



June 22, 2004

# Current Issues

## More growth for Germany

### Innovation in Germany

## Windows of opportunity

Germany's innovation system badly needs a boost. Output is still strong, but prospects are dim due to structural problems. Notorious weaknesses include slow structural change towards cutting-edge technologies, weak supply of risk capital, and declining contributions to innovation from SMEs.

A long list of remedies is under discussion, and the government is slowly starting to tackle some of them in its current "Year of Technology". However, they all aim at catching up with other nations' higher standards. Catch-up is essential, but not enough. To gain a true competitive edge, Germany needs to *take steps others have not taken*, in domains where it is on an equal footing with competitors:

- *Attract foreign brains while the US deters them from entering.*  
The new US homeland security policies seriously deter foreign top talent from going to the US. Germany should, and could, attract a significant share of this human capital.
- *Incite innovation by appreciating companies' intellectual property (IP).*  
Most financial service providers do not employ in-depth IP valuations. Taking the lead here would not only encourage R&D activity, but also generate competitive advantages for financiers ahead on the learning curve.
- *Set up a balanced IP protection regime to foster the creation and flow of ideas.*  
Stronger IP protection is not always better. Chances are that patents on software, common practice in the US and on the brink of being legalised in Europe, in fact stifle innovation. Europe could still alter course.
- *Deregulate the airwaves to foster experimentation in mobile services.*  
The weakly regulated internet produced a wealth of innovations. Airwaves, heavily regulated around the globe, could be the next innovation dorado – Germany's tentative steps towards liberalisation should be bolstered.

All four of these windows of opportunity promise swift positive effects on the German innovation system. But none of them will stay open for long. Government, but also academia, industry and financial service providers, should act rapidly and boldly.

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The German government declared 2004 the “Year of Technology“. For good reason, as bold measures to bring Germany’s innovation system back on track are badly needed. Output is still strong, but severe structural problems threaten its prospects for the years to come.

Presumed remedies – raising R&D spending, improving education etc. – have been tossed back and forth, a set of actions has been announced by the German federal government. Most of them are stuck in the stage of announcements. This is too bad. But the proposed actions have another common property: they all aim to raise German standards closer to the best practice observed elsewhere.

To be sure, this catch-up is crucial without any doubt. But in order to gain a true competitive edge in innovation capabilities, Germany needs to take innovation-fostering steps *others have not taken*. This basic principle of competitive strategy seems to have dropped off the radar. This report points to some of these windows of opportunity: Attracting the best foreign brains as long as the US deters them from going there, fostering R&D investment by encouraging systematic appreciation of companies’ intellectual property (IP), crafting a carefully balanced IP protection regime, and creating an innovation dorado in the wireless spectrum. In all these areas, Germany is in an equal or even better starting position than competing nations. And in all of them, rapid action is key and can lead to swift improvements.

Sketches of these opportunities are given on the following pages, precluded – as a launching pad – by those strengths and weaknesses of the German innovation system that will take longer to be altered substantially. The table on this page provides an overview, including a quick look at opportunities’ inevitable companions: lurking threats.

Opportunities	Threats
<ul style="list-style-type: none"> <li>• Attract foreign brains while the US deters them</li> <li>• Incite innovation by appreciating IP systematically</li> <li>• Balance IP protection to foster the flow of ideas</li> <li>• Deregulate the airwaves to boost experimentation</li> </ul>	<ul style="list-style-type: none"> <li>• Be aware of the precaution principle in R&amp;D. Obligations to check for any possible risks of innovation in advance is detrimental. But EU is heading there.</li> <li>• Do not make innovation a command economy. Funding specific technology is good, but be aware of politicians’ pet projects.</li> <li>• Do not nurture established clusters only.</li> </ul>
Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• High share of employees working in R&amp;D</li> <li>• Strong rises in companies’ innovation spending</li> <li>• Good framework conditions for innovation</li> <li>• Decent output by the academic community</li> <li>• High output of triadic patents</li> <li>• Strong sales share of market novelties</li> </ul>	<ul style="list-style-type: none"> <li>• Slow structural change towards cutting-edge tech</li> <li>• Endangered R&amp;D spending level (gov’t &amp; companies)</li> <li>• Weak supply of risk capital</li> <li>• High regulatory burdens</li> <li>• Weak and declining innovation participation of SMEs</li> <li>• Dwindling supply of highly qualified personnel</li> </ul>



## Strong output, clouded prospects

At first sight, Germany's innovation system keeps going strong. This is the overall impression one gains when analysing some of the most common innovation indicators<sup>1</sup> (*strengths*):

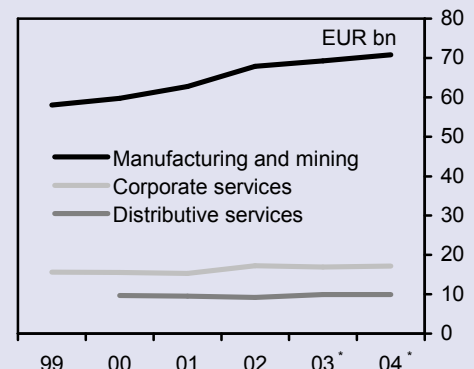
- The share of *human resources employed in business R&D*, relative to all employees, is high by international standards. This includes not only scientists and engineers, but also administrative and support staff. Germany ranks sixth internationally (2001), following Finland, Sweden, Denmark, Japan and Belgium.
- *Companies' expenditures on innovation* – meaning the whole process from invention to implementation, not just R&D – rose strongly from 2001 to 2002, and as a general rule companies planned to raise them further from 2002 to 2004 (see figure).
- The *framework conditions for innovation* are still rated fifth-best in the world in the Global Competitiveness Report 2003/04 by the World Economic Forum (see figure; fourth-best in 2002/03). This indicator includes the strength of firm clusters and linkage of science and industry, among others.
- The *output of Germany's academic community* in the form of scientific publications is sound, though not in the lead internationally, regarding both quantity and quality.
- Germany's *triadic patent output* (per million inhabitants) ranks fifth worldwide, well above the OECD mean and the US output – and is still on the rise. In fact, the OECD and US values are stagnating and declining, respectively (see figure; most recent data for 1998).
- German businesses have kept up their *innovation success*, as measured by sales of market novelties relative to total sales (2001/02: about constant in manufacturing at 7.4/7.6% and corporate services at 6.9/6.8%; in distributive services a dip from 2.7 to 1.5%).

Last but not least, all this helps German makers of advanced technology to excel in integrating into their products the more sophisticated cutting-edge technologies (which often are developed abroad, see below). Closer inspection of the German innovation system reveals a set of predominantly structural *weaknesses*, though. They do not affect Germany's innovation performance heavily today, but – if not cured or counterbalanced – will certainly do so tomorrow:

- Germany's *structural change towards cutting-edge technologies* is stumbling. This category of goods gains ever more importance in world trade, but Germany's respective foreign trade deficit rose from 1.5% in 1991 to 2.5% in 2001. And even in its traditional stronghold, the advanced technologies, the foreign trade surplus is dwindling. Germany's comparative advantage in foreign trade with R&D-intensive goods mainly rests on its automobile powerhouses.
- The *total funds spent domestically on R&D* (not on the whole innovation process, compare above) in Germany rose slightly up to 2002 (to 2.52% of GDP). This increase is credited to business only, as the state's share has been on the decline for years. But companies plan to reduce their part in 2003/04, too (see figure

### More for the new

Innovation spending by German companies, from invention through to marketing



\* Company estimates  
Source: Mannheim Innovation Panel 2003

### Solid ground for innovation

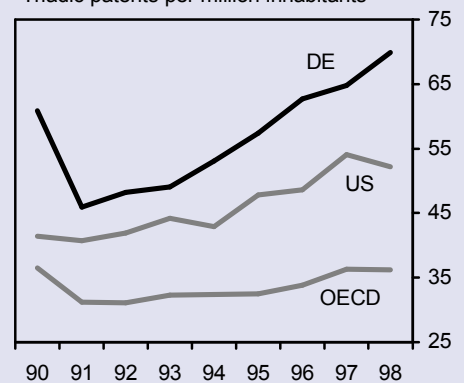
National innovative capacity ranking\*

1. USA (1)
2. Finland (3)
3. United Kingdom (2)
4. Japan (5)
5. **Germany (4)**
6. Singapore (10)
7. Sweden (7)

\* Ranking aims to measure a country's potential to generate commercially relevant innovations in the next years, comprising a broad set of indicators. By M. Porter and S. Stern for the Global Competitiveness Report 2003/04. Numbers in brackets: rank in 2002. Source: MIT Technology Review 05/2004

### Germany keeps patenting

Triadic patents per million inhabitants



Source: OECD 2004

<sup>1</sup> See also Hofmann, J. (2003). Innovation in Germany: Mind the gap! *Current Issues*, Deutsche Bank Research.

on next page). The German government's 3% goal for 2010 (Lisbon agenda) seems hardly achievable.

- Germany's *market for venture capital* has not yet recovered from the setback after early 2000 and does not display many signs of doing so soon. Thus, many companies – especially the young and innovative ones – lack a main channel of financing.
- *Regulatory burdens* on entrepreneurship and business in general are comparatively high in Germany. This includes, but is by no means limited to, labour market regulation and is empirically backed by the Global Competitiveness Report and OECD studies. For example, the latter found that setting up a company in Germany takes exceptionally long (up to 24 weeks; UK 1 week, US 2, JP 4, FR 15).
- The *innovation contribution of German SMEs* is low and will probably decline further. The share of innovating SMEs fell steadily between 1998 and 2002 (see figure), and SMEs' spending on innovation decreased in 2001/02 (in manufacturing and distributive services; rise in corporate services). For 2003/04, further reductions are in the pipeline.
- Finally, the *supply of highly qualified personnel* is bound to decrease, as expected graduate/retiree ratios among both scientists and engineers as well as other highly qualified are expected to plummet in coming years (see figure). The well-documented mediocre quality of German schooling will not help either.

### Me-too measures don't make a star

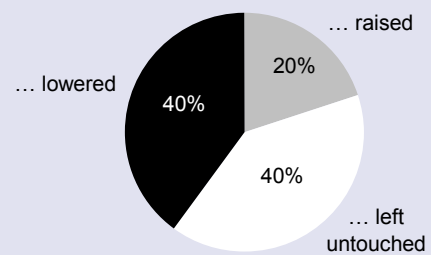
The above list is no secret to business leaders and policy makers. In some areas businesses have to take action. But the options open to them – especially those open to SMEs – are somewhat limited in an economically tense situation. When there is only little leeway for businesses to take innovation-enhancing measures, it is the turn of governments and legislators to reconsider the framework.

In fact, the German federal government announced a set of actions lately. This January, it released its "Weimar Innovation Guidelines", which provided a good coverage of areas relevant for improving innovation performance in Germany, but missed out on proposing tangible measures. The paper's main effect proved to be the creation of a high-ranking circle of "Partners for Innovation" from government, academia and industry. Its members will likely represent today's main R&D fields and industry interests – and possibly less of those new fields essential for deep structural change tomorrow. Beyond these moves, which might well get stuck in the realm of lip service, enhanced financial support has been announced:

- ... for a selection of cutting-edge technology fields, namely nanotechnology (today already EUR 100 million per year), micro electro-mechanical systems (no numbers given), and research on the human genome (EUR 134 million in 2004-07). This is in addition to a vast range of other research fields sponsored directly by the federal government, amounting to a total of EUR 4.2 billion in 2003, which dwarfs spending on the above cutting-edge fields.
- ... for technology-intensive start-ups and SMEs regardless of technology field, by investing in risk capital funds via a fund of funds managed by the European Investment Fund (substantial part of the "High-Tech Masterplan" announced in February 2004). EUR 250 million is supplied by the German government, the same sum by the European Investment Fund. This seems to be a good move.

### Endangered R&D spending

Share of German companies' R&D expenditures (w/o design, marketing etc.) planned to be...\*

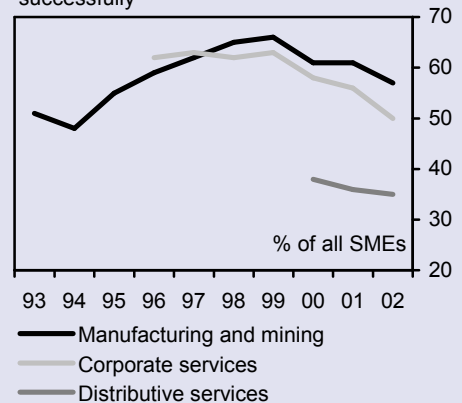


\* from 2003 to 2004

Source: Stifterverband für die Deutsche Wissenschaft 2004

### SMEs off the innovation track

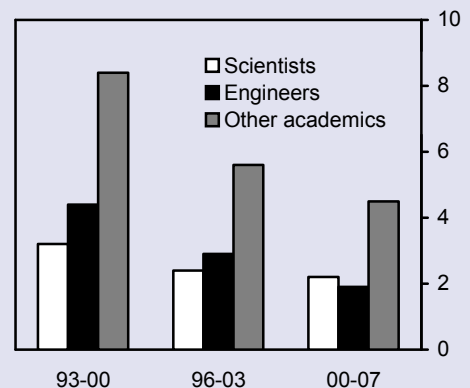
Share of German SMEs innovating successfully



Source: Mannheim Innovation Panel 2003

### Brains running short

German graduate/retiree ratios



Source: German Federal Ministry of Education and Research 2003

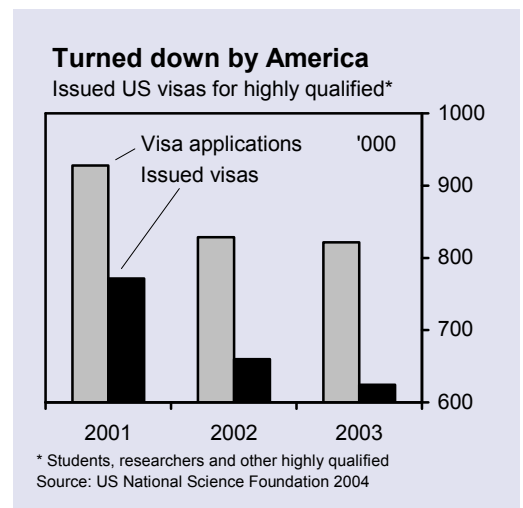
- ... for the development of elite universities in Germany. The government is arranging a competition among German universities for a total EUR 1.9 bn of additional support over five years, 75% to be paid by the federal government and the rest by the *Länder*. Up to ten universities will be chosen. Selection criteria will be education and research excellence as well as established links to industry. The success of this funding is uncertain though, as in Germany the *Länder* are in charge of education. The federal government can invest in universities only via *Länder* accounts, risking dilution.

In addition, the German federal government has announced a programme called "Information Society Germany 2006". However, it mainly lists actions already under way and does not make financial commitments. To sum up, all these actions will (1) boost Germany's innovation performance in the long term only, and (2) aim to foster a catch-up with other nations' higher standards in the respective fields. They are me-too measures. As such, they are necessary, but not sufficient to gain a competitive edge over other countries in at least some disciplines of the innovation race. Thus, the remainder of this report is devoted to areas where first-mover advantages are still within reach for Germany.

## Dress up, get brains

*Opportunity 1: Attract foreign brains while the US deters them.* Due to fear of homeland security threats, the US continues to deter foreign brains from entering the country. Many would-be foreign students or researchers wait inappropriately long for a visa or do not get one at all, despite successful college applications. Others do not even bother to apply, as hassles imposed on them by the US government already seem to outweigh the benefits of a US higher education. These effects are by no means limited to students from countries supposed to be terrorist hotbeds. In effect, numbers of applications and granted visas are taking a plunge (see figure). Heads of the US National Science Foundation and leading universities are sounding public alarm. This is a window of opportunity for Germany to enhance its pool of talent as these students and researchers look for alternatives. Other countries are in the starting blocks, too, but Germany might be able to take advantage of its overall strong reputation in science and engineering education.

*Measures to take.* By the time their restrictive policies take noticeably negative economic effect, the US will alter course. This might take a handful of years, but no more. Thus, above all, swift action is key. Excellence of selected academic institutions, as currently pursued by the German government, might serve as a lighthouse to attract top talent, and maybe money. But this is not enough: Germany needs to further dress up by (1) allowing true competition and independence in academia on all levels; (2) combatting administrative burdens and hierarchical sleaze in universities; (3) adjusting to the internationally accepted Bachelor/Master formats; and by (4) rigorously improving labour market regulation and, of course, immigration policies. In the latter arena, most controversially disputed in Berlin lately, a compromise finally seems possible. A draft bill is due in mid-June – and should be scrutinised for its effects on innovation. Among other aspects, it actually seems to aim for a reduction of immigration hurdles for the highly qualified, as well as a temporary right of residence for foreigners after graduating from a German university, enabling a job search.





## Appreciate knowledge

*Opportunity 2: Incite innovation by scrutinising companies' IP systematically.* The more companies can turn their intellectual property (IP) into cash, the more incentive to innovate they have. Protected IP can enable businesses to generate monopoly profits, to earn licensing royalties, or even to obtain loans backed by it. To do so effectively, companies' IP has to be valued in a trustworthy and comparable fashion. Today, only part of a company's IP can be capitalised in its balance sheet. And investors' valuation of a company's future performance usually takes IP into account employing a rather casual approach, if at all. There do not seem to be major differences across countries in valuation procedures, either.

This is a window of opportunity for many countries, but especially for Germany. In international comparison, the value added by German SMEs is high, and their number big – but they tend to be covered weakly by financial analysts. Thus, their IP is a buried treasure. Fostering an appreciation of the intellectual property of German R&D-intensive SMEs will propel their innovation efforts and overall economic performance. Financial service providers partnering with these companies will build experience in IP valuation, gaining a competitive edge over peers in risk assessment for both conventional lending and trading securities backed by IP assets. All this might be fuelled additionally by setting up an exchange for IP assets – in fact, the company operating the stock market in Hamburg, Germany, is considering doing just that. This could help SMEs in particular to find buyers for their IP. Their networks usually have a shorter reach than those of large corporations.

*Measures to take.* IP holders should manage their intellectual assets actively, which might include formal valuation processes. Some larger corporations already excel in this discipline, but many SMEs neglect or completely ignore it. Financial service providers should (1) broaden and deepen the valuation of their clients' IP (looking at formal protection, synergies within the IP portfolio, availability of relevant human capital, local linkage to suppliers and academia etc.); they should (2) strive to establish standardised and transparent IP valuation procedures to generate comparability and trust; and (3) cooperate with outside valuation specialists for a jump start along the learning curve. Doing all this is easier said than done, but worthwhile, as it is likely to trigger a positive feedback cycle: more structured IP valuation generates trust among investors, which in turn increases the value of a company's IP. If traded on this basis, the market will price IP more efficiently, further reducing risk for financiers. This eventually drives investment in innovation.

## Let ideas flow

*Opportunity 3: Set up a well-balanced IP protection regime that keeps fostering the creation and diffusion of ideas.* Rapid diffusion of innovation is key for economic growth. Formal IP protection through patents, copyrights and brands is a prerequisite for a large chunk of innovation diffusion: it enables controlled licensing of IP. The importance of this kind of knowledge transfer has surged in recent years. Worldwide licensing revenues increased tenfold from 1990 to 2000, to USD 100 billion per year. A growing number of R&D-intensive businesses realises that licencing out their IP can constitute a substantial share of their revenues, which in turn encourages innovation efforts. Bearing this in mind, one could be tempted to consider ever stricter IP protection regimes to provide ever more stimuli for innovation.



This conclusion is wrong, however. A prime example is patents on software, which might at first sight be seen as a logical expansion of the classic technology patent. But creating software differs markedly from creating machinery and the like: MIT researchers Bessen and Maskin argue that innovation in software is both strongly sequential (one invention building on a previous one) and complementary (thriving on parallel approaches to the same problem), far more so than in other technology fields. In fact, they found empirical evidence that software patenting substitutes R&D activity, rather than encouraging it, and conclude: "For industries like software or computer, there is actually good reason to believe that imitation becomes a spur to innovation, while strong patents become an impediment"<sup>2</sup>. In accordance with other academics, they strongly favour copyright over patent protection for software. Copyrighting provides both adequate leeway for sequential innovation and enough protection for marketable software products.

The cited studies analyse the US software market, where patentability has been introduced gradually since the early 1980s, lowering patent granting standards and strengthening enforcement (see figure). 20 years later, the EU is following suit: the Council of the EU has introduced a controversially discussed pro-patent bill to the European Parliament, due to be enacted this summer. Thus, the rapidly closing window of opportunity for Germany – and the EU in general – is to alter course, keep the legacy copyright system for software, and thereby provide a better-balanced IP protection regime than software's old bull: the US<sup>3</sup>.

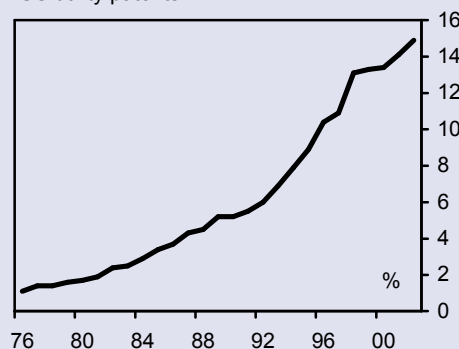
**Measures to take.** The German government is among the tentative critics of the EU software patent bill. This position should be bolstered, by (1) putting forward academic evidence and (2) making SMEs' concerns heard. SMEs are crucial providers of pathbreaking innovations, but would be most adversely affected by patentability. The majority of them is deterred by the costs of patenting themselves, but would have to navigate around software patent portfolios of large corporations.

## Create an airborne playground

**Opportunity 4: Deregulate the airwaves to foster experimentation with new mobile services.** The internet created an enormous bubble in financial markets. But it also unleashed an unprecedented gush of creativity and innovation, much of which constitutes now, beyond the valley of tears, the building blocks of healthy growth in e-commerce. This wealth of innovation in the heydays of the internet boom had a simple cause: the internet has always been a weakly regulated medium, enabling technologists and entrepreneurs to tinker with applications that make innovative use of its transmission capabilities, without asking anybody for permission<sup>4</sup>. And here comes the fourth window of opportunity: a similar stream of

### Hard protection for soft ware

Share of software patents in total  
US utility patents



Source: J. Bessen and R. M. Hunt 2004<sup>2</sup>

<sup>2</sup> Bessen, J., and Maskin, E. (2000). Sequential innovation, patents, and imitation. *Working paper*, Dep. of Economics, Mass. Institute of Technology; Bessen, J., and Hunt, R. M. (2004). *Working paper*, School of Law, Boston University.

<sup>3</sup> One might object that despite having a software patent system (and others not), the US is dominating world software innovation and markets. The glorious US performance in software has to be credited to a mix of other factors, though, with the strong Silicon Valley cluster with its superb industry-academia linkage ranging among the most important.

<sup>4</sup> A second important prerequisite has been the so-called end-to-end principle of the internet: A "stupid" network that is open to almost any kind of usage that intelligent end-points (PCs, servers etc.) employ it for – including those not invented yet.

innovations could be sparked by liberalising the German (or European) airwaves.

Today, the aether is heavily regulated around the globe. The state allocates licences, sometimes by auction, to public and private entities for the use of specific parts of the wireless spectrum. The way an allocated frequency block is used is tightly controlled by the regulator, too. This hinders innovation. In Anglo-American countries, deregulation of the airwaves has therefore been discussed for years, but advanced to larger scale free trading in Australia and New Zealand only. One reason for slow deregulation is that auctioning and allocating a resource kept artificially scarce seems to be lucrative for the state. But this is true only in short-term perspective (and sometimes not even then, as tax losses due to unexpected write-offs on companies' UMTS licence expenditures reveal): innovation and thus possible long-term tax income, often outclassing one-time auction gains, are precluded. Another reason put forward frequently is that tight regulation is needed to prevent parallel transmissions from interfering with each other. But this argument is rapidly fading, as technological solutions are in reach.

**Measures to take.** The current German regulation scheme roughly resembles those found in the US and most other countries. But a new version of the German telecoms regulation bill is about to be introduced to parliament. It will tentatively prepare the ground for trading frequencies and will allow for small-scale experimentation on frequencies licensed to others. But this will not be enough to spur innovation on a grand scale, because the traditional allocation process still dominates. We urge that the regulator (1) allow for a secondary market for re-selling licences in significant chunks of the wireless spectrum, and (2) seriously evaluate giving away parts of the wireless spectrum to the commons (as done in the case of the internet), creating an unparalleled innovation dorado: without the need for a licence and the associated financial burden, everyone could use these transmission channels for the creation of new mobile devices and services. As an example, the rapidly spreading Wireless Local Area Networks (WLANs) emerged in such a free channel.

## Use Europe

The common feature of these four opportunities for more innovation in Germany is *expanding* – expanding the human capital base, the IP valuation approach, the diffusion of ideas, and the gateway to airwaves. This leads to a fifth window of opportunity for Germany, one that will hopefully stay open for much longer: expanding cooperation in R&D with the new EU member states. The rising complexity of R&D projects and compression of product life cycles increasingly demand cooperation. The EU incumbents that most effectively leverage the R&D capacities of the eastern countries will benefit, big time.

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