German Institute
for Economic Research
(DIW Berlin)
Koenigin-Luise-Str. 5
14195 Deutschland
customerservice@diw.de

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Capacity for Innovation: Among Leading Industrial Countries, Germany only Manages a Middle Rank

Heike Belitz and Axel Werwatz

The capacity of people and companies to bring about innovations, that is, to create new knowledge and implement this in new marketable products and services, is of prominent importance for growth and prosperity in highly developed industrial countries. On commission of *Deutsche Telekom Stiftung* and *Bundesverband der Deutschen Industrie* (BDI, Federation of German Industries), DIW Berlin has prepared an overall indicator of innovative capacity for the first time this year, in which Germany and 12 other leading industrial countries are studied.[1] Germany takes sixth place following frontrunner USA, three Scandinavian countries and Japan, but does not have any clear advantages over the other large European countries, Great Britain and France.

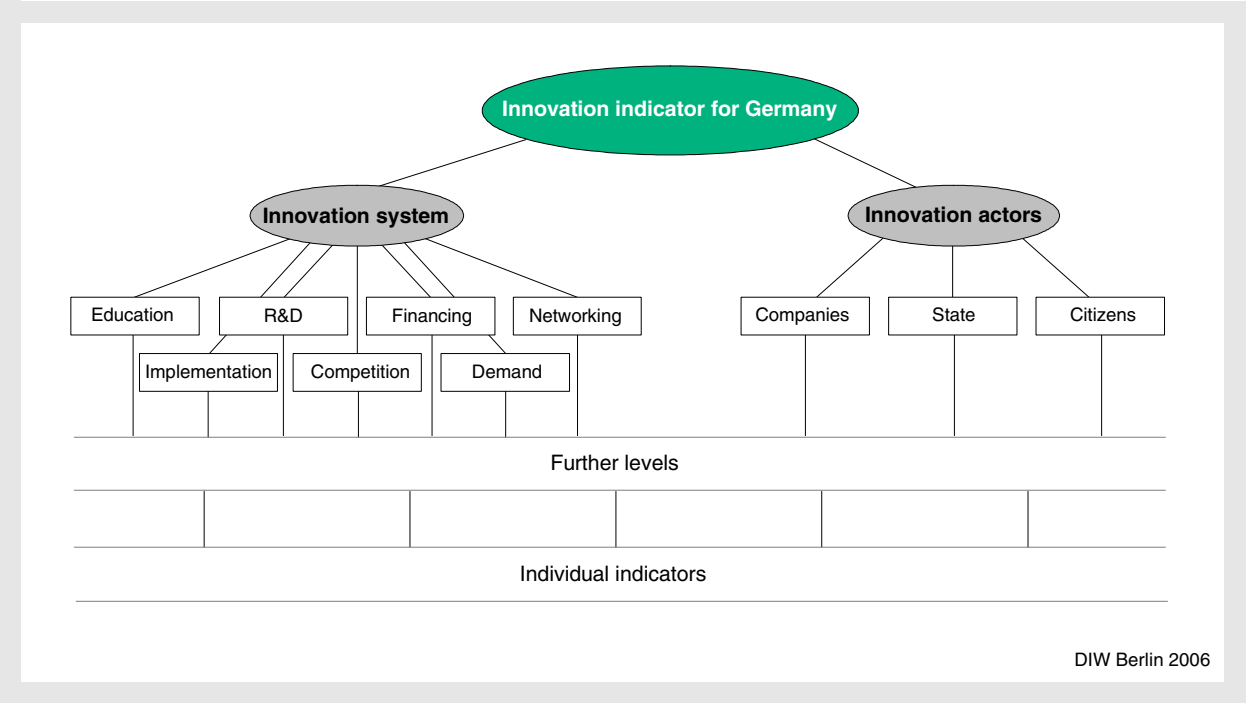
A closer look at the multi-facetted, multilevel indicator reveals particular weaknesses of the German innovation system, these being in the area of education and in the financing of high-risk innovations. In addition, behavior and attitudes in the German populace which could support innovations are much less pronounced than in many comparable countries. This especially pertains to a willingness to take risks, to the knowledge and scientific understanding that people have, and also the participation of women in the innovation processes.

The term 'innovation' refers to new products, processes and organizational solutions which companies introduce into production procedures and on the market.[2] In order to do so, they put newly acquired knowledge to use, which is often knowledge they have developed themselves with great effort

[1] Cf. A. Werwatz, H. Belitz, T. Kirn, J. Schmidt-Ehmcke and R. Voßkamp: 'Innovationsindikator Deutschland' (Innovation Indicators for Germany), 2005 report. Research project on commission of Deutsche Telekom Stiftung and Bundesverband der Deutschen Industrie (BDI, Federation of German Industries), published in DIW Berlin: 'Politikberatung kompakt', no. 11, Berlin 2005; also released by Deutsche Telekom Stiftung and Bundesverband der Deutschen Industrie: 'Innovationsindikator Deutschland 2005 – Ergebnisse einer Studie des DIW Berlin'. Bonn/Berlin 2005. cf.. www.innovationsindikator.de.

[2] J. Schumpeter: 'Theorie der wirtschaftlichen Entwicklung' (Theory of Economic Development). Berlin (1911) 1993.

Figure 1
Structure of the 'Innovation Indicator in Germany'



Source: DIW Berlin.

and the risk of failure. The capacity of firms and people of a nation to steadily achieve innovations in the context of changing production and market conditions is designated as innovative capacity. It is a decisive prerequisite for the growth of productivity and prosperity in innovation-driven economies.[3] An economy's capacity to innovate cannot be directly observed and assessed. It depends on the behavior of the key innovative actors – companies, state organizations and citizens –, on the relationships between them and on the societal framework conditions which form the national innovation system.[4] Thus, in order to assess a country's innovative capacity, a method must be used which covers all these aspects and enables them to be seen in context.

The framework conditions in a national innovation system are to be found in seven areas:

- Education,
- Research and development,
- Financing innovations,
- Networking of innovation actors,
- Implementation of innovations in production,
- Regulations that promote innovations and competition,
- Innovation-friendly demand.

The quality of these conditions determines the innovative capacity of companies, who, acting together with the state and the citizens, configure this innovation system themselves. The overall indicator thus summarizes seven components of innovative capacity on the system side and three on the actor side (cf. figure 1). By narrowing down this broad approach, a composite score results for Germany's innovative capacity as compared internationally – the 'innovation indicator for Germany.' But by means of differentiation, the contributions that the individual areas of the innovation system make towards the total result and the role its key actors play in it can be identified. In this manner, an 'innovation profile' for Germany can be derived which lays out the country's strengths and weaknesses in relation to those of the countries it is compared with.

[3] From a historical perspective, Porter distinguishes between three stages of competitive development: factor-driven, investment-driven and innovation-driven. The final tier includes leading industrial countries as well as Hong Kong and Singapore. Cf. M. E. Porter: 'Building the Microeconomic Foundations of Prosperity: Findings from the Business Competitiveness Index'. In: 'World Competitiveness Report 2004-2005'. World Economic Forum, Geneva 2004.

[4] The concept of a national system of innovation is defined and demarcated in various ways in literature. Cf. among others B. A. Lundvall: 'National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning'. London 1992; and R. R. Nelson and N. Rosenberg: 'Technological Innovation and National Systems'. In: R. R. Nelson (ed.): 'National Innovation Systems'. Oxford 1993, pp. 3-21.

Countries compared

The investigations were first carried out for Germany, ten other leading EU countries (Austria, Belgium, Denmark, Spain, Finland, France, Great Britain, Italy, the Netherlands and Sweden) as well as for the United States and Japan. It is these countries in particular that are to be viewed as competitors with Germany since their companies compete on international markets, they exhibit a similar development and income level and the institutional framework conditions are similar. In addition, a large number of comparable detailed economic indicators is available for these countries.

Since many German companies view themselves to be subject to heavy competitive pressure from rising Asian and East European countries, the question naturally arises as to why these countries were not included in the comparison. Research on the catching-up process of these countries has revealed that they have pursued very different paths in this regard, and that institutions and policies which functioned well during the catch-up phase no longer suffice or even become a hindrance once the level of developed countries has been reached.[5]

[5] J. Fagerberg and M. M. Godhino: 'Innovation and Catching-up'. In: J. Fagerberg, D. C. Mowery and R. R. Nelson (ed.): 'The Oxford Handbook of Innovation'. New York 2005, pp. 514-543.

In light of this, the reference countries for Germany are to be sought, then, among the leading industrial nations that have similar framework conditions for innovation and face similar challenges – including competition from countries catching up economically and developmentally.

In order to assess the innovative capacity of these highly developed countries and in order to carefully differentiate them, a total of almost 150 individual indicators, some of them already a combination of several characteristics, were used to evaluate the innovation system and the behavior of individual actors – companies, state and citizens. Thus, using these individual indicators as a basis, the 'innovation indicator for Germany' is developed incrementally from one stage to the next, from the 'basics' upwards via several intermediate levels to the 'top' representing the overall composite indicator. At all levels of aggregation, the scores determined can be used to establish intermediate ranking for the countries compared. The procedure serving to standardize and combine the indicators in this step-by-step process is described in box 1. The manner in which the individual, basic-level indicators are used in establishing the composite innovation indicator is explained in detail using the example of how highly qualified women participate in the innovation process (cf. box 2).

Box 1

Method

Data Sources for Individual Indicators

The individual indicators used were selected on the basis of theoretical approaches by which innovation is explained as a technical, economical and social phenomenon. Key sources for obtaining comparable figures of the innovation systems and the behavior of the actors in the countries being analyzed are the following:

- Data made available nationally and internationally on research and development, education, trade, production and employment, which is provided by the OECD (Organization for Economic Co-Operation and Development) and Eurostat among others, in addition to indicators calculated by DIW Berlin,
- Summarized indicators developed by other authors, which evaluate complex factors influencing innovative capacity using a similar method of multi-level approach, for example the regulation of product markets (OECD) and the information and communication infrastructure (World Economic Forum in cooperation with INSEAD business school),
- Surveys of actors in innovation process that provide an international comparison, for example of companies (Executive Opinion Survey implemented by the World Economic Forum) and individuals (Eurobarometer, World Values Study).

Data gathered from surveys provides a valuable supplement and alternative to the 'hard' statistical facts on the innovation system, since such facts often are not available at all for many phenomena or do not take sufficient account of the qualitative aspects.

Standardization

In order to be able to compare and summarize the individual indicators, first all data – both the 'hard' facts and the 'soft' survey results – are converted to a uniform scale. This is done using the following formula:

$$Y_{1\text{ to }7} = 6 \times \frac{(Y - Y_{min})}{(Y_{max} - Y_{min})} + 1$$

Essentially, this formula reflects the distance from the original value Y of a country to that of the 'front-runner' (Y_{max}) and that of the 'last of the lot' (Y_{min}), and then converts this interval to a position on a scale of 1 to 7.[1]

[1] The interval to the front-runner or to the final country was rescaled according to a range from 1 to 7 because many of the individual indicators culled from the world-wide survey of executives done by the World Economic Forum were already measured in a 'raw state' on this scale.

Box 1 continued

The variables Y were selected in such a way that based on the findings of theoretical and empirical research, it can be assumed that higher values are 'better' than lower ones, in other words, innovative capacity rises with increasing Y.
Standardizing the individual indicators by means of fitting them to a uniform scale is a necessary step since some indicators' original scales substantially vary, which means the indicators cannot be meaningfully compared and aggregated in an 'untreated' state. The transformation proposed here not only results in all individual indicators (and all interim results derived therefrom) being a part of one uniform scale, but also maintains the relative intervals which the comparison countries exhibit on the original scale of the respective indicator. This is important when aggregating the individual indicators and empirically weighting them on the lower levels, where the variation of an indicator from one country to the next is used as central information.

Weighting and summarizing the indicators based on the principal statistical components

The summarized indicators are calculated on every level as a weighted average of the components. The weighting is determined empirically on the lower levels of indicator formation (i.e. based on the data) using the statistical procedure of principal component analysis (PCA). Using the first principal component,[1] this analytical procedure calculates exactly that weighted average of the individual indicators that exhibits the largest variation between the countries being compared. In order to obtain this result, the first principal component determines the weighting of the individual indicators exactly in such a way that specifically those indicators are 'rewarded' with a relatively high weight that themselves exhibit a high variance from one country to the next, while harmonizing well with the other individual indicators where the direction of the variance is concerned. This is based on the following concept: differences in the innovative capacity of the countries being compared, all of them highly developed, are to be looked for wherever the indicators between the countries vary the most.
On the second-to-last level, where seven sub-indicators are summarized on the side depicting the innovation system, the weighting is supported by empirical findings obtained from a survey of 73 primarily high-ranking executives employed by major, internationally operating German and foreign companies that are either manufacturers of commercial goods or active in the service provision industry. This survey provided information on the importance that the components of the German innovation system had, which information was then deployed in weighting the sub-indicators.
In combining the system indicators and the actor indicators to create the overall innovation indicator, the system indicator is given double weighting. By giving the system side a greater weight, the great importance that a country's innovation system has for its innovative capacity is taken into account. Furthermore, this weighting also reflects the abundance of research results available on the various countries' innovation systems, while considerably less is known at the moment about the attitudes and the behavior of the actors and their influence on innovative capacity.[2]

Low sensitivity

It is conceivable to use alternative methods to the one deployed in the present report; this applies in particular for weighting. In order to determine whether the results would stand up to challenge, alternative calculations were performed. The results obtained when using alternative standardization methods (exclusively using ranks throughout the entire process), alternative weighting (equal weighting or application of the weighting used in the principal component analysis throughout the entire process) and alternative structures (fewer interim levels) reveal no significant deviances to the results presented here. Especially on the upper levels (cf. figure 1), the ranking obtained in the alternative calculations are always highly correlated with the 'ideal version' of the innovation indicator for Germany (as a rule at a ratio of clearly above 90%). It is in particular the make-up of the 'top-performer' group and the 'last-in' group that is very consistent when reviewed in this way.
This low sensitivity of the results obtained is caused on the one hand by the stability that the various results obtained for each country exhibit, across all levels and areas: the top countries have almost no weaknesses while the countries bringing up the rear of the overall ranking also seriously lag behind in many partial areas and on interim levels. On the other hand, the multilevel quality and complexity inherent in the system (almost every 'phenomenon' is described by summarizing several indicators) had the effect that no – potentially erroneous – individual indicator significantly impacted the results.

[1] The calculated values of the first main components were in turn subsequently adjusted to the standard scale between 1 and 7 for the purpose of doing further calculations.

[2] Thus, using the 'actors' component of the innovation indicator in this form in order to assess innovative capacity represents an 'innovation' in itself, as compared to studies on the topic done thus far.

Specific features

The procedure outlined above has several features distinguishing it from other summarized indicators that were prepared for similar investigations[6]:

– Concept: the overall indicator is comprised of a system side *and* an actor side so that the innovation processes are captured in their many technical, economical and social facets.

– Structure: the performance of a country as recorded by the overall indicator can be precisely and comprehensively traced back to its performance on every interim level. In this way, it can be demonstrated

Box 2

Taking the participation of women into account in the innovation indicator

Both through their behavior as well as their attitudes, citizens affect the innovative capacity of a country. In the lower-level indicator 'innovation-relevant behavior of citizens,' social capital, company establishment activity, knowledge and scientific understanding as well as the participation of women in the innovation processes are measured.

In many industrial countries, the creative potential that highly qualified women represent for the innovation process is, for the most part, not used. While at the present time, half of all college graduates in the EU are female, the share of women in the mathematical-scientific area amounts to 40%, in the engineering field 20%; the fraction of researchers in companies is even less than 15%. In order to implement the Lisbon Strategy, the European Commission thus believes it is imperative that the number of female researchers in companies be quadrupled.[1]

The following indicators are used to measure female participation in the innovation process:

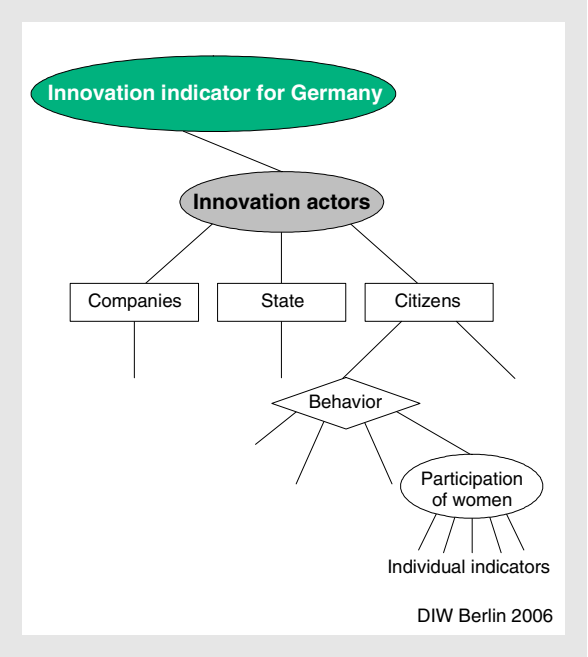
1. 'Hard' data provided by the European Statistical Office Eurostat[2] or the OECD[3]:
   - Percentile of women of
   - college graduates,
   - college graduates in the fields of natural sciences, technology and information sciences,
   - research personnel,
   - employees with tertiary education in sciences and technology,
   - employed scientists and engineers.

2. 'Soft' data provided by the survey of executives done on commission of the World Economic Forum[4]:
   - employment opportunities for women in the private sector; they range from 1 (limited and more likely to be available for positions of little import) to 7 (just like men);
   - wage equality; wages for women are categorized from 1 (clearly lower than those of men) to 7 (equal to those of men).

Figure 2

Structure of Innovation Indicator

Participation of women



Source: DIW Berlin.

Though in Germany the percentile of female college graduates is slightly above 50%, the percentile of women with a degree in natural sciences or technology is lower than in many other countries (cf. table 1). The low percentage of women professionally engaged in scientific research is also notable. In assessing equal opportunity for women in professional life, as evaluated using the survey of executives performed by the World Economic Forum, Germany comes out rather poorly, ranking only in the lower third.

Once the individual indicators used are summarized by means of the principal component analysis (cf. box 1 as well) where the sub-area indicator 'Female Participation' is concerned, Germany thus ultimately ends up in 11th place. The leaders of the group are the Scandinavian countries and the USA.

[1] European Commission: 'Women in Industrial Research: Analysis of statistical data and good practices of companies'. Luxembourg 2003.

[2] Cf. Eurostat: NewCronos data base.

[3] Cf. OECD: 'Main Science and Technology Indicators'. Paris 2005-1.

[4] Cf. World Economic Forum: 'The Global Competitiveness Report 2004–2005'. New York 2004.

what sub-areas or partial areas in any given country represent a particular strength or a weakness.

– Data: a particularly large number of almost 150 individual indicators and composite indicators from many diverse sources is incorporated. In this context, 'hard' facts as well as 'soft' indicators on the attitudes of executives and citizens and their judgment are used.

– Weighting procedure: on the 'lower' levels, the indicators are weighed corresponding to their variance between countries. The seven sub-indicators of the system side are weighted on the basis of a separate

Table 1

Indicators for the Participation of Women in the Innovation Process for 13 Industrial Countries

Overall ranking		'Hard data'					'Soft data'	
		College graduates	College graduates in the natural sciences, technology and information sciences	Research personnel	Employees in science and technology with tertiary education	Scientists and technicians	Employment opportunities in the private sector	Wage equality
		2001	2001	2002	2003	2003	2004	2004
		Share of women (%)					Scale from 1 (low) to 7 (same) as compared to men	
SWE	1	60.0	34.6	30.9[2]	58.9	35.5	5.5	5.1
FIN	2	61.1[1]	26.8[1]	29.9	55.9	26.4	6.0	5.1
DNK	3	56.5[1]	28.5[1]	26.3	54.2	27.8	6.1	5.5
USA	4	57.3	32.1	28.2[2]	25.4[2]	24.6[2]	5.7	5.0
GBR	5	56.4	33.0	28.9[1]	48.3	17.2	5.2	4.9
BEL	6	56.7	24.6	25.3[2]	51.1	50.9	5.1	4.8
ESP	7	57.2	30.8	36.3[4]	50.2	41.6	4.0	4.0
ITA	8	57.3[1]	36.3[1]	28.7	47.7	32.2	3.7	3.8
FRA	9	55.5[1]	29.7[1]	27.7	51.2	23.3	4.5	3.4
NLD	10	55.4	17.8	18.8[1]	45.6[3]	28.7[3]	4.5	4.9
DEU	11	52.2	23.0	14.3[2]	42.4	21.2	4.5	4.5
AUT	12	48.1	24.3	20.7	52.9	29.3	4.2	3.2
JPN	13	48.8	14.2	11.6[4]	36.8[2,5]	32.1[2,5]	4.1	4.5

1 2000. — 2 2001. — 3 2002. — 4 2003. — 5 DIW Berlin estimates.
Sources: Eurostat; OECD; World Economic Forum; DIW Berlin estimates.

survey of executives. On the actor side and ultimately when the system indicator and the actor indicator are aggregated, plausible weights were awarded because other information was lacking.

Results

In a group of 13 leading industrial countries, Germany's innovative capacity was given an 'average' ranking in the middle of the field. Taken by itself, 6th place for the innovation indicator, following the United States as leader, three Scandinavian countries and Japan is not yet cause for worry. However, the relatively low score of 4.66 (on a scale of 1 to 7) indicates, held against that obtained by the United States (7), but also Finland (6.01) and Sweden (5.83), that Germany suffers from considerable disadvantages in innovative capacity when compared to these front-runners (cf. figure 3). A country such as Germany, whose growth and prosperity are based on innovations to a substantial degree, must strive to achieve a top position in the world, not necessarily in the ranking, but definitely with an indicator score that is close to the maximum score.

The advantages that Germany has to offer in terms of innovative capacity, and the disadvantages it suffers from, as compared internationally are illustrated in the tiers of the 10 sub-indicators (cf. figure 4). Accordingly, particular advantages are given on the systems side in the areas of implementation of innovations – in the sense of companies enjoying success with R&D intensive products on international markets – and networking; serious disadvantages were pinpointed in the education sector and where the financing of innovations is con-

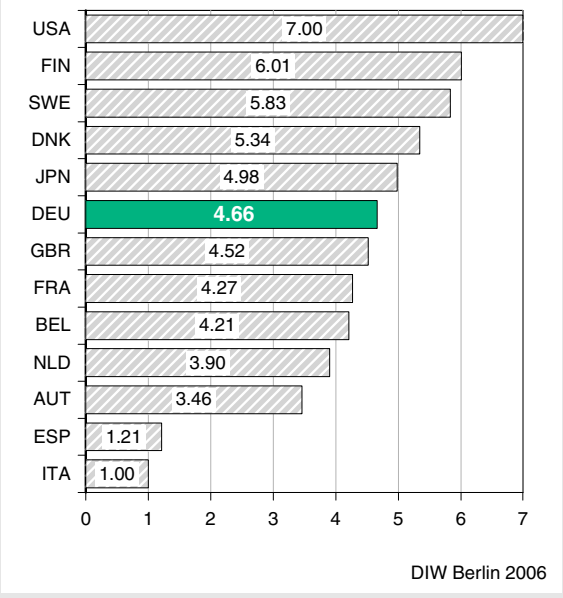
[6] Cf. among others, European Commission: European Innovation Scoreboard 2004 – Comparative Analysis of Innovation Performance. Commission Staff Working Paper, SEC (2004) 1475, Brussels 2004; World Economic Forum: The Global Competitiveness Report 2004–2005, New York 2004; A. L. Porter et al.: 'Indicators of technology-based competitiveness of 33 nations', 2003 Summary Report. Georgia Institute of Technology, Atlanta 2003; N. Hülskamp and O. Koppel: 'Deutschlands Position im Innovationswettbewerb – Ergebnisse des IW-Innovationsbenchmarkings' (Germany's competitive position in terms of innovation – results of the innovation benchmarking performed by the Institut für deutsche Wirtschaft (IW, German Economic Institute)). In: *IW-Trends,* issue 3/2005. Analyses done for Germany on a broader basis are published in the regular reporting of the Bundesministerium für Bildung und Forschung (BMBF, German Federal Ministry of Education and Science) on technology performance that is prepared by several institutes; cf. www.technologische-leistungsfaehigkeit.de.

cerned. Surprisingly, Germany's worst ranking was on the actors side, in the innovation-relevant behavioral patterns and attitudes of the population. The German deficits are grave also due to the fact that, as international comparisons reveal, the countries making up the frontrunner group are ahead not in a few but in many areas. The United States achieves its outstanding innovative capacity because almost all influencing factors are at a high level.

Germany's strengths

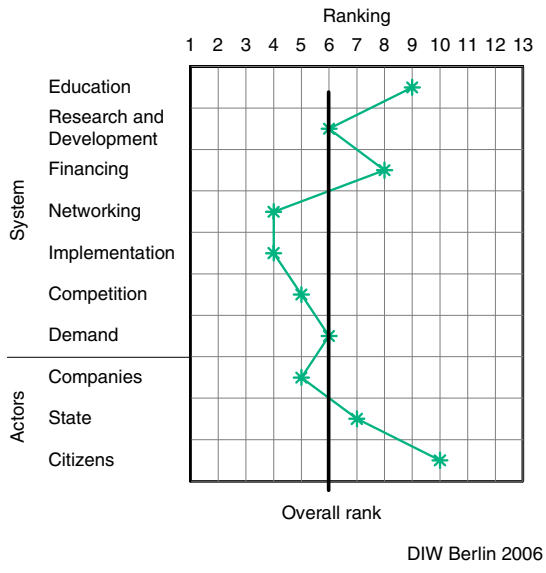
Since they can make use of an excellent infrastructure (information and communication infrastructure as well as physical infrastructure) and a pronounced culture of corporate networking, while also being driven by intense competition, it is Germany's industrial companies in particular who continue to achieve extraordinary market success with innovative products, making Germany the 'world champion of exports.' This explains Germany's good performance in the area 'implementation of innovations' (cf. table 2). Nevertheless, a glance 'behind the scenes' of this sub-indicator reveals: Germany gains points here due to its traditional strengths in the field of advanced technology.[7]

Figure 3
Scores of Countries for the Overall Indicator
Score 7 = ranking 1



Source: DIW Berlin calculations.

Figure 4
Innovation Profile in Germany



Source: DIW Berlin calculations.

In contrast, Germany clearly loses ground in future-oriented cutting edge technologies[8] and where the new establishment of innovative companies is concerned.

Germany's weaknesses

The two greatest weaknesses of the German innovation system are the education system (schools, colleges and universities) and the financing of innovations, especially in the private sector (cf. table 2). While the scarcity of venture capital is acute at the current time, scarcity of human capital is currently not as severe a problem as Germany is living off the expansion of the educational

[7] High technology goods are goods requiring intense research prior to being marketed, whose expenditures for research and development make up a percentage of the turnover greater than 3.5%. Cf. in this context the definition provided in the reports on technology performance published regularly by the Bundesministerium für Bildung und Forschung (BMBF, German Federal Ministry of Education and Science), loc. cit.

[8] Goods are counted as goods of cutting edge technology if the expenditures for research and development they require make up a percentage of the turnover greater than 8.5%. For reasons of enabling a clear demarcation in this regard, the pharmaceuticals industry, office equipment/computer devices, radio/TV/news technology (media technology) as well as airline and spacecraft construction were all combined in the cutting edge technology industrial sector.

Table 2
Ranking of Countries for the System Indicator and its Sub-indicators

Country	Overall ranking	Sub-indicators						
		Education	Research	Financing	Networking	Implementation	Competition	Demand
Weighting (%)	x	21.9	20.3	2.1	14.9	9.5	11.4	19.9
USA	1	1	3	1	1	1	1	1
SWE	2	3	2	4	5	5	10	2
FIN	3	5	1	2	3	2	8	7
DNK	4	2	4	6	6	3	3	10
JPN	5	11	5	10	2	6	4	4
DEU	6	9	6	8	4	4	5	6
GBR	7	8	10	3	7	9	2	3
FRA	8	6	9	5	9	7	12	5
BEL	9	4	8	11	10	10	9	9
NLD	10	10	7	7	8	8	7	8
AUT	11	7	11	9	11	11	6	11
ESP	12	13	13	12	13	13	11	12
ITA	13	12	12	13	12	12	13	13

Source: Weighting from the company survey done by DIW Berlin/BDI; DIW Berlin calculations.

system and the baby-boomer-driven high number of graduates of the 1970s and 1980s. But many factors indicate that in the middle term, the German educational system is headed towards considerably greater difficulties than the systems of other countries are in providing the innovation process with sufficient amounts of qualified human capital.

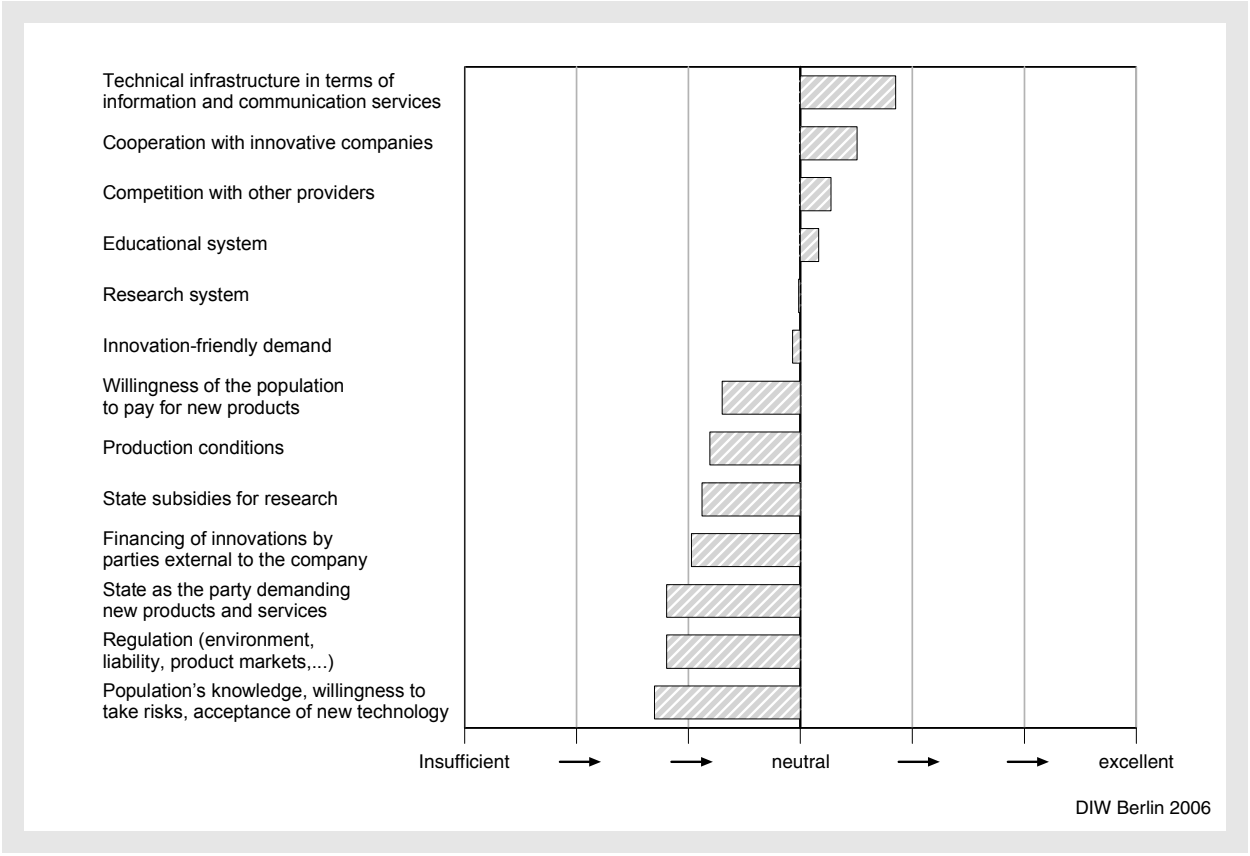
An even more serious weak point of Germany's innovative capacity can be found on the actor side. While companies hold 5th place and the country takes 7th, thus securing a middle position among the group of nations, the evaluation of behavior promoting innovations and the attitude of the population is clearly less favorable (10th place, cf. table 3). This finding has variou facets:

Table 3
Ranking of Countries for the Actor Indicator and its Sub-indicators

Country	Overall ranking	Sub-indicators		
		Companies	State	Citizens
Weighting (%)	x	50	30	20
USA	1	2	2	1
FIN	2	1	1	3
SWE	3	4	3	2
JPN	4	3	8	7
DNK	5	6	4	5
DEU	6	5	7	10
GBR	7	8	6	6
NLD	8	9	10	4
FRA	9	10	5	9
BEL	10	7	11	8
AUT	11	11	9	13
ESP	12	13	12	11
ITA	13	12	13	12

Source: DIW Berlin calculations.

Figure 5
Conditions for Innovations in Germany from the Perspective of Companies



Source: Written survey of 73 managers working for internationally operating companies in Germany, done in spring of 2005 by DIW Berlin and BDI.

compared internationally, the population is relatively risk-averse, the participation of women in innovation processes is low, scientific knowledge and interest exhibited in science and technology are below-average. Finally, activities for establishing innovative businesses are particularly weak.

Conclusion and policy implications

A consistent and concise bird's-eye view of the national innovation system and its actors clearly shows that Germany still has pronounced strengths. They are to be found in particular in the implementation of incremental innovations[9] provided by companies active in research-intense industries and in the field of knowledge-intense service provision, and these companies in fact are successful on the global market. What is a problem, however, is that the strengths of the German innovation system are more related to the current factors making up its innovative capacity, the prerequisites of which were primarily created in the past (infrastructure, networking). Pitted against this are serious weaknesses, for example, the state of the education system and the innovation-relevant attitudes and behavioral patterns of the population. They will have an impact far into the future, and the concern is justified that Germany's innovative capacity will drop.

Obviously, these disadvantages will affect major, internationally active corporations only marginally. In a survey done by DIW Berlin and BDI, the executives stated that the educational system in Germany was a positive factor for Germany as a location to do innovative business (cf. figure 5). However, the companies they work for are considered appealing employers and can select their employees on all qualification levels from what still is a large pool of applicants. Likewise, the weaknesses in financing innovations by parties external to the company hardly impact them since they finance

[9] What is being referred to here are continual improvements in dominating technologies as compared to 'radical innovations' that introduce completely new techniques.

their innovations almost exclusively within the company.

For the location factor 'innovation-relevant attitudes and behavioral patterns of the citizens,' there is, however, major concurrence between its poor indicator score as compared internationally and its evaluation by the companies surveyed, who assessed this factor as being the largest disadvantage in Germany.

Thus, the success that powerfully innovative companies enjoy on the global market cannot gloss over the fact that Germany's weaknesses concern the very roots of innovative capacity.

Education is the foundation on which research and innovation can be built up. Innovative capacity expresses itself in the globally outstanding performance of companies, resting on a broad basis of well-educated, motivated and flexible specialists. The core task of innovation policies pursued by the German government should consist of laying the cornerstone for this by means of a good education, which begins in kindergarten and extends up to an excellent tertiary education in technical colleges and universities.

Education is a key point from which to approach the objective of improving the attitudes of the population regarding innovation and technology. More than anything else, the topic of innovation must be placed in the center of societal debate and activity. The present 'innovation indicator for Germany' is to intensify this debate in Germany and provide it with a new impetus by means of an annually published report.

The analysis reveals: although Germany's innovative capacity is still commendable, it falls considerably behind the leading 'innovation countries.' Substantial improvements require persistent efforts that must be made by all actors over the long term, both in terms of excellence as well as breadth. The northern European countries, positioned in front of Germany, have proven that this is possible even in difficult times. They managed to increase their innovative capacity, doing so under European conditions, so that it is hardly less than that of the American frontrunner.