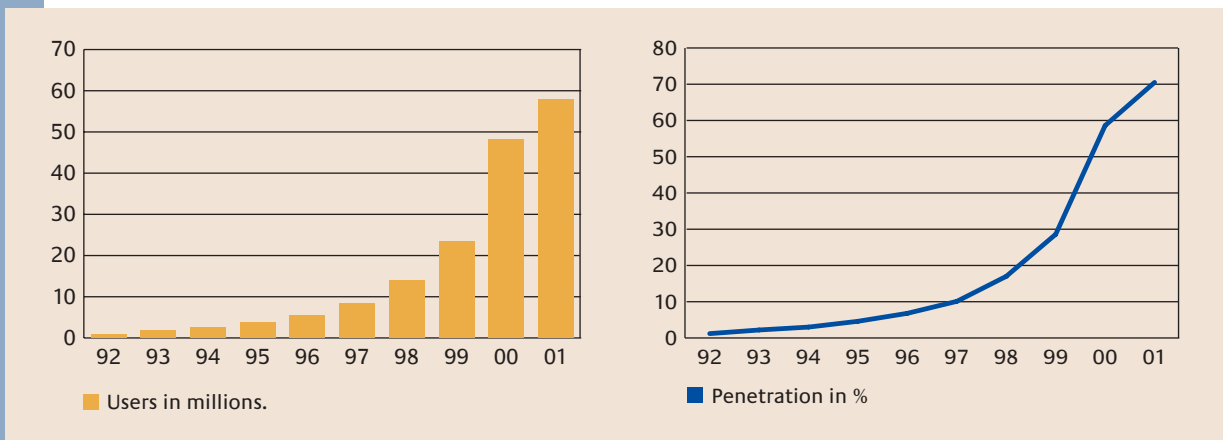
The latest development in the telecommunications markets is impressive evidence of this. From 1991 to 2001 the number of suppliers of telecommunications services rose from about 150 to around 2000; during the same period the market for telecommunications services more than doubled, to an overall volume of about EUR 66 billion. Since the full opening of the market in 1998 telephone charges have fallen dramatically. The cost of a one-minute peak period call within Germany, for example, has fallen from around 30 cents to about 2 cents a minute. Mainly owing to the big price falls, but also because of the dramatic increase in use of the Internet, nearly twice as many transactions go through the networks today than three years ago. New communications products, which hardly played any part ten years ago, like the Internet and the mobile phone, are now regarded as essentials by broad sections of the community.

The **liberalisation of the electricity market** in 1998 also had a lasting effect in stimulating innovation and rationalisation. Electricity prices to industrial customers have fallen by around 30 % and prices for private households by about 15 %, in each case adjusted for eco tax. New suppliers have entered the electricity market, new products are being offered, and electricity exchanges commenced operating in Frankfurt a.M. and Leipzig. Now they have merged to form one central exchange in Leipzig.

In the **postal market** some segments, like courier, express and parcel services and some letter post, are already open to competition. Two thirds of the total annual volume of turnover of about EUR 22 billion is now earned in free competition.

However, **opening markets** can also involve **risks,** like lack of security and a fall in quality standards, and price dumping by companies that formerly dominated the market. These risks will be decisively reduced by legally prescribed or contractually agreed security and quality requirements and by competition supervision exercised by the cartel authorities and the Regulatory

THE DEVELOPMENT IN MOBILE PHONE USE



Source: RegTP; 2001 estimate

LIBERALISATION OF THE ELECTRICITY MARKET PROVIDED SUSTAINED STIMULUS TO INNOVATION AND RATIONALISATION

Authority for Telecommunications and Postal Services within their mandates.

In the process of liberalisation the **competition situation in the various national markets in Europe** must be taken into account. The markets should be opened in coordinated action by the member states of the European Union, in order to avoid distortion to competition between companies in different countries. If Germany, for example, liberalised unilaterally, foreign monopolies could acquire market advantages at the expense of German companies, while the foreign market would remain closed to German firms. That is why we urgently need European regulations on opening markets rapidly to enable competition to function in Europe.

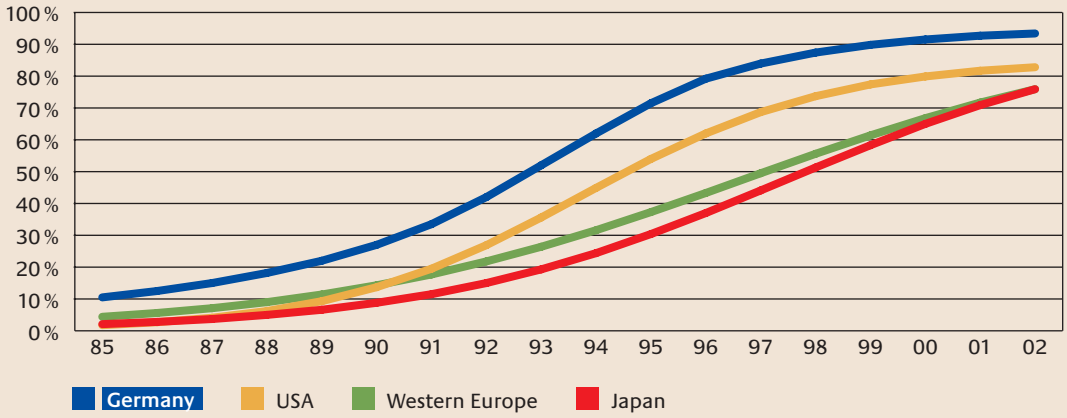
To enable growth markets to develop their full innovative force **clear and reliable framework conditions** need to be created to promote development in the open markets. Without the necessary data security and clear regulations on electronic signatures, for example, it is inconceivable that electronic commerce could replace the traditional methods to any greater extent. National and European norms are basic prerequisites for new applications to become established across a broad front and new products to be developed on their basis.

Big potentials for innovation are not only released by opening national markets, they are also released by **free traffic in goods and capital between national markets.** Hence, the continuous reduction of barriers to trade and capital transactions between states and economic blocs is also of great importance in innovation policy. The progress achieved through efforts to free world trade are reflected i.a. in the development of exports of R&D-intensive goods, which rose from EUR 160 billion in 1991 to EUR 315 billion in 2000.

Open markets are an important prerequisite for new technological products to become established worldwide. Products of this type often first have to prove themselves on a regional market before they can be successful in international markets as well. The decisive factor for the success of national products on world markets is in how far other countries can be persuaded to accept the new innovative design and give up the technical variant they have preferred to date. If that proves possible the regional market becomes a **lead market,** setting technical standards worldwide. A classical example of this is the fax. The main development came from Germany but it was only when the machine was available in Japan that it was able to displace the telex machine, because written Japanese is so complex; then Japan became the lead market for fax machines. A more recent example is the mobile phone, which first became established on the Scandinavian market before its victorious progress on the world market.

Germany has many products that could enable it to become a lead market. There are good prospects for new applications in automotive technology, high-speed transport systems, alternative energy production and in new optical technologies like lasers and medical equipment for keyhole surgery.

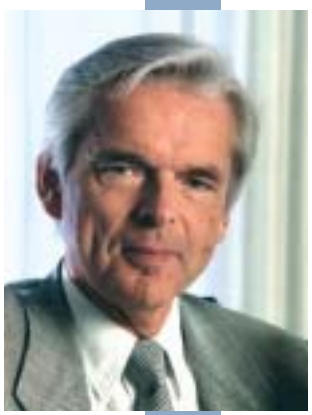
THE MARKET DIFFUSION OF ANTI-BLOCK SYSTEMS IN PASSENGER CARS



Source: BMBF: Report on Germany´s Technological Performance, 2001

INTERVIEW

1. In which areas do the strengths of German mechanical engineering and plant construction lie compared with our international competitors?
Our particular strength is that we can offer excellent products right across the range in mechanical engineering and plant construction. 14 % of German mechanical engineering firms are world market leaders for their products, and just under 60 % are in the top five in their markets. These competitive strengths are based on highly innovative products. But without tailor-made solutions for individual customers, technology-related services, flexible and rapid reaction to customer needs and without a global service this position would not be conceivable.



ROLF R. KUHNKE, MANAGING PARTNER OF KUHNKE GMBH, MALENTE, AND VICE-PRESIDENT OF THE GERMAN MECHANICAL ENGINEERING AND PLANT CONSTRUCTION ASSOCIATION.

2. With which technological innovations will German mechanical engineering and plant construction firms be particularly successful in future?
We are particularly successful at integrating the latest technologies into products. The integration of microelectronics or sensor technology into modern machines and plant is one example. Software and electronics already account for up to 30 % of the value created in mechanical engineering products and plant construction – and the trend is rising rapidly.

3. In how far are the mechanical engineering firms profiting from opening markets?
We export two thirds of our output. That is why we need open world markets like a fish needs water. Where markets are being liberalised, as in Eastern Europe or China, one can expect high growth rates. In some markets, like drive technology, we have already seen growth rates close to 100 % a year. That is also good for the labour market in Germany.

4. What do you see as an innovation-friendly climate?
Good interplay between the three partners, science, industry and the state is important. The division of labour should be clear: industry engages in applied research oriented to practical needs, in order to be strong in competition. Science helps us with constant stimulus and a constant source of new knowledge. The state concerns itself with basic research, education and the infrastructure, whereby business also has an obligation in training. State promotion of research is meaningful but it must not lead to distortion of competition. Lower taxes will certainly do more to promote innovation than state finance for individual companies' projects.

LIBERAL MARKETS RELEASE NEW MARKET POTENTIALS.

The German Government will advance market liberalisation, nationally and internationally, create the necessary legal conditions for this and support companies in exploiting market potentials for the application of new technologies. It will accord the technologies in which Germany may be expected to develop a lead market a special position in its research and innovation policy.

What are we doing specifically?

- In the telecommunications sector we want to strengthen competition further in the local network section. To do this we are improving the conditions for competitors to gain access to the Deutsche Telekom networks, by line sharing, for example, (where the competitor only buys part of the capacity of the connecting cable line, possibly to offer fast access to the Internet). Another example is resale, where the competitor can sell capacity he has purchased on to a third party. By the end of 2002 we will also introduce the possibility of preselecting the operator and call-by-call selection of a different operator in the local network. We are also promoting the construction of alternative network infrastructures, e.g. the future universal mobile telecommunication system (UMTS) and broadband cable networks.

- We shall optimise the regulations in the telecommunications sector by mid-2003 through further developments in the legislation and, where necessary, adapt them to changes in market conditions. We also want to accelerate the regulatory processes and make them more efficient. The long-term aim remains to reduce the extent and intensity of the regulations sufficiently to ensure that competition can function without regulatory intervention.

WIND POWER

At the end of 2001 Germany had more than 11,500 wind parks in operation with installed output of more than 8,750 megawatt. They were producing more than eleven terawatt hours of electricity a year, which was about 2 % of German electricity generation. In Schleswig-Holstein about 20 % of the electricity need is already met from wind power. That puts Germany in first place worldwide in installed output, even ahead of the United States and Denmark. The growing demand and growing competition between producers has greatly stimulated the development of this technology in Germany and this has brought the cost of the plant down to around € 750 to € 1000 per kilowatt, giving the German manufacturers of wind power plant a leading position worldwide. Now German producers of wind power plant and the components firms employ more than 30,000 people. Their turnover is more than € 2 billion. The European Union has set itself the aim of expanding the share of electricity from renewable sources to 22 % of the single electricity market by 2010. Wind power will account for an important share of this and German manufacturers have an excellent starting position in this European growth market.

LIBERALISATION STANDS FOR NEW SERVICES

■ In the action programme **"Innovation and Jobs in the Information Society of the 21st Century"** of September 1999 we developed and implemented a comprehensive strategy for the information society. The action programme helped to create a reliable legal framework for the information society and accelerate the spread and use of the new information and communications technologies in society, business and the administration. The recently published progress report "Information Society Germany" shows that all the aims set for the action programme have been achieved or could actually be exceeded.

■ With the **Law on Electronic Commerce** and the new Digital Signature Act we have created, in cooperation with our European partners, the conditions for commercial transactions on the Internet. With new **laws on data protection, and on consumer rights and copyright** we have also helped to preserve the interests of Internet users that need protection and so enabled an even broader basis of confidence in the Internet to develop.

■ With the reform of the energy and cartel legislation in 1998, Germany opened its electricity and gas markets. Another amendment to the energy legislation will supplement the existing legislation, especially in terms of the **gas market liberalisation.** Together with the association agreement between consumers and suppliers, which is still to be adjusted, this should enable more competition and more innovation in the form of better services in the gas market as well.

■ In the provision of **postal services** we want to open the market for letter post further in harmony with the progress in liberalisation within the European Union.

■ We want to negotiate further **international opening of markets** as part of a new and comprehensive world trade round under the umbrella of the World Trade Organisation (WTO). The concern here is to reduce customs duties and other obstacles to trade and facilitate international trade, through better access to markets and less bureaucracy. The developing countries should also be more integrated in the world economy.

■ We will continue to **support exports of high-tech products** by German industry with the proven range of foreign trade instruments, in particular the Hermes Export Credit guarantees. To improve the transparency of the measures to promote exports we have created the "Foreign Trade Gate" on the Internet under www.ixpos.de. The Federal Ministry of Economics and Technology has also set up a task force to facilitate contact between interested exporters and the responsible agencies of foreign government.

■ In the **promotion of specialist research** we are setting priorities in the areas of technology where Germany has the potential to be a **lead market tomorrow,** and where German firms are in a good starting position. We will also set conditions in other policy areas that will enable Germany to make good use of the traditional advantages it has in certain technology fields.

Human Capital

The Most Valuable Resource for Innovation

VOCATIONAL TRAINING GIVES
ASSURANCE FOR THE FUTURE

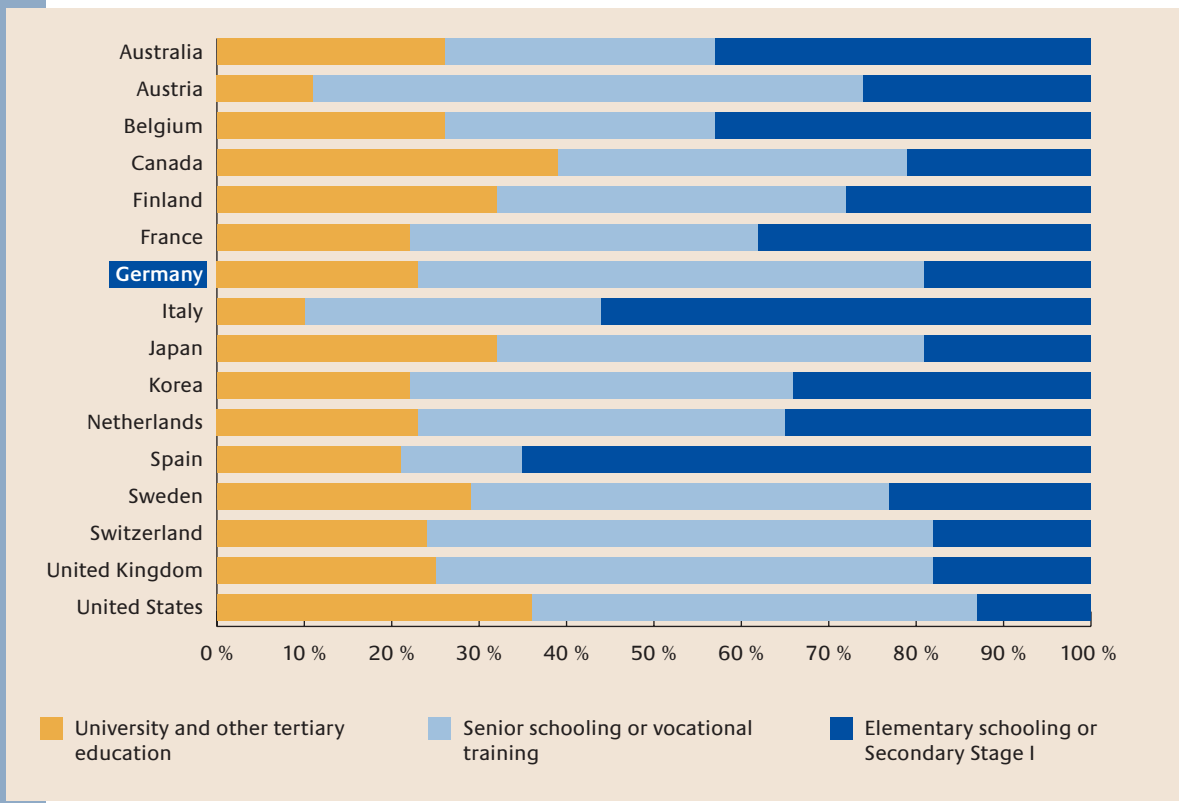
Well trained personnel are the backbone of a modern industrial nation in international innovation competition. A good basic vocational training and further training will determine whether young people can meet the challenges of the world of tomorrow. And it will also determine whether they are in a position to make that world of tomorrow innovative.

The people in Germany have a high level of skills by international comparison; scarcely any other country has a higher share of the workforce with vocational qualifications. A decisive factor here is the dual system of vocational training, which is an important area in Germany. By comparison, the share of young adults commencing a university course is currently around 32 %, which is lower than the OECD average of 45 % in 1999.

The trend in university entrance has been rising again most recently (+4.7 percentage points since 1998), and this is encouraging; the increase in the number receiving grants through the reform of the Federal Law on Education and Training Promotion, and the recently introduced shorter courses leading to the bachelor and master degrees, should encourage even more young people to enter university.

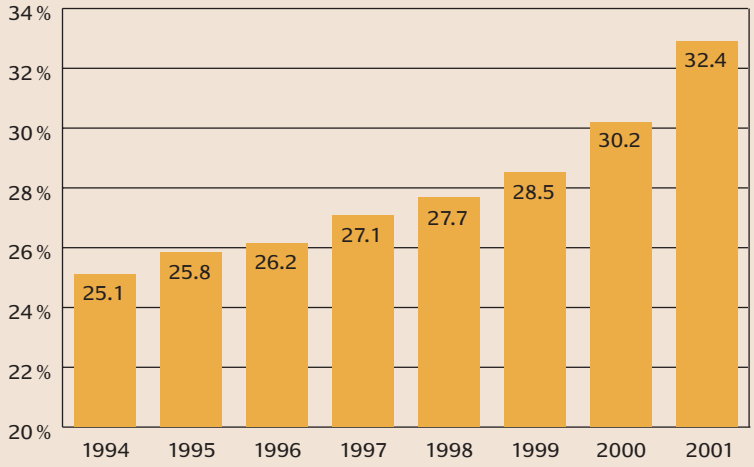
On the way to the knowledge society Germany needs skilled personnel more urgently than ever. Many companies are complaining of difficulties in finding suitable applicants for vacancies advertised. In the next few decades, when the number of young people coming on to the labour market will fall further, there will probably be an even greater need for skilled personnel than there

THE LEVEL OF EDUCATION AND TRAINING BY COUNTRIES
POPULATION AGED 25-64 BY HIGHEST QUALIFICATION IN 1999



Source: OECD 2001: calculations by BMBF
Note: Austria reference year 1998; the post-secondary, non-tertiary level is included in "vocational training"; in the Netherlands, Spain and Sweden, however, this level is included in "tertiary education".

RATIO OF UNIVERSITY ENTRANTS IN GERMANY 1994 - 2001



Definition: Sum of net ratios of university entrants in individual years; only universities and technical universities, not including colleges of administration etc.; a year is the winter semester of the previous year and the summer semester of the same year.

Source: Federal Statistical Office, calculations by BMBF using the OECD method.

is today. For whereas now there are about 17 million people under 20 in Germany, in 2030 there will only be 13 million.

But the **requirements** which **tomorrow's graduates** will have to face will also continue to rise. Technological change, new forms of work organisation, more internationalisation and the accelerated development of knowledge are bringing changes to which the entire education and training system in Germany must adjust. Against that background it is not acceptable for young people in Germany to lack essential basic competences compared with people of the same age in other countries, as the OECD PISA study showed they do. The provision of key qualifications is of central importance for the German education and training system.

The German **dual system of vocational training** is highly regarded in other countries. It is also still the main training route for young people after they leave general school. Around two thirds of each year's school-leavers learn one of the c. 350 nationally recognised skilled occupations. However, the technological innovations, the structural change in the economy and the changes in work organisation are a permanent challenge to the dual system of vocational training. Occupations that have been established for many years are becoming obsolete, and new occupations are needed in new fields like information technology or the media. So the modernisation of training ordinances and the creation of new training courses are a constant task for vocational training policy.

A course of study that meets **modern requirements** and is of high quality determines the level of start-up capital with which students leave to enter the world of work in business and research. So it is a constant task for the universities to keep adjusting the contents and organisation of their courses to the changing requirements of the world of work, and in doing so take account of the changing patterns of living and professional desires of young people.

International orientation is increasingly becoming the prerequisite for excellence in research and teaching in German universities. Germany cannot afford to see its best brains leave to work abroad because they have better conditions there. The leading position of US research today is due to a considerable part to the achievements of foreign personnel. One quarter of all the professors in the university faculties of science and engineering in the United States are foreigners today, and Germany is one of the main source countries. German universities must regain and retain their attraction for internationally mobile top level personnel – for foreign top level scientists and young recruits as well as for German personnel who want to come back.

Today more than ever qualification includes not only training but **further and advanced training,** in the sense of lifelong learning. The idea that a person is sufficiently qualified for his future occupational or professional life when he has acquired one skill belongs in the world of yesterday. But if offers of advanced training to be accepted and widely utilised there must be transparency and quality standards need to be developed. Above all, the universities must also see advanced training as a task, more than hitherto; but they can also see it as an opportunity and seize it.

Germany is on the way to the information and knowledge society. A **knowledge of information technology (IT)** is already a core skill that is taken for granted. The provision of the basic computer skills and use of the

INFORMATION TECHNOLOGY –
A KEY QUALIFICATION NOW
AVAILABLE TO ALL IN GERMANY

Internet must therefore be integrated in school teaching and occupational training. This requires not only the appropriate knowledge on the part of teachers and trainers but also the appropriate hardware in schools and vocational schools. But those who are already firmly established in the world of work must be given the opportunity to join the path into the information society through suitable further training courses.

INTERVIEW

1. The Humboldt University is regarded as the "mother of all modern universities". What should be the aims of university reform?
The German universities must be internationally competitive in research and teaching. That includes actively recruiting the "best brains", from students through doctoral candidates to young academics and professors. In two words: "People matter!" In teaching graded, modular course leading to bachelor and master degrees need to be introduced so that we can offer better structured courses lasting for clearly defined periods of time, while retaining the possibility of moving from one faculty to another.

PROFESSOR DR. JÜRGEN MLYNEK,
PRESIDENT OF THE HUMBOLDT
UNIVERSITY IN BERLIN

2. How would you define a modern, efficient university management? How should the management structures and decision-making processes be designed?
The German universities must professionalise their management structures if they want more autonomy. This will include a full-time presidium, for instance, and an independent board of trustees, like the board of managing directors and the supervisory board for a company. On principle: the office and the responsibility must be better integrated and internal university decision-making processes must be speeded up.

3. What induced you to start introducing the post of junior professor at the Humboldt University?
Independence and autonomy at an early stage for young personnel in research and teaching must be the declared aim of a university that has undertaken to promote and support new entrants to academic life. Young recruits to university staff and research need clear time horizons to be able to plan their professional careers better. We should drop the requirement of the Habilitation as a condition for obtaining a university teaching post.

4. How should the universities adjust to the changing requirements of the labour market for university graduates?
The universities should provide the labour market with graduates who have the ability to engage in lifelong learning as well as a broad and basic knowledge of their special field. There must be interaction between professional training and education – training to earn a living, education as a human being and to cope with the demands of life. I regard it as wrong to orient a university course to current market needs. The students should be taught team work, language competence and media competence more than hitherto.

VOCATIONAL TRAINING MEANS A FUTURE

The German Government wants to see the contents of training courses in Germany – in the dual system of vocational training and at universities – adapted rapidly to the new requirements. It also wants attractive offers of advanced vocational training. The German Government is making every effort to make Germany permanently more attractive to top level scientists and research personnel and to new recruits at home and abroad.

What are we doing specifically?

▮ We are **modernising vocational training and creating new skilled occupations.** For the start of the 2002/2003 training year eight new skilled occupations are to be created and eleven existing occupations brought up to date, including the big category of clerical worker in industry, which covers a very large number of people. Since 1998 we have reorganised 55 skilled occupations and created 18 new ones. We are modernising the dual system of vocational training, for example by offering the possibility of choosing between various obligatory building blocks, areas of employment and periods abroad. We are also making competence in handling information technology compulsory in the training ordinances in accordance with the special features of the individual occupations.

▮ We will also improve **permeability and transparency between the various training routes,** above all between vocational training and the universities. It is our aim to develop further the structures for the acquisition of top qualifications through basic and advanced vocational training. We want to expand these routes more systematically, as is now being done by developing an IT advanced training system.

▮ We will take the **two-tier university qualifications of bachelor and master** out of the experimental phase and make them standard qualifications in the University Framework Law. These qualifications will not only make it easier to transfer to the university systems in other countries, the clearer structures of the courses will also help to shorten the times spent at university in Germany, which are long by international comparison.

▮ **Exploiting potential for innovation** also means ensuring that no barriers are created for persons wishing to start at university. To ensure equality of opportunity we are therefore retaining the principle of **no fees** for the first course of study that provides an occupational qualification. The reform of the **Federal Law on Education and Training Promotion** gives substance to the obligation of the German Government and the federal states to give financial assistance to students whose parents cannot make a contribution to financing their studies.

▮ With the reform of the **legislation on university service** that came into force at the beginning of this year Germany will become very much more attractive as a university location for creative recruits from within Germany and abroad. The introduction of the post of junior professor will enable young academics to teach and engage in research independently and autonomously from the age of 30, as is usual in other countries. We are supporting the federal states in setting up the first 3,000 junior professorships by providing around € 180 million. Moreover, the remuneration of university professors will no longer depend on their period of service, as it did before the reform, it will depend on performance and commitment. That will create the neces-

EQUAL OPPORTUNITY FOR NEW INNOVATION POTENTIAL

sary flexibility for top level personnel to be rewarded in accordance with their achievements.

▮ We want to make German universities more attractive to recruits and top level personnel from abroad, and offer German academics alternatives to working abroad, or encourage them to return to Germany ("brain gain" instead of "brain drain"). By **offering research awards** that entail working in Germany to researchers abroad we will induce foreign personnel to come to Germany, and encourage German researchers to return, from the United States, for instance. The Wolfgang Paul Award for top level scientists and the Sofya Kovalevskaya Prize for young researchers are the most lucrative research awards ever offered in Germany.

▮ We are increasing our **advertising for German universities and research institutes.** We have set up a "Concerted Action on International Marketing for Germany as a Location for Education and Research" with the federal states, the universities, the research institutes and foreign trade chambers. With our campaign "Hi Potentials! International Careers made in Germany" we are advertising worldwide for highly gifted scientific and technical recruits, with an Internet platform under www.campus-germany.de.

▮ With our **Green Card initiative** we are making an important contribution to easing the shortage of IT specialists on the labour market. By the end of July 2003 a total of 20,000 specialists can be admitted to work in Germany with these cards, and that quota has not yet been filled. With the planned reform of the immigration legislation we also want to make it generally easier for foreign researchers, highly qualified personnel and university graduates to live and work in Germany.

▮ We will give **"lifelong learning"** high priority. A commission of experts is to take stock of the present financing flows by the end of 2003 and develop realistic strategies and concepts for the promotion of individual lifelong learning after vocational training. Under the "Learning Regions" Programme we are promoting regional networks that are to develop innovative concepts to promote lifelong learning for their region.

▮ We want to make it easier to **compare and utilise advanced training qualifications** in order to improve the quality of the courses on offer and achieve a higher share of participants in courses. We are supporting the work of building up a new department to test training courses at the Warentest Stiftung (Goods Testing Foundation), and from July it will be appraising advanced vocational training courses.

▮ With the concept for action **"Inclusion not Exclusion"** we are supporting the integration of information technology in every area of education. Important elements here are the activities "Schools on to the Net", the new programme "New Media in Education" and the implementation of an advanced IT training concept. We have also earmarked a total of € 130 million in UMTS funds for the purchase of modern hardware and media and learning software for vocational schools.

▮ The **Education Forum** established by the German Government and the federal states presented its recommendations on reform of the German education system in November 2001. In particular, they indicate how the aspects of the school system which the OECD PISA study showed to be particularly in need of improvement can be improved. The German Government and the federal states will jointly engage in the implementation of the recommendations until the first implementation report is presented in 2004.

New Technologies Opportunities for New Businesses

A CULTURE OF
INDEPENDENCE CAN ONLY GROW
IN THE RIGHT SOIL

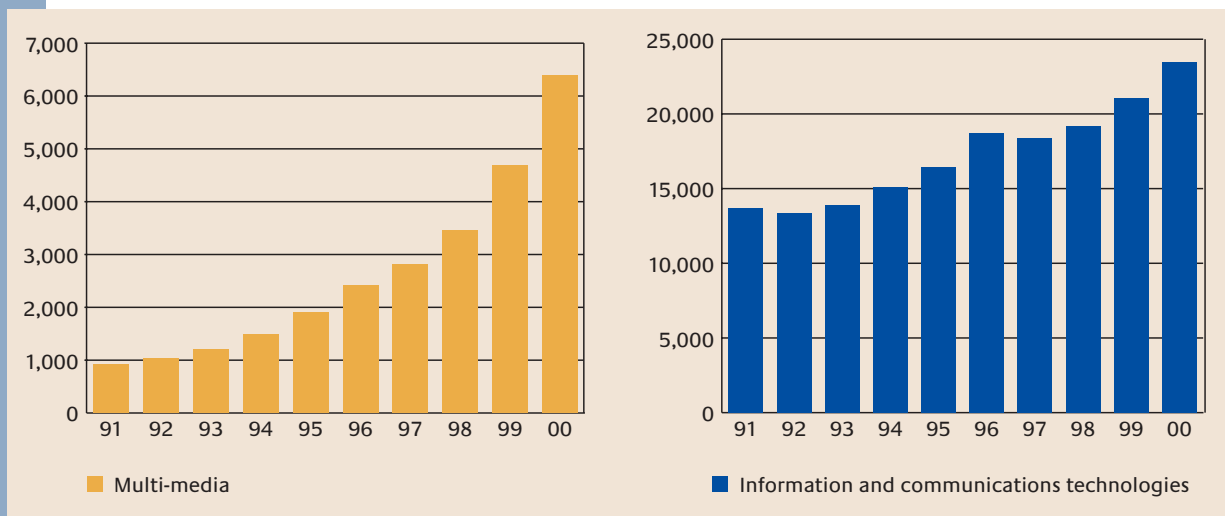
Behind really pioneering innovations are generally individual entrepreneurs. Werner von Siemens and Carl Friedrich Benz were visionaries who had the great gift of combining scientific curiosity with enterprise and business sense. They created countless new jobs and played a large part in deciding the future efficiency of an entire economy.

There are people of the capability of Siemens and Benz today. Every year about 40,000 **technology-based firms** are founded in Germany. They are **pacemakers of structural change,** and they create new and viable jobs for the future. Two to three new jobs are filled in every new technology-based firm that is founded, and in the research-intensive branches of industry it can be as many as five. Companies founded as a result of research are a special case. There are about 2,500 of these "spin-offs" a year and they are particularly efficient at translating new research results into economic value creation. In recent years, with the dynamic in the information and communications technologies and in biotechnology, they have enjoyed a particular upswing. The number of companies established from non-university research institutes alone has tripled every year since the mid-90s and is now around 180 a year. These new companies are also particularly employment-intensive.

But on the whole **entrepreneurship** could be more dynamic in Germany. According to the 2001 Global Entrepreneurship Monitor (GEM), a study of new business activity in a number of countries, only one out of 14 adults a year in Germany is involved in setting up a business – putting us in tenth place out of 13 countries examined in western Europe. Much may be due to the German mentality. In scarcely any other country is the fear of failure as great as here; at the same time successful entrepreneurs are less highly regarded here than abroad.

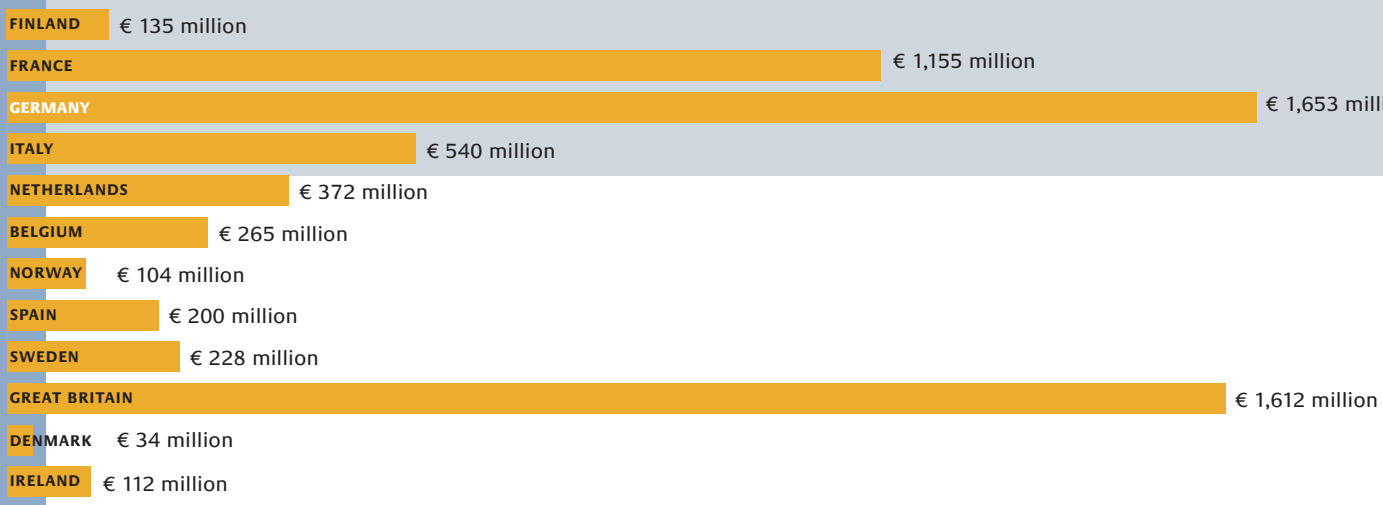
The ground for a **culture of entrepreneurship** is laid in schools and universities. In Germany boys and girls are not really made aware of "entrepreneurship". In the universities as well only a good 10 % of students feel they are well informed on the subject of setting up a business. In many cases the necessary mobility between subjects is lacking, and the teaching staff lack the practical qualifications. For good reason the authors of the GEM study warn that successful measures like EXIST need to be expanded or professorships in entrepreneurship established.

NEW BUSINESSES IN THE NEW TECHNOLOGIES



Source: BMBF 2002; calculations by ZEW based on the ZEW New Business Panel.

EARLY PHASE VENTURE CAPITAL ("SEED" AND "START-UP") IN SELECTED COUNTRIES 2000



Source: European Venture Capital Association, 2001

The extent to which **innovative companies can stimulate structural change** is evident from a glance across the Atlantic. While in Silicon Valley more than 70 % of all the companies with a turnover of more than € 50 million were only founded after 1985, the share of such firms in the German high tech regions of Munich and Stuttgart is less than 20 %. However, the new business boom in Germany towards the end of the 1990s, particularly in the new economy, is cause to hope that we can make up some of this ground.

Finance is the **main obstacle** for many new entrepreneurs. The hectic development of the equity participation market and the New Market in the 1990s has multiplied the supply of equity capital, which is very welcome. As well as venture capital companies, private individuals, "Business Angels" as they are called, are helping new firms, not only by offering capital but also by making their experience available. Promotional measures have also been set up for the phase preceding the actual foundation of the firm to make the step into independence financially viable. Not for nothing is Germany in the lead, according to the GEM study, in the official promotion of new businesses.

For a long time it was not lack of funds but lack of promising projects that was regarded as the main obstacle. Now the supply of participation capital is falling. New companies are having great problems in obtaining finance or follow-up finance, partly because their sales markets have not developed as expected. The burst of the "dot.com" bubble has caused many capital investors to take a much more restrictive attitude towards new commitments. The way out through placing a new technology-based firm on the New Market is now practically closed. But the present drought cannot conceal the fact that the equity participation market has become the main instrument of finance in recent years for new technology-based firms. Equity participation companies should keep their eyes on the good long-term prospects that new and current commitments to new businesses offer, in their own well-considered interests as well.

BUSINESS ANGELS

Business Angels are private capital investors who also offer their business experience. Three years ago the term "business angel" was almost unknown in Germany. There was an informal market, but it was largely invisible. Today Germany has an almost national supply with around 40 Business Angels Networks that can provide financial investors and know-how for new firms regionally, nationally or on the Internet. Nevertheless, this market is still only at the start of its development, and it is still clearly under-sized compared with the United States.

INNOVATIVE RESEARCH STIMULATES STRUCTURAL CHANGE

INTERVIEW

1. What particular opportunities do you see for German companies in the biotech sector?
The development of biotechnology is still in a relatively early stage here, for Germany was late to jump on to a train that was already moving very fast. Every biotech firm – and this is what distinguishes this industry from many others - has to be globally oriented right from the very first second. Nevertheless, Germany has a number of regional strengths and advantages that should be exploited. The output of German research institutes is on a high level, and naturally, local firms can make better use of it. Moreover, German firms have advantages in technological perfection and reliability. Particularly in a sector that so far has depended very greatly on forecasting cultivating these qualities will certainly pay off.

DR. LUTZ MÜLLER-KUHRT, CHAIRMAN OF THE BOARD OF MANAGING DIRECTORS OF THE ASSOCIATION OF GERMAN BIOTECH FIRMS

2. How can new biotech firms position themselves between the big pharmaceutical concerns and science?
Compared with the United States cooperation between universities and pharmaceutical concerns has never functioned properly in Germany. Bureaucratic structures, inadequate communication cultures and a lack of the will to commercialise are largely responsible. New biotech firms have therefore played a key role on the interface between science and business. Whereas initially they were only making commercial use of early research results and played only a minor role in value creation, now they are becoming increasingly self-confident and are changing from being suppliers to being partners. As biopharmaceutical firms, some are becoming regional or specialised competitors of the pharmaceutical industry, others are aiming for market niches that are not the main interest of the multinational concerns.

3. What importance do you attach to the legal conditions and the financial environment (the trends on the stock markets) for business growth?
Germany's biotech industry is now less dependent on legal or promotional policy conditions than it was five or ten years ago. Nevertheless some regulations are urgently needed and should be introduced, like internationally competitive taxation of profits from the sale of shares acquired through staff shareholding schemes, or the possibility of carrying losses forward if there are significant changes in the structure of shareholders. The financial conditions in Germany are still above-average. Nevertheless, a growing number of start-up financings are failing today and this is leading to more stringent selection of new businesses and stronger focus on companies in the growth phase – on principle a sensible development.

THE GERMAN GOVERNMENT STANDS BY NEW ENTREPRENEURS

The German Government intends to support the culture of entrepreneurship, promote the appropriate direction of teaching in schools and universities and provide intensive support for new businesses that are established on the basis of university research and at research establishments. It will continue to strengthen the development of the equity capital market, particularly in the consolidation phase, and hold competitions to draw attention to opportunities for new businesses.

What are we doing specifically?

By sponsoring the JUNIOR project we are enabling boys and girls as young as Class 9 and 10 to play at founding their own business and managing it. Under this project 220 fictitious new businesses were set up throughout Germany in the 2001/2002 school year, with 2,800 pupils participating. In addition, we are planning to hold an Internet-supported schools competition with a plan game on setting up technology-based firms. This is for groups of interested pupils at vocational schools and in the senior forms in grammar schools. The plan game is intended to introduce the pupils in a playful way to the possibility of setting up in business or working as technical developers or inventors.

In cooperation with Deutsche Ausgleichsbank and partners from business we have launched an initiative to set up professorships in entrepreneurship at universities and technical universities. This is to prepare students for the possibility of opening their own business after their scientific training. More than 40 of these professorships have now been set up, and more than half of the new professors have commenced teaching. Our aim is to create 80 of these posts with support from businesses.

With our programme "EXIST – New Business start-up from Universities" we are supporting the work of building up five regional networks with partners from science, business and politics. With the new EXIST-Transfer programme we are supporting the work of building up more new business networks, in which the experience gained in the present EXIST regions can be utilised. EXIST is an international pilot scheme and an international model, and it is already being used in many regions in other European countries and in the regions not receiving promotion in Germany.

With EXIST-Seed or the EEF-Fund (facilitating the establishment of new businesses from research establishments) we are supporting potential new entrepreneurs in the phase of identifying ideas and developing them, by giving them a subsistence allowance for up to one year and providing consultancy. EXIST-Seed has so far only been available in the EXIST regions, but we are examining the possibility of extending it to other university regions.

"EXIST – NEW BUSINESS START-UP´S FROM UNIVERSITIES"

As part of a competition for ideas five new business start-up networks were selected for promotion in 1998 in a graduated procedure. They were "bizeps" (Wuppertal/Hagen), "dresden exists", "GET UP" (Jena/Ilmenau/Schmalkalden/Weimar), "KEIM" (Karlsruhe/Pforzheim) and "PUSH" (Stuttgart). The network activities include information events and intensive public relations work to draw attention to the idea of setting up in business. A wide range of basic and further training courses related to setting up in business have been worked out and some have been integrated in curricula. In addition, measures to support concrete plans to set up a business have been taken in all the networks (e.g. special coaching programmes, new business guides, an exchange for reference orders). So far more than 450 innovative new businesses have evolved in the EXIST regions. A study presented last summer on courses in German universities that are relevant to setting up in business confirmed the success of EXIST. Of the seven universities that have the best attitude and activity on entrepreneurship six are in the EXIST regions.

RECOGNISING AND UTLISING THE OPPORTUNITIES TO SET UP IN BUSINESS OPENS UP NEW PERSPECTIVES

With our **Equity Capital for Small Technology-Based Firms (BTU) Programme** we are promoting the provision of equity capital for new technology-based firms. Despite the higher risks to budget funds that are already evident we will continue this programme, for this promotion has become an essential pillar in the market for equity capital.

In 2001 we launched the **BTU Early Phase Programme** to enable us to support promising plans for new businesses even in the early development phase. In addition to equity capital new entrepreneurs receive extensive consultancy while preparing to open their business and in implementing these plans. So in future we will be able to offer potential new entrepreneurs a comprehensive package of promotion, from structures in universities and technical universities that support innovation through accompanying the preparatory phase of setting up a business to financing the project.

In the new federal states we are promoting particularly innovative research and development projects under the **FUTOUR 2000 Programme** by combining consultancy, grants and sleeping partnerships held by the tbg (Technologie-Beteiligungs-Gesellschaft – Technology Participation Company) of Deutsche Ausgleichsbank. In this way we are giving a chance to companies in which a commercial equity capital company will not yet take shares. We hope we will have helped about 200 technology-based firms to start up when the programme ends in 2003. Judging by experience to date they will create about 3,500 highly skilled and viable jobs in their first six years of operation.

With our **Biochance Programme** we are promoting new biotech firms. The aim here is to open up the scientific potential in the young German biotech research field in order to transfer innovative and promising research results from science to industrial application. So far 44 firms have received about € 45 million in promotion. We shall continue this successful programme.

With our **Multimedia competition for new businesses** we want to stimulate more people to set up businesses in the multimedia field. Every year up to 100 innovative business ideas receive awards if they appear to offer particularly good prospects of a successful launch and sustained development. The prize winners are also given the opportunity to present their business ideas to a selected group of investors.

With our new "Guidelines" we are encouraging public research establishments to take **shares in new businesses** founded by members of their own staff. The research establishments can contribute up to 25 % of the capital for a new technology-based firm without appraisal by the ministries. This gives the scientists who are leaving to set up in business access to additional funds, it helps to mobilise venture capital and also assures the research establishments an appropriate share in the innovation's market success.

BTU

The BTU Programme has two variants for the award of funding and they are used depending on market requirements.
The Co-Investor Model: The Technologie-Beteiligungs-Gesellschaft of Deutsche Ausgleichsbank (tbg) takes shares in new technology-based firms if another shareholder, generally in the private sector (the lead investor) is providing at least the same amount of funds as tbg.
The Funding Model: Kreditanstalt für Wiederaufbau funds part of the outlay by equity investors who hand on these funds in the form of equity capital to new technology-based firms. KfW releases the equity investors from liability for the funding loan. An amount of around € 3.2 billion has been provided in equity capital under this programme since 1995. The BTU promotion has made an essential contribution to putting the German early phase equity capital market in first place in Europe.

Short Innovation Cycles

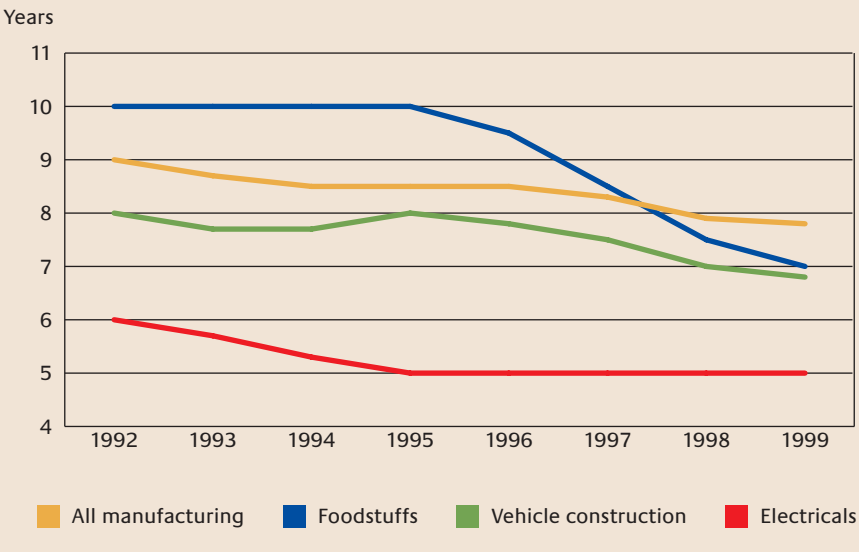
New Challenges to SMEs

In an age when new knowledge can flash round the world in seconds companies have less and less time to achieve an innovation advantage on the market with new products and processes. Newly introduced products are being displaced at ever shorter intervals by new products. In the last decade alone the **average product life** cycle has shortened by a year and it is now just under eight years. In some sectors, like vehicle construction or measurement, control and regulation technology the lifetime of products has shrunk even more. The innovation spiral is gyrating ever faster and facing companies with great challenges. Only companies that are constantly re-appraising their product range, investing in research and development and that are always open to new scientific and technological knowledge from outside will be able to keep a step ahead in innovation competition in the long term.

In Germany about 37 % of industrial firms have so far carried out their **own research and development:** that is about 23,000 firms. Of these just under half only engage in research and development on an irregular basis, that is, from time to time. That is particularly the case with small and medium-sized firms, which often do not grow to the necessary size to build up their own R&D departments, and certainly not to finance risky R&D projects. These firms can often carry out research and development only in cooperation with external partners, or they commission an external institute to do the work.

Specialised technical competence is important, but it is far from being a guarantee that companies are really open to innovations from outside. Of the 23,000 industrial firms that carry out their own research and development in Germany only 5,000 have drawn essentially on more recent scientific research results for their innovations. Studies of German, British and American firms have also clearly shown that the decisive factor in market success is whether companies plan, implement and steer the whole innovation process systematically. In addition to specialised technological knowledge we need an **innovation culture,** and this is where many small and medium-sized firms in Germany have problems.

PRODUCT LIFE CYCLES IN MANUFACTURING



Definition: Moving three-year average for the lifetime of products with biggest turnover.

Source: ZEW, Mannheimer Innovationspanel

INTERFACE FOR MANY DIFFERENT PROCESSES: THE INTERNET

INTERVIEW

1. How are the traditional craft firms adjusting to new technological developments?
The craft firms respond to the wishes and requirements of their customers and consumers, they acquire information from guilds, trade associations and craft chambers and from the trade press. Their owners and the wives helping in the business attend further training courses offered by the guilds, the trade associations and the craft chambers.

ANNEGRET SANDERS, MANAGING DIRECTOR OF BUCHBINDEREI SANDERS, HAMBURG AND FEDERAL CHAIRWOMAN OF UFH, WOMEN ENTREPRENEURS IN THE CRAFTS.

2. What special technological developments did your company have to cope with? What challenges will it have to face in future?
Without EDP equipment the work would be impossible even in the small craft firms. Companies have to have e-mail. The Internet will also be essential in future for a firm to present itself and take orders. Technical requirements will have to be implemented specifically for their trade.

3. What are you doing to keep your staff up to the latest state of knowledge?
We offer in-house training courses for our staff. They also attend seminars held by manufacturers or on specific products. Further training is also necessary in special fields to enable the company to cover a broader range. The staff are also trained not only on specialist subjects but on selling high-quality services and products, on the spot, with the customer. There are also courses to increase staff motivation.

4. Are women entrepreneurs still disadvantaged in the crafts compared with their male colleagues?
Greater demands are made on them. Women with a master's qualification still have to be better than the men to be fully accepted. When they own the business the issue of unequal pay no longer applies.

THE CRAFTS AND MODERN TECHNOLOGY GO HAND IN HAND

In fact, the application of the new technologies offers small and medium-sized firms in Germany in particular excellent opportunities to open up new markets with big growth potentials, because they are very close to the market and flexible. But greater efforts are needed in these firms to improve competence at innovation and make greater use of new knowledge. The state must support small and medium-sized firms as competitors, compensate disadvantages due to size and so set the right incentives to develop competence at research and innovation.

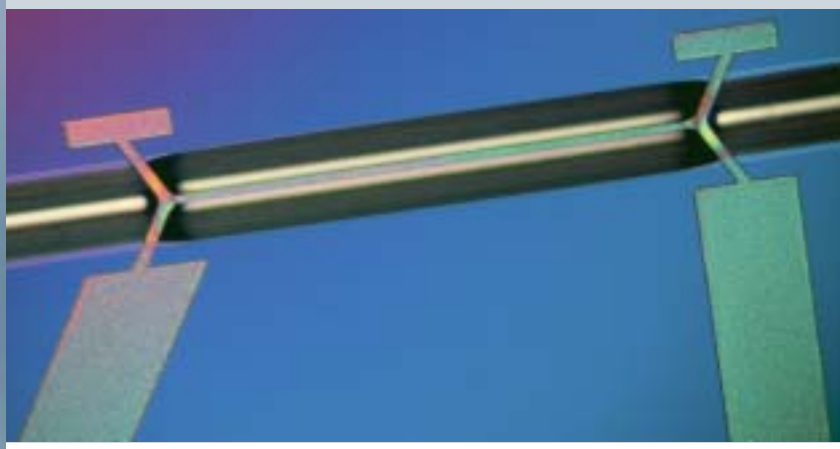
In future, too, the German Government will orient its innovation policy largely to the needs of the SME sector. It will support small and medium-sized firms in introducing and applying new technologies with promotional programmes suited to requirements, and involve these firms more in the officially supported research projects.

What are we doing specifically?

We have made technological promotion for SMEs more transparent and better suited to requirements, and for this purpose reorganised it in three lines of promotion. With the "Innovation" promotion line we are supporting new technology-based firms in developing new products, processes and services. With the "Research Cooperation" promotion line we are supporting joint research projects between small and medium-sized firms and research institutes. With the "Technological Consultancy" line we are supporting the transfer of knowledge into SMEs. We will coordinate the individual programmes (see also the chapters "New Technologies" and "Complex Technologies") even better and adjust them to the new challenges of the future.

- Under the ERP Innovation Programme "Kreditanstalt für Wiederaufbau" finances innovative projects by small and medium-sized firms by providing long-term loans at favourable interest rates or equity capital. The commercial banks which handle the loans or the equity investors are released from part of the risk of default. In future we want to provide even greater incentives for the provision of equity capital. In doing this we want to take due account of the future regulations under the Basel II Agreement, which will change the conditions for financing with borrowed funds for small and medium-sized firms.

- The Special R&D Programme for the New Federal States has the aim of strengthening the efficiency and competitiveness of the R&D potential in the East German private sector. We give grants to innovative firms and external industrial research establishments to enable them to carry out valuable but risky projects that are highly relevant to markets. In future we will continue the conversion of this promotion, which has already started, into support for innovative projects that stimulate growth in structurally weak regions.



COMPETENT AND EFFICIENT: SMES AND TECHNOLOGY.

Considerable promotional funds also flow to innovative small and medium-sized firms under the **specialised technology programmes of the German Government.** Through joint research in collaborative efforts these firms profit not only from the current project promotion but also over the long term from the build up of networks and cooperation. We are making these specialised programmes more attractive to small and medium-sized firms by simplifying access to the programmes and slimming down the application and approvals procedures. At the same time we are considerably extending the range of consultancy available by setting up a new SME Consultancy Office to ensure that the consultancy can be given from a single source.

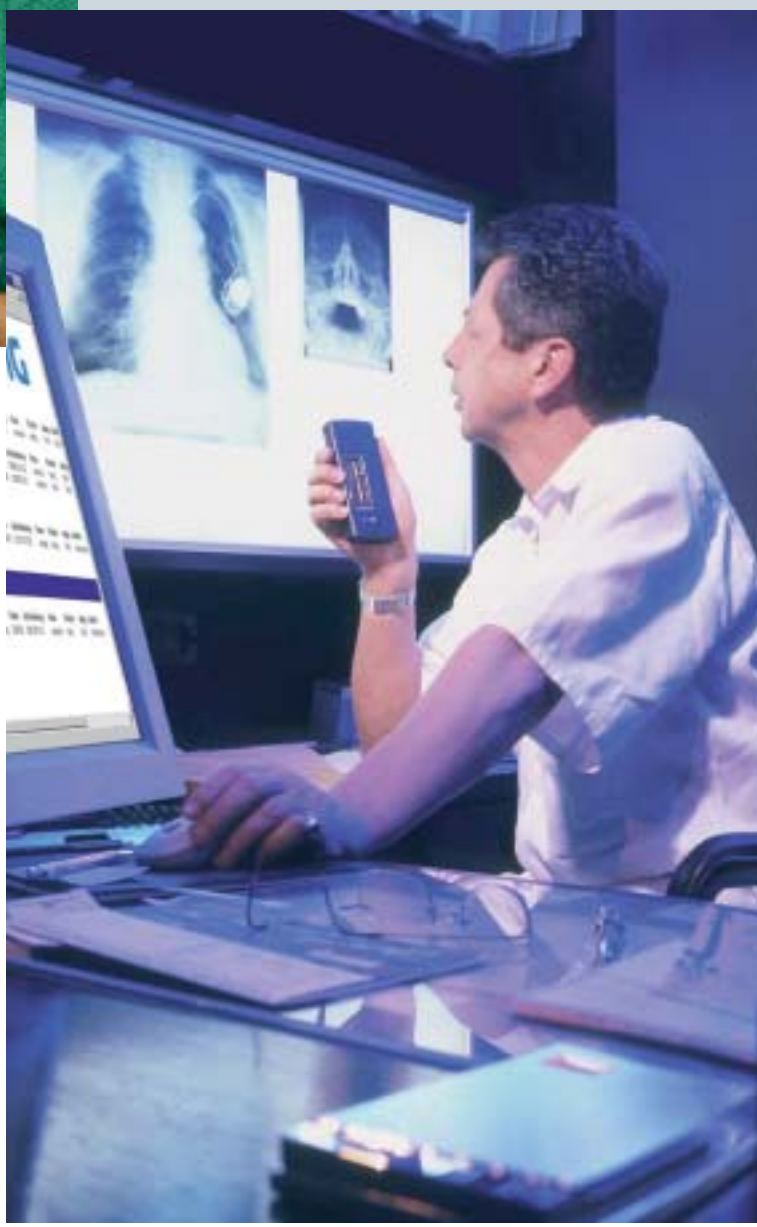
With the **Learning Culture to Develop Competence Programme** we are supporting the work of building up efficient and continuous learning structures in companies and strengthening the occupational competences of women and men at work. The programme is being supplemented by a measure "New Competences for Industrial Skilled Workers (NAKIF)", the aim of which is to promote independent learning directed by experience in the work process.

With the research programme **"Innovative Work Organisation – The Future World of Work"** we are supporting the development of instruments and strategies that should ensure companies' ability to innovate. This includes trying out new concepts for the transition from old to new corporate and organisational structures, for example, and the development of new forms of work organisation.

With various pilot projects we are **promoting the testing of new technologies in small and medium-sized firms** to stimulate the broad application of these technologies. One example is LERNET (network based learning in SMEs and the public administration), in which new forms of further training are being tried out in small and medium-sized firms and the public administration on the basis of the new information and communications technologies. Models are to be worked out for self-organised learning, that will increase the acceptance and quality of network based further training and induce imitation effects.

We are supporting **24 regional "E-Commerce" competence centres** and the further development of vocational training centres into **specialised competence centres in the crafts,** where staff from SMEs will find an extensive range of information, consultancy and training. With the business plan competition for IT-supported innovative services we are stimulating the development of services competences in the crafts. We are also promoting the evolution of model applications for SMEs and pilot schemes to make work in electronic commerce user-friendly.

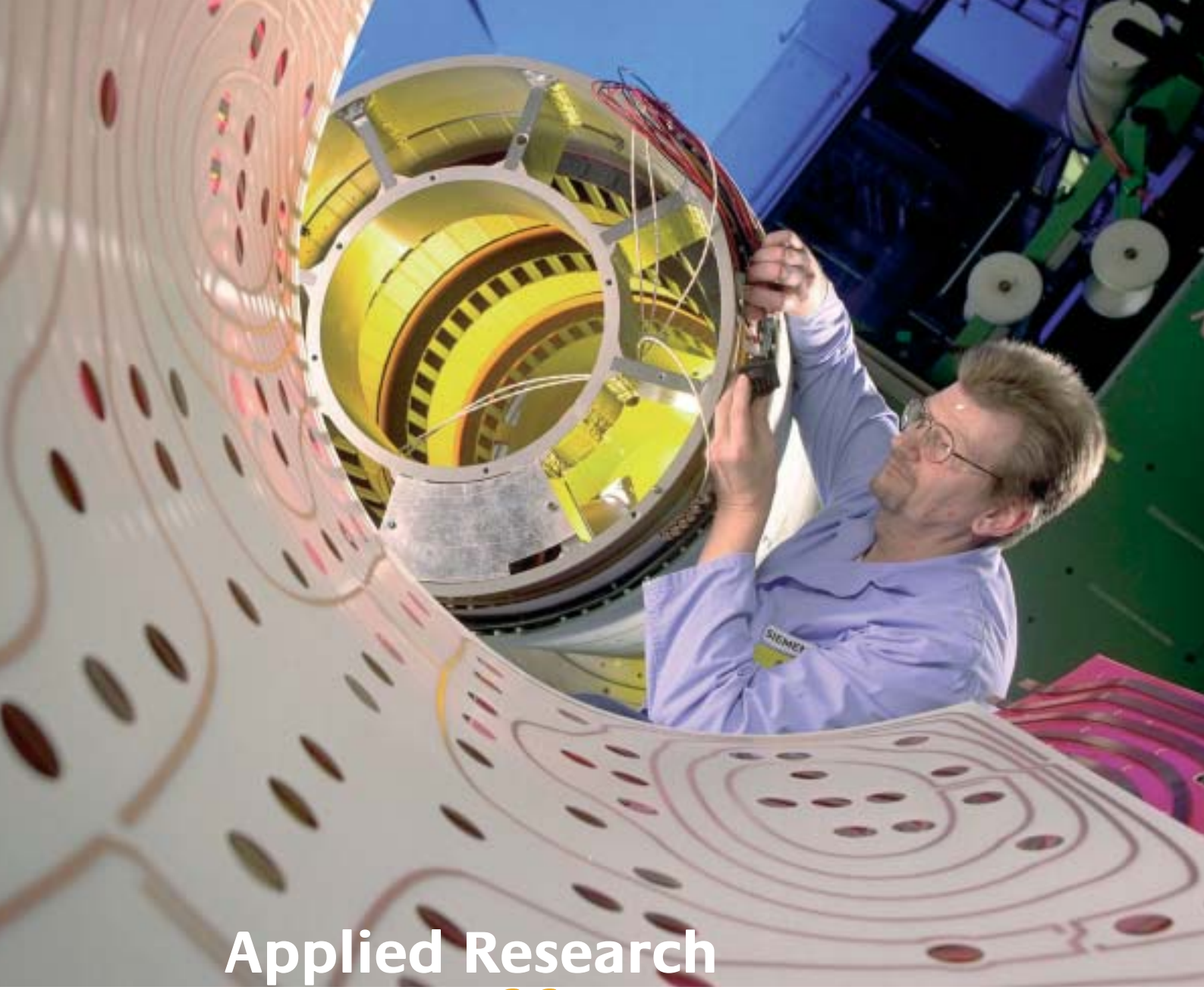
NEW TECHNOLOGIES PROVIDE STIMULUS IN THE CRAFTS.



INNOVATIONS FROM SMES DETERMINE THE DAY'S WORK.

With the technology-oriented Visitor and Information Programme (TOP) we are promoting the exchange of practical experience between innovation-oriented skilled and management personnel from companies. In one-day events companies that are "technological pioneers" in their fields of business demonstrate to other companies on the spot the successful use of innovative technologies and corporate structures. This programme is so designed that it can be largely self-financing in future.

With the new **Consultancy Programme on Innovation Management** we are supporting the initiation and implementation of product and process innovations by small firms in the new federal states. The firms receive consultancy and management services for their innovation projects through one of the agencies for technology transfer and innovation promotion. The firms must make a substantial contribution themselves, scaled according to the extent and intensity of the consultancy.



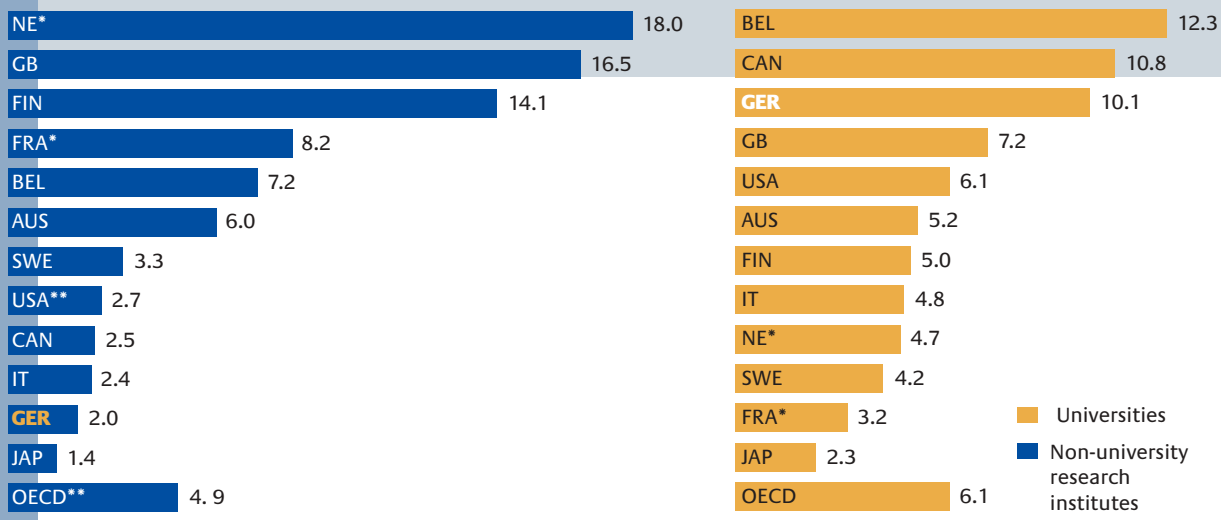
Applied Research

More Efficiency

and

Better Exploitation of Results

R&D FINANCE FOR UNIVERSITIES AND NON-UNIVERSITY RESEARCH INSTITUTES THROUGH THIRD PARTIES IN BUSINESS



Definition: share in percent of funds from third parties in business in total R&D expenditure, average for 1998/99.

* 1997/1998.

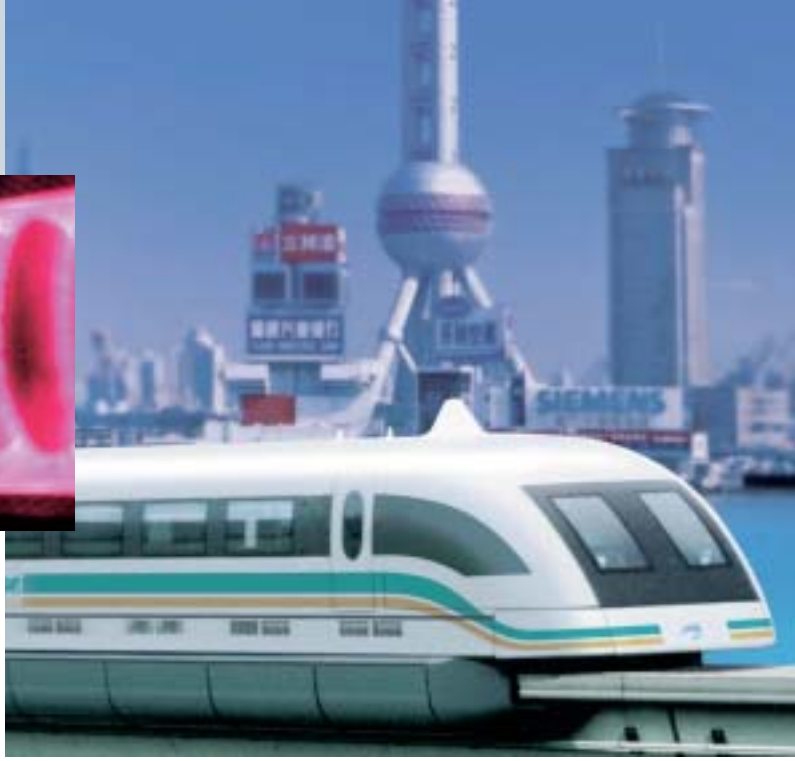
** Estimated using data from US Science and Engineering Indicators (Tables 2-60) and Abramson et al. (1997, 137ff.), OECD average incl. US estimates.

Source: OECD, Basic Science and Technology Statistics. – Calculations by ZEW

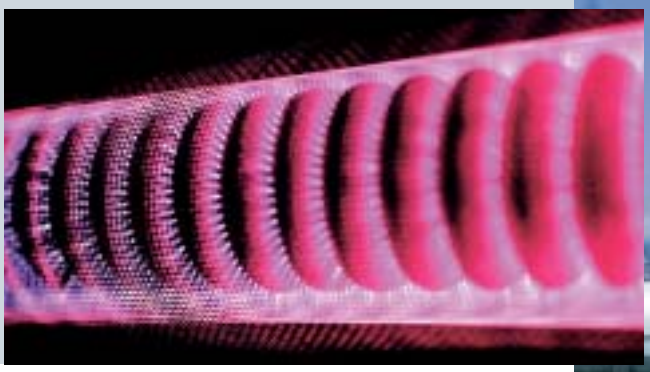
Research is not an end in itself. The aim is to lead in the long term to economic growth and new jobs. For this all the links in the innovation chain – from basic research through to the diffusion of new products and processes – have to be networked. **Applied research** occupies an important position here between pure science and marketing. Applied research and development is performed primarily in companies, but a considerable part of publicly funded research is also applied research. In any case, in many knowledge-intensive technology fields it is no longer possible to draw a clear dividing line between basic and applied research. Publicly funded research is automatically confronted with questions of application here, and for this kind of research the question of the efficient transfer of technology arises; that means first and foremost timely cooperation between science and industry in identifying themes and in observing and supervising R&D projects.

Cooperation between science and industry in research and the exploitation of results works with varying degrees of success in Germany. **In research institutes outside universities** considerable progress has been made in recent years in utilising new R&D results. Patent registrations have doubled in these establishments in the last ten years, in some areas they have actually tripled. These institutes have also been successful in concluding licence agreements and earning income from these, which now amounts to about 0.7 % of total R&D expenditure. That figure is high by international standards as well. But there is room for improvement in the acquisition of research funds from industry.

In the **universities** the situation is quasi the reverse. There every tenth euro used in research now comes from industry – a share that leaves little room for further increase. But there is still considerable potential for increasing exploitation. In patents the German universities can be proud of their position on a European comparison, but overseas universities are clearly ahead. In addition, German university professors often resign their patent rights at an early stage, or they do not fully pursue them, and licence agreements are only achieved in exceptional cases. The American universities can now finance about 2.3 % of their research from licence income, while the German universities are still far from achieving this level. One of the biggest obstacles so far has been the privilege granted to university teaching staff, that has ensured sole right of exploitation of their results to the professors. This has prevented an efficient exploitation infrastructure from being built up in the universities.



RESEARCH CREATES MOBILITY – THE TRANSRAPID AGAINST THE SHANGHAI SKYLINE



RESEARCH HELPS THE ENVIRONMENT – A CLEANER CAR DIESEL ENGINE

Altogether a clear trend has been recognisable in companies in recent years towards **outsourcing applied research** and increasing commissioned research. Where fifteen years ago only about every eleventh euro spent on research by companies went to external R&D contracts, at the end of the 90s it was just under every seventh. Contracts to other countries have doubled, but there have also been considerable growth rates in contracts to the German private sector. This mainly reflects the growing practice of outsourcing research activities hitherto performed in-house and an increase in R&D contracts between divisions in multinational concerns. In the research scene the universities and professors have profited most from the general trend.

The **Fraunhofer Institutes** are also eagerly sought as partners for commissioned research. The Fraunhofer-Gesellschaft has been very successful at using its scientific competence to solve companies' research and development problems by identifying their needs at an early stage. In doing this they draw greatly on the knowledge basis they build up through their preliminary research, and this makes them interesting research partners for private companies. As soon as private R&D services providers can perform comparable work the Fraunhofer Institutes withdraw from the R&D market in question.

Altogether applied research in publicly funded research institutes in Germany needs to be more efficient. The German research institutes need **more competition, more responsibility and less bureaucracy** to be able to provide the incentives correctly. The right incentives are also needed on individual level. Committment to the transfer of results should pay off for the scientist, both financially and in terms of career advancement.

Applied research is also an important task for the institutions that ensure that the **technical and economic infrastructure** functions well in Germany, and which therefore bear a great responsibility for Germany's quality as a location for research. The Federal Institute of Physics and Metrology (Physikalisch-Technische Bundesanstalt – PTB), the Federal Institute for Materials Research and Testing (Bundesanstalt für Materialforschung und -prüfung – BAM) and the German Institute for Standardisation (Deutsches Institut für Normung – DIN) are recognised worldwide. Their main function is measurement, testing and standardisation, but they also perform some research in cooperation with industry.

The **PTB** is the national metrology institute in Germany and so it is responsible for ensuring that measurements are uniform and generally observed, and that measurement is carried out correctly. That is an important condition of quality in production, in consumer protection and in medicine. The "correct" time, for example, is set using a group of atomic clocks that are among the most exact in the world.

The **BAM** guarantees safety and reliability in chemical, environmental and materials technology. Containers for the transport of dangerous substances, for instance, are tested and safety norms are worked out for them. Another task is to develop and provide reference procedures and materials, especially for analytical chemistry and testing techniques.

The work of the BAM and the PTB is increasingly international in orientation. This is to ensure that technical regulations and the procedures for approving products are uniform worldwide and so facilitate trade.

The **DIN** is a non-profit organisation run by companies in the private sector. Around 1,650 associations and companies are members. Owing to the progressive globalisation the main focus of its work is now more in the international arena, working out norms that can be applied worldwide and integrating them in the German standards.

RESEARCH MAKES IT POSSIBLE – HIGH TEMPERATURE SUPRA-CONDUCTORS ARE ATTACHED TO A CABLE THAT CAN BE USED FOR APPLICATIONS USING MAINS CURRENT.

RESEARCH TREADS NEW PATHS - THIS INDEPENDENT RADIO SENSOR DOES NOT NEED A BATTERY, IT DERIVES ITS ENERGY FROM MEASUREMENT – HERE THE RISE IN TEMPERATURE WHEN AN ARTICHOKE IS COOKED.

INTERVIEW

1. What makes the Fraunhofer Institutes successful on the interface between science and industry?
In cooperating with industry the concern is not only to analyse the problem and gain new knowledge, but to solve the problem. So research must be oriented to need. The client, industry, must be sure that the research institute will remain a close partner until the problem is solved.

PROFESSOR DR.-ING. DR. H.C. MULT. HANS-JÜRGEN WARNECKE, PRESIDENT OF THE FRAUNHOFER-GESELLSCHAFT, MUNICH

2. What demands does industry make on the institutes engaging in applied research?
There must be mutual understanding – and this must start with the choice of vocabulary. The problems and how to find the solutions must be worked out. The work has to be carried out under pressure of time and costs and within a given budget.

3. How do you ensure the link between scientific competence and orientation to industry's needs?
Research as it is performed in the Fraunhofer Institutes cannot be entirely funded by industry, if we still want to be in the lead and so still attractive for industry in a few years as well – as we must be. The Fraunhofer Institutes' method of financing takes account of this. More than a third of our total expenditure of € 1 billion comes from the German Government and the states as a basic grant for preliminary research. In preliminary research we have to keep estimating what industry will probably need in five to ten years or what it will probably be able to implement.

4. What efforts are the Fraunhofer Institutes making to translate their research results into marketable innovations?
Whether a new solution to a problem is an innovation will be decided by the customer or the market. Our research results are implemented firstly by companies in intensive cooperation, as part of projects and commissioned research. Another way is to found a new business, and a great number of these have evolved from work by the Fraunhofer Institutes. 60 % of our earnings from industry come from cooperation with small and medium-sized firms.

APPLIED RESEARCH MAKES LIFE EASIER - THANKS TO NEW TECHNOLOGY, EQUIPMENT AND COMPUTERS CAN BE OPERATED WITH SIMPLE GESTURES

Innovation policy will ensure that applied research in publicly funded institutions guarantees the efficient transfer of the results of new scientific research into industry. It will also ensure that publicly funded applied research takes due account of the requirements of the market without losing sight of its public obligation to research.

What are we doing specifically?

The Federal Ministry of Education and Research and the Federal Ministry of Economics have met the special need for action in this field by launching a joint action programme, "Knowledge creates Markets". In this programme we have initiated a number of measures to strengthen the transfer of knowledge and technology in Germany, of which the following are now being implemented:

- By abolishing the traditional "privilege for university teaching staff" we have strengthened the role of the university in the exploitation of research results. The reform of § 42 of the Law on Inventions by Employees, that came into force in February 2002, has given the universities the right to claim inventions by all their employees, including the academic staff, patent these in their own name and utilise them on their own account in business. The inventors in the universities will be given a significant part of the receipts from the exploitation.

- We are promoting the development of patent and exploitation agencies as an infrastructure for patenting and exploitation that will operate on professional level throughout Germany. In particular, it will support the universities in making effective use of the opportunities offered by the abolition of the university teaching staff privilege. We are at the same time giving the universities grants towards the costs of acquiring and defending patents. We are also supporting the development of a new exploitation agency with comprehensive powers in the four centres of the Helmholtz-Gemeinschaft that operate in the life sciences.

- We are promoting the provision of information for and the training of scientists and research administrative staff on the questions of patenting and exploitation. This is intended to create a broad awareness of patenting and exploitation in research and help research workers to cooperate effectively and without friction over their inventions with the university or its patent and exploitation agency.

- We are supporting the development and build up of a national exploitation network. This is to make it easier for those involved in the exploitation process to find their way to the market. The network should also help to improve contacts with industry and provide a contact address for demand from industry.

- In the European context we are working to ensure that a grace period for innovations is incorporated in European patent law within the near future. This should make it easier for both research staff and companies to combine the publication of research results or product developments and their registration as patents in future. We are also supporting efforts at European level to lower registration costs for Europe-wide patents by introducing the Community patent.

NO BOUNDS TO INFORMATION THROUGH THE NEW TECHNOLOGIES

With our **SME patent action** we are promoting the awareness of patents in small and medium-sized firms in Germany. They are being given financial support for their first patent registration, including research in patent data banks and the technical approval and exploitation of the protected invention. For this they can draw on the competence of the national network that developed out of the association project "Stimulating Innovation in German Industry (INSTI)". We also offer financial support and skilled assistance to freelance inventors during the patenting and exploitation of their innovative ideas through the Fraunhofer Patent Office for German Research (www.patente.bmbf.de).

Now that the reform of the university service legislation has come into force we are pursuing the aim of making **remuneration more oriented to performance,** for scientific employees at **research institutes outside universities** as well; this should also reward commitment to the transfer of results. Model regulations on salary scales are to be agreed first for some research institutes as a pilot scheme.

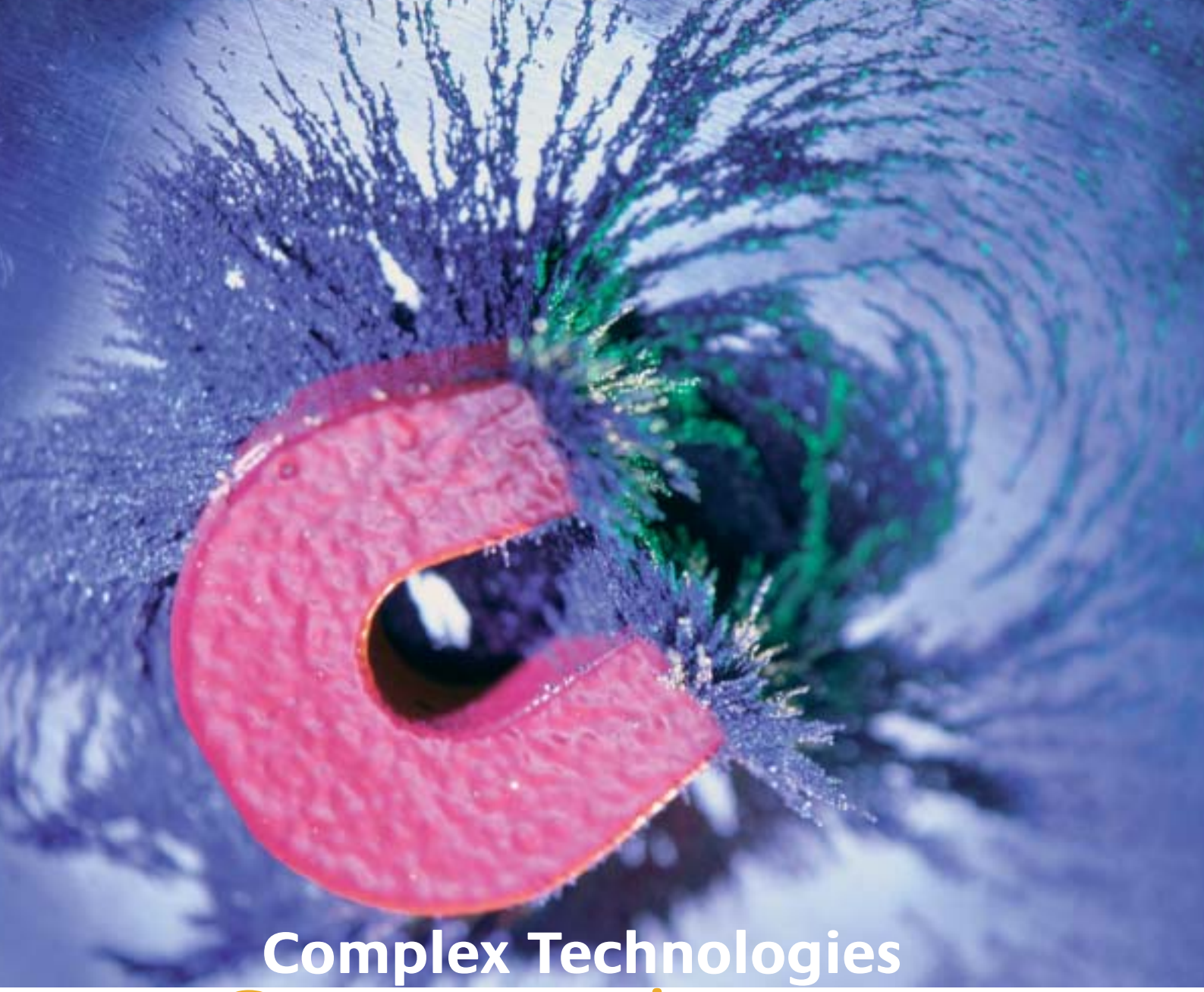
We are giving our research institutes **greater responsibility** in budgeting. Greater scope for flexibility in handling the budget was already introduced for these establishments in the 2002 budget.

With the transition to **programme-oriented promotion** in the centres of the biggest German research organisation, the **Helmholtz-Gemeinschaft,** we are creating a new method of financing to strengthen flexibility and achieve greater orientation to performance and results. In future the funds will be allocated in competition and depend on the quality of the programme proposals submitted by the centres. Around 25 % of the research budget of the Federal Ministry of Education and Research, namely around € 1.5 billion a year, will be affected. The first funding under the new system is to be carried out as early as 2003 for the two first research areas, "Health" and "Transport and Space". Through its membership in the organisations´s senate, industry will be in a position to incorporate its proposals and considerations in the selection of the programmes.

We will ensure that the **Federal Institute for Materials Research and Testing (BAM)** and the **Federal Institute of Physics and Metrology** (PTB) continue to expand their cooperation with industry and with international partners, and can perform their increasingly complex tasks efficiently with highly qualified personnel. To optimise the range of tasks and the strategic direction of the PTB further this institute is currently being evaluated by a commission of international experts. The evaluation report will be published at the end of 2002.

Their close proximity to practice and their close contacts with firms, as well as their regional ties, make the technical universities the preferred partners for cooperation, particularly with small and medium-sized firms. With our programme **"Application-Oriented Research and Development at Technical Universities"** we are promoting the execution of research projects. We are also supporting collaborative efforts between small and medium-sized firms and technical universities through the German Government's specialised technology programmes.

In the **new federal states** we will continue to support the **external industrial research institutes and R&D services providers** that are close to industry with project-tied funds. These establishments have proved efficient and effective in the transfer of R&D results to industry, as they have close contact with customers and markets.



Complex Technologies

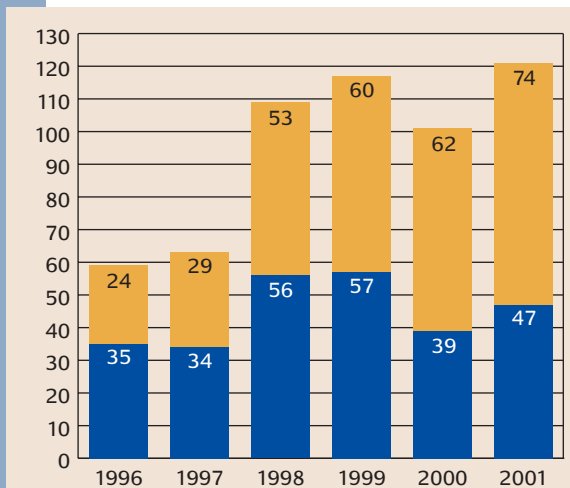
Cooperation and Networking

NETWORKS AND RESEARCH ASSOCIATIONS MATCH THE GROWING COMPLEXITY OF RESEARCH AND TECHNOLOGY

The world of research today has become more complex. It is less and less possible for the individual fiddling in the quiet of his/her room to solve technological problems. Increasingly comprehensive solutions are needed on which researchers from different subjects and establishments work together. Many technical questions are beyond the technological competence and financial resources even of one individual company.

We need **collaborative research efforts** in which the individual partners from companies and research institutions incorporate their ideas and competences to solve technical problems together and develop new marketable products and services. There can be cooperation in every form from bilateral link-ups right through to big networks with a large number of participants. The collaboration of researchers in an association with industry is another efficient way – beside commissioned research and patent utilisation (see the chapter "Applied Research") – to make the knowledge in universities and research institutes available to companies in industry in a profitable way.

PROMOTION OF RESEARCH COOPERATION



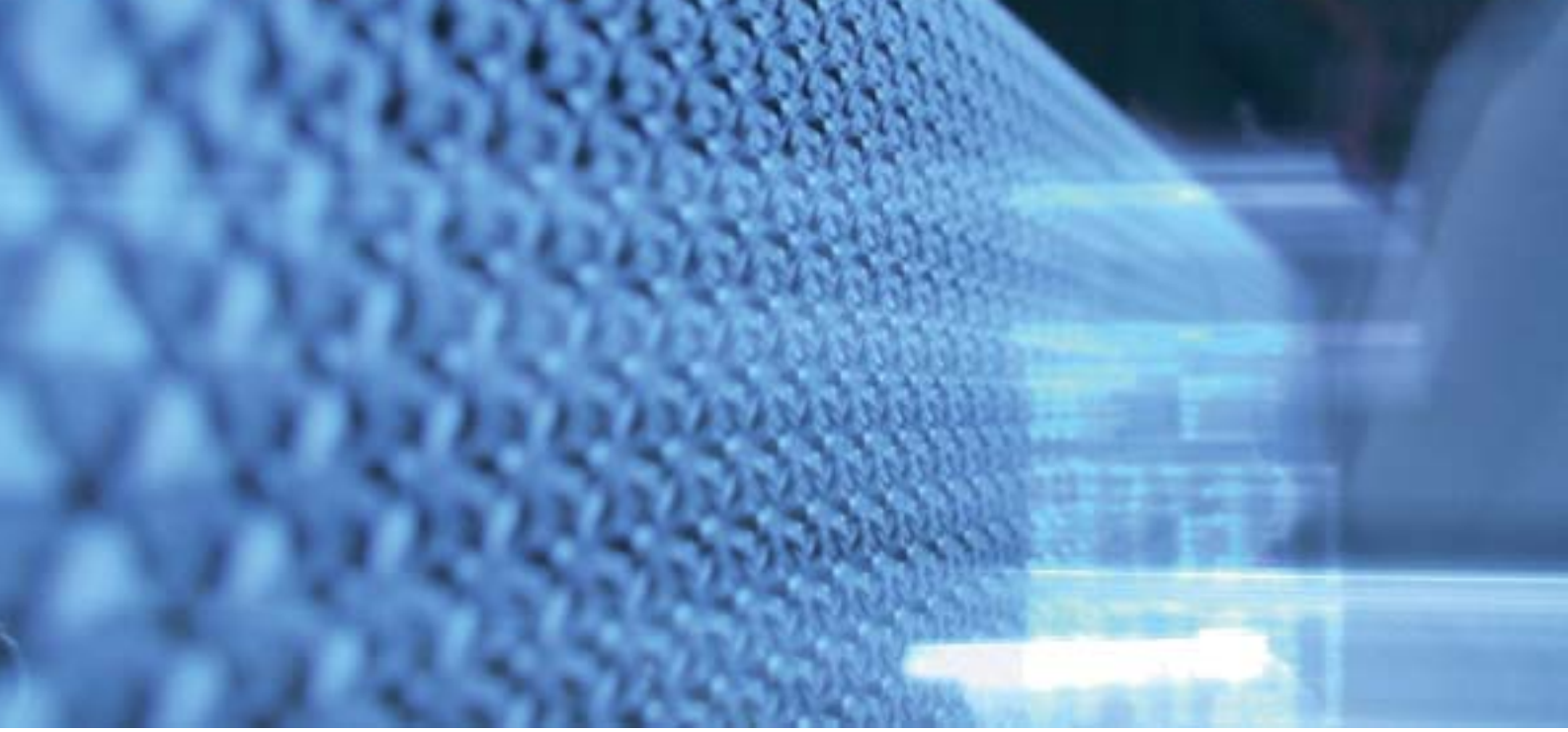
Promotion under the PROINNO and preliminary programmes (in million euros)

Source: Federal Ministry of Economics

How difficult, but how necessary, cooperation between people in different institutions is was already recognised by Henry Ford, who said that linking up is a start, staying together is progress, working together leads to success.

By international comparison the **willingness of German industrial firms to cooperate** in research and development is average. About 23 % cooperate with other companies, universities or research institutes (EU average 25 %). Compared with companies in other EU countries, however, German companies cooperate particularly frequently with partners from research.

It was recognised at an early stage in research and innovation policy that one of the tasks was to initiate cooperation between companies and research establishments. Programmes oriented to small and medium-sized firms have been designed specifically to **promote cooperation and joint ventures.** A growing number of collaborations of companies and research partners are being supported under the specialised technology programmes as well. In many of the specialised programmes, like those for the production technologies and informatics, almost all the research funded is collaborative research. The importance of research institutions as partners in collaborative projects has risen continuously. Every third euro that flows to companies as promotional funding flows to collaborative projects in which research institutions are partners. Pioneering projects make inter-disciplinary collaboration research possible in strategic fields that are important for the economy (cf. chapter "Quantum Leaps in Technology").



COOPERATION KEEPS PROCESSES ALIVE.

INTERVIEW

1. How important is cooperation with research for your company?
Particularly for us as a medium-sized firm it is essential on the one hand to expand our general competence and innovation, and on the other to concentrate our internal resources on the R&D areas that will help our product development and our specific corporate know-how. That is why we need cooperation in R&D.

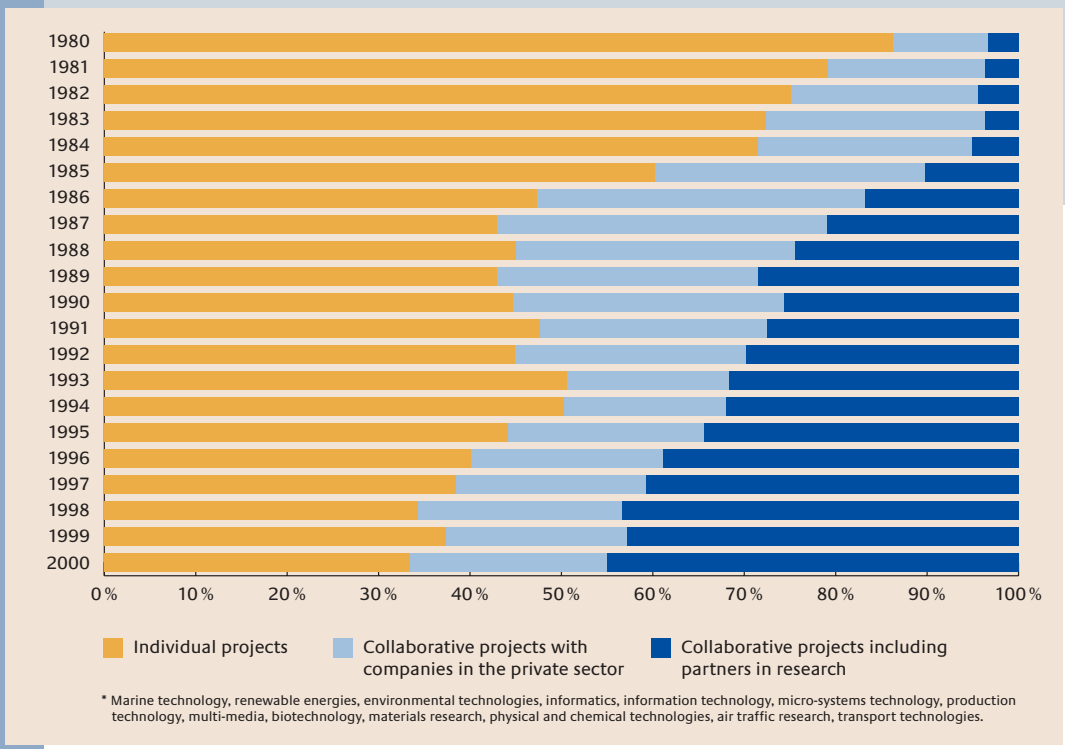
2. What induced you to join the German Federation of Industrial Research Associations (AiF)? And in your view what particular features distinguish Cooperative Industrial Research (IGF) from other research collaborations?
The associations that are members of the AiF offer the unique opportunity of cooperating with other companies in institutionalised form, vertically (with suppliers or raw materials producers) and horizontally (with direct competitors) in the pre-competition stage.

YVONNE PROPPERT, MANAGING DIRECTOR OF DR. POEHLMANN & CO. GMBH, HERDECKE

3. In what form can you incorporate your specific ideas for research in the IGF?
Within the organisation proposals for possible research projects can be made to the office or generated in discussions within the various organs of the research association (the board of managing directors, the research committee, other committees, working groups and circles). Frequently the work of these organs in particular provides important stimulus for our company. Moreover, the processing of knowledge in advance of research projects provides important information for all the member firms, and in some cases makes further research unnecessary.

4. How has your commitment to the AiF affected the competitiveness of your firm?
Other research joint ventures generally end when the project is completed. The institutionalisation of joint research under the umbrella of the AiF has created a network of companies in the same branch, independent of any individual research project, that will be of benefit to the companies as an information platform over the long term, even after specific R&D projects are completed. The network gives medium-sized firms access to important information and to research establishments, other project sponsors and other associations that are members of the AiF.

SHARE OF COLLABORATIVE RESEARCH* IN TOTAL DIRECT CIVIL PROJECT PROMOTION BY THE GERMAN GOVERNMENT 1980-2000



Source: Federal Ministry of Education and Research, PROFI databank, calculations by ZEW

AUCOTEAM INGENIEURGESELLSCHAFT FÜR AUTOMATISIERUNGS- UND COMPUTER-TECHNIK MBH, BERLIN – AN EXAMPLE OF COOPERATION WITH RESEARCH

In 1991 enthusiastic staff and management in the research division of Elektro-Apparate Werke Berlin laid the foundation for the company's successful advance to an efficient systems enterprise producing automation and data communications equipment and software engineering for industry and the administration. The company specialises on commissioned developments and R&D services, and environmental and reliability testing. Today the firm employs 150 people, 95 of whom are in R&D, and it has an annual turnover of around € 15 million. R&D project promotion enabled it to profile more strongly on risky and investment-intensive research fields, in which it worked closely with research institutes and companies in Germany and abroad. For example, it carried out an R&D joint venture on process conductor technology with a Polish firm. AUCOTEAM also joined the innovation network "Intelligent Measurement Systems", a model project with public funding for the formation of innovation networks.

For the German Government cooperation and networking in research and innovation activities continue to be among the most important elements of its research promotion. The knowledge gained from the system-evaluation of collaborative research promotion by the Federal Ministry of Economics will flow into the renewal of the structure of promotion.

What are we doing specifically?

By promoting Cooperative Industrial Research (IGF) we are supporting branch networks of small and medium-sized firms that are members of the AiF (German Federation of Industrial Research Associations). Building up on the results of joint research the companies can develop company-specific solutions for new processes and products. For research projects that extend beyond the branch and are based on particularly pioneering technologies the ZUTECH variant of the programme is available.

INNOVATIVE PROCESSES NEED SYSTEMS MANAGEMENT – LEAD PROCESS TECHNOLOGY IN THE STEEL INDUSTRY

INNOVATIVE PROCESSES NEED SYSTEMS – PRODUCING METAL BODY PARTS IN THE AUTOMOTIVE INDUSTRY

With our programme **Promotion of Innovative Networks – InnoNet** we are promoting collaborative projects in which at least two research establishments are cooperating with at least four small or medium-sized firms to develop high-tech products, processes or services. This measure is intended to make joint research and development possible where the conditions are not (yet) given for participation in a research association in the AiF or research associations have not (yet) been formed.

With our programme **Innovation Competence for Small and Medium-Sized Firms – PRO INNO** we are supporting national and international research cooperation between small and medium-sized firms as well as with research establishments and enabling companies to start or resume research and development. In addition, the temporary transfer of R&D personnel between companies and research establishments is also being promoted. Applicants from the new federal states are given special preference.

With the new promotional measure **Network Management East – NEMO** the formation of regional networks of small and medium-sized firms with research establishments that are close to industry is being supported in the new federal states. Under this programme only the network managers receive support, not the individual companies. This is to enable the com-

THE RESULTS OF THE SYSTEM-EVALUATION

The programmes of the Federal Ministry of Economics that are designed to promote cooperation in research and networking between small and medium-sized firms and research institutes were for the first time subject to a general system-evaluation. For this purpose, an independent commission of external scientists and programmes users worked out a number of proposals, which they presented in December 2001. A preliminary version was put on the Internet, to enable suggestions from companies, associations and other interested parties to be taken into account in drawing up the report. On the basis of the recommendations from the commission we will develop further the promotional programmes they have assessed and gradually concentrate them just on two programme lines:

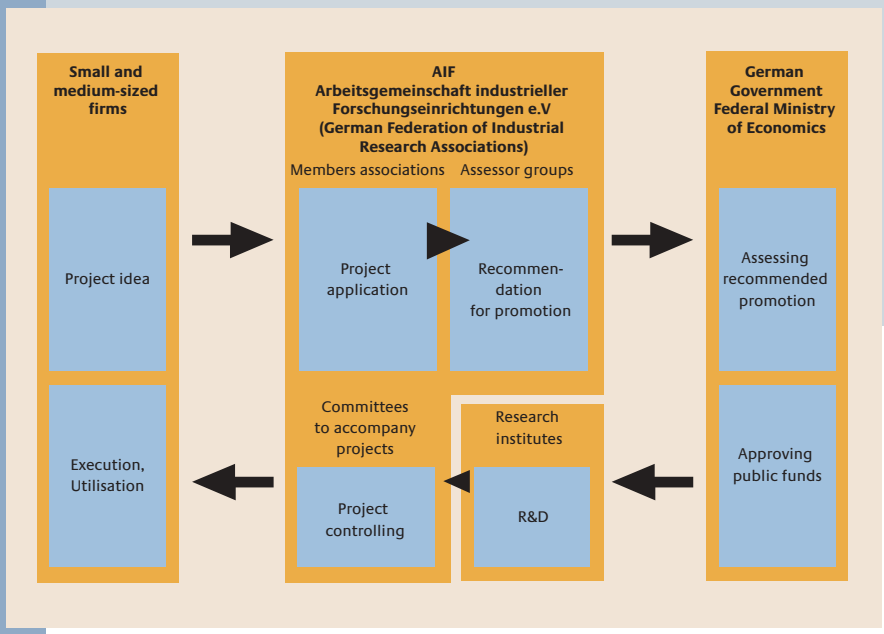
1. Promotion of R&D projects before the competitive stage to develop technological platforms, that is, technological solutions for a number of users, e.g. groups of companies or whole branches.
2. Promotion of marketable R&D joint ventures between companies or with R&D establishments that are designed to work out company specific solutions.

Our aim in this is:

- to make competitive tenders the rule
- to involve small and medium-sized firms more in planning and executing joint research
- to give companies promotional funds for further projects only if they have successfully executed the previous promoted R&D projects and
- to give preference to funding structurally weak regions, mainly in eastern Germany.

The aim is to make the system of promotion more transparent and use the promotional funds more efficiently.

HOW THE AIF WORKS



Source: Federal Ministry of Economics

panies to utilise synergy effects from cooperation with other companies and research institutes and enter the market with their partners with greater technological competence and on a broader technological basis.

Under our specialised programmes on **specific research themes that are particularly relevant for the future** we promote **collaborative projects** in which representatives of the universities and research institutes and companies, particularly small and medium-sized firms, work together as equal partners. The promotion is given for a limited period. However, the networking that is created between the partners in the joint venture is a desirable side effect of an collaborative project, and in many cases it lasts beyond the actual duration of the project.

Pioneering visions are a special form of promotion for research collaborations. They are focussed on social needs, e.g. the themes of mobility, health and the environment. The research projects are inter-disciplinary and they network new technological developments with questions of social need (see also the chapter "Quantum Leaps in Technology"). The pioneering visions build up on experience that we have acquired with lead projects as pioneer instruments. The German Government is currently funding 37 **pioneering projects** on seven problem areas with a total volume of more than half a billion euros.

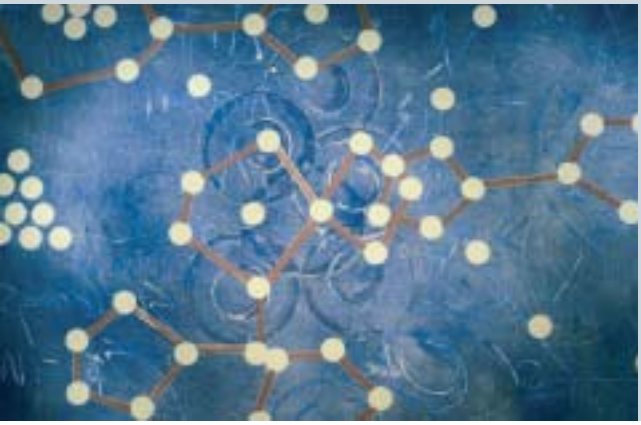
ROBOT SYSTEMS HANDLE BAGGAGE AT AIRPORTS

MICROSYSTEMS TECHNOLOGY 2000+ – STRONG SMES IN SUCCESSFUL ASSOCIATIONS

Under the Microsystems Technology 2000+ promotional concept the implementation of microsystems technology is being promoted across a broad front in selected branches or fields of application like communications, automotive, laboratory, medical and environmental technology. The concept specifically supports the building up of networks of research establishments and companies. Small and medium-sized firms are particularly represented in this promotional programme, accounting for more than 80 % of the industrial partners. They are succeeding in contributing to value creation across all the production stages. Disadvantages of size in marketing are more than compensated by the cooperation between the firms. More than a third of all the partners are taking part in this programme for the first time.
Microsystems technology is being incorporated in many firms that have so far hardly been active in this field, or are entirely new to it.

Innovation Clusters

New Regional Concepts for Promotion



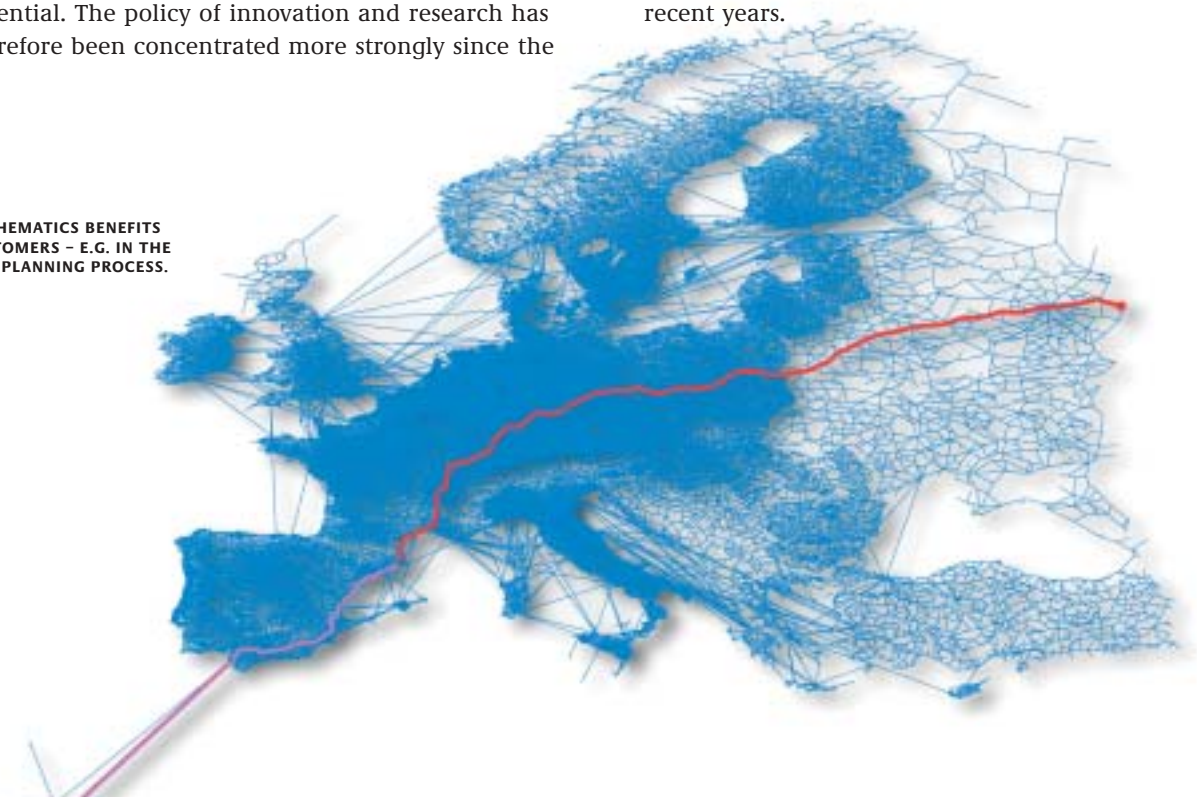
INNOVATION POLICY ORIENTED TO REGIONAL NEEDS OPENS UP NEW FIELDS OF TECHNOLOGY.

Germany is distinguished internationally by a **strongly decentralised research and development structure,** which is otherwise practically only to be found in the federative United States. Germany has a whole number of regional R&D centres that provide an important basis for the economic strength of their region but whose influence extends beyond it as well. Compared with countries like France and Great Britain, where research is largely concentrated in the region around the capital, Germany has important advantages in the diffusion of new technologies. New technological developments can spread more rapidly over geographical areas and be taken up more rapidly by companies in Germany through the decentralised R&D centres.

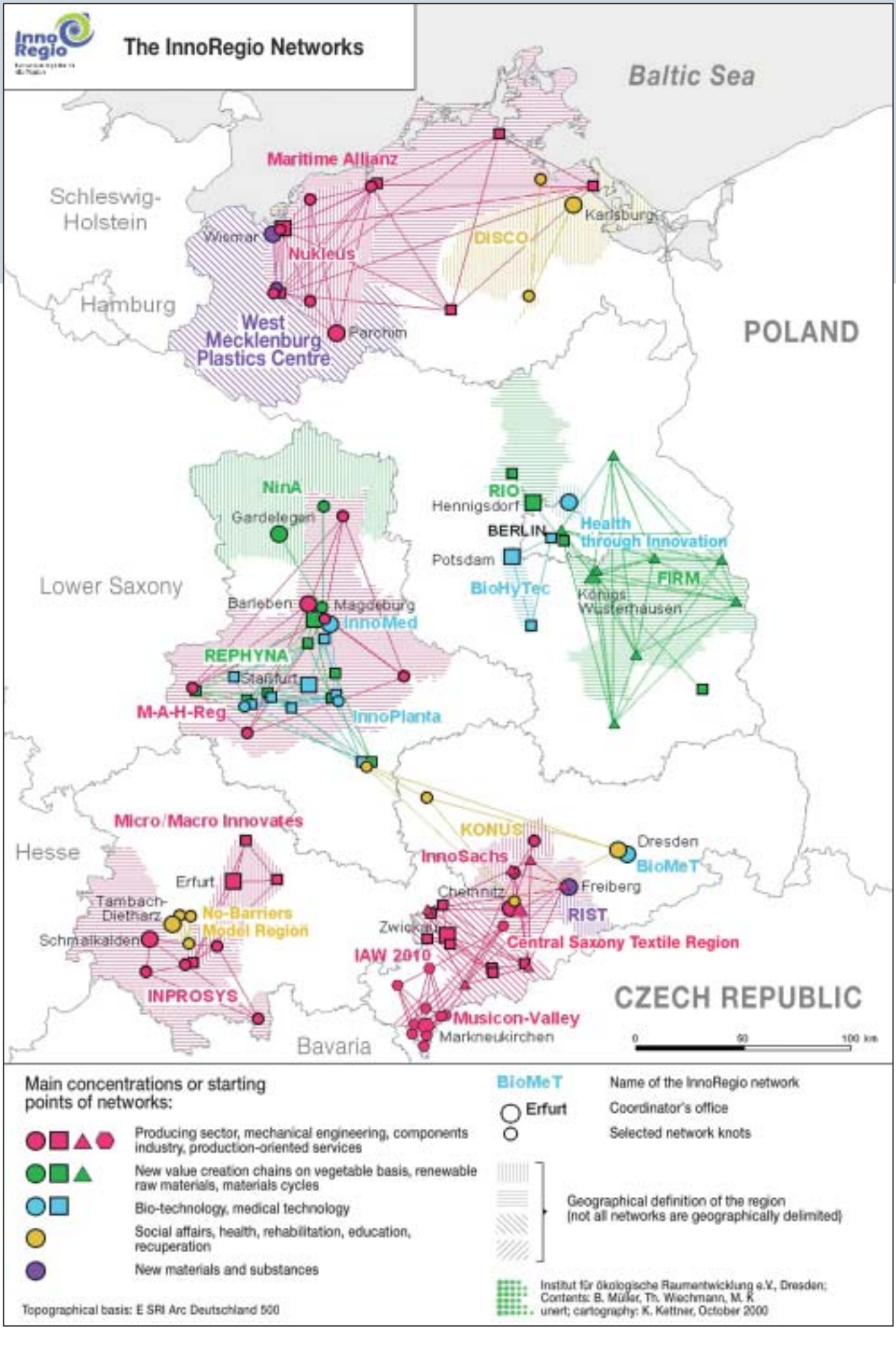
Regional concentrations of innovation activities frequently evolve in those fields of technology in which industry is in an early phase of the innovation cycle. In this phase the exchange of knowledge that is tied to personnel, personal contacts and close relations to universities and research establishments are particularly important. The BioRegio competition held in 1995 showed how an innovative mood can be created in a region through regionally-oriented promotion competitions in new fields of technology with a high future potential. The policy of innovation and research has therefore been concentrated more strongly since the mid-1990s on the region as the seedbed of innovative growth processes.

The regionally-oriented approaches in promotion are of particular importance for the **new federal states,** where small and medium-sized firms account for a far above average share of innovation. Whereas 22 % of R&D personnel in the old states work in companies employing fewer than 1,000 people, in the new states the figure is 72 %. In many of these companies elaborate innovation projects can only be successfully marketed if it proves possible to combine competences, optimise interfaces to publicly funded research and embed the firm's activities in a regional innovation profile. For this the regional strengths must be identified and expanded.

In some fields of technology (optics, pharmaceuticals, electronic components, medical technology, and in some sections of mechanical engineering) east German companies are now more intensively engaged in research than west German firms. Positive developments need to be stimulated through appropriate promotional measures that follow up on the scientific and technological strengths of east German regions. Tenders in regionally-oriented innovation policy have revealed the high potential of the new federal states in this way in recent years.



MATHEMATICS BENEFITS CUSTOMERS – E.G. IN THE LINE PLANNING PROCESS.


The InnoRegio Networks
Baltic Sea
Maritime Allianz
Schleswig-Holstein
Wismar
Nukleus
DISCO
Karlsburg
Hamburg
West Mecklenburg Plastics Centre
Parchim
POLAND
NinA
Gardelegen
RIO
Hennigsdorf
BERLIN
Health through Innovation
Potsdam
BioHyTec
FIRM
Königs Wusterhausen
Lower Saxony
Barleben
Magdeburg
InnoMed
REPHYNA
Stassfurt
M-A-H-Reg
InnoPlanta
Micro/Macro Innovates
KONUS
Dresden
Hesse
InnoSachs
BioMeT
Erfurt
Freiberg
Chemnitz
Tambach-Dietharz
No-Barriers Model Region
RIST
Zwickau
Schmalkalden
Central Saxony Textile Region
IAW 2010
INPROSYS
CZECH REPUBLIC
Musicon-Valley
Markneukirchen
Bavaria
0
50
100 km
Main concentrations or starting points of networks:
Producing sector, mechanical engineering, components industry, production-oriented services
New value creation chains on vegetable basis, renewable raw materials, materials cycles
Bio-technology, medical technology
Social affairs, health, rehabilitation, education, recuperation
New materials and substances
Topographical basis: E SRI Arc Deutschland 500
BioMeT
Name of the InnoRegio network
Erfurt
Coordinator's office
Selected network knots
Geographical definition of the region (not all networks are geographically delimited)
Institut für ökologische Raumentwicklung e.V., Dresden; Contents: B. Müller, Th. Wiechmann, M. K unert; cartography: K. Kattner, October 2000

INTERVIEW

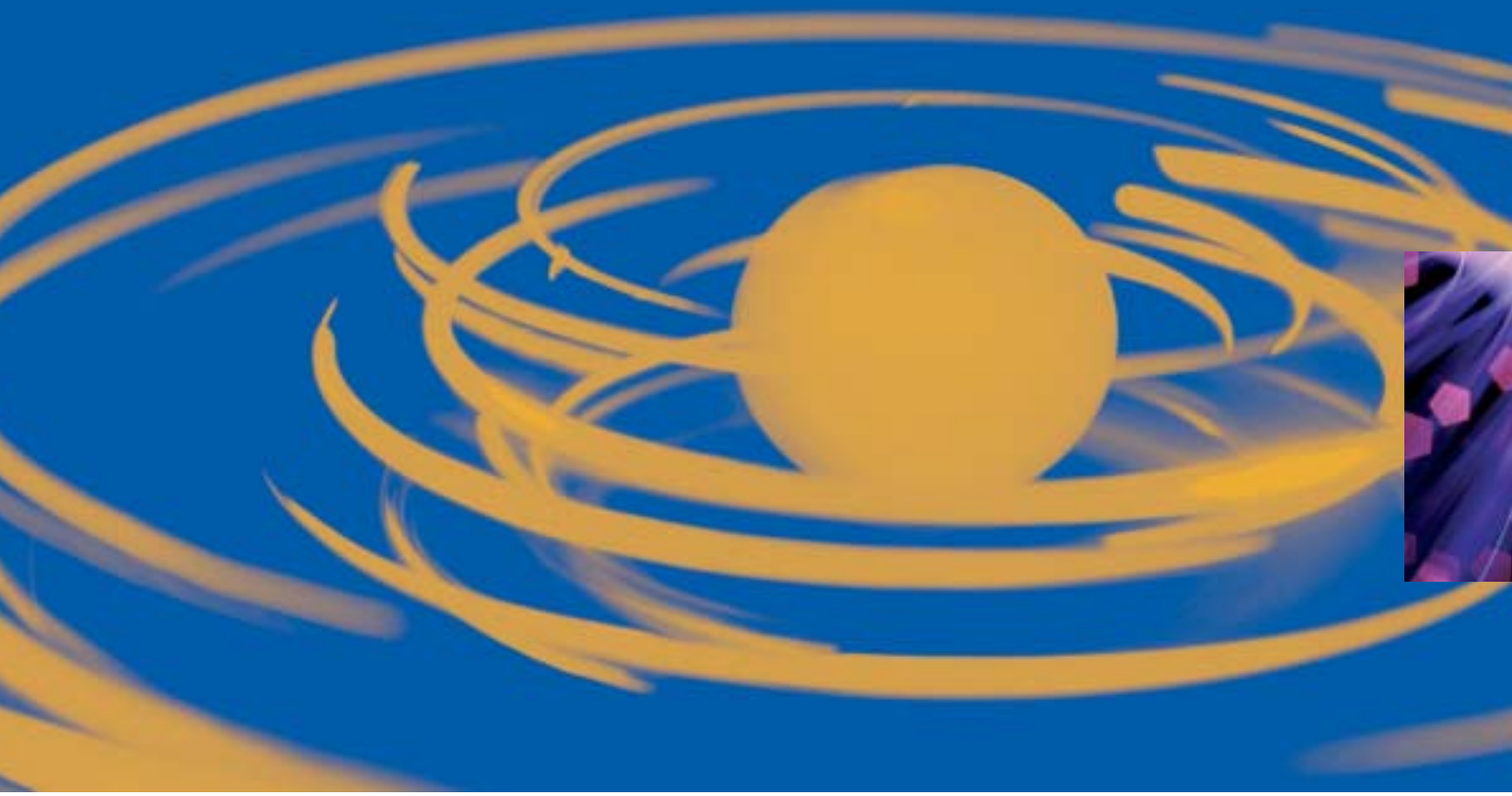
1. InnoRegio relies on cooperation in innovative networks. What is the MAHREG InnoRegio initiative? Who has formed a strategic alliance in this case?
The MAHREG Automotive Competence Network is an alliance of automotive suppliers in the Magdeburg-Anhalt/Harz region. The aim is to intensify cooperation between the c. 100 commercial firms, research institutes and universities and technical universities in order to achieve synergy effects in developing innovative products, processes and services. The purpose is to increase the market positions of the automotive components firms in Saxony-Anhalt.

PROFESSOR DR. EBERHARD AMBOS, OTTO VON GUERICKE UNIVERSITY MAGDEBURG AND CHAIRMAN OF THE BOARD OF MANAGING DIRECTORS OF SACHSEN-ANHALT AUTOMOTIVE E.V., MAGDEBURG.

2. InnoRegio is designed for lasting economic effect in the regions, with higher value creation and new jobs. Are any of these effects apparent after the first year of implementing the MAHREG concept, and if so, which?
During the first year of working together the aim was to intensify cooperation in R&D and increase the volume of production of the manufacturing firms. New research centres, like the Creative Competence Center (CC) in Harzgerode and the INFERTA Institute of Manufacturing Techniques in Vehicle Construction in Magdeburg were able to start operating and create additional jobs for skilled personnel. The expansion of the production of extra strong light metal parts for engines by the Rautenbach-Guss firm in Wernigerode has been a particular success. At present a new production plant for light metal vehicle parts is being built in Wernigerode with ThyssenKrupp.

3. What else has MAHREG changed in your region?
In future the cooperation is to be directed to complex products by automotive components firms in Saxony-Anhalt. They include a complete cylinder head and the industrial implementation of innovative reshaping processes (high pressure reshaping of internal parts). Electronic parts and multi-media solutions for vehicles are also being developed and put into production.

4. With InnoRegio a new approach was also chosen for promotion policy. In view of the experience with MAHREG how should promotion in the new federal states be increased to direct research to the marketing of its results at an early stage?
During the InnoRegio activities it has proved possible to combine the promotional activities in a state across ministries and departments. The work in collaborative projects is of particular importance. Experience has shown that special effects result from close integration of basic and applied research and production firms. That should be continued consistently. Above all, promotion policy should be directed to the very costly phase of transfering development results into practice.



The German Government is increasingly relying on promotional approaches to stimulate regional competence centres in pioneering areas of technology. It will put the existing and successful regional promotional measures in the new federal states on a steady basis, to enable scientific and technical crystallisation points to evolve there with a high commercial potential and a strong influence outside their region.

What are we doing specifically?

- We are promoting regional competence networks in new technology fields that include innovation chains from basic research to application, with complementary measures, like training skilled personnel. This is bringing together a wide range of actors from business, science, society and the financial sector in inter-disciplinary cooperation, in order to coordinate their innovative activities more. The best competence networks are distinguished on our Internet platform www.kompetenznetze.de.

- With our BioProfile promotional competition we are supporting projects to coordinate biotechnology research and the transfer of research results into applications by providing € 50 million over five years. This is to sharpen regional profiling in regard to the available innovation potential.

- With InnoRegio we will support the implementation of innovation concepts in 23 InnoRegio regions in the new federal states by 2006, worked out and executed by a range of partners in research, education, business and the administration. In opening up the innovation potentials we are relying particularly on the participants' own initiatives to stimulate developments that are self-sustaining in the long term. A total of € 255 million has been earmarked for this measure to finance a wide range of coordinated individual and collaborative projects, mainly in research and development, basic and further training and consultancy and network activities in the individual regions.

- With the new programme "Innovative Regional Growth Cores" the principles of the InnoRegio initiative – thematic focussing, self-organisation, sustainability and incorporation in regional innovation strategies – are being developed further. However, the programme shifts the main focus more to collaborative projects with a high market potential. The partners from business, research and finance are to define core technological competences jointly right from the start, and develop strategies for their future markets, with appropriate projects and means of financing. So far nine growth cores have been awarded about € 40 million for a period of three years. This year we will include more projects in our promotion and the measure will be continued in the next few years.

COMPETENCE NETWORKS IN NEW AREAS OF TECHNOLOGY HAVE AN INFLUENCE THROUGHOUT THE ECONOMY

NETWORKS REVEAL NEW POTENTIALS

The tenders for the InnoRegio and Growth Core programmes have revealed a high potential of viable regional innovation initiatives in the new states. However, these could not be incorporated in promotion at short term. This potential is being exploited in the **"Inter-regional Alliances for the Markets of Tomorrow"** initiative. Twenty-four innovation forums were held in 2001, at which regional competences were assessed and innovation fields defined where in future innovation strategies with division of labour are to be pursued in the regions in question.

As part of the general investment promotion measure of the **Federal/State Joint Scheme "Improvement of Regional Economic Structures"** which covers the structurally weak areas, and so especially the new federal states, a growing number of innovation projects are being supported. They include technology centres to attract new businesses, projects to train human capital and R&D projects by small and medium-sized firms. Between 1995 and 2001 about € 900 million in promotion flowed to innovative projects.

OPTONET – AN EXAMPLE OF NETWORKED ACTION

In the OptoNet competence network, that is located in Jena, more than 60 participants from companies, universities, research institutions, banks, municipalities and regional establishments have joined up to play an active part in the national and international development of optical technologies, for example by taking up research themes and helping to work out areas for the concentration of promotion. They are also coordinating policy on attracting businesses, creating new occupational profiles and training personnel in optics. The core region is Thuringia, where the optics sector has a total turnover of € 500 million and employs 6000 people. However, this network is also cooperating with partners throughout Germany, especially South Germany.

Global Markets

Integrating

Research and Industry in the International Innovation Networks

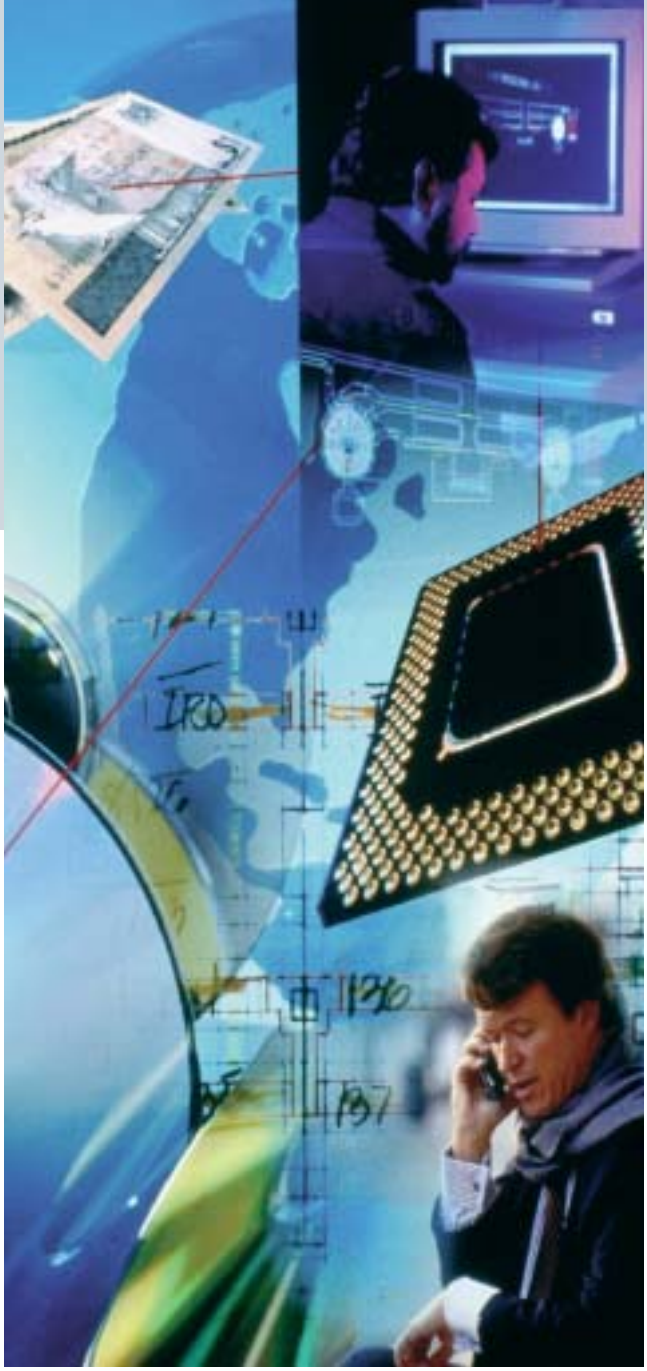
GLOBALISATION AND LOCALISATION ARE NOT MUTUALLY EXCLUSIVE

Firms that want to be successful in global markets must think and act internationally during their research and development. Worldwide knowledge stops less and less at national frontiers. More than 85 % of relevant knowledge today is "produced" outside Germany. So it is of crucial importance for Germany as a location of innovation for researchers and businessmen to cooperate with the best partners in research and business worldwide and play an active part in competence networks that are operating worldwide as well.

In the **internationalisation of research and development** German companies have made clear progress in recent years. The growing internationalisation is above all a reflection of the export orientation of German firms. For many export goods can only be sold abroad if they are adapted to the market conditions there, and for this research and development in the foreign target markets is necessary. Another important motive for the internationalisation of research and development is to have access to and participation in top level research abroad. Finally, a growing share of research abroad by German firms results from the acquisition of foreign firms and their R&D capacities. So this is an expression of increased activity by German firms in mergers and acquisitions, where Germany has now risen to be the third most important country after the United States and Great Britain.

Altogether German firms have grasped the need of the time. R&D expenditure by German firms abroad is higher than ever before at € 7.1 billion – and the growth rates in recent years have been impressive. But **cooperation with partners abroad** has also increased. Nearly 10 % of patents registered by German inventors in Europe are based on joint ventures in research with partners abroad – more than twice as many as 15 years ago. At the same time German industrial firms are also cooperating more with foreign partners in innovative projects than firms in hardly any other country in Europe.

Scientific research is also increasingly internationally oriented. Membership of international competence and research networks is now the norm for German universities and research institutes. Top research posts are increasingly being advertised internationally, and assessment groups with an international spread of members are now the rule in many cases for decisions on selection and evaluation; they ensure quality to worldwide standards. The German research institutes are opening more to international cooperation, with companies as well, depending on their subject areas. This is particularly true of the Fraunhofer-Gesellschaft, which now finds it easier to enter into joint ventures with foreign partners.

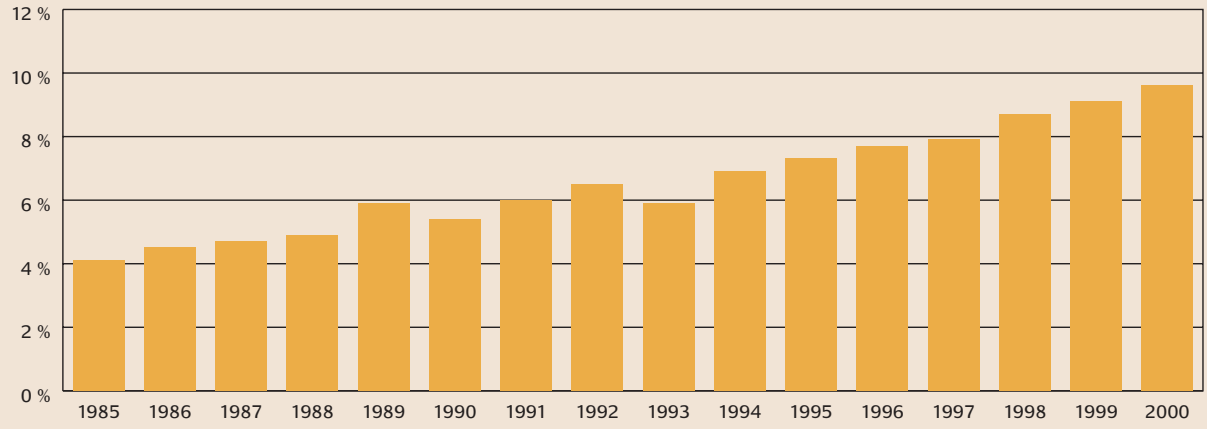


INTERNATIONAL COOPERATION IS POSSIBLE THROUGH MANY CHANNELS

While international joint ventures are usual for large companies, it is often more difficult for **smaller and medium-sized firms** to find suitable international partners. Language and mentality problems and the lack of knowledge of the research world in the other country are the main obstacles to cooperation. So it is understandable that only 35 % of the innovative industrial SMEs in Germany are working with foreign partners, while 75 % of the big companies are.

But **international cooperation** offers **excellent chances** particularly to small and medium-sized firms. Many of them are working in technological niches where only a few companies are active anywhere in the world, so the range of potential partners for them in research or among other companies in Germany is limited. The growing integration in Europe, particularly, now is opening up new opportunities here that have not yet been sufficiently exploited. The inclusion of the eastern European states is particularly important for us, because of their geographical proximity and their traditionally good contacts with German partners.

REGISTRATIONS OF GERMAN INVENTIONS WITH INTERNATIONAL PARTICIPATION AT THE EUROPEAN PATENT OFFICE



Definition: Share of registrations of German inventions with international participation at the European Patent Office in all German inventions registered there. The figures for 2000 are a projection.

Source: PATDPA; calculations by the Fraunhofer ISI.

INTERVIEW WITH DR. FRANK PETER HERRMANN, MANAGER OF ACI ANALYTICAL CONTROL INSTRUMENTS GMBH, BERLIN

1. What induced you to carry out an R&D joint venture with an east European partner?
The starting point was the search for marketable solutions for processes and equipment for environmental measurement (start-up product), from which a family of products was to be continuously developed. As we have little capacity for basic development we needed a partner in the research field. It was appropriate to utilise our many years of experience in scientific and engineering joint ventures in areas of innovative measurement equipment construction with our Russian partners.

2. Where do you see the advantages of international cooperation in research and development?
The advantage of cooperating with Russia is the excellent engineering training of their researchers. Young engineers can be incorporated in the development of marketable products in a very short time.

3. What part do the promotional consultancy and information services offered by the public authorities play?
The public promotion has been and still is the decisive financial aid, both for modern product development and in sustaining the necessary preliminary developments. The incorporation of young foreign researchers and developers in an exchange of personnel enables knowledge to be transferred in an uncomplicated way, but it also enables quality and product management to be realised. The contact offices of the AiF are very helpful in the search for new contacts.

4. What particular obstacles had to be overcome?
Joint development projects with young Russian technology-based firms require considerable additional financial expenditure, because promotion on the Russian side is almost impossible or can only be given at conditions that are not acceptable to new technology-based firms. Building up a joint German-Russian project promotion fund could help here. Other difficulties are the lack of information on the market economy among our Russian partners and the elaborate customs formalities at the Russian borders.

INTERNATIONAL JOINT VENTURES BRING PEOPLE TOGETHER ALL OVER THE WORLD.

The German Government is supporting small and medium-sized firms particularly in entering into international partnerships. It regards it as an integral part of business policy for any R&D establishment to formulate and pursue its objectives for cooperation with partners in industry and research abroad. For the rest, measures to make Germany more attractive to foreigners as a location for research and innovation still have high priority.

THE EUROPEAN RESEARCH AND INNOVATION AREA

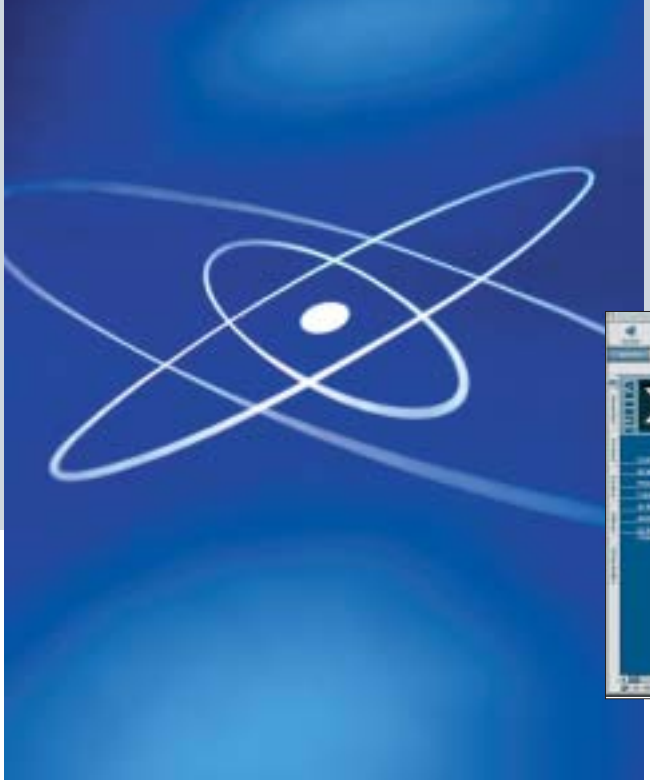
The European Commission has launched an initiative to link the various national research systems in Europe more strongly and so make more efficient use of the existing technological potentials. The main motivation is that Europe still lags behind the United States in many areas of research, like biotechnology and the information and communications technologies. Hence, the European Commission will provide particularly strong and sustained support for the European networking of the big research centres and for larger research projects of relevance for the future, in genetic research, for instance. Altogether it has earmarked € 17.5 billion for this in its new Research Framework Programme for 2002-2006. The member states are also being asked to work more intensively together in designing their national research and innovation policies.

What are we doing specifically?

- Under the PRO INNO programme we are promoting international cooperation in research, especially the employment of foreign scientists in small and medium-sized German firms. A particularly large number of partnerships are being set up with central and eastern European establishments and personnel. So this programme is making a contribution to integrating the central and eastern European research potentials in the European Community.

- We are supporting the "Technology Cooperation Network" operated jointly by the AiF (German Federation of Industrial Research Associations), the Confederaton of German Chambers of Industry and Commerce and the Fraunhofer-Gesellschaft. The purpose of the network is to provide consultancy for German SMEs that are preparing and carrying out R&D joint ventures with foreign partners in central and eastern Europe, Asia and Latin America. The network is structurally adjusted to the efficiency of the locations and the demand, and it is being expanded in view of the coming expansion of the EU eastwards.

- In Scientific-Technical Cooperation (WTZ) we are promoting cooperation between German universities, research institutes and companies with foreign partners in preparing and executing joint research projects. Most of the projects being promoted are with partners in eastern European countries and other newly developed countries; most of them are also close to practical application and fit into the main areas of concentration of the specialised programmes of the Federal Ministry of Education and Research. Particular value is laid on the exchange of scientific personnel. In addition, contact seminars and exchanges for small and medium-sized firms are being organised.



We are supporting the **European Commission** in its efforts to network the European research activities more strongly. Here we are paying particular attention to ensuring that the instruments of the new Research Framework Programme (2002-2006) are transparent and user-friendly, so that small and medium-sized firms in particular have good chances of becoming partners in the European innovation networks. Competent consultancy offices in specialised research institutes are helping with the applications. For specific questions from small and medium-sized firms we have regionalised the consultancy system more to enable assistance to be given "on the spot". The consultancy is provided by the national AiF contact offices in conjunction with the regional Innovation Relay Centres (www.aif.de).

We are a member of the **EUREKA Initiative.** In each member state contact offices provide assistance in preparing international cooperation in industry, especially by bringing together suitable partners and means of promotion. The presence of EUREKA throughout Europe through publications and at trade fairs, conferences and other events is helping to make projects bearing the EUREKA quality seal known throughout Europe (www.dlr.de/EUREKA).

In regard to **Germany's attractiveness as a location for research and innovation** we have greatly improved the general conditions for companies recently. Examples are the comprehensive tax reform with considerable reductions in corporate taxation, and the better conditions in the capital and equity capital markets. This is reinforcing our measures to achieve a "brain gain" of top scientists and young academics (cf. the chapter "Human Capital").

We are advertising more for Germany as a location for research and innovation. We have installed an **expert on foreign investment** who will advertise Germany as a location for business under www.invest-in-germany.de. The location of new businesses in the new federal states is supported by the **Industrial Investment Council (IIC),** www.iic.de, with a team of experts on the various branches. The IIC is working closely in this with the economic promotion agencies in the new states.

The internationalisation of research and development is being accompanied by a research and innovation policy that is increasingly **internationally networked.** Hence we are engaged in an intensive exchange of views both bilaterally (e.g. with the United States, Japan, Sweden, Great Britain and France) and with international organisations (especially the EU and the OECD). We also advise the eastern European states and the newly developed countries, like China, in designing their research and development policies.

Quantum Leaps in Technology

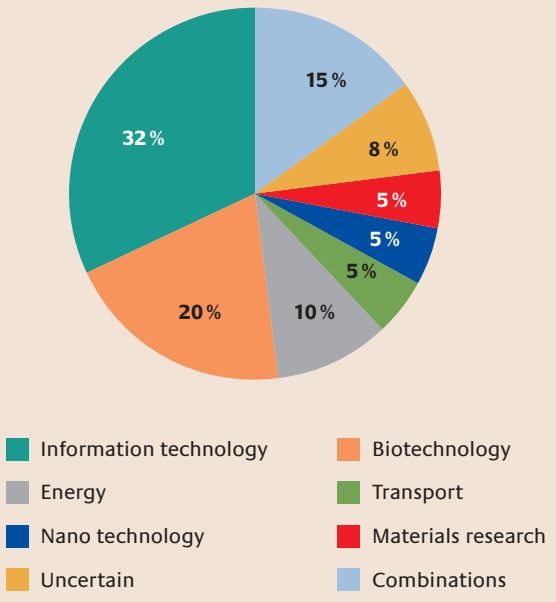
Opportunities for Society

NEW TECHNOLOGIES – FROM PEOPLE FOR PEOPLE

Since the pioneering studies by the Russian economist Kondratieff we know that economic growth processes run in waves lasting many years. These are known as the Kondratieff cycles. Each cycle is started and borne by a decisive basic innovation.

It is generally agreed that for the last ten to twenty years we have been in the fifth such cycle since industrialisation, and that it is based essentially on micro-electronics and the information and communications technologies derived from this. The invention of the transistor to replace the electron tubes in computers did come in the late 1940s, but only with its further development through miniaturisation and on to the modern micro-processors did it become possible to produce ever more powerful computers at affordable prices. With the constant improvements in software and the arrival and spread of the Internet they have determined the dynamic of growth for years.

POSSIBLE BASIC TECHNOLOGIES OF THE NEXT GROWTH CYCLE



Distribution of the answers to the question "Which technology will support the next great wave of economic growth?"

Source: Survey of its readers by The Economist in Science & Technology Quarterly, December 2001

Not for nothing did the term "New Economy" become general towards the end of the 1990s for the structural change started by the increased use of the information and communications technologies. Studies have shown that at that time about one fifth to one quarter of annual economic growth in Germany was due to the growing use of these new technologies, and in the United States more than half.

But the fifth Kondratieff cycle will not last forever either. Experts assume that the growth cycle driven by the information and communications technologies will probably reach its peak in the course of this decade, and so there are already fevered speculations about which areas of technology could replace them as the driving forces of growth.

Bio- and genetic technology is generally regarded as the most likely. Now that the genetic code has been deciphered and most recently the human genome as well, and several laboratories have succeeded in performing genetic modifications, prospects have been opened up of developing entirely new methods of therapy and medication. Considerable improvements in the treatment of complaints that are now still regarded as incurable, like cancer, Alzheimer's disease and Parkinson's disease, are appreciably closer with these new methods. There are also huge potentials for the use of bio- and genetic technology in agriculture and environmental care.

TRANSLATING SCIENTIFIC PROGRESS RAPIDLY INTO INNOVATIVE PRODUCTS AND PROCESSES FOR SOCIETY – THAT IS WHAT RESEARCHERS ARE WORKING ON.

Nano technology could be another promising candidate for a new basic innovation. The technological quantum leap here came in the early 1980s, when the development of the screen scan microscope made it possible for the first time to observe and control manipulations on atomic and molecular level. Since then enormous technical progress has been made and there are possible applications in nearly all the classical areas of technology – from micro-electronics, through materials research and energy management to bio-medicine. Nano technology transcends the disciplines of the bio-sciences, physics, chemistry and engineering, and so it is a typical example of how the most interesting research themes of our time are increasingly making an inter-disciplinary approach necessary (see diagram on p. 61).

What basic technology will become established as the driving force of growth for the future depends not only on the degree of technological innovation. On economic level it must have a demand potential that can sustain world economic growth over a phase of several decades. For this it must be possible to use the technology in many areas of the economy and in daily life, so that demand flows can be redirected over the long term.

Finally, any possible resistance and fears must be overcome if a new technology is to become established. Only when consumers are ready to accept and help to support the changes to everyday life that the spread of a basic technology involves can a new technology finally become established. When the first railway line, from Nuremberg to Fürth, went into operation in 1835, many people were afraid that the “high” speed of the

THE BIOTECHNOLOGY AGE – A VISION

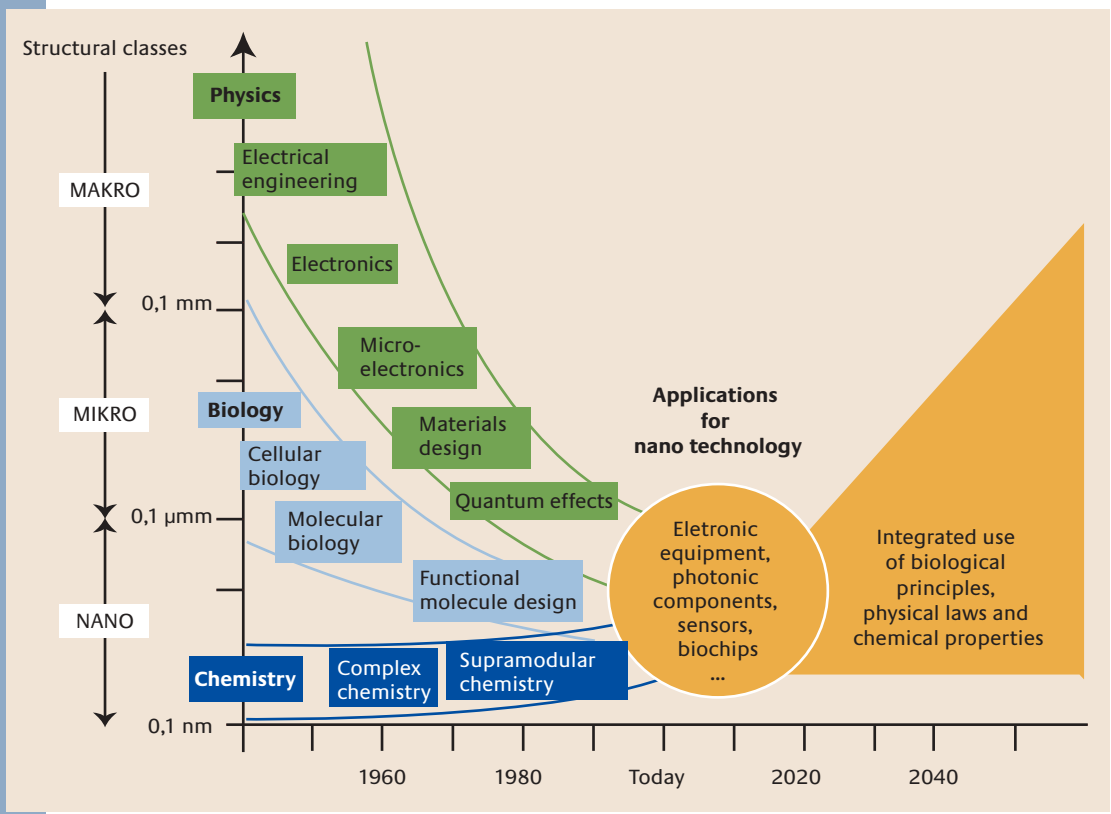
Diseases are often due to genetic causes. Many of these diseases will become curable with the new therapies that will be available. Innovative, individually tailored medication will also be possible. Organs can be reconstructed out of material from the patient’s own body. Foodstuffs free of allergies will be available. Farmers will very largely be able to refrain from using pesticides. Plants will grow faster, the crops will be richer, while the plants will be resistant to drought, cold, salt or heat, and so will help to reduce famine in the world. Biotechnology is already replacing certain harmful substances in advance of industrial production, it is saving resources and sparing the environment.

new form of transport would damage their health, Only when these fears were overcome and people gradually became adjusted to travelling by train did the railway become an important pillar of technical development in the century before last.

That shows that it is an **essential task for research and policy** to make people aware of the opportunities offered by new technologies and ensure that the risks can be overcome. Opportunities and risks must be weighed in intensive dialogue between all the social forces involved. This also means that the German Government may object in an individual case to a solution that is technically feasible if it is not accepted by society.

"World demand for vehicles will not exceed a million - if only because of the lack of available chauffeurs." This well-known and drastic underestimate by Gottfried Daimler in 1901 clearly shows that **the future cannot be predicted.** As the Austrian economist Hayek rightly admitted, no one can presume to know what the future will be like – not even the government itself. However, that does not relieve us of the obligation to pursue a forward-looking policy. The experience of the

INTER-DISCIPLINARY CONNECTIONS IN THE NANO COSMOS



Source: vdi-tz, 2001

FOR THE NEXT GENERATION COMMUNICATION HAS MANY FACES

past should be a lesson to us here. In the second, third and fourth growth cycle since industrialisation – with the railway, electricity and the motor car – Germany was still one of the pioneers. But in micro-electronics and the information and communications technologies we were relegated to a lower place by competitors in the United States and Japan. If we want to avoid being left behind in the next growth cycle we have no choice, we must concern ourselves with the future.

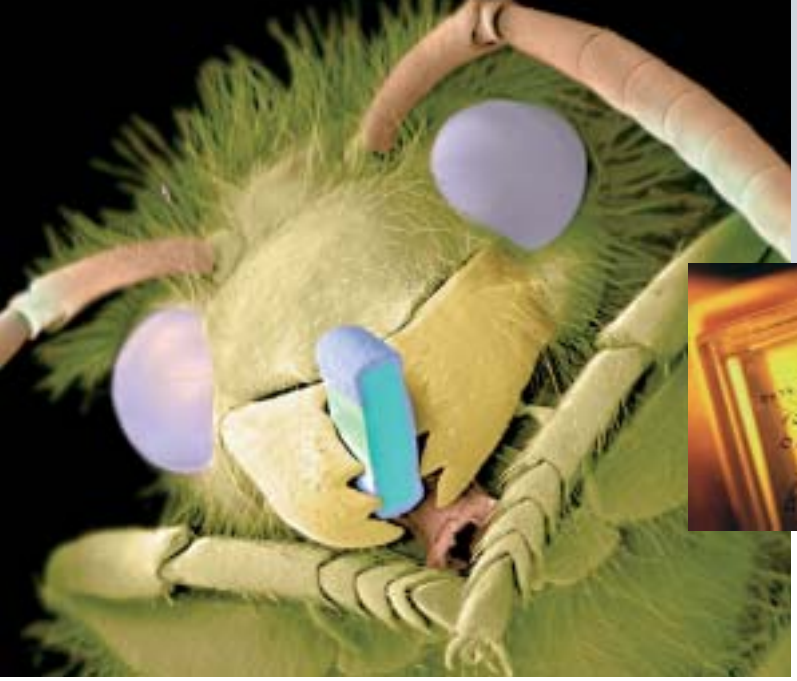
In this context the task for research and innovation policy is above all to enable basic research to be carried out in areas of technology from which the basic innovations could come. The knowledge acquired through scientific research must be made available to companies through joint research projects and support given to the marketing of high risk research. This is not limited to the fields that are already known to be promising for the future, and over which there is general consensus. It includes processes that will enable future fields of technology and application to be recognised at an early stage, inter-disciplinary approaches to be used in research and the right signals to be set today. Above all, it means the difficult task of setting priorities in promotional policy that will unite what is technically possible with what is economically desirable and on which a social consensus can be achieved.

INFORMATION AND COMMUNICATIONS TECHNOLOGIES – A GLANCE INTO THE FUTURE

In a few years new cordless transmission techniques will be developed (like the fourth generation of mobile phones, i.e. the next development stage of UMTS) with high rates of data transmission, first up to 2 Mbit/s and later up to about 100 Mbit/s, and the correspondingly high performance end equipment. The Internet of tomorrow will be fast, mobile, efficient, omni-present and able to deliver tailor-made information.

"Tomorrow" (c. 2005):
A wife and mother with a job will do her shopping by mobile phone while on a relaxing train journey, without her children for once; she will order the next theatre tickets, download a feature film and cast a glance at her securities portfolio before, supported by her electronic assistant, settling back to enjoy the music of her choice through her headphones.

"The Day after Tomorrow" (c. 2010):
Special video spectacles will make direction finding easier for the car driver, e.g. by blending in the appropriate arrows showing the route to be taken. The same pair of spectacles will also enable passengers in cars to watch films with sound and vision far superior to the quality of home videos today. If the viewer's pulse rate rises too much during a horror film the equipment will send a warning signal. Of course the user can be sure of his dream woman or her dream man, with the proper profile of interests: if he or she enters a defined radius the flirt alarm will vibrate a polite warning.



BUILDING PARTS FROM LILIPUT, SENSATIONAL MEASUREMENTS – NEW TECHNOLOGIES MAKE GERMANY INTERESTING AS A LOCATION FOR TECHNOLOGICAL INVESTMENT

INTERVIEW

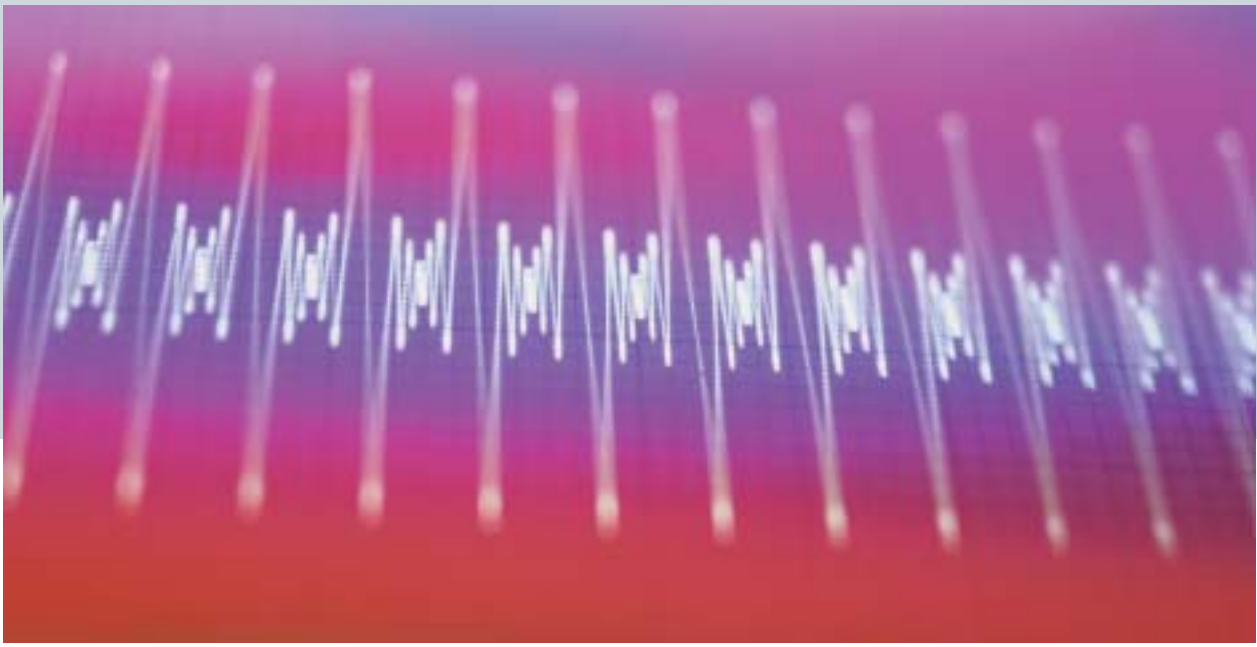
1. In which areas of technology are you expecting the biggest advances in the next few years or decades? Which has the greatest economic potential?
As in the past we will experience the most exciting and most important developments at the interfaces between the individual fields of knowledge in future, too. The inter-disciplinary approach and the transfer of knowledge are therefore still the big challenges. Examples of this are biotechnology, in the border area between chemistry, biology and informatics, or nano technology in the border area between physics, chemistry and the materials sciences.

2. Which fields of technology are of particular interest for Germany as a location for technological investment and research?
On the one hand, new technologies can develop with particular success in Germany where we already have a leading position – for example, in vehicle and plant construction or chemicals. On the other hand, additional opportunities are opening up in new fields, where the dynamic development phase has only just begun and where decisive leaps in technology are to be expected in the next few years. One example of this is plant biotechnology. And here the efforts of companies, science and policy must be combined to lay the foundation for Germany to occupy a leading position in the future.

DR. STEFAN MARCINOWSKI, MEMBER OF THE BOARD OF MANAGING DIRECTORS OF BASF, LUDWIGSHAFEN

3. How does a company like BASF recognise the markets of tomorrow in good time and direct its research activities to those markets?
Firstly, by keeping our eyes and ears open to the needs of our customers and consumers today and tomorrow and secondly, with well functioning feelers for the latest scientific trends. That is our recipe for success. In research and development we therefore rely on intensive cooperation between our research and business divisions and on external partners in research and industry as well as our customers.

4. How does BASF succeed in bridging the gaps that often exist between scientific disciplines and uniting researchers from different subject areas in joint research projects, while at the same time ensuring the necessary proximity to practical needs?
Both with internal projects and joint ventures all the partners must derive benefit from the cooperation. Consistent project management with clearly defined objectives, milestones and break-off criteria will increase efficiency and create transparency in decision-making. At BASF the operative business divisions are involved in the innovation process right from the start. They also finance most of the R&D projects – and that is the best possible guarantee of the necessary orientation to the market and customers.



FOR THE GERMAN GOVERNMENT PROMOTING RESEARCH MEANS PROVIDING STIMULUS AND SHAPING PROCESSES.

The German Government sets its priorities in technology-specific research promotion in areas that appear to hold particular promise for the future in technology and applications. It shapes processes designed to enable these areas to be identified at an early stage, and it initiates intensive dialogue with the general public in order to create openness to new technologies, and in order to incorporate social ideas of value.

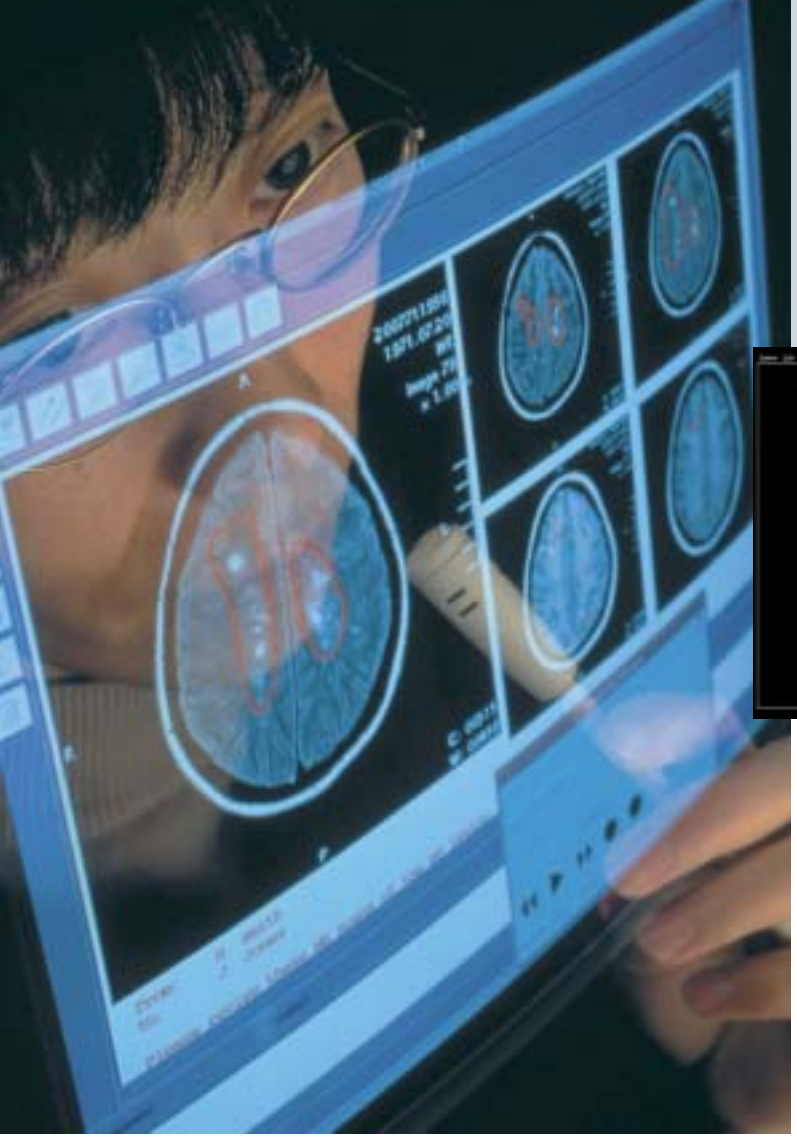
What are we doing specifically?

▮ We set our priorities for specialised research promotion in those fields of technology which we believe have the greatest potentials as driving forces of growth for the world of tomorrow. In nano technology, optical technology and the information and communications technologies we are launching three new programmes this year, which will provide major stimulus to innovation in German industry and help to create new jobs. Research in the IT sector alone will receive a total of € 1.5 billion in project funds and the same amount in basic institutional funding for five years under the programme "IT Research 2006". In the same area we are developing and testing new applications by holding competitions, e.g. in order to open up the potential that will result in future from linking up the mobile phone with the Internet.

▮ Genetic research is a special priority area of research promotion. Here Germany is putting itself in first place world wide with total finance for project promotion of c. € 440 million for 2001-2003. Of this amount the German Government is investing € 175 million of the savings on UMTS interest payments in building up a national genetic research network. Ethical, social and legal questions related to genetic research will be integrated, and a broad discussion held with the general public.

▮ With our FUTUR Research Dialogue we have started a strategic process to identify promising themes for research in broad dialogue with specialists and the public. It is the aim of FUTUR to reach new focal points and set new priorities for research promotion, formulate these as pioneering visions and derive concrete research projects from them. Here we are deliberately not starting with new technological developments, we are asking what the need is in our society and what contribution the new technologies can make to meeting it.

▮ We are devoting more promotion than ever to interdisciplinary questions in research, for new technological quantum leaps are to be expected precisely in the border areas of research fields. Pioneering visions takes research beyond the borders of the individual subjects. Ideas and knowledge are combined and synergies created that cannot be created in the individual disciplines



SCIENCE AND SOCIETY IN DIALOGUE.

THE SOMIT LEAD VISION – GENTLE OPERATIONS WITH INNOVATIVE TECHNOLOGY

Many health problems require surgery. Broken bones, cancer and diseases of the internal organs will not be curable in the foreseeable future, either, without surgical operations. The traditional methods involve fear and pain for the patient and convalescence periods. The SOMIT lead vision aims to enable operations to be carried out with minimal surgery and minimal side-effects. This requires technical progress in a number of areas. Micro-systems technology and materials research can provide the miniaturised instruments and materials the human body will not reject; information technology provides the "built-in intelligence" needed to steer the mini-instruments and biotechnology provides the techniques to identify as exactly as possible the genetic changes in the tissue that have caused the disease and so reduce to a minimum what has to be removed

alone. Pioneering visions also provide incentives to utilisation, because they already describe the objective of the research. At present the pioneering visions "European Long Distance Goods Transport 2010", "Transport Management 2010" and "Gentle Operations with Innovative Technology" are in preparation (cf. chapter "Complex Technologies").

- We are strengthening **innovation and technical analysis** in Germany. Here we want to enable early discussion of the chances and risks of new technologies, and particularly tackle the ethical issues of new technological developments at an early stage. The new term "innovation and technical analysis" is intended to show that, unlike "estimating the consequences of technological development" we are also aware of the opportunities offered by new technologies.

- We are initiating **dialogue between research and society.** In conjunction with the big research organisations and the **"Stifterverband für die deutsche Wissenschaft"** we have launched a national initiative "Science in Dialogue". After the "Year of Physics" and the "Year of the Life Sciences" this year we are turning to the geosciences. We are also organising events where discussions can be held with experts from companies, associations, science and consumer organisations on the possible applications for new research results.

Selected Addresses

INSTITUTIONS

Arbeitgemeinschaft Industrieller Forschungs-vereinigungen „Otto von Guericke“ e.V. (AiF)
Bayenthalgürtel 23
D-50968 Köln
Tel: 02 21/3 76 80-0
Fax: 02 21/3 76 80-27
Internet: www.aif.de

Bundesanstalt für Materialforschung und -prüfung (BAM)
Unter den Eichen 87
D-12205 Berlin
Tel: 0 30/81 04-0
Fax: 0 30/811 20 29
Internet: www.bam.de

Bundesministerium für Wirtschaft und Technologie (BMWi)
Scharnhorststraße 34–37
D-10115 Berlin
Tel: 0 18 88/6 15-9
Fax: 0 18 88/6 15-70 10
Internet: www.bmwi.de

Bundesministerium für Wirtschaft und Technologie (BMWi)
- Advice on promotion -
Scharnhorststrasse 34–37
D-10115 Berlin
Tel: 0 18 88/6 15-76 49, -76 55
Fax: 0 18 88/6 15-70 33
Internet: www.bmwi.de

Bundesministerium für Bildung und Forschung (BMBF)
Heinemannstrasse 2
D-53175 Bonn
Tel: 0 18 88/57-0
Fax: 0 18 88/57-36 01
Internet: www.bmbf.de

Bundesministerium für Bildung und Forschung (BMBF)
- Information Office for BMBF Promotion -
Wallstrasse 17-22
D-10179 Berlin
Tel: 0 18 88/57-27 11
Fax: 0 18 88/57-27 10
Internet: www.fz-juelich.de/ptj

Bundesverband der Deutschen Industrie e.V.
Breite Strasse 29
D-10178 Berlin
Tel: 0 30/20 28-0
Fax: 0 30/20 28-24 48
Internet: www.bdi-online.de

Business Angels Netzwerk Deutschland e.V. (BAND)
Semperstrasse 51
D-45138 Essen
Tel: 02 01/8 94 15-60
Fax: 02 01/8 94 15-10
Internet: www.business-angels.de

Deutsche Ausgleichsbank (DtA)
Ludwig-Erhard-Platz 1–3
D-53179 Bonn
Tel: 02 28/8 31-0
Fax: 02 28/8 31-22 55
Internet: www.dta.de

Deutscher Industrie- und Handelskammertag (DIHK)
Breite Strasse 29
D-10178 Berlin
Tel: 0 30/2 03 08-0
Fax: 0 30/2 03 08-10 00
Internet: www.dihk.de

Deutsches Institut für Normung e.V.
Burggrafenstrasse 6
D-10787 Berlin
Tel: 0 30/26 01-0
Fax: 0 30/26 01-22 60
Internet: www.din.de

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (FhG)
Leonrodstrasse 54
D-80636 München
Tel: 0 89-12 05-01
Fax: 0 89-12 05-3 17
Internet: www.fhg.de

Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF)
Ahrstrasse 45
D-53175 Bonn
Tel: 02 28-308 18-0
Fax: 02 28-308 18-30
Internet: www.helmholtz.de

INSTI-Projektmanagement Institut der deutschen Wirtschaft Köln
Gustav-Heinemann-Ufer 84–88
D-50968 Köln
Tel: 02 21/49 81-8 32
Fax: 02 21/49 81-8 56
Internet: www.insti.de

Kreditanstalt für Wiederaufbau (KfW)
Palmengartenstrasse 5-9
D-60325 Frankfurt am Main
Tel: 0 69/74 31-0
Fax: 0 69/74 31-29 44
Internet: www.kfw.de

Patentstelle Deutsche Forschung bei der Fraunhofer-Gesellschaft
Leonrodstrasse 68
D-80636 München
Tel: 0 89/12 05-02
Fax: 0 89/12 05-4 98
Internet: www.pst.fhg.de

Physikalisch-Technische Bundesanstalt (PTB)
Bundesallee 100
D-38116 Braunschweig
Tel: 05 31/5 92-0
Fax: 05 31/5 92-92 92
Internet: www.ptb.de

Technologie-Beteiligungs-Gesellschaft mbH (tbg) der Deutschen Ausgleichsbank
Ludwig-Erhard-Platz 1–3
D-53179 Bonn
Tel: 0228/831-2290
Fax: 0228/831-2493
Internet: www.tbgbonn.de

A full list of the public research institutes in Germany can be found under www.forschungsportal.net

PROJECT ADMINISTRATORS

Arbeitsgemeinschaft betriebliche Weiterbildungsforschung e. V. (ABWF)
- Project administrators for learning culture competence development -
Storkower Strasse 158
D-10402 Berlin
Tel: 0 30-4 21 87-0
Fax: 0 30-4 21 87-3 05
Internet: www.abwf.de

Arbeitsgemeinschaft Industrieller Forschungsvereinigungen „Otto von Guericke“ e.V. (AiF)
- Berlin office -
- Project administrators for PRO INNO, NEMO and R&D Personnel Promotion East -
Tschaikowskistrasse 49
D-13156 Berlin
Tel: 0 30/4 81 63-3
Fax: 0 30/4 81 63-4 01
Internet: www.aif.de

Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
- Project administrators for multimedia projects -
Linder Höhe
D-51147 Köln
Tel: 0 22 03/6 01-36 72
Fax: 0 22 03/6 01-30 17
Internet: www.dlr.de/PT/

- Project administrators for innovative work organisation, EUREKA -
Südstrasse 125
D-53175 Bonn
Tel: 02 28/38 21-0
Fax: 02 28/38 21-2 48
Internet: www.dlr.de/PT/

F.A.Z.-Institut für Management, Markt- und Medieninformation GmbH - Project administrators for TOP -
Mainzer Landstrasse 195
D-60326 Frankfurt am Main
Tel: 0 69/75 91-11 33
Fax: 0 69 /75 91-23 01
Internet: www.top-online.de

Forschungszentrum Jülich GmbH – PTJ
- Berlin office -
- Project administrators for BIOCHANCE, BIOPROFILE, EXIST, FUTOUR, INNOREGIO and innovative regional growth cores -
Wallstrasse 17–22
D-10179 Berlin
Tel: 0 30/2 01 99-4 35
Fax: 0 30/2 01 99-4 70
Internet: www.fz-juelich.de/beo

Fraunhofer Services GmbH
- Project administrators for R&D project promotion East -
Torstrasse 49
D-10119 Berlin
Tel: 0 30/44 02-10 15
Fax: 0 30/44 02-10 80
Internet: www.fhms.de

VDI-VDE-Technologiezentrum Informationstechnik GmbH
- Project administrator for FUTOUR, INNONET and the Multimedia New Businesses Competition -
Rheinstrasse 10b
D-14513 Teltow
Tel: 0 33 28/4 35-0
Fax: 0 33 28/4 35-1 41
Internet: www.vdivde-it.de

For project administrator of other promotional programmes see www.bmbf.de/pt.html

Further up to date information on the individual policy areas can be found on the Internet sites of the ministries: www.bmwi.de and www.bmbf.de. More detailed information on the promotional programmes is in the joint publication by BMWi and BMBF “Innovationsförderung” and the promotional data bank of BMWi, http://db.bmwi.de) and in the promotion list of BMBF, www.bmbf.de.
We also draw attention to the patent server of BMBF, www.patente.bmbf.de and the CORDIS data bank of the EU, www.cordis.lu.

Brochures

The following publications may be obtained from BMWi:

- Energieforschung
- Kooperationen planen und durchführen
- Die deutsche Industrie: Basis für Wohlstand und Beschäftigung
- BMWi-Dokumentation 502 – Förderung der Grenzregionen zu den Beitrittsländern
- Forschrittsbericht zum Aktionsprogramm der Bundesregierung „Innovation und Arbeitsplätze in der Informationsgesellschaft des 21. Jahrhunderts“
- Energiebericht – Nachhaltige Energiepolitik für eine zukunftsfähige Energieversorgung
- Innovationsförderung – Hilfen für Forschung und Entwicklung
- Wirtschaftliche Förderung – Hilfen für Investitionen und Innovationen
- Zukunft Mittelstand – Mittelstandspolitik 2002

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The following publications i.a. may be obtained from BMBF:

- Zur technologischen Leistungsfähigkeit Deutschlands 2001
- Ausbildungsförderung - BAföG, Bildungskredit und Stipendien
- Bauen und Wohnen im 21. Jahrhundert
- Das neue Aufstiegsfortbildungs-föderungsgesetz
- Faktenbericht Forschung 2002
- Forschung für den Regenwald
- IT-Forschung 2006
- IT-Weiterbildung mit System
- Raumfahrt in Deutschland

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