

RESEARCH, INNOVATION  
AND TECHNOLOGICAL  
PERFORMANCE IN GERMANY

EXPERTENKOMMISSION  
FORSCHUNG  
UND INNOVATION

EFI

# REPORT

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## SUMMARY

### **Current developments and challenges**

Germany must develop a stronger innovative dynamic if it is to hold its own in the face of growing international competition. The leading position which Germany has traditionally had in high-value technologies can only be maintained by continuing to make high levels of investment in the automotive and chemical industries and in electrical and mechanical engineering. In other fields there is considerable catching up to be done, above all in cutting-edge technologies and in the knowledge-intensive services. The government can give important impulses by providing funding for research institutions, supporting knowledge and technology transfers, and by introducing suitable measures to support company R&D.

The implementation of the High Tech Strategy in 2006 led to an increase in funding for research and development and made national R&I policies more effective. For the continuation of the High Tech Strategy, it would now be appropriate to focus on particularly important fields. These should be identified on the basis of foresight processes. The main aim should be to promote fields of innovation which offer considerable potential for the future and where the aid provided will develop significant leverage.

In many cases, interesting results from publicly-funded research are not marketed effectively in Germany. The Expert Commission suggests establishing a 'Commercialisation Fund' to improve the transfer of research results for commercial applications. Where there are various possible applications, or a need for coordination between actors, then standardisation is another important consideration in the commercialisation of innovative technologies. The state should provide more support for companies involved in standardisation processes than it has in the past.

Shortages of equity capital represent a key constraint on innovation for German companies. The situation has grown worse as a result of the current crisis. There remains a need for a long-term improvement in the framework conditions for the provision of company equity. Important incentives for innovation would also be provided by improvements to the framework conditions for business angels and venture capital investors. In addition, the Expert Commission continues to favour the introduction of tax incentives for R&D. This should be structured in such a way that it also encourages cooperation between business and science. If budget constraints only allow limited tax incentives for R&D, then this should initially be introduced primarily for SMEs.

Additional investments in education are a precondition for strengthening the innovation potential in Germany. The Expert Commission recommends that even more importance should be attached to providing greater equality of social opportunities for access to education. The Expert Commission also approves of lifting the restriction on cooperation between the Federal Government and the Laender concerning education, and favours the reexamination of federal responsibilities for education.

When funds are in short supply, they must be deployed efficiently and effectively. This is only possible if state measures are evaluated regularly, and here there is considerable scope for improvement in Germany. All government departments should allocate about one percent of their planned budget to research into evaluation research, which should be anchored in a single institution. The results should be made readily available to the public.

## CORE TOPICS OF THE REPORT

### **A systematic increase in the international competitiveness of the German R&I system**

Research and innovation worldwide is subject to a process of transformation which is forcing the highly-developed countries to adopt a new alignment for their R&D activities. The German R&I system must be oriented more towards the challenges of the future and to new topics. This affects both the state and business sectors.

The industrial R&D system in Germany is concentrated mainly in the most important export industries, above all the automotive industry. However, the structural changes towards services and the expansion of the growth fields of cutting-edge technology are less advanced in Germany than in other highly-developed countries. Where German companies expand their R&D activities, particularly in the dynamic high-tech fields, these are often located in other countries. This can lead to the abandonment of strategically important sectors in Germany, and it impairs the effectiveness of cooperation with public sector basic research.

The system of public non-university research is well developed in Germany. However, some institutions do not have a clear remit or research profile – in particular the Helmholtz and Leibniz Associations. The system of government department research should be focussed on tasks of national importance.

Successful innovation depends on the interactions between actors from basic research, the educational system, the business sector, the ministries and the legislative and executive branches. Cohesive and uniform innovation policies should provide effective support for the formation of close ties between these actors at the national level and thus ensure the formation of a better value-creation chain for innovations in specific promising areas.

The effectiveness of German R&I policies is impaired by the way in which responsibilities are divided between various Federal ministries and Laender ministries. The web of departments, project agencies and research institutions is at least in part responsible for the fact that there has not yet been any comprehensive strategic reorientation of innovation policies.

Against this background, the Expert Commission makes the following recommendations:

- German businesses can only compete internationally if they successfully implement innovations. A key condition for this is a systematic increase in expenditure on R&D in public institutions and increased innovation expenditure by businesses. The newly formulated High Tech Strategy must provide additional impulses so that businesses will continue to invest in research and innovation.
- It is essential that active steps are taken to expand cutting-edge technology. This applies above all for segments in which comparative advantages can be secured globally. Investments should be avoided in fields which are subject to international subsidy wars.
- Greater efforts should be made to expand knowledge-intensive services ('services designed in Germany') where these are complementary to existing focal points in the economy. This requires support strategies which are specifically tailored to suit innovation processes in the services sector.
- The High Tech Strategy should be targeted at selected fields of technology. This involves harmonising these fields with those identified in the foresight process and with the investment priorities of the business sector.
- The distribution of funds and the 'division of areas of specialisation' between the various scientific institutions should not be regarded as unchangeable. This applies in particular for departmental research at the levels of the Federal Government and Laender departments. Structural reforms are necessary in order to improve the effectiveness of non-university research organisations. More attention should be paid to strategic coherence.
- Knowledge and Technology transfer from non-university research and from the universities should be expanded as a priority. This goal must not be neglected in the justifiable pursuit of scientific excellence. The management and incentive structures of many research institutions are in need of further improvements. The business sector should also make use of the specific potential of public research within the framework of its innovation strategies.
- As an R&I location, Germany needs new models for the cooperation between the business sector on the one hand and the universities and non-university research institutions on the other hand. The same applies for cooperation within public research.
- Strong research must be financed appropriately and supported through modern accounting and budget instruments. Currently, competition in research is distorted by differences in cost models. In the short term, a flat rate programme payment should be introduced to cover the indirect costs incurred in projects supported by the Federal Government. In the medium-term it is appropriate to reimburse in full the costs of the research institutions carrying out third-party funded projects.

### **Reforming the Bologna Reform**

In the course of the EU's 'Bologna Process', German study programmes are being reorganised to confer bachelor's and master's degrees. The intention is to create an internationally-comparable system, providing education of a high standard which is suited to individual needs. In addition Europe should be strengthened as an educational region which is also very attractive for non-European students. The worldwide exchange of students should be increased, and equal access to higher education should be possible for all social strata. The bachelor's degree should already provide a full, first-level

qualification for subsequent careers. The reform in Germany was associated with the hope of modernising and reorganising the curricula, reducing the numbers of drop-outs, and increasing the demand for university courses in general and for mathematics, computer science, natural sciences and engineering in particular. However, so far it has not really been possible to reach these goals.

Hardly any changes have been made to course contents, but students have fewer options to choose from than they had in the diploma or magister courses. Teaching staff face higher teaching commitments overall, and the resultant workload is detrimental to their research and also reduces the individual tutoring of students.

The Expert Commission also sees problems in the elimination of ‘orientation’ periods as a result of shortening the length of secondary education and of the university courses. Furthermore, the relationship between the system of dual vocational training and the new bachelor’s degree courses remains unclear. There are also controversial discussions about how many graduates can or should go on to study for a master’s degree.

On a positive note, there has so far been no evidence of a reduction in the level of qualification of young scientists as a consequence of the Bologna Process, and nor do there seem to be any problems in career entries as a result of the changeover.

In the opinion of the Expert Commission the following measures are necessary for the further development of the Bologna Process reforms in Germany:

- In general, universities have not been allowed sufficient autonomy in the implementation of reforms and the shaping of curricula. Where they are given more scope, the universities should use this in order to increase the involvement of employers, alumni and students in the development of courses.
- Obstacles to mobility can be overcome by more generous recognition of previous coursework and credits and the reliable specification of equivalents in course regulations. This should be combined with more comprehensive and more generous financial support for student mobility, an increase in the number of courses taught in English, and support for cooperation agreements between German and foreign universities.
- A bundle of measures is required in order to lower the high numbers of course drop-outs: grants and loans for students, options to organise study programmes flexibly or to study part-time; information, advice and preparatory courses prior to committing to a subject or in the initial phases of a degree course; higher quality of teaching, and better course organisation. This also includes checks on performance at an early stage and detailed feedback.
- Student fees are an important component of university finances in some Länder and they make sense when the receipts are invested in the teaching. But they must not act as a disincentive to young people who want to study. In particular students from low-income households must be offered the best possible financial conditions. This includes expanding and increasing the student grant system (*Bafög*) as well as improving the mobilisation of private sources of funding.
- The supervision of doctoral students in structured programmes such as the DFG post-graduate colleges should be included as part of the teaching duties. Currently, the time spent in this way by professors is to the detriment of research, active institutional involvement, individual career counselling, and the supervision of student organisations. Appropriate adjustments should be made to the personnel structure of the universities.

### **Favourable conditions for innovation rather than special innovation programmes for eastern Germany**

The economic performance in eastern Germany is still considerably below the national average. The R&D expenditure as a share of gross domestic product is also lower than in western Germany. This is due to the relatively low contribution from the business sector. Although there is a shortage of broadly-based innovative companies in eastern Germany, there are some encouraging signs. Both in the new Laender and in Berlin, the representation of cutting-edge technology is above average and is showing considerably more signs of growth than in western Germany. Furthermore, the innovation intensity in the knowledge-intensive services is considerably higher. A further strength of the R&I system in eastern Germany is the well-developed public research and university landscape, producing a relatively large number of patents and publications.

Certainly, the innovation potential and innovation performance in the new Laender has not yet reached the level of the old Laender, but the evident weaknesses of the eastern German university and research landscape are not fundamentally different from those of the structurally-weak regions of western Germany.

- The primary task of the R&I policies of the Federal Government is to strengthen the overall position of Germany in the competition for innovations. The Expert Commission no longer sees any need to develop new programmes specifically for R&I policies in eastern Germany.
- Accelerating the process of convergence is not a task for innovation policies, but rather for structural policies. Within the framework of the Joint Task ‘For the improvement of the regional economic structure’ (GRW) the Laender should make greater use of their scope for action in order to focus subsidies on forward-looking branches of the economy in regions with high development potential.
- The Expert Commission is in favour of providing institutional support for external industrial research institutions if they take on important tasks relating to knowledge and technology transfer and can demonstrate that their research is of a sufficient quality.
- Fiscal R&D support and an improvement in the framework conditions both for the provision of companies with equity and for business angels and providers of venture capital would have particularly positive effects in eastern Germany, in view of the weak equity basis of many companies there.

### **Catching up in the field of electromobility**

Electromobility offers the opportunity to achieve a significant reduction in CO<sub>2</sub> emissions and significantly improves the security of energy supplies for the transport sector in the medium term. The strategy for the development of electromobility must be integrated in a broader, multimodal strategy for future traffic and transport systems. At present Germany is poorly positioned both in the key technology of vehicle batteries and in power electronics. Both scientists and the business sector misjudged the technological developments. Considerable efforts are now required in order to catch up with the leading nations in this sector.

The Federal Government and the Laender have already undertaken a series of measures in the field of electromobility. At the federal level, EUR 500 million has been made available from the second economic stimulus package for 2009 and 2010. There are



currently 17 model regions and ongoing fleet trials for electromobility, and more are being planned. However, in the opinion of the Expert Commission the support projects, R&D activities and marketing measures are not sufficiently harmonised between the federal government, the Laender, the European Union and the manufacturing sector.

In order to establish a lead market for electromobility it will be necessary to concentrate efforts, for example by the rapid and radical conversion of transport in large conurbations to electric vehicles. The development of the new market will require state programmes to support a change in attitudes among vehicle purchasers. This will be necessary in order to reach the high production volumes required for economies of scale. In the opinion of the Expert Commission, national initiatives alone will not be sufficient.

The Expert Commission therefore proposes the following measures:

- The National Electromobility Development Plan is an important first step towards strengthening the position of Germany. Markedly improved coordination and a tighter control of public sector activities are now required in the field of electromobility in order to achieve significant progress. The fragmentation of the national and Laender programmes must be overcome; strategies and initiatives must be developed with a long-term perspective.
- Universities, non-university research institutions, and research promotion organisations should develop stronger and more comprehensive activities in the field of electromobility. In addition to research work, suitable training programmes are necessary to address existing shortages in skilled personnel.
- German companies are not cooperating sufficiently with one another on electromobility. A dialogue should be initiated rapidly with the business companies in order to bring the actors out of their isolation. The Federal Government should only provide further state support when appropriate cooperation is achieved in the field of electromobility.
- On the basis of the existing development expertise in the European automotive sector, the Federal Government should work towards a joint European approach in order to strengthen the European position overall and to achieve economies of scale.
- In contrast to current plans, the Federal Government should only select a few regions – if possible in connection with neighbouring countries – as locations for the market launch of new mobility strategies. This would offer the opportunity of establishing lead markets.
- It must be made attractive for car buyers to turn their backs on the heavy, high-powered vehicles of the fossil-fuel era. Users of electric cars should not only be offered financial stimuli but also additional benefits, e.g. the use of bus lanes in urban areas, or special E-lanes on main highways around the conurbation.

### **Careful reforms of patent systems and reorganisation in Europe**

Patent systems should be structured so that they provide incentives for innovation and thus generate benefits for the economy as a whole. The current systems do not always fulfil this purpose satisfactorily. In the USA, the tightening of patent protection in the mid-1980s caused an escalation of competition for patents. In most sectors this led to an increase in litigation.

In Europe, there has been an increase in patenting activity since the 1990s. In addition, patent applications have become considerably more complex. Applicants are increasingly resorting to tactics which introduce uncertainty to the system. Despite falling quality, however, the grant rate at the European Patent Office has remained almost constant. In view of these developments, the framework conditions should be amended in order to discourage or prevent behaviour which obstructs innovation and progress. Above all, patents should not be granted at all for marginal inventions.

At the European level, efforts are being made to introduce an EU patent. In addition, a European and EU Patent's Court, replacing the current fragmented national systems. The Expert Commission welcomes these initiatives. The focus of such an implementation should be on the efficiency of future systems and their quality orientation. German policy-makers should draw on the undisputed advantages of the German patent jurisdiction, and aim to ensure that the central Court of Justice in the new legal system is anchored in Germany.

The Expert Commission notes that stronger patent protection and increased numbers of applications do not in themselves ensure more innovation and growth. Rather it is important to maintain the quality of the patent system:

- Quality advantages which the European patent institutions currently have over other regions, in particular the USA, should be maintained and expanded.
- The quality orientation of the European patent offices must be further improved. A functioning patent system must implement sufficiently exacting provisions concerning novelty and inventive step. Patent officers should be encouraged to reject marginal patents and to sanction unacceptable application behaviour.
- The Federal Government should continue to support the formation of European institutions in the patent system, i.e. a unified patent court system and an EU patent. Efforts should be made to ensure that the new institutions bring further improvements with them in comparison with the existing system. Harmonisation is not an end in itself.
- The behaviour of patent applicants has changed considerably in recent years. Therefore care must always be taken when interpreting patent data, with the inclusion of control groups and other reference measures.



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