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# POLICY DEPARTMENT A
## ECONOMIC AND SCIENTIFIC POLICY

Economic and Monetary Affairs

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Environment, Public Health and Food Safety

**Industry, Research and Energy**

Internal Market and Consumer Protection

# Innovation and Industrial Policy

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**POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY**

INDUSTRY, RESEARCH AND ENERGY

# Innovation and Industrial Policy

## STUDY

**Abstract**

Following the Lisbon Strategy for Growth and Jobs, great efforts have been undertaken by most Member States to further improve their innovation support. Moreover, the European Commission aims at a more coherent, more coordinated approach towards innovation policy. The present study gives advice on how innovation policy could be better integrated with industrial and research policy based on a comparative analysis at country level and an in-depth examination of a sample of nine different European sectors.

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## DISCLAIMER

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| **ACARE** | Advisory Council For Aeronautics Research in Europe |
| **ACEA** | European Automobile Manufacturers' Association |
| **AI** | Artificial Intelligence |
| **APUs** | Auxiliary Power Units |
| **ARRA** | American Recovery and Reinvestment Act |
| **ATM** | Air Traffic Management |
| **BEC** | Battery Electric Vehicles |
| **BERD** | Business Expenditure on R&D |
| **BMBF** | Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research) |
| **BNIC** | Bio/Nano/Information Technology and Cognitive Sciences |
| **BRIC** | Brazil, Russia, India, China |
| **BTL** | Biomass-To-Liquids |
| **CAP** | Common Agricultural Policy |
| **CIAA** | Confederation of the Food and Drink Industry of the EU |
| **CIP** | Competitiveness and Innovation Framework Programme |
| **CIS** | Community Innovation Surveys |
| **CNG** | Compressed Natural Gas |
| **CPD** | Construction Products |
| **CTMM** | Centre for Translational Molecular Medicine |
| **CWTS** | Centre for Science and Technology Studies, Leiden University |
| **DG** | Directorate-General |

| | |
|---|---|
| **DG ENTR** | Directorate-General for Enterprise and Industry |
| **DNA** | Deoxyribonucleic acid |
| **DTI** | Department of Trade and Industry |
| **E&O** | Electrical and Optical |
| **E&Y** | Ernst and Young |
| **E7** | PR China, India, Brazil, Russia, Indonesia, Mexico, Turkey |
| **EBTP** | European Biofuels Technology Platform |
| **EC** | European Commission |
| **ECPG** | European Cluster Policy Group |
| **ECTP** | European Construction Technology Platform |
| **EEI** | Electrical Engineering Industry |
| **EESA** | Emergency Economic Stabilisation Act |
| **EFTA** | European Free Trade Association |
| **EIS** | European Innovation Scoreboard |
| **EIT** | European Institute of Technology |
| **EO** | Earth Observation |
| **EPO** | European Patenting Office |
| **ERC** | European Research Council |
| **ESTEP** | European Steel Technology Platform |
| **ESTP** | European Space Technology Platform |
| **ETP** | European Technology Platform |
| **ETPC** | European Technological Platform For Construction |
| **ETP SMR** | European Technology Platform on Sustainable Mineral Resources |
| **ETEPS** | European Techno-Economic Policy Support Network |

| | |
|---|---|
| **ETS** | EU Emissions Trading Scheme |
| **EU** | European Union |
| **EU27** | European Union with 27 Member States |
| **Eurostat** | European Statistical Office |
| **EV** | Electric Vehicles |
| **FCV** | Fuel Cell Vehicles |
| **FECYT** | Fund for Science and Technology |
| **FP7** | Seventh Framework Programme for Research And Development |
| **FTC** | Technology Platform – Future Textiles and Clothing |
| **FTP** | Forest Based Sector Technology Platform |
| **GCI** | Global Competitiveness Index |
| **GDP** | Gross Domestic Product |
| **GERD** | Gross Domestic Expenditure on R&D |
| **GHG** | Greenhouse Gas |
| **GIS** | Global Innovation Scoreboard |
| **GM** | Genetically modified |
| **GMO** | Genetically modified organism |
| **GNSS** | Global Navigation Satellite Systems |
| **GPT** | General Purpose Technologies |
| **GPS** | Global Positioning System |
| **HEV** | Hybrid Electric Vehicles |
| **HRST** | Human Resources in Science and Technology |
| **ICAO** | International Civil Aviation Organisation |
| **ICE** | Internal Combustion Engines |

| | |
|---|---|
| **iSci** | Integrated Science |
| **ICT** | Information and Communication Technologies |
| **IMF** | International Monetary Fund |
| **IP** | Intellectual Property |
| **IPR** | Intellectual Property Rights |
| **IT** | Information Technologies |
| **ITRE** | Committee on Industry, Research and Energy |
| **JASPERS** | Joint Assistance to Support Projects in European Regions |
| **JEREMIE** | Joint European Resources for Micro to Medium Enterprises |
| **JESSICA** | Joint European Support for Sustainable Investment in City Areas |
| **JP** | Japan |
| **JSPS** | Japan Society for the Promotion of Science |
| **KBBE** | Knowledge-Based Bio-Economy |
| **KIBS** | Knowledge-Intensive Business Services |
| **KIS** | Knowledge Intensive Services |
| **LCA** | Large Commercial Aircraft |
| **LCC** | Life-Cycle Costing |
| **LMI** | Lead Market Initiative |
| **NACE** | General Industrial Classification of Economic Activities in the European Communities |
| **NIS** | National Innovation Strategy |
| **NRC** | National Research Council of Canada |
| **NRP** | National Reform Programme |
| **NSF** | National Science Foundation |
| **NUTRIM** | Nutrition and Toxicology Research Institute Maastricht |

| | |
|---|---|
| **OECD** | Organisation for Economic Cooperation and Development |
| **OEM** | Original Equipment Manufacturers |
| **PCT** | Patent Cooperation Treaty |
| **PhD** | Doctor of Philosophy |
| **PHEV** | Plug-in Hybrid Electric Vehicle |
| **PPP** | Public Private Partnership |
| **R&D** | Research and Development |
| **RFID** | Radio frequency identification |
| **RTD** | Research and Technology Development |
| **RIS** | Regional Innovation Scoreboard |
| **RSFF** | Risk-sharing Finance Facility |
| **S&E** | Science and Engineering |
| **S&T** | Science and Technology |
| **SESAR** | Single European Sky ATM Research |
| **SII** | Summary Innovation Index |
| **SIW** | Sectoral Innovation Watch |
| **SMEs** | Small and Medium-sized Enterprises |
| **SNE-TP** | European Nuclear Energy Technology Platform |
| **SNSF** | Swiss National Science Foundation |
| **SRA** | Strategic Research Agenda |
| **SSH** | Social Sciences and Humanities |
| **T&C** | Textile and Clothing |
| **TBP** | Technology balanced payment |
| **TPWind** | European Wind Energy Technology Platform |

| | |
|---|---|
| **UN** | United Nations |
| **UNECE** | United Nations Economic Commission For Europe |
| **US** | United States |
| **VCs** | Venture Capitalists |
| **VC** | Venture Capital |
| **WDI** | World Development Indicators |
| **WIPO** | World Intellectual Property Organisation |
| **WSSTP** | Water Supply and Sanitation European Technology Platform |
| **3D** | Three-dimensional |

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# EXECUTIVE SUMMARY

Innovation is essential for Europe's competitiveness and a major driver for Europe's prosperity. Hence the EU has made innovation a top priority within the last ten years and European leaders have encouraged innovation through several strategies, funding opportunities and assessments. However, Europe's national innovation systems differ substantially, as well as their innovation performances. Therefore in recent years most Member States have undertaken great efforts to improve their innovation support measures by, for example, investing in research and implementing new or better instruments in support of innovative SMEs. This level of financial engagement is at risk in the current global economic crisis and, as a direct impact, the innovation gap in the EU risks widening again. Governments need to consolidate their innovation support activities: they need to further integrate different policies horizontally (like R&D, industrial and innovation policy) and vertically (like EU, national and regional policy), and they particularly need to unite in a common course and vision.

## Aim of the study

Due to the requirement for a more coherent EU-strategy and against the background of the 'Innovation Union' and the Communication on 'Industrial Policy', the presented study was requested by the ITRE committee of the European Parliament. It provides background information and advice on priority measures and actions to be undertaken in the fields of innovation and industrial policy. The study gives a comparative analysis of the recent competiveness and innovation performance at country level (Chapter 2). Additionally it presents an analysis of future potential of a selection of nine European industrial sectors (Chapter 3), and lastly identifies and discusses a number of policy options for the EU's innovation and industrial policy (Chapter 4).

## Comparative country analysis

The European Union shows a strong and leading innovation performance, in particular when compared with the BRIC countries, although China has narrowed the gap and is already ahead of the EU27 with respect to competitiveness. However, the EU27 lags considerably behind Japan and the US in terms of innovation and competitiveness, although it has been converging over the last five years. The innovation growth rate in the EU27 is twice that of the US and three times that of Japan. If the positive trend is maintained, the innovation gap could close. This sounds promising but needs intensification and acceleration. Of particular concern are those areas where Europe is clearly outperformed by the US or Japan and hence is facing future policy challenges. According to the analysis this includes: new patenting measures, stronger business R&D expenditure, more public-private co-publications and new researchers. The EU27 in comparison with Switzerland gives a different picture: Switzerland is highly innovative with an accelerating growth and a clearly higher innovation growth than Europe.

A country comparison of innovation performance within Europe initially shows some well-known facts, for example that certain leading European countries have an innovation performance well above average. Secondly it can be concluded that there are very promising signs of an overall process of convergence within the EU27 with respect to innovation performance.

Several general innovation policy challenges affecting most countries were identified: human resources and the need for more educated employees; the impact of the financial crisis resulting in an economic downturn, which again results in difficult access to financing and firm investments; the need for more public and private R&D expenditure; the need to

increase innovation and better convert research into innovations; as well as the need to foster private-public cooperation.

The proposed new headline indicator, 'the share of fast growing innovative firms in the economy', can serve to indicate 'innovative competitiveness' and as such it could be used to set targets and assess the impact of both innovation and industrial policy.

Since individual EU Member States are at different stages with regard to their innovation performance, different strategies (national and regional) tailored to their specific weaknesses are needed to support innovation. In addition to national and regional strategies, a European strategy such as the EU Innovation Union addressing innovation challenges common to all EU Member States and supporting the EU27 as a whole is required. A demand-driven innovation policy has to match the needs of all current sectors.

## Sectoral potential and constraints

The sector perspective is also very important because industries differ, sometimes substantially, and consequentially innovation is driven by many different factors depending on the industry. The analysis of nine sector-cases has shown that a number of challenges affect all sectors (e.g. knowledge creation/transfer, human resources, financial constraints, ICT and furthering the Single Market), while other challenges are very sector-specific (e.g. regulation issues, specialist knowledge, in-house R&D, finance). In general, the non-R&D and non-technological factors are of growing importance in manufacturing, and also in services and in emerging sectors.

The discussion of the potentials and constraints at sector-level regarding innovation shows that many industrial policy aspects emerge, which support the argument for a more integrated approach regarding innovation and industrial policy.

With respect to global competitiveness, several European industries are very well positioned. Examples include: automotive, aerospace, electrical engineering and business services. In other sectors Europe has a good starting position but cannot compete with the world's leading countries – yet. One example for this is the biotechnology industry. The European textile and clothing sector and the European food and drink industry are facing declining competitiveness on a global scale and have to find ways to enhance innovative competitiveness. One important policy option is to promote cross-sector diffusion and absorption: converting research on General Purpose Technologies, like ICT and biotech, into innovations in other sectors.

A pressing issue in the food and drink sector is, for instance, the blurring border between normal nutrition, prevention of sickness, and medicine, and the definition of regulations at this intersection. Also the construction sector faces substantial challenges which call for quick integration of new technologies.

Adjusting to global trends and fast evolving markets are major challenges for the European countries and industries.

## Policy options for the EU's innovation and industrial policy

These global trends result in several policy conclusions: first, Europe should maintain leadership in key priority RTD areas by focusing and concentrating efforts; secondly, Europe must not fall behind in R&D expenditures; thirdly, Europe should be attractive for talent, so that there will be a switch from 'brain drain' to 'brain circulation'. Furthermore, effective governance is crucial, and a challenge in this respect is to integrate research and innovation policy with industrial policy. Their joint goal is to enhance the innovative competitiveness of the European Union.

Besides the common economic goal of enhancing competitiveness, research, innovation and industrial policy are also instrumental in addressing wider societal needs, e.g. global challenges like climate change, energy, food security, health and an ageing population.

From discussing the policy options and cases of good practice, the following conclusions emerge: European innovation and industrial policy must provide platforms for horizontal innovation and industrial (policy) topics; innovation policy should not merely fund technological innovation; and the 'linear', supply-driven innovation model should no longer dominate. There need to be strategic approaches, which not only promote closer interaction among sectors but also among policy-makers (from different policy fields and different levels of government). European innovation and industrial policy is therefore recommended to:

- **Increase demand-driven innovation with platform-based policies:** Matching supply and demand for innovation is an interactive process that needs to be organised. This could be done for instance through platforms. The present format of the European Technology Platforms is a good example of how to organise a 'meeting and discussion place' for users and producers.
- **Develop strategic approaches which integrate R&D, innovation and industrial policy:** A challenge is to design strategic approaches which integrate innovative competitiveness-enhancing policies in a coherent package. Various good examples of policy instruments at different levels can contribute to such strategic approaches: The Lead Market Initiatives at EU-level, cluster policies at national level and Smart Specialisation at regional level.
- **Address societal challenges with new instruments:** The EU is facing many societal challenges. Most of them are global and require global cooperation. These challenges could be addressed with new instruments, by applying existing concepts of Lead Markets, Technology Platforms, Innovation Partnerships, Open Innovation and Smart Specialisation.
- **A more coherent EU strategy for innovative competitiveness:** At EU level 'the flagships' need a common strategic roadmap, which aligns policy concepts and programmes from different DGs of the European Commission. The linkages between existing policy instruments, which address innovative competitiveness, should be reinforced and improved.
- **Create European Research Centres:** Research is quite fragmented in Europe. This could be improved by bundling the expertise even beyond borders. A first step towards 'European Research Centres' could be to set up Joint Institutes (after the example of Joint Programming) which are co-funded by the EU.
- **Enhance the capacity for strategy development at regional level:** It is necessary for policy-makers to invest in strategy development in cooperation with relevant stakeholders. Since the sub-national, regional policy level is of high importance for innovation and competitiveness-enhancing policy activities, it is important to support policy intelligence and the development of Smart Specialisation strategies.
- **Better coordination between national and regional levels of governance:** Today, real interaction between policy-makers from national and regional governments is limited. In many cases, better institutional mechanisms need to be developed to foster this cooperation.
- **Create a single market for business services:** The European Union aims at functioning as a single research area, business environment and innovation system.

However, this aim is not yet achieved for business services, a market that is still fragmented and non-transparent. Therefore possibilities for further harmonisation of existing legislation and administrative procedures should be addressed and bureaucratic barriers reduced.

- **Give special attention to ICT in innovation and industrial policy:** Since the use of Information and Communication Technologies (ICT) is essential for the innovativeness and competitiveness of every sector or economy, and affects every aspect of society, it deserves special attention in terms of governance and policies.
- **Make more use of innovative instruments to finance innovation:** In times of financial crisis, public finances are scarce. Therefore new solutions should be explored in order to finance innovation. Good practice examples are the financial schemes which include co-funding from the European Investment Bank, e.g. in cooperation with the Framework Programme (Risk-Sharing Finance Facility).
- **Improve policy learning from 'own practice':** In past years the European Commission has focused mainly on 'learning from others' by organising the exchange of good practice between Member States. Policy experiments are often not supported. Improvement and renewal of innovation policy should be mainly a demand-driven and user-driven, interactive process. Because of major differences within Europe, individual Member States and regions should first of all learn from evaluating and assessing their own policy practices.

# INTRODUCTION

Innovation, as a central and crucial factor for Europe's competitiveness and a driver for its prosperity, is recognised as such by European leaders and has been supported on various levels for the last decade(s). Examples of support measures are funding programmes, innovation policies and strategies or studies on innovation. However, Europe's national innovation systems and structures are very heterogeneous, as are their innovation and competitiveness performances.[1] This is clearly rooted in very different legislative and budgetary powers, policies, national institutions and mechanisms. Therefore innovation across European Member States appears in diverse forms with respect to sectors, markets or activities.[2]

Following the Lisbon Strategy for Growth and Jobs,[3] great efforts have been undertaken by most Member States to further improve their innovation support. They invested, for example, in R&D or implemented new innovation support instruments targeting SMEs in particular. One thousand support measures for innovation are currently listed in the INNO-Policy Trend Chart – Europe wide.[4] These measures address improvements in the technology transfer areas, as well as better access to finance and a variety of other measures.

However, this level of financial engagement is at risk in the current economic crisis and cutbacks of public budgets are imminent. The 2009 Innobarometer on 'Strategic trends in innovation'[5] concludes that the greatest impacts of the economic crisis are likely to be in manufacturing sectors which are mainly medium to low-tech areas and in catching-up countries (according to the European Innovation Scoreboard, 2008). This may lead to a widening of the innovation gap in the EU as a direct consequence of the crisis.[6]

European governments are in need of a more coherent, more coordinated approach towards innovation support, and not only in times of an economic crisis. However, the pressure on public budgets adds to the urgency of this matter. The integration of different policy areas, like for example industrial and R&D policy, has already started but progress is slow. The 'broad-based innovation strategy for Europe'[7] picks up the idea of an innovation-based society, and aims at providing the right framework to support all types of innovation and expanding the boundaries of today's innovation policy instruments.

## Aim of the study

Against the background of the 'Innovation Union', as well as the Communication on 'Industrial Policy' released in October 2010[8], the requested study provides background information and advice for the members of the ITRE Committee on priority measures and actions to be undertaken in the fields of innovation and industrial policy. The overall aim of the study is to give guiding insight and advice towards the ultimate goal of integrating innovation and industrial policy into an innovative competitiveness policy.

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1 Kaiser, R.; Prange, H. (2004).

2 Pro Inno Europe (2009c).

3 See: http://ec.europa.eu/growthandjobs/index_en.htm

4 See: http://www.proinno-europe.eu/trendchart

5 See: http://www.proinno-europe.eu/metrics

6 Pro Inno Europe (2009b).

7 EC (2006).

8 EC (2010a).

## Structure of the study

The study consists of the following chapters:

- Chapter 1 addresses the challenges in measuring innovation.
- Chapter 2 provides a comparative analysis of the current innovation performance and competitiveness at country level. Different sets of indicators are presented and discussed.
- Chapter 3 presents an analysis of the sectoral potentials and constraints for innovation in the light of current and future challenges.
- Chapter 4 draws conclusions and formulates policy recommendations for the EU's innovation and industrial policy.

## Rationale for the used approach

**Chapter 1** serves as an introduction to measuring innovation based on indicators.

**Chapter 2** practically explores the use of two indicator sets performing a comparative analysis on the innovation performance and competitiveness of selected countries with the EU27. With this the chapter identifies the strengths and weaknesses of the EU27 and of several Member States, giving first input to formulate a European strategy in order to keep up with Europe's main competitors, such as the United States or Japan. However, the comparative use of indicators alone cannot provide enough input for policy-makers, in particular with respect to specific industries, to develop an integrated European strategy.

Therefore **Chapter 3** provides an in-depth examination of a sample of nine different European sectors with respect to current and future challenges using a qualitative, future-oriented approach. At this point the sector perspective is very important because industries differ, sometimes substantially, and consequently innovation is driven by many different factors depending on the industry.

**Chapter 4** finally gives advice on how innovation policy could be better integrated with industrial and research policy. The chapter first recalls policy conclusions resulting from the country and sector-analysis and additionally recapitulates recent EU strategies. A discussion of different policy concepts and good practice leads then to a number of concrete recommendations to better integrate innovation policy with industrial policy and thus strengthen Europe's competiveness.

# 1. MEASURING INNOVATION: SOME METHODOLOGICAL OBSERVATIONS

**KEY FINDINGS**

- The **aim of Chapter 1** is to provide some insights into measuring innovation.
- There are various **composite indicators** that measure innovation performance based mainly on the measurement of technological capabilities.
- The **challenges** of **measuring innovation** are to measure new forms of innovation; to improve comparability at national and international levels; to interpret and use data on innovation performance at regional level; and to measure progress and changes over time. Across these areas, there is a discussion on how to render statistical systems more flexible and responsive to the introduction of new and fast-evolving concepts.
- The EU launched the development of a **single indicator** to measure 'the share of fast growing innovative firms in the economy'.
- Depending on the **sets of indicators** used, the performance on innovation might differ. For instance, the performances of the BRIC countries taking the European Innovation Scoreboard indicators look quite different from the performance taking the 12th pillar (on innovation) from the Global Competitiveness Report.

The study is based on desk research and analysis, building on existing studies and documents. The research is of an exploratory nature and is conducted by a team with varied and complementary backgrounds.

## 1.1. Definition

Reflecting the increasing importance given to innovation policy and innovation as a driver of economic performance, it seems to be important to have a shared understanding of the meaning of 'innovation'.

Traditional concepts of innovation, for example from the Organisation for Economic Co-operation and Development (**OECD**) *Oslo Manual*, define innovation as 'the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations'[9].

**Eurostat** defines an innovation as being 'the results of new technological developments, new combinations of existing technology, or the use of other knowledge acquired'[10].

The Community Innovation Survey (**CIS**) defines innovation as 'a new or significantly improved product (good or service) introduced to the market, or the introduction within an enterprise of a new or significantly improved process'[11].

While up until the 1980s, 'the dominant perspective viewed innovation as synonymous with research and development (R&D)-based creative activities to develop technical

[9] OECD (2005c)

[10] See: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Innovation_statistics

[11] See: http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

inventions'[12] – leading to innovation measured by R&D investments, scientific publications, patented inventions, etc. – a broader perspective on innovation was taken in the 1980s, separating invention from innovation. This broader perspective was reflected in the definition of innovation given in the OECD's first *Oslo Manual* of 1992, which also provided practical guidelines on the measurement of innovation – including both R&D and the many other ways in which firms can innovate.[13]

## 1.2 Provenance of data on innovation performance, measures and progress

Reflecting the increasing importance given to innovation policy and innovation as a driver of economic performance, there exists a broad range of surveys and scoreboards covering innovation in some manner.[14] The following sources provide the backbone for the underlying study, since they represent a collection of national or regional data and indicators of relevance to innovation measurement.

**The Community Innovation Surveys (CIS)**[15] are a series of surveys that are carried out by national statistical offices according to an EU-wide definition. These surveys provide data on the innovation performance of different regions and sectors in all EU Member States, Norway and Iceland.[16]

**The European Innovation Scoreboard (EIS)**[17,18] is a well-established analytical tool to compare the national innovation performance of EU Member States and other countries, and builds on the existing EIS methodology. The EIS includes in the analysis of innovation performance the United States, Japan, Australia, Canada, Israel, Switzerland and the Associated Countries, Croatia and Turkey. Data from the CIS surveys are used for the annual European Innovation Scoreboard (EIS).[19]

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[12] See: http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

[13] See: http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database. These guidelines were the basis for the first CIS (CIS-1) within the European Union which was carried out first in 1993 and repeated in 1997, 2001, 2005, 2007 and 2009.

[14] See for instance: EIS (2009).

[15] http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

[16] 'The Community Innovation Survey, abbreviated as CIS, is conducted in every EU Member State to collect data on innovation activities in enterprises, i.e. on product innovation (goods or services) and process innovation (organisational and marketing). The CIS is based on the Eurostat/OECD *Oslo Manual 1997*. The legal basis for the CIS is Commission Regulation (EC) 1450/2004 of 13 August 2004 carrying out Decision No 1608/2003/EC of the European Parliament and of the Council on the production and development of Community statistics on innovation.

The survey covers areas such as new or significantly improved goods or services, and the introduction of new or significantly improved processes, logistics or distribution methods. It also gives information on the characteristics of innovation activity at the enterprise level, thereby creating a better understanding of the innovation process and the effects of innovation on the economy.

The CIS produces a broad set of indicators on innovation activities, innovation spending, effects of innovation, public funding, innovation cooperation, sources of information for innovation, main obstacles on innovation activity and methods of protecting intellectual property rights.' (Source: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Community_innovation_survey_%28CIS%29).

[17] See: www.proinno-europe.eu/page/european-innovation-scoreboard-2009

[18] 'Following the adoption of the Innovation Union Communication in October 2010, the European Innovation Scoreboard (EIS) - a well established and recognised tool for assessing innovation performance in EU Member States - has been reworked and renamed the Innovation Union Scoreboard (IUS).' (Source: http://ec.europa.eu/enterprise/policies/innovation/facts-figures-analysis/innovation-scoreboard/index_en.htm).

[19] The EIS 2008 Methodology Report explains in detail the new methodology that has been used for the EIS 2008 report and is also intended for the 2009 and 2010 reports. The revision of the EIS methodology was a direct result of the challenges discussed in the EIS 2007 report to: 1) measure new forms of innovation; 2) assess

The **CIS** and the **EIS** are the two main instruments being used in the scope of European activities on innovation. Both provide an important part of the data to be analysed in the present study, in particular in the scope of the countries' comparative analysis (see Chapter 2).

'**PRO INNO Europe®**[20] is an initiative of the Directorate General Enterprise and Industry (DG ENTR of the European Commission), which aims to become the focal point for innovation policy analysis, learning and development in Europe, with a view to learning from the best and contributing to the development of new and better innovation policies in Europe.'[21] PRO INNO Europe delivers data and analyses which help to understand 'the sources and patterns of innovative activity in the economy'[22]. The following results provided by PRO INNO Europe are, among others, of particular importance and is considered in the present study: the **INNO-policy TrendChart**, which 'describes and analyses major innovation policy trends at national and regional levels across Europe'[23]; the **Global Innovation Scoreboard 2008**, which provides 'an overview on the main trends, results and determinants of the innovative performance of countries across the world'[24]; the ***European Innovation Progress Report 2008***, which 'analyses challenges and policy responses from the perspective of a typology of failures in innovation systems'[25]; the ***European Innovation Progress Report 2009***,[26] which concentrates on the innovation effects of the recent economic crisis; and the **Innobarometer 2009**,[27] which evaluates public support measures from the business perspective.

**Europe INNOVA**[28] – under the auspices of the DG ENTR – assembles innovation support measures, actors and agencies, in order to analyse innovation trends.[29] The **Sectoral Innovation Watch (SIW)** of Europe INNOVA gives detailed insights into sectoral innovation performance and current sectoral innovation dynamics across Europe. Other elements of INNOVA SIW are the foresight of sectoral innovation challenges and opportunities.

Beyond this data this study employs – where relevant – the most recently available information, data and information from Eurostat *Facts and Figures*; the ***Global Competitiveness Report 2010–2011*** (in particular analysed in Chapter 2), OECD and OECD Innovation Policy reviews,[30] as well as recent EC sources, such as the Commission staff working document on *European Industry in a Changing World*.

overall innovation performance; 3) improve comparability at national, regional and international levels; and 4) measure progress and changes over time. See: Pro Inno Europe (2008).

[20] See: www.proinno-europe.eu

[21] See: http://ec.europa.eu/enterprise/glossary/index_en.htm

[22] See: http://ec.europa.eu/enterprise/glossary/index_en.htm

[23] See: www.proinno-europe.eu/trendchart

[24] See: www.proinno-europe.eu/page/global-innovation-scoreboard-1. This therefore represents a complementary tool to the EIS.

[25] See: www.proinno-europe.eu/trendchart/european-innovation-progress-report

[26] See: www.proinno-europe.eu/trendchart/european-innovation-progress-report

[27] See: www.proinno-europe.eu/promotion-pro-inno-europe-results/page/inno-metrics-publications

[28] See: www.europe-innova.eu

[29] See: http://ec.europa.eu/enterprise/glossary/index_en.htm

[30] OECD Innovation Policy reviews. See: www.oecd.org/sti/innovation/reviews and OECD (2010).

## 1.3. Benchmarking issues

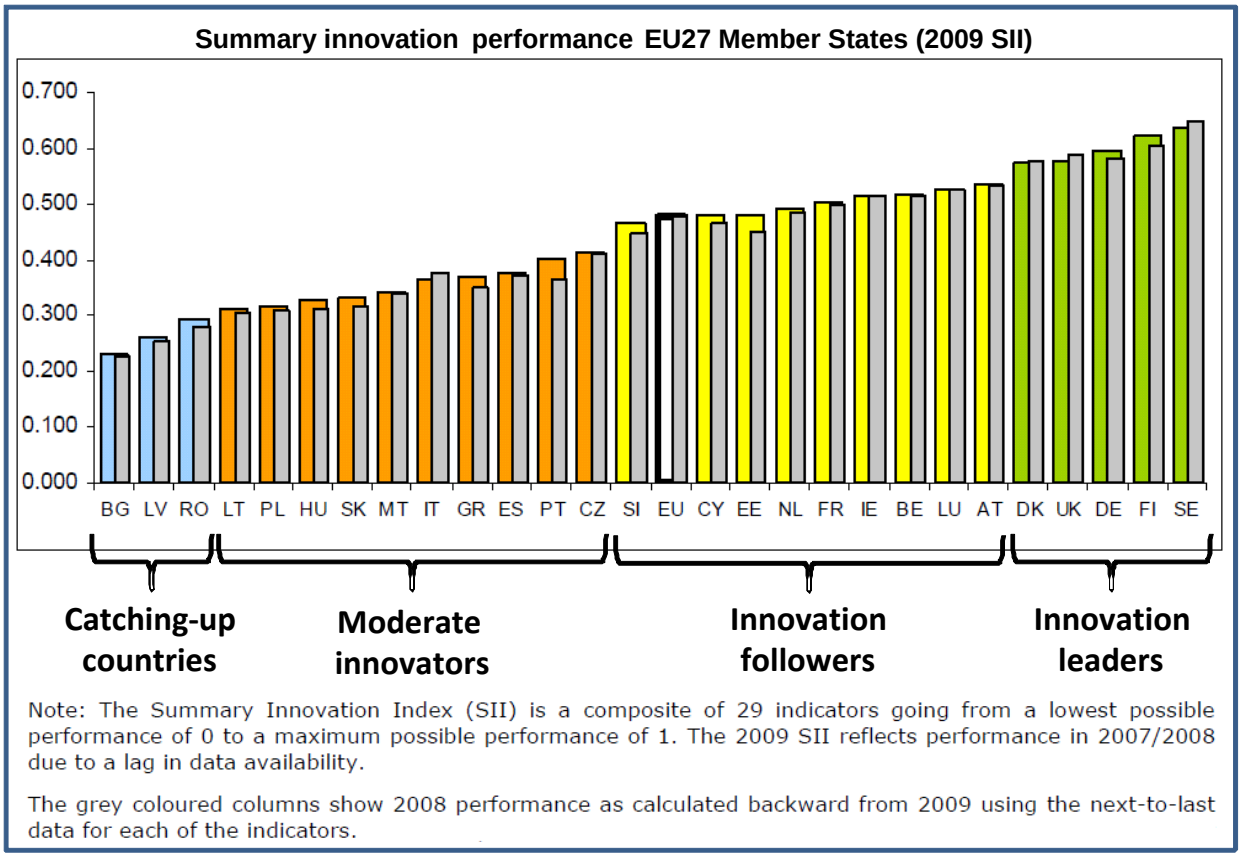
In fact, the observed heterogeneity of innovation challenges across sectors and countries makes it generally difficult to benchmark good or best practice for innovation performance. However, the EIS divides the 27 EU Member States into four innovation categories:

- Innovation leaders (innovation performance is well above the EU27 average and also above the performance of all other countries);
- Innovation followers (innovation performance is close to or slightly above the EU27 average);
- Moderate innovators (innovation performance is below the EU27 average);
- Catching-up countries (innovation performance is well below the EU27 average, but the innovation growth rate is above average).[31]

However, this ranking of countries or regions on a composite indicator does not provide much help in developing a regional, national or EU strategy or in identifying relevant directions of specialisation.

Besides recognising the difference in the level of innovation among countries and regions, it is important to also recognise the diversity in policy options and strategies among regions and countries.[32] Even among the innovation leaders there is a large diversity in terms of recent trends, challenges and options for 'Smart Specialisation' strategies.

**Figure 1: Innovation performance in Europe**




**Source:** Hugo Hollanders, MERIT - Maastricht University (www.eis.eu).

[31] www.proinno-europe.eu/page/innovation-performance-1

[32] EC (2010f).

The European Innovation Scoreboard (EIS) is based on various indicators. These indicators measure the country's innovation performance. In a recent 'Methodology Report' the indicators are described in detail, with reasons for selecting the indicators and for the grouping of indicators are given.[33] Hereafter, the EIS indicators are grouped into 'enablers', 'firm activities' and 'outputs'. Each of these groups captures specific aspects of innovation.

The interpretation and use of data on innovation performance has to cope with a number of challenges:[34]

- Measure new forms of innovation and adequately reflect the variety of innovation processes, actors and interlinkages;
- Assess overall innovation performance;
- Improve comparability (national and international);
- Interpret and use data on innovation performance at regional level;
- Measure changes over time.

### Measuring new forms of innovation

'Innovations are the direct and indirect outcomes of different activities: basic research carried out in universities, research in firms' R&D labs, production. Additionally, innovations can have different nature, i.e. technological and non-technological, tangible and intangible. It is still difficult to gather quantitative information on all these aspects, and even more to get them in a comparable standard for a large number of countries.'[35]

Non-technological and non-R&D factors are becoming more important in the context of sectors, e.g. in manufacturing, services and emerging sectors. Composite indicators are based to a large extent on measuring technological capabilities and innovation. This leads to an important issue related to the capturing of innovation activities. If mainly technological issues are captured, the picture of some countries might miss certain parts of the innovation performance and therefore display a lower performance. When developing new indicators this matter should be addressed. The measurement of technological capabilities should also include new forms of innovation, although the formulation of appropriate indicators probably need further research attention.[36]

### Assessing innovation performance

Assessing the innovation capacity of a country involves a credible assessment of the effectiveness of the innovation process. Countries can improve their innovation performance by improving the effectiveness of their innovation processes (without necessarily increasing their contributions to innovation). It is important to continue to improve the measurement of the degree of innovation and identify areas for improvement, drawing, for example, on scientific studies in this area.

### Improving comparability at national and international levels

In a globalised world, the European Union must look to new and emerging global competitors. Therefore, the EIS must include more countries outside the European Union.

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[33] Pro Inno Europe (2008).

[34] Pro Inno Europe (2008).

[35] Archibugi et al. (2009a).

[36] Archibugi et al. (2009a).

Comparable results of reference data must be collected from harmonised databases supported by international institutions like the OECD and the World Bank.[37]

### Interpretation and use of data at regional level

The scarce availability of comparable data at regional level leads to low experiences in the use and interpretation of these data. The 2009 Regional Innovation Scoreboard (RIS) 'Methodology Report' identified five key limitations of using CIS data at regional level:[38]

- 'Misreporting of regional activities in the CIS for multi-establishment enterprises'[39]: For most countries, CIS data is collected at enterprise level. When enterprises are active in more than one region it is not possible to obtain reliable information on which region the innovation activity actually took place.
- 'Lack of a regional stratum in the CIS sample design'[40]: 'Not all Member States have considered NUTS 1 or NUTS 2 levels in their national surveys and therefore cannot produce reliable and representative regional data.'[41]
- 'Too small CIS sample size: In some Member States the size of the CIS survey sample is too small to allow for any further reliable breakdown at the regional level.'[42]
- 'Overrepresentation of CIS indicators at the regional level'[43]: Eight of the 29 indicators that EIS uses at national level are CIS data. In contrast, eight of the 16 indicators RIS uses at regional level are CIS data. Therefore in the mix of indicators the CIS data is overrepresented at regional level which could lead to a 'bias in favour for certain regions'[44].
- 'Missing data: For many regions data are not available for all indicators.'[45]

### Measuring the dynamics of innovation performance over time

Measuring the dynamics of innovation over time requires new approaches, such as taking into account trends over time, and innovation dynamics in the market that can be expected to change over time.

### The need for new indicators

There is a need for new indicators that capture fast changing economic environments, the dynamics of innovation and innovation processes, new forms of innovation and also non-technological improvements.

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[37] Pro Inno Europe (2009b).

[38] Pro Inno Europe (2009a).

[39] Pro Inno Europe (2009a).

[40] Pro Inno Europe (2009a).

[41] Pro Inno Europe (2009a).

[42] Pro Inno Europe (2009a).

[43] Pro Inno Europe (2009a).

[44] Pro Inno Europe (2009a).

[45] Pro Inno Europe (2009a).

This is expressed by the **OECD Blue Sky Forum**:

- 'Research on innovation in the broad sense is currently fragmented. There is need for a general framework of analysis and greater coordination of research efforts. The goal is to understand the entire story of innovation, from inputs to economic and social impacts.
- Indicator and related econometric research must move forward from innovation inputs and activities to include the outputs and impacts of innovation.
- New methods of analysis are necessary to understand innovation processes, which will require improved data access, data linkages and the adoption of interdisciplinary approaches to data.
- A marked improvement in the policy relevance of innovation research is required in order to create a science of science policy.'[46]

The **European Union** addressed this need by launching the development of a single indicator (headline indicator). A 'High Level Panel on the Measurement of Innovation' proposed as a headline indicator 'the share of fast growing innovative firms in the economy'[47]. This indicator would be a single indicator (in contrast to composite indicators, such as the Global Competitiveness Index [GCI] or Summary Innovation Index [SII]) measuring entrepreneurial activity. At firm level it links innovation and growth. At country level it can serve to indicate 'innovative competitiveness' and as such it could be used to set targets and assess the impact of both innovation and industrial policy. The indicator may sound simple; however, a development phase of about two years is foreseen to precisely formulate the indicator.[48]

## 1.4. Observation of statistical innovation performance

According to the European Commission, the share of companies in the European Union that demonstrate innovative behaviour (via the introduction of new or improved products, processes, services, marketing methods or organisational changes) stood at 53% in 2007,[49] but only 25% of such companies typically introduce new goods or services in national markets other than their own,[50] thus many are failing to take advantage of the single market.[51]

By using a composite indicator to summarise the overall innovation performance, the EIS 2009 estimates that the innovation gap between the EU27 and the United States is still considerable, even though it shrank from a deficit of 32 percentage points in 2005 to a deficit of 22 percentage points in 2009. The corresponding deficit with Japan is 30 percentage points.[52] Trends over time are depicted in Figure 2.

[46] OECD (2007).

[47] HLP (2010).

[48] HLP (2010).

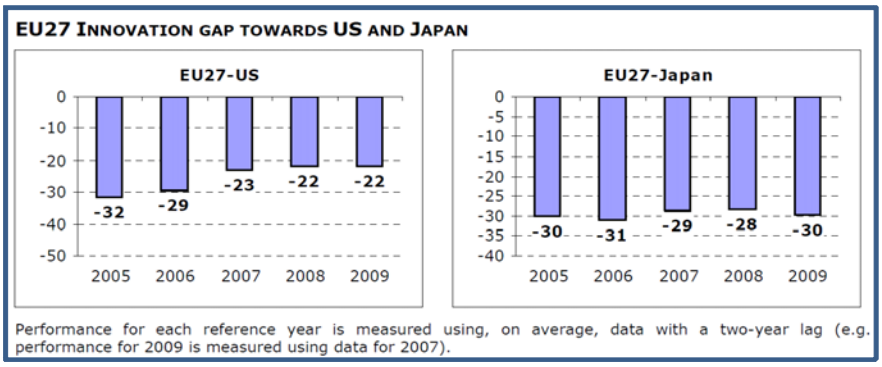
[49] See Annex II of EIS (2009).

[50] Pro Inno Europe (2004).

[51] EIS (2009).

[52] EIS (2009).

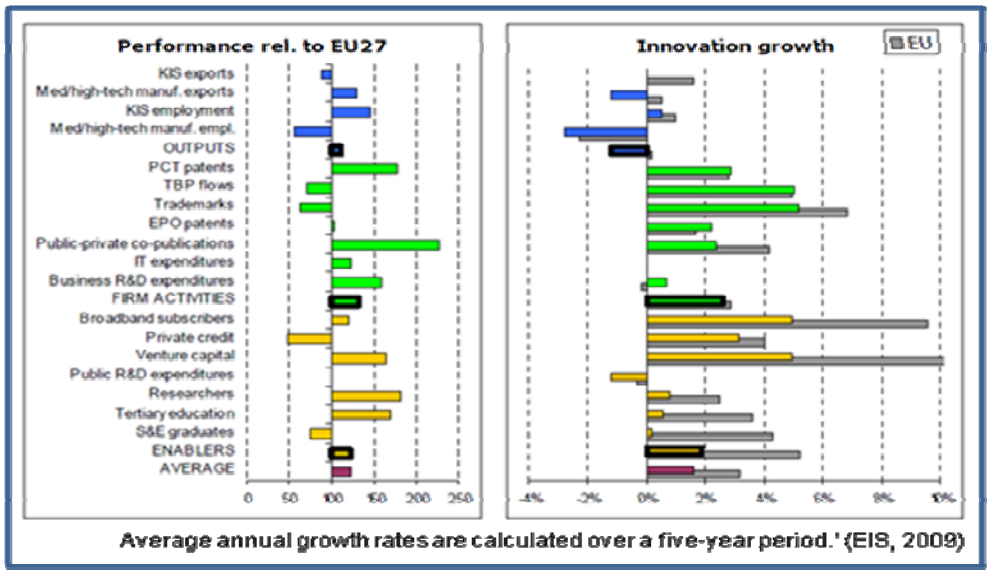
**Figure 2: Overall innovation gaps between the EU27 and the US and Japan**




**Source:** European Innovation Scoreboard 2009 (EIS, 2009).

Breaking down the composite indicator into its constituent parts, Figure 3 shows that the United States performs better than the EU27 along 11 dimensions out of the 17 for which comparative data is available, although the innovation lead shrank along many of these dimensions as EU27 growth rates over the period 2005–2009 exceeded those in the United States. A similar situation also exists with regard to Japan.

**Figure 3: EU27-US innovation performance indicators**

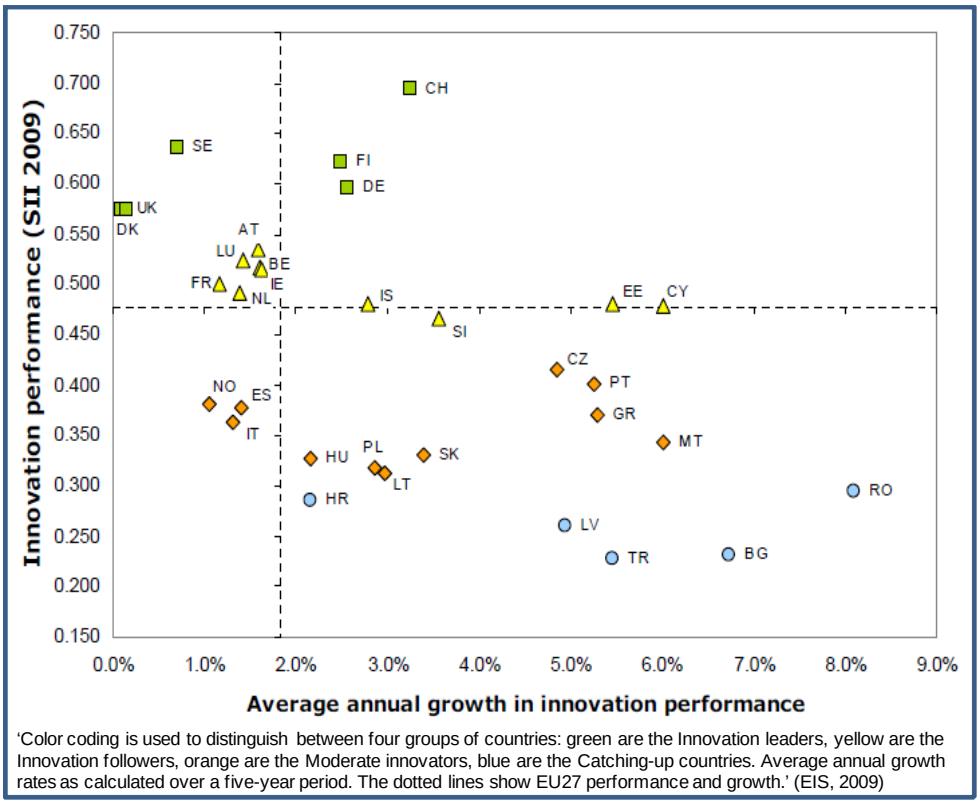



**Source:** European Innovation Scoreboard 2009 (EIS, 2009).

Depending on the sets of indicators used, the performance on innovation might differ. For instance, the performances of the BRIC countries taking the European Innovation Scoreboard indicators look quite different from the performance taking the 12th pillar (on innovation) from the Global Competitiveness Report. Looking at the EIS comparison (see Chapter 2, Figure 13) the order of innovation performance relative to the EU27 is India (worst performer), Brazil, Russia and China (best performer). When looking at the innovation indicator (12th pillar) from the GCI, the order is Russia (worst performer), Brazil, India and China, whereby India and Brazil are very close in performance (see Chapter 2, Figure 12). Similar effects can be observed looking at the EU27 and EU Member States comparison or the EU27 and US/Japan/Switzerland.

There is a wide divergence across the European Union in both innovation performance levels and annual average innovation growth (see Figure 4). Nevertheless, there is an overall process of convergence within the EU27 since most countries with an innovation performance below the EU27 average show an annual growth rate that is well above the EU27 average. In addition, the majority of countries with an innovation performance above the EU27 average show annual growth rates below the EU27 average.

**Figure 4: Innovation performance convergence in Europe**




'Color coding is used to distinguish between four groups of countries: green are the Innovation leaders, yellow are the Innovation followers, orange are the Moderate innovators, blue are the Catching-up countries. Average annual growth rates as calculated over a five-year period. The dotted lines show EU27 performance and growth.' (EIS, 2009)

**Source:** (EIS, 2009).

The divergence in innovation performance within the European Union is even wider if regional innovation performance is considered. The 2009 edition of the Regional Innovation Scoreboard reveals 'that all countries have regions at different levels of performance. This emphasises the need for policies to reflect regional contexts and for better data to assess regional innovation performances. The most heterogeneous countries are Spain, Italy and the Czech Republic, where innovation performance varies from low to medium-high.'[53]

[53] www.proinno-europe.eu/repository/64-regional-innovation-performance

## 1.5. Concluding discussion on indicators

Innovation can be defined in many ways. Since innovation, as a concept, is not a simple parameter that can be measured, various indicators are developed. 'All these indicators are based on a variety of statistical sources in order to capture the multidimensional nature of technological change.'[54] There are a variety of indicators used in various innovation measurements.

Measuring innovation performances can be used for ranking and benchmarking. For instance, the ranking of countries can be done by using a composite indicator (e.g. Global Competitiveness Index [GCI] or Summary Innovation Index [SII]). These indicators have the advantage that they capture all information in one number.[55] This allows an easy comparison with a large number of countries. However, such ranking does not provide much help in developing a regional, national or EU strategy or in identifying relevant directions of specialisation. For such analyses, it is necessary to look at the underlying set of indicators of the composite indicator. For instance, the SII is composed of 29 indicators that capture innovation input as well as innovation output factors (see Annex a-c). Looking at these indicators in detail it is possible to identify relative strengths and weaknesses of a country in relation to its own average performance and in comparison with other countries.

A disadvantage of the use of indicators is that the measurement is providing a picture of the past, since the statistical values used always relate to previous years. As a result, the EIS 2009 does not capture, for instance, the effects of the financial crisis. The advantage of using indicators is that they are objective, clear, reliable and transparent. In addition, it is easy to monitor developments of a country when using the same set of indicators over several years.

So far, only indicators for a country (i.e. at national level) are discussed. However, a country consists of regions that may differ substantially in their innovation performance. In order to obtain a complete picture of a country, it might be necessary to analyse regional indicators in addition to national indicators.

Depending on the set of used indicators, the innovation measurement can provide different pictures of the country's performance. This could be observed in the country comparison when looking at the EIS innovation performance and at the innovation pillar of the GCI. In particular, this occurs when a composite indicator is used for a ranking of countries.[56]

The need for new indicators that capture fast changing economic environments, the dynamics of innovation and innovation processes, new forms of innovation and also non-technological improvements is addressed by the EU through the launch of the development of a headline indicator. This indicator would be a single indicator (not a composite indicator) measuring entrepreneurial activity. The advantage of a headline indicator would be that it is a single value for each country and therewith, as discussed above, easy to compare. In addition, since this indicator aims at indicating 'innovative competitiveness' it could be used to set targets and assess the impact of both innovation and industrial policy

Innovation measurements based on indicators are a tool for policy-makers to assess the performance of their country or region regarding strengths and weaknesses compared with other countries and regions. In addition, it helps to monitor changes in performance and whether introduced innovation policy measures are successful.

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[54] Archibugi et al. (2009b).

[55] Archibugi et al. (2009b).

[56] A comparison of several composite indicators and the consistency of the results has been studied in: Archibugi et al. (2009b).

# 2. COMPARATIVE ANALYSIS OF INNOVATION PERFORMANCE

## KEY FINDINGS

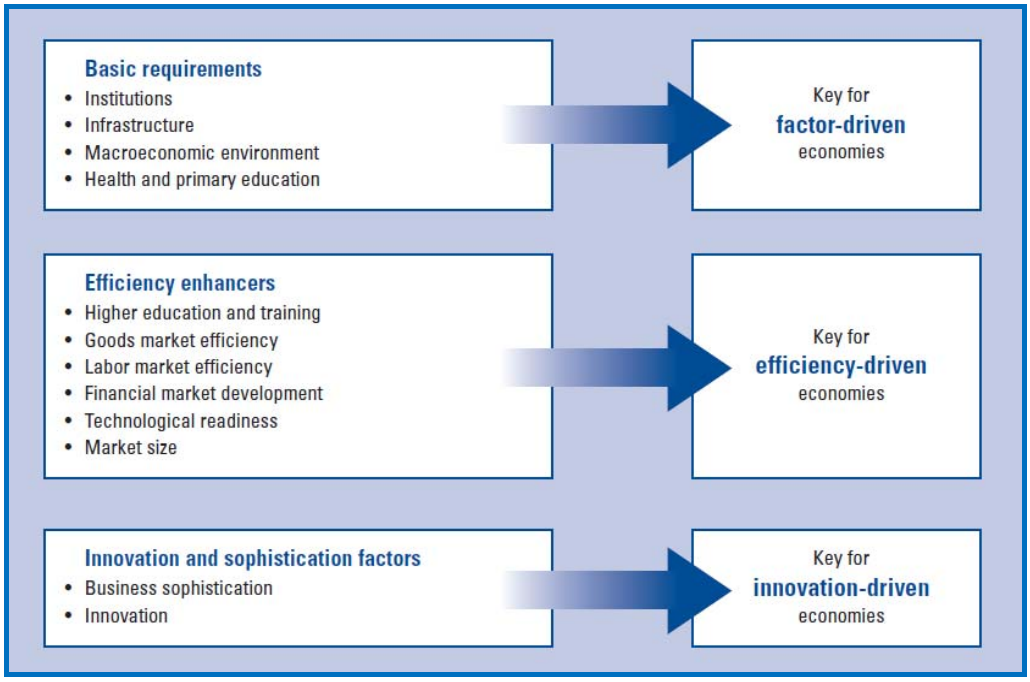
- The **aim of Chapter 2** is to provide a comparative analysis of competitiveness, innovation performance and innovation growth of the EU27 with several other countries as well as a comparison of individual EU Member States. These comparisons found:
- The **innovation gap** between the **EU27 and Japan or the US** is still considerable, even though the gap regarding the innovation performance diminished notably between 2005 and 2009. The gap regarding competitiveness between the EU27 and the US and Japan is still significant.
- The **EU27 has a strong lead** compared with the so-called **BRIC countries** (Brazil, Russia, India and China) but China rapidly narrowed the gap towards the EU27 between 2005 and 2009. With regard to competitiveness, China is already the closest to the EU27.
- The competitiveness and innovation gap between the **EU27 and Switzerland** is still significant and the latter is even increasing, as Switzerland's innovation growth rate is higher than the EU27 average growth rate.
- There is still a **wide divergence across the EU** in terms of competitiveness, innovation performance and annual average growth rates. There are, nevertheless, signs of an **overall process of convergence** regarding innovation performance within the EU27, with most countries with below-average performance displaying faster growth rates than those whose performance is above the average.
- **Innovation policy challenges** relate to human resources and the need for more educated employees; the impact of the financial crisis resulting in an economic downturn which again results in a difficult access to financing and firm investments; the need for more public and private R&D expenditure; the need to pace up innovation and/or to better convert research into innovations, as well as the need to foster private-public cooperation.
- Depending on their **innovation stage**, the EU Member States focus on different support measures. The higher the innovation stage, the higher the focus on R&D cooperation. Since individual EU Member States are at different stages regarding their innovation performance, different strategies (national and/or regional) tailored to the specific weaknesses of the countries are needed to support the innovation.
- The number of **support measures** and the **annual budget** are for most countries not directly linked. The majority of support measures address a policy priority to which only a small amount of the annual budget is allocated.
- In addition to the national and/or regional strategies, a **European strategy**, such as the EU Innovation Union, that addresses innovation challenges common to all EU Member States and supporting the EU27 as a whole is required. For instance, a demand-driven innovation policy has to match the needs of important sectors.

Section 2.1 briefly introduces the set of indicators used for the comparative analysis. (The Annexes a-e contain the detailed list of indicators.) Section 2.2 provides an overview of the competitiveness and innovation performance of the EU27 as a whole, and presents the results of a comparison between the EU27 and selected non-European countries and Switzerland. Section 2.3 provides a comparison of individual EU Member States and the EU27 regarding competitiveness, innovation performance and growth. It further identifies innovation policy challenges for the EU27. Section 2.4 discusses innovation policy observations.

## 2.1. Introduction of indicators

The World Economic Forum defines 'competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country'.[57] A set of determinants are defined – the so-called 12 pillars of economic competitiveness (see Figure 5) – to capture the different levels of productivity and competitiveness. These pillars are calculated 'by including a weighted average of many different components, each measuring a different aspect of competitiveness'[58]. The comparison of the countries is done along these pillars. Since the aim of this chapter is to provide a comparative analysis of the current innovation performance and innovation policy at country level, the 12th pillar on innovation and its seven underlying indicators were also analysed (Annex e shows the global competitiveness index in detail).

**Figure 5: Twelve pillars of competitiveness**



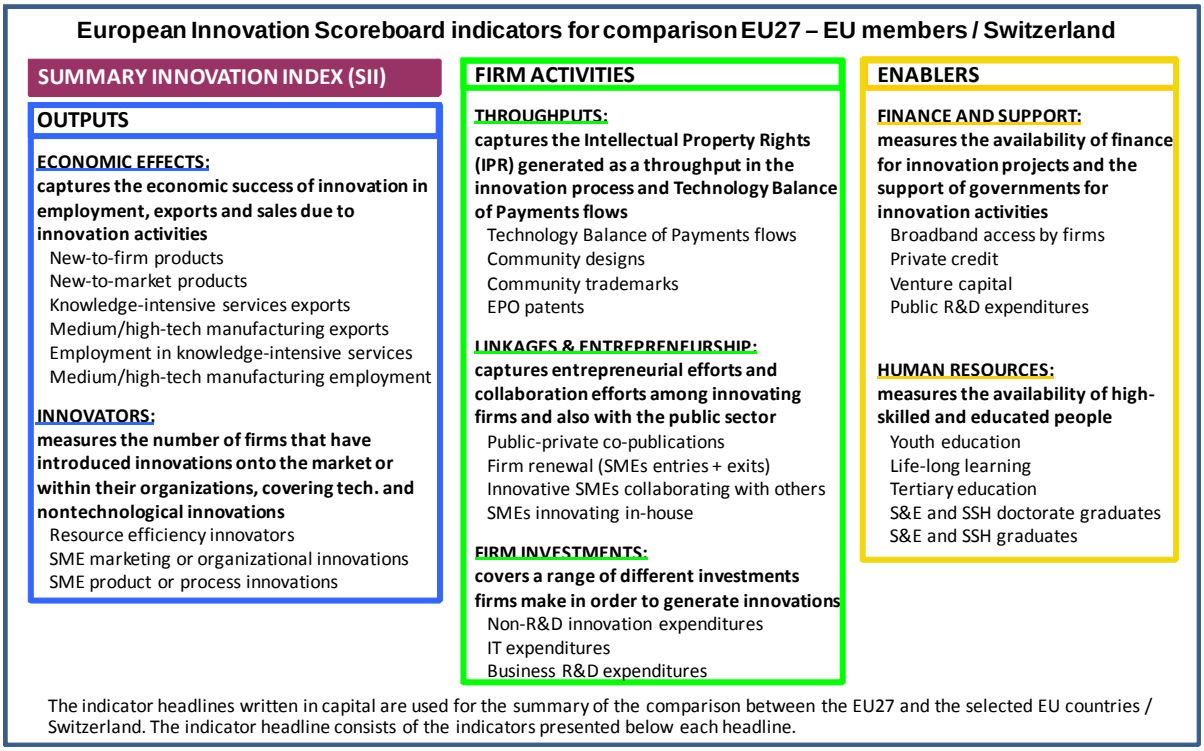

**Source:** WEF (2010).

[57] WEF (2010).

[58] WEF (2010), pp. 4–9.

In the second part of the country comparison, the innovation performance and the innovation growth were analysed in relation to the EU27's performance using different sets of indicators for the US and Japan comparison (see Annex a), for the comparison with the BRIC countries (see Annex b), and for the comparison with European countries (see Figure 6 and Annex c).

**Figure 6: EIS indicator groups and indicators**




**Source:** Own compilation based on EIS (2009).

## 2.2. Comparative analysis of selected non-EU countries and the EU as a whole

Against the background of the EU 2020 strategy objectives and in order to be able to design and implement efficient European innovation policies in the future, it is necessary to understand where the European Union stands today in comparison with other global players. Therefore this chapter conducts a comparative analysis between the EU27 and selected non-EU countries with regard to their performance in innovation and industrial growth (e.g. investments, productivity, employment, patents).

The following countries were selected for the comparative analysis:

- main competitors of the EU27: the United States and Japan
- new emerging competitors: the BRIC countries
- Switzerland, as a member of the European Free Trade Association (EFTA) and the Schengen Treaty.

The indicators on global competitiveness, innovation performance and innovation growth provided in this chapter are based on three main sources: the *Global Competitiveness Report 2010–2011*[59], EIS 2009[60] and on the INNO-Policy TrendChart - Innovation Policy Progress Report of the individual countries.

### 2.2.1. The EU27 as a whole

#### EU27 competitiveness

The EU27's competitiveness score for the different indices is determined by calculating the average of all 27 countries of the European Union as provided by the *Global Competitiveness Report 2010–2011*.[61] The overall Global Competitiveness Index (GCI) is a score between 1 and 7. The higher the score, the better the performance. The overall GCI for the EU27 is 4.7, which would position the EU27 as one of the top 30 countries[62]. The EU27 consists of very diverse Member States: 10 of its members are ranked in the top 20, five (Sweden, Germany, Finland, Netherlands and Denmark) are even in the top 10 of the most competitive countries worldwide, while six countries are ranked below position 50. Greece, for instance, is on 83rd position, the lowest among the Member States. This is mainly due to a low performance on macroeconomic environment and labour market efficiency.[63]

The EU27's competitive strengths are institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, and technological readiness (see Figure 7). The EU27's main competitive weaknesses are innovation driven by low government procurement of advanced technology products, company spending on R&D and capacity for innovation.

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[59] WEF (2010).

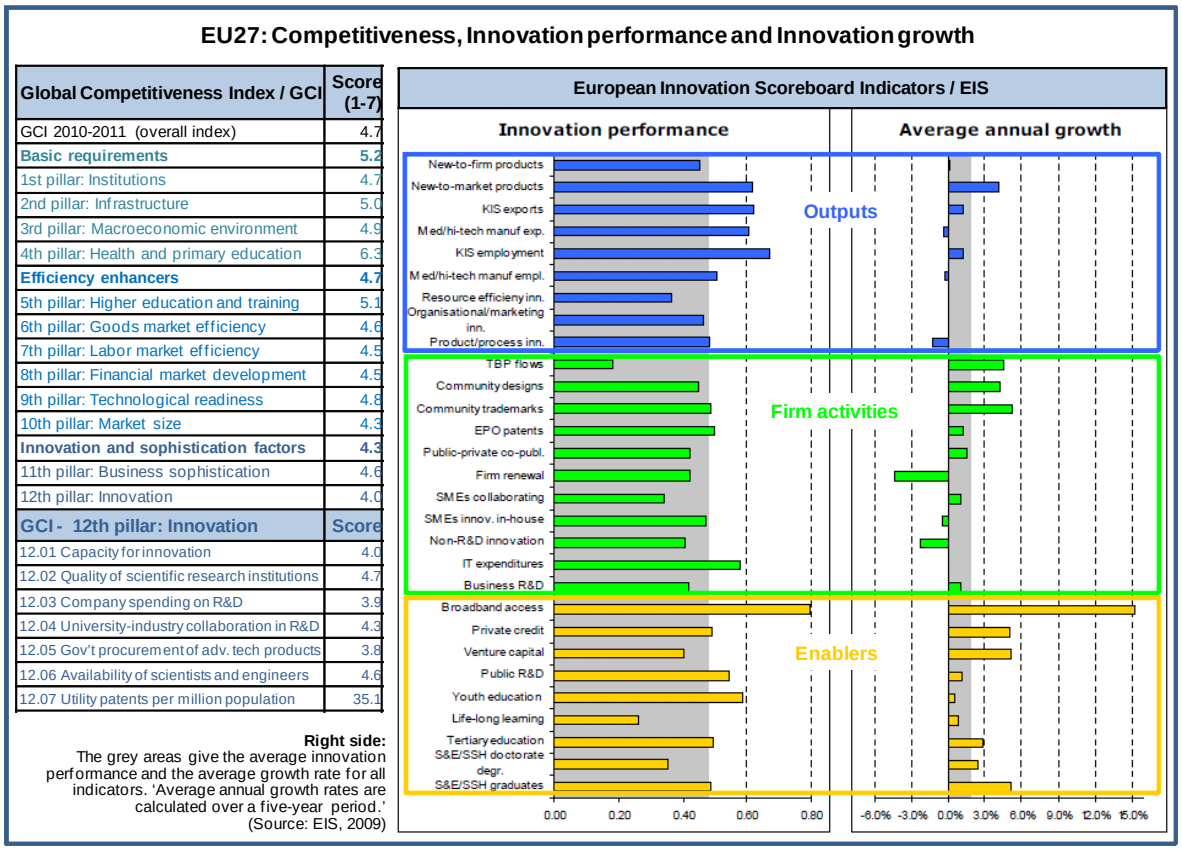
[60] EIS (2009).

[61] WEF (2010).

[62] According to the ranking of scores provided by WEF (2010), p. 15.

[63] WEF (2010), p. 186.

**Figure 7: EU27 competitiveness, innovation performance and growth**




**Source:** EU27 global competitiveness: own calculation of average on EU country data provided by WEF (2010), EIS (2009).

## EU27 innovation performance

The average innovation performance of the EU27 on all indicators is about 0.48 (Summary Innovation Index [SII]). The SII is a score between 0 and 1. The higher the score, the better the performance. For the individual EU Member States, the SII ranges from 0.23 to 0.64. The EU27 shows a relatively strong performance (i.e. most indicators are above the average on all indicators) related to the groups of indicators' 'enablers' and 'outputs'. For instance, the enabler 'broadband access by firms' is by far the highest indicator, nearly double the average score. For the third group of indicators, 'firm activities', most indicators are average or below average. The only exception is information technology (IT) expenditure, which is above average. The EU27 shows a relatively weak performance related to technology-balanced payment (TBP) flows (firm activities) and lifelong learning (enablers).

## EU27 innovation growth

The innovation growth of the EU27 shows a moderate average annual growth rate of about 1.8% between 2005 and 2009 (see Figure 7 and Annex d). This improvement is particularly due to better performances related to the enablers of innovation. In this dimension, all indicators show a positive growth rate and two-thirds of them are above average. For instance, the broadband access by firms shows an impressive growth of 15%. For the firm activities dimension, seven indicators increase, some of them significantly. However, three indicators show a decline. The output dimension shows the lowest performance growth: three indicators have a negative growth rate and four indicators have a positive growth rate, but partly below average.

### EU27 policy priorities addressed by the support measures

More than one quarter of the policy measures of the EU27 as a whole address R&D cooperation. In addition, strategic research policies (long-term agendas) and measures designed to support innovative start-ups are addressed. The priorities to follow are policy measures concerning excellence, public research organisations, direct support of business R&D, knowledge transfer, support in innovation management and advisory services, and support of organisational innovation.[64]

## 2.2.2. Comparison between the EU27 and the United States

This subsection analyses the US competitiveness, a comparison of the EU27 and US competitiveness, a comparison on innovation performance and innovation growth and policy priorities addressed by support measures. Based on these analyses, the EU27's innovation policy challenges related to the US are identified.

### US competitiveness

The United States is in fourth position worldwide in the overall GCI 2010–2011 ranking. However, there is a trend of decline: in 2008 the United States was in first position and in 2009 in second position.[65] The United States has the largest domestic market size and a large foreign market size. Looking in detail at innovation (see Figure 8, table), all indicators are of notable competitive advantage. US university–industry collaboration is the best worldwide. Its utility patents per million population are the third highest in the world. This is possible because of high-quality research institutions and a high number of available scientists and engineers. In addition, the capacity for innovation and company spending on R&D are quite high.[66]

On the other hand, there are some weaknesses. The indicators related to 'basic requirements' are relatively low. These include the pillars on infrastructure, institutions, health and primary education, and macroeconomic environment. The latter pillar is one of the weakest features of the US environment, characterised by low national saving rates, high government debt (83.2% of GDP), and imbalanced government budget[67] leading slowly to public indebtedness. In order to retain its competitive position worldwide, it is important for the United States to develop a strategy on how to improve the macroeconomic environment.

### Comparison of EU27 and US competitiveness

The US performance on competitiveness is far better than the EU27 performance (see Figure 8, web-diagram). The United States outperforms the EU27 on most of the pillars except two: health and primary education, and macroeconomic environment. In particular, there is a huge gap between the US and the EU27 related to the innovation pillar. Looking in detail at the 12$^{th}$ pillar, innovation, (see Figure 8, table) all the US indicators are well above the EU27 indicators.

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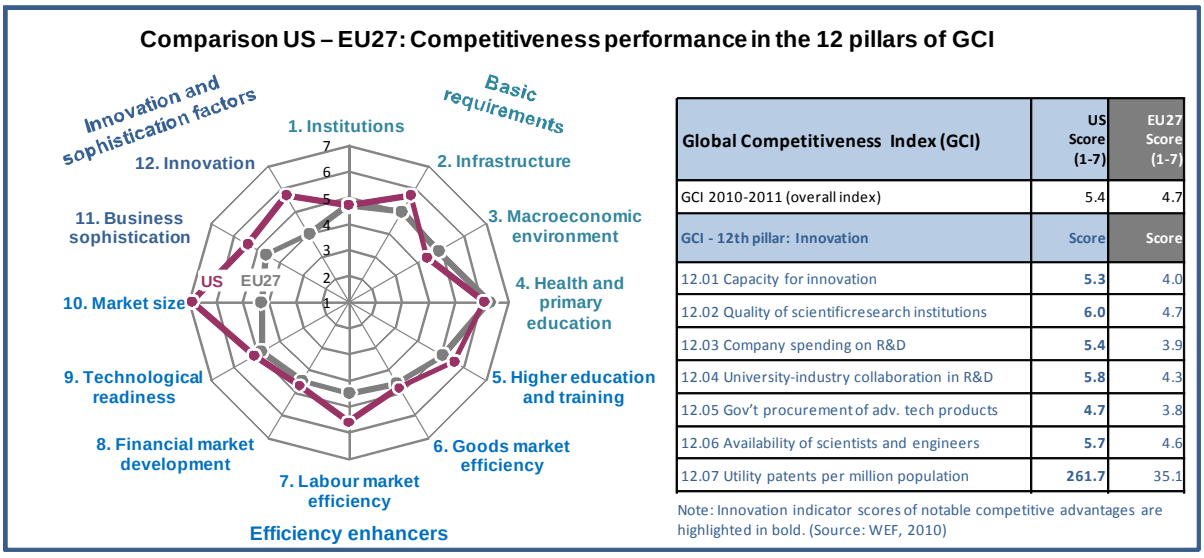
64 EC (2009i), pp. 28-29.

65 WEF (2010), p. 340.

66 WEF (2010), p. 341.

67 WEF (2010), p. 341.

**Figure 8: Comparison of the EU27 and the US: competitiveness**




| Global Competitiveness Index (GCI) | US Score (1-7) | EU27 Score (1-7) |
|---|---|---|
| GCI 2010-2011 (overall index) | 5.4 | 4.7 |
| GCI - 12th pillar: Innovation | Score | Score |
| 12.01 Capacity for innovation | **5.3** | 4.0 |
| 12.02 Quality of scientificresearch institutions | **6.0** | 4.7 |
| 12.03 Company spending on R&D | **5.4** | 3.9 |
| 12.04 University-industry collaboration in R&D | **5.8** | 4.3 |
| 12.05 Gov't procurement of adv. tech products | **4.7** | 3.8 |
| 12.06 Availability of scientists and engineers | **5.7** | 4.6 |
| 12.07 Utility patents per million population | **261.7** | 35.1 |

Note: Innovation indicator scores of notable competitive advantages are highlighted in bold. (Source: WEF, 2010)

**Source:** Own presentation based on WEF (2010).

### Comparison of EU27 and US innovation performance

There is an innovation performance gap between the EU27 and the United States as Figure 9 displays. The average innovation performance of the United States scores about 20% better than the EU27 average. The United States outperforms the EU27 on 11 indicators, significantly for instance in public-private co-publication, while the EU27 is better on six indicators, especially related to private credit and employment in medium-high and high-tech manufacturing.

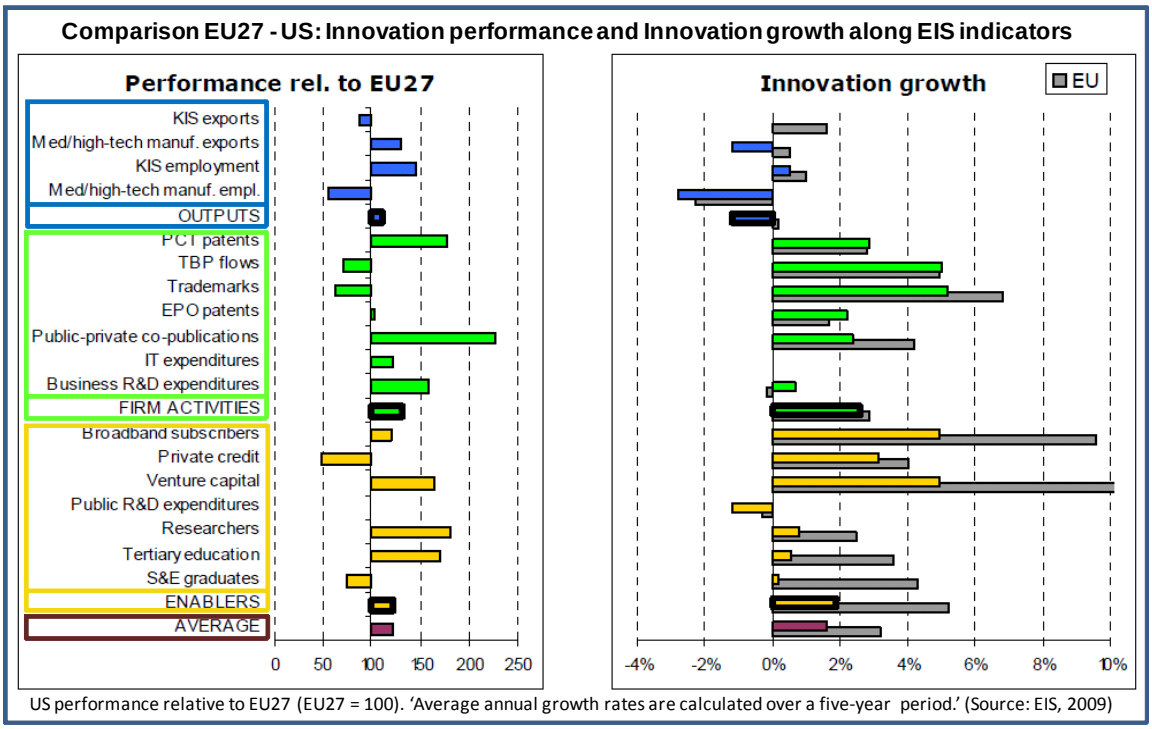
The 'firm activities' indicators are, on average much higher than for the EU27. For instance, the US score for public–private co-publications is more than double the EU27 score. The United States outperforms the EU27 on most of the enablers: in particular, venture capital, number of researchers and tertiary education are much higher for the United States than for the EU27.

### Comparison of EU27 and US innovation growth

Although there is an innovation gap between the United States and the EU27 (see the subsection above), the EU27 is closing this gap since the average innovation growth is higher for the EU27 than for the United States. The growth rate of the United States is 1.6%, while the growth rate of the EU27 is 3.2%.[68] The growth rate for most US indicators is below (for some, significantly below) the EU27 growth rate. The United States outperforms the EU27 notably only in the growth rate of the following indicators: business R&D expenditure and patents registered at the European Patent Office (EPO).

[68] The growth rate for the EU27 is different from that reported in the subsection 'EU27 innovation growth' as the set of indicators used for the comparisons for the EU27 and the United States and the EU27 and Japan are different from that used in the EIS (EIS, 2009, p. 22).

**Figure 9: Comparison of the EU27 and the US: innovation performance and growth**




**Source:** EIS (2009).

### US policy priorities addressed by the support measures

The top five policy priorities that are addressed by US support measures are public research organisations, R&D cooperation (joint projects and public–private partnerships with research institutes), research infrastructures, strategic research policies (long-term research agendas), and innovation strategies.[69]

The United States spends about 91% of its annual budget on other horizontal policies (exclusive of society-driven innovation), 7.2% on fiscal incentives in support of the diffusion of innovative technologies, products and services, and under 1% on strategic research policies (long-term research agendas).[70]

Most US support measures (about 10% of the total number of measures) address energy. The other R&D fields that are addressed are space, industrial production, health, socio-economic sciences and humanities, and information and communication technology (ICT).[71]

### EU27 main innovation policy challenges related to the US

Based on the country comparison between the US and the EU27 on competitiveness, innovation performance and growth, the following policy challenges for the EU27 can be identified in order to catch up with the performance of the US:

- Improve patenting: There is a huge gap regarding patenting between the EU27 and the US. For instance, the utility patents per million population for the US is more than seven times higher than the EU27 average. The US indicator on TPC patents is

[69] EC (2009a), p. 23.

[70] EC (2009a), p. 24.

[71] EC (2009a), p. 25.

about 75% higher than the EU27 indicator. Since the annual average growth rate for both is about the same, it is unlikely that the EU27 can catch up on this indicator without a dedicated strategy.

- Improve public-private R&D cooperation: This includes an improvement in public-private co-publications and in university-industry collaboration in R&D.
- Improve R&D expenditure: The US company spending on R&D is significantly higher than in the EU27. For instance, the US indicator on business R&D expenditure is about 55% higher than the EU27 indicator and it is growing, while the EU27 indicator is slightly declining.
- Improve the availability of researchers, scientists and engineers. The number of US researchers is significantly higher than the EU27 average. This is also mirrored by the higher availability of scientists and engineers in the US.

**Main findings**

- The comparison between the EU27 and the United States shows that, overall, the US performance on competitiveness is far better than the EU27 performance.
- The comparison also shows that the United States leads innovation performance. Overall the average US innovation performance indicator is about 20% higher than the EU27 indicator.
- The EU27's strengths in comparison with the US are related to private credits, employment in medium-high and high-tech manufacturing, and trademarks.
- The rate of innovation growth in the EU27 is twice as high as the US rate. This suggests that the EU27 can slowly close the gap in innovation assuming that the rates remain stable.
- Although the EU27 is slowly improving its performance relative to the United States, the innovation gap is still considerable. This gap is mainly caused by four areas: patenting measured under the Patent Cooperation Treaty (PCT)[72]/utility patents, public–private co-publications/university–industry collaboration in R&D, business R&D expenditure, and the availability of researchers, scientists and engineers.

### 2.2.3. Comparison between the EU27 and Japan

This subsection compares Japan with the EU27 in relation to the same indicators and issues as the previous subsection.

**Japan's competitiveness**

Japan is in sixth position worldwide in the overall GCI 2010–2011 ranking. Japan could improve its position over the last two years: In 2008-09 Japan was in eighth position and in 2009-10 in ninth position.[73]

Japan is notably competitive in the areas of business sophistication, innovation and market size (see Figure 10). However, Japan has a serious weakness (similar to that of the United States) on macroeconomic environment. In particular, the indicator for the government budget balance is low, as is that for government debt. Japan has the highest public debt

[72] The PCT is an international treaty, administered by the World Intellectual Property Organisation (WIPO), between more than 125 countries.

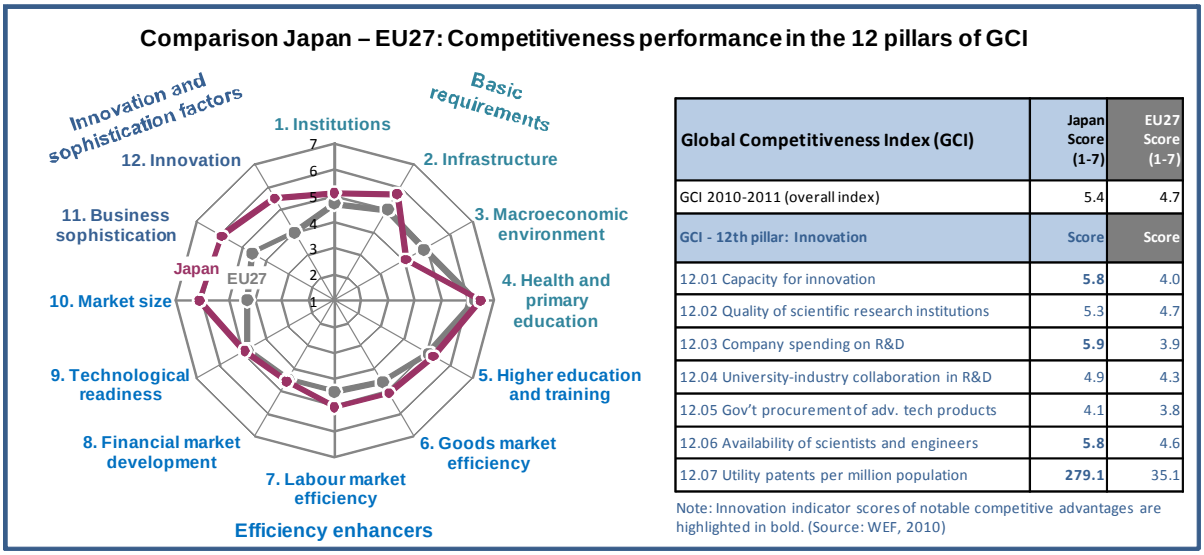
[73] WEF (2010), p. 196.

level in the world, amounting to 217.6% of gross domestic product (GDP).[74] On the other hand, Japan's macroeconomic situation enjoys two notable competitive advantages: low inflation and interest rate spread.[75] These two indicators might have contributed to maintaining Japan's overall high position.

### Comparison of the EU27 and Japan: competitiveness

Japan is well in the lead over the EU27. In nearly all pillars of competitiveness, Japan outperforms the EU27, apart from the pillar on macroeconomic environment, and the performance of Japan is very near to the EU27 average for technological readiness, financial market development, higher education and training, and health and primary education. Japan clearly outperforms the EU27 in all indicators of the innovation pillar, and in four indicators Japan is significantly ahead of the EU27.

**Figure 10: Comparison of the EU27 and Japan: competitiveness**




| Global Competitiveness Index (GCI) | Japan Score (1-7) | EU27 Score (1-7) |
|---|---|---|
| GCI 2010-2011 (overall index) | 5.4 | 4.7 |
| **GCI - 12th pillar: Innovation** | **Score** | **Score** |
| 12.01 Capacity for innovation | **5.8** | 4.0 |
| 12.02 Quality of scientific research institutions | 5.3 | 4.7 |
| 12.03 Company spending on R&D | **5.9** | 3.9 |
| 12.04 University-industry collaboration in R&D | 4.9 | 4.3 |
| 12.05 Gov't procurement of adv. tech products | 4.1 | 3.8 |
| 12.06 Availability of scientists and engineers | **5.8** | 4.6 |
| 12.07 Utility patents per million population | **279.1** | 35.1 |

Note: Innovation indicator scores of notable competitive advantages are highlighted in bold. (Source: WEF, 2010)

**Source:** Own compilation based on WEF (2010).

### Comparison of the EU27 and Japan: innovation performance

Japan's innovation performance is about 30% better than the EU27's (see Figure 11). Overall, Japan outperforms the EU27 in all three indicator groups: firm activities, enablers and outputs. Japan is leading on 12 indicators. As for the United States, a number of the indicators are significantly higher than for the EU27. For three indicators Japan's performance is more than 100% better: business R&D expenditure, number of researchers and patenting measured under the PCT. However, the EU27 outperforms Japan on five indicators. Overall, the innovation gap between the EU27 and Japan is even higher than that between the EU27 and the United States.

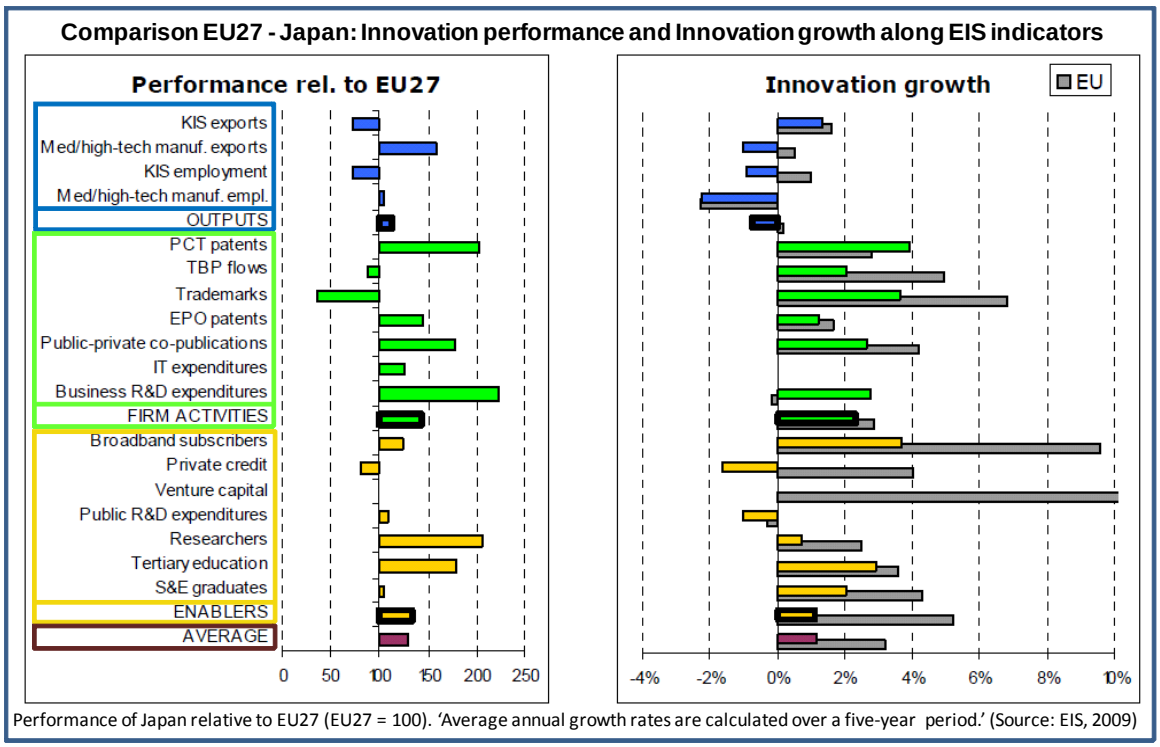
[74] WEF (2010), p. 402.

[75] WEF (2010), p. 196.

### Comparison of the EU27 and Japan: innovation growth

The picture regarding Japan's innovation growth is quite different from that of its innovation performance (see also Figure 11). Here the EU27 is in the lead in nearly all indicators. Overall, the average growth rate of the EU27 is 3.2%, while Japan's growth rate is 1.16%.[76] As a result, the EU27 is closing the gap in innovation performance. The EU27 is catching up with Japan faster than with the United States, since Japan's growth rate is the lowest of the three countries. For five indicators, Japan's growth rate is even negative. Japan's innovation growth is higher than the EU27 average only in two indicators: business R&D expenditure and PCT patents. For these two indicators Japan is also improving its lead over the United States.

**Figure 11: Comparison of the EU27 and Japan: innovation performance and growth**




**Source:** EIS (2009).

### Japan's policy priorities addressed by the support measures

The top five policy priorities that are addressed by Japan's support measures are innovation strategies, direct support of business R&D (grants and loans), R&D cooperation (joint projects and PPP with research institutes), strategic research policies (long-term research agendas) and career development (e.g. long-term contracts for university researchers).[77]

[76] EIS (2009), p. 23.

[77] EC (2009b), p. 26.

Japan spends 57% of its annual budget on innovation strategies, 42.4% on strategy policy documents (official documents, policy consultation papers, green or white papers, operational programmes of structural funds), and 0.3% on direct support of business R&D (grants and loans).[78]

Most Japanese support measures (about 15% of the total number of measures) address energy. The other R&D fields that are addressed are biotechnology, environment (including climate change), materials, ICT, transport, nanosciences and nanotechnologies, services, industrial production, health, and social science and humanities.[79]

### EU27 main innovation policy challenges related to Japan

Based on the country comparison between Japan and the EU27 on competitiveness and on innovation performance and growth, the following policy challenges for the EU27 can be identified in order to catch up with Japan. These are quite similar to the challenges related to the US:

- Improve patenting: There is a huge gap regarding patenting between the EU27 and Japan. For instance, the utility patents per million population for Japan is even higher than for the US and about eight times higher than the EU27 average. Japan's indicator on TPC patents is about 100% higher than the EU27 indicator. Since for both the annual average growth rate is about the same, it is unlikely that the EU27 can catch up on this indicator without a dedicated strategy.
- Improve R&D expenditure: Japan's company spending on R&D is significantly higher than in the EU27. For instance, Japan's indicator on business R&D expenditure is more than two times higher than the EU27 indicator (also higher than the US indicator). This indicator has an annual growth rate of nearly 3% while the EU27 indicator is slightly declining.
- Improve availability of researchers, scientists and engineers. Japan's number of researchers is more than two times higher than the EU27 average. This is also mirrored by the higher availability of scientists and engineers in Japan. The above two statements are also true for the US, although the US indicators are slightly below the Japanese indicators.
- Improve public-private R&D cooperation: This includes an improvement in public-private co-publications and in university-industry collaboration in R&D.

### Main findings

- Japan ranks two positions below the United States on competitive performance, but it is far better than the EU27 performance.
- The comparison of the innovation performance shows that Japan leads the EU27. Japan's overall performance is about 30% better than the EU27 average, and also better than the US performance.
- Japan's innovation growth rate is nearly three times lower than the EU27 rate. With stable growth rates, the EU27 can close the innovation gap with Japan, perhaps even faster than the United States can, since its growth rate is slightly higher.

[78] EC (2009b), p. 27.

[79] EC (2009b), p. 28.

- Although the EU27 is slowly improving its performance relative to Japan, the innovation gap is still considerable. As for the US, this gap is mainly caused by four areas: patenting measured under PTC/utility patents, business R&D expenditure, availability of researchers, scientists and engineers, and public–private co-publications/university–industry collaboration in R&D.

### 2.2.4. Comparison between the EU27 and the BRIC countries

Over the last decades, the BRIC countries have emerged on the economic and political agenda due to the considerable size of their economies and their high economic growth rates.[80] However, there are differences in their competitive and innovation performance as well as in their innovation growth, as Figures 12, 13 and 14 show.

#### BRIC countries: competitiveness

The BRIC countries are characterised by high population, all among the ten largest worldwide. According to the overall GCI 2010–2011 ranking Brazil is in 58$^{th}$ position worldwide, Russia 63$^{rd}$, India 51$^{st}$, and China is in 27$^{th}$ position.[81] All these countries enjoy a competitive edge in market size. Brazil, Russia and China are efficiency-driven economies while India is still a factor-driven economy.

#### Comparison of the EU27 and the BRIC countries: competitiveness

Overall, three of the BRIC countries – Brazil, Russia and India – lag behind the EU27 in competitiveness. China is an exception, and is slightly in the lead over the EU27 (see Figure 12).

The EU27 is much better than **Brazil** in terms of basic requirements and efficiency enhancers. In particular, Brazil lags far behind in scores for macroeconomic environment and goods market efficiency. The gap is notably closer for innovation and sophistication factors. Brazil is quite close to the EU27 average in business sophistication, characterised by high local supplier quantity, local supplier quality, extent of marketing, and state of cluster development.[82] Looking at the innovation pillar in detail, Brazil is better in government procurement of advanced technological products and is equal on university–industry collaboration in R&D.

The largest gap regarding competitiveness exists between the EU27 and **Russia**. Russia is worse in all pillars of competitiveness apart from market size. However, the gap is relatively huge for institutions, financial market development, technological readiness, and business sophistication. With regard to the innovation pillar, Russia's indicators are all below the EU27 average.

[80] Archibugi et al. (2009a).

[81] WEF (2010), p. 15.

[82] WEF (2010), p. 107.

**Figure 12: Comparison of the EU27 and the BRIC countries: competitiveness**

Comparison BRIC countries – EU27

| | Brazil | Russia | India | China | EU27 |
|---|---|---|---|---|---|
| **Global Competitiveness Index** | Score (1-7) | Score (1-7) | Score (1-7) | Score (1-7) | Score (1-7) |
| GCI 2010-2011 (overall index) | 4.3 | 4.2 | 4.3 | 4.8 | 4.7 |
| **Basic requirements** | **4.3** | **4.5** | **4.3** | **5.3** | **5.2** |
| 1st pillar: Institutions | 3.6 | 3.2 | 4.0 | 4.4 | 4.7 |
| 2nd pillar: Infrastructure | 4.0 | 4.5 | 3.5 | 4.4 | 5.0 |
| 3rd pillar: Macroeconomic environment | 4.0 | 4.5 | 4.5 | 6.1 | 4.9 |
| 4th pillar: Health and primary education | 5.5 | 5.9 | 5.2 | 6.2 | 6.3 |
| **Efficiency enhancers** | **4.4** | **4.2** | **4.4** | **4.6** | **4.7** |
| 5th pillar: Higher education and training | 4.3 | 4.6 | 3.9 | 4.2 | 5.1 |
| 6th pillar: Goods market efficiency | 3.7 | 3.6 | 4.1 | 4.4 | 4.6 |
| 7th pillar: Labor market efficiency | 4.1 | 4.5 | 4.2 | 4.7 | 4.5 |
| 8th pillar: Financial market development | 4.4 | 3.2 | 4.9 | 4.3 | 4.5 |
| 9th pillar: Technological readiness | 3.9 | 3.6 | 3.3 | 3.4 | 4.8 |
| 10th pillar: Market size | 5.6 | 5.7 | 6.1 | 6.7 | 4.3 |
| **Innovation and sophistication factors** | **4.0** | **3.4** | **4.0** | **4.1** | **4.3** |
| 11th pillar: Business sophistication | 4.5 | 3.5 | 4.3 | 4.3 | 4.6 |
| 12th pillar: Innovation | 3.5 | 3.2 | 3.6 | 3.9 | 4.0 |
| **GCI - 12th pillar: Innovation*** | Score | Score | Score | Score | Score |
| 12.01 Capacity for innovation | **3.8** | **3.5** | **3.6** | **4.2** | 4.0 |
| 12.02 Quality of scientific research institutions | **4.2** | 3.9 | **4.7** | 4.3 | 4.7 |
| 12.03 Company spending on R&D | **3.8** | **3.2** | **3.6** | **4.1** | 3.9 |
| 12.04 University-industry collaboration in R&D | **4.3** | 3.7 | 3.7 | **4.6** | 4.3 |
| 12.05 Gov't procurement of adv. tech products | **3.9** | 3.5 | 3.5 | **4.5** | 3.8 |
| 12.06 Availability of scientists and engineers | 4.0 | 4.3 | **5.2** | 4.6 | 4.6 |
| 12.07 Utility patents per million population | 0.5 | **1.4** | 0.6 | 1.2 | 35.1 |

Note: *Innovation indicator scores of notable competitive advantages are highlighted in bold. (Source: WEF, 2010)

**Source:** Own presentation based on WEF (2010).

The gap on competitiveness between **India** and the EU27 is similar to the gap between Brazil and the EU27. India is worse in most of the pillars of competitiveness. Notable weaknesses of India are on low health standards and primary education and on technological readiness. India is outperforming the EU27 on financial market development and market size. With regard to the innovation pillar, India has a notable competitive advantage related to the availability of scientists and equals the EU27 on its quality of scientific research institutions.

Overall **China** leads the EU27 on competitiveness. China outperforms the EU27 on macroeconomic environment, market size, and labour market efficiency. However, China notably lags behind the EU27 in technological readiness, higher education and training, and infrastructure. Compared with the EU27, China leads on capacity for innovation, company spending on R&D, university–industry collaboration in R&D, and government procurement of advanced technological product.

### Comparison of the EU27 and the BRIC countries: innovation performance

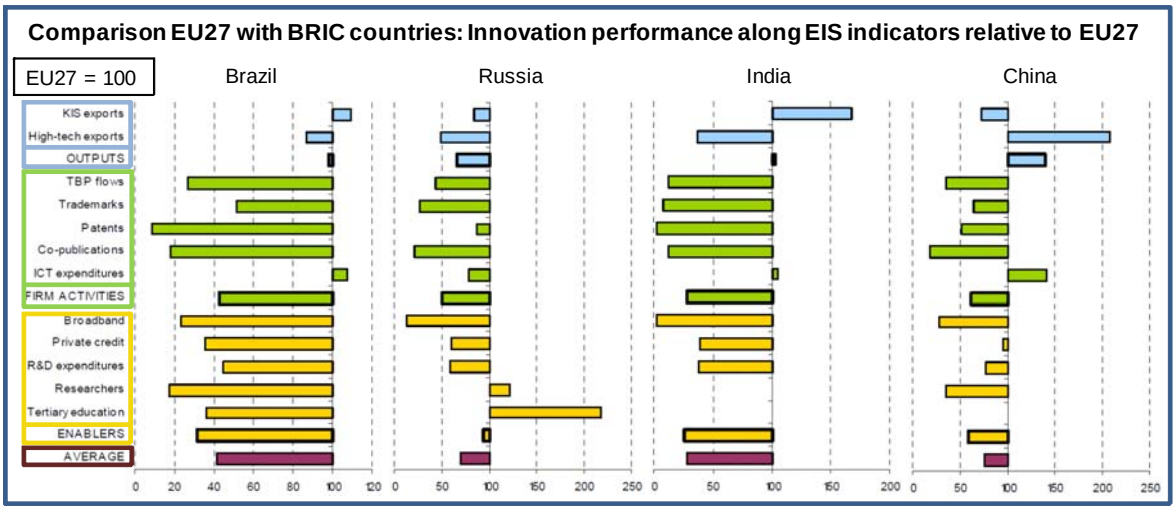
Overall, the EU27 outperforms the BRIC countries in innovation performance (see Figure 13). The EU27 lead compared to **Brazil** is significant. Brazil's worst performances are on patents, researchers and co-publications. The only two indicators on which Brazil leads the EU27 are KIS exports and ICT expenditure.

The picture for **Russia** is quite similar to the one for Brazil. The EU27 performs better than Russia on most indicators, in particular on broadband, co-publication, trademarks, TBP flows and high-tech exports. In contrast, Russia notably outperforms the EU27 in tertiary education and researchers. This results in a higher average performance than for Brazil, but still well below the EU27.

**India** is the worst performer of the BRIC countries. The EU27 performs better on almost all indicators, in particular for broadband and patent (scores are nearly zero). The two indicators on which India outperforms the EU27 are ICT expenditure (valued slightly above the EU27) and KIS exports, in which India scores significantly better than the EU27.

**China** is the best performer of the BRIC countries, although the EU27 outperforms China on most indicators, in particular on researchers, broadband, co-publications and TBP flows. China significantly outperforms the EU27 on high-tech exports and ICT expenditure.

**Figure 13: Comparison of the EU27 and the BRIC countries: innovation performance**




**Source:** Own compilation based on EIS, 2009.

### Comparison of the EU27 and the BRIC countries: innovation growth

The annual average innovation growth rates for Brazil, India and China are higher than the EU27 growth rate. Only Russia's growth rate is lower than the EU27's (see Figure 14).

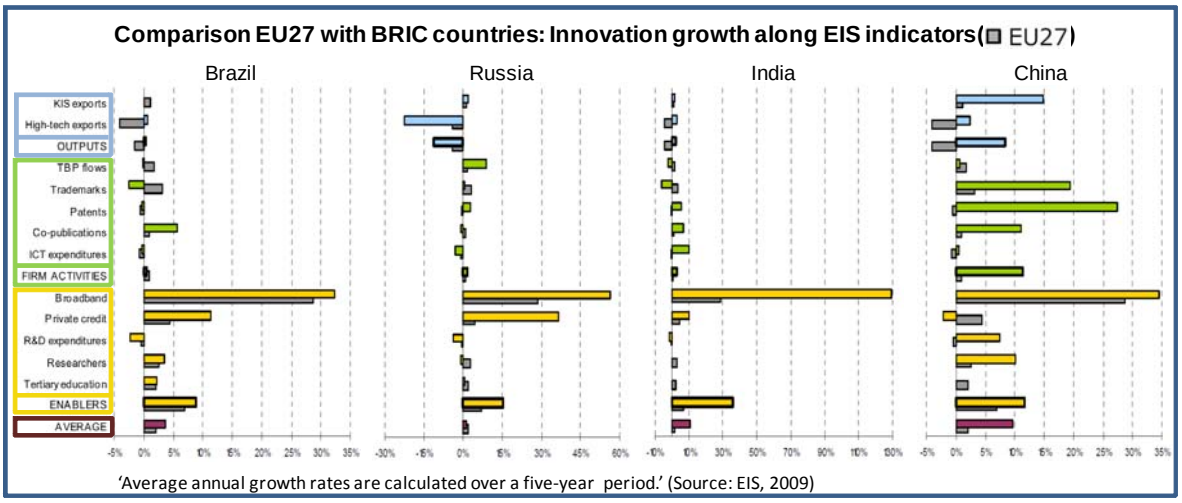
Overall, **Brazil** has an average performance growth which is nearly two times higher than the EU27's growth rate. Although the EU27's growth rate for broadband is remarkable, Brazil's growth rate for this indicator is even higher. Furthermore, Brazil is growing much faster than the EU27 on private credits and co-publication. The EU27's growth is better for R&D expenditure and trademarks.

**Russia** has an average performance growth which is lower than the EU27 growth rate. The innovation growth for private credits is much higher in Russia than in the EU27. This is also the case for broadband and TBP flows. However, high-tech exports, R&D expenditure and IT expenditure are declining for Russia.

Overall, **India** has the highest average growth rate of the BRIC countries which is five times higher than the EU27 rate. India's growth rate on broadband performance is about 130%. This is by far the highest within the BRIC countries. Trademarks and R&D expenditure are slightly declining for India.

**China** has an average growth rate which is nearly five times higher than the EU27 rate and it is slightly lower than India's growth rate. China's growth is higher than the EU27 average for almost all indicators. Only the indicator on private credits is declining. China is the only BRIC country for which the R&D expenditure growth rate is increasing, even significantly. Also impressive are the growth rates for patents, trademarks and co-publication.

**Figure 14: Comparison of the EU27 and the BRIC countries: innovation growth**




**Source:** Own compilation based on EIS (2009).

### EU27 main innovation policy challenges related to BRIC countries

The EU27 is still leading regarding competitiveness and innovation performance, although the BRIC countries catching up. The main challenge is to maintain or widen the innovation gap. Therefore the EU27 should closely monitor the BRIC countries performances, particularly those of China since it is already very close.

### Main findings

- BRIC countries are characterised by a considerable economic size and high population growth rates. They are mainly in a catching-up situation, although assessments can vary with different sets of indicators.
- The comparative analysis on competitiveness puts the BRIC countries in the following order: China is in the lead, followed by India and Brazil. Russia is the worst player. India and Brazil are currently experiencing a decline in competitiveness, while Russia is stable and China is improving.
- Brazil, India and Russia are well behind the EU27 in terms of competitiveness, while China is slightly above the EU27.
- Looking at the innovation pillar: all BRIC countries have a notable competitive advantage relative to their own performance in at least three of the seven innovation indicators. This means that for innovation, all BRIC countries are in a good position to make further improvements.

- The comparative analysis on innovation performance shows China slightly in the lead, followed by Russia, Brazil and then India. However, there is still an innovation gap between the EU27 and the BRIC countries.
- The innovation growth on some indicators is impressive. For instance, India's growth in broadband is about 130%. The other BRIC countries also have a high improvement growth in broadband. Indeed, this is one of the main drivers for the high growth. The other driver for Brazil, Russia and India is private credits which is significantly high for Russia. Actually it is more than 3 times higher than for Brazil and India.[83] In contrast, China's growth index is the result of several well-performing indicators.
- The comparison between the EU27 and the BRIC countries shows that there is still a considerable gap between the EU27 and each of the BRIC countries. However, the EU27's lead is decreasing, in particular over China and India. If China can maintain its high growth rate, it may close the gap with the EU27 sooner than expected. China is challenging, since its growth does not only rely on improving performance in broadband or private credits, but also derives from growth in trademarks, TBP flows and KIS exports. In addition, China's overall competitiveness is already slightly higher than the EU27 average. Therefore the EU27 must find ways to handle the potential output of these countries and explore ways to stimulate its own economic and innovation growth.

### 2.2.5. Comparison between the EU27 and Switzerland

#### Switzerland's competitiveness

Switzerland is in first position worldwide (in the overall GCI 2010–2011 ranking), maintaining this position from 2009.[84] Switzerland has huge competitive advantages in all pillars of innovation (all ranked within the top eight). The only exception is the pillar 'market size'. Its competitive situation is characterised by a well-functioning goods market, excellent quality in higher education and training, high business sophistication, and a macroeconomic environment that is among the most stable in the world.

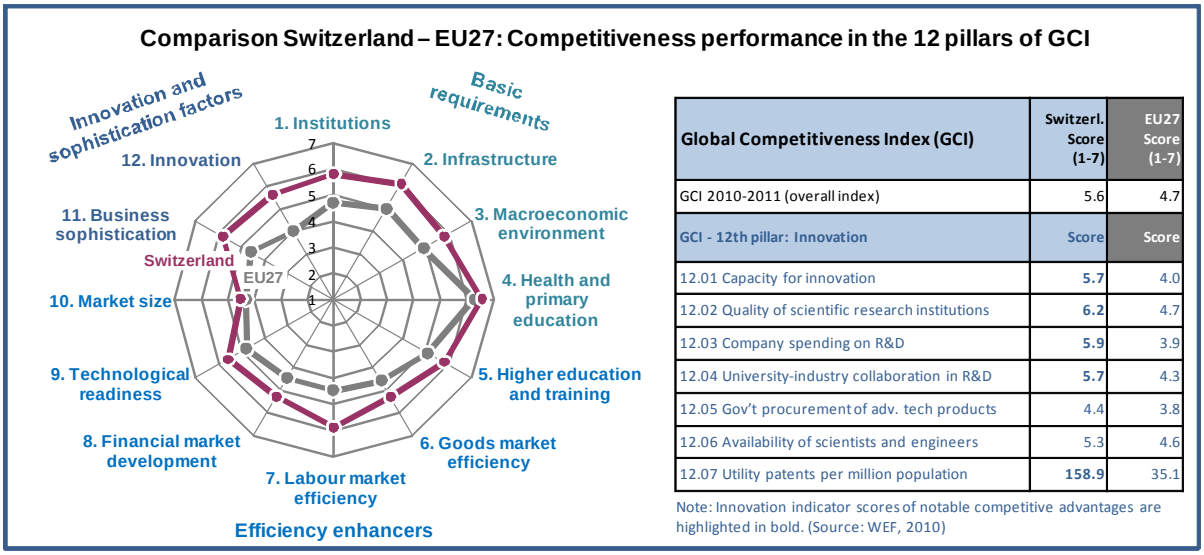
#### EU27 and Switzerland comparison: competitiveness

Switzerland is the top player regarding competitiveness worldwide and scores much better than the EU27 in all pillars as shown in Figure 15. In particular, Switzerland outperforms the EU27 in labour market efficiency and innovation.

[83] Please note that the impact of the financial crisis is not mirrored in the indicators yet. Therefore the growth rate on private credits may change significantly in the next EIS analysis.

[84] WEF (2010), p. 312.

**Figure 15: Comparison of the EU27 and Switzerland: competitiveness**




| Global Competitiveness Index (GCI) | Switzerl. Score (1-7) | EU27 Score (1-7) |
|---|---|---|
| GCI 2010-2011 (overall index) | 5.6 | 4.7 |
| **GCI - 12th pillar: Innovation** | **Score** | **Score** |
| 12.01 Capacity for innovation | **5.7** | 4.0 |
| 12.02 Quality of scientific research institutions | **6.2** | 4.7 |
| 12.03 Company spending on R&D | **5.9** | 3.9 |
| 12.04 University-industry collaboration in R&D | **5.7** | 4.3 |
| 12.05 Gov't procurement of adv. tech products | 4.4 | 3.8 |
| 12.06 Availability of scientists and engineers | 5.3 | 4.6 |
| 12.07 Utility patents per million population | **158.9** | 35.1 |

Note: Innovation indicator scores of notable competitive advantages are highlighted in bold. (Source: WEF, 2010)

**Source:** Own compilation based on WEF (2010).

### Comparison of the EU27 and Switzerland: innovation performance

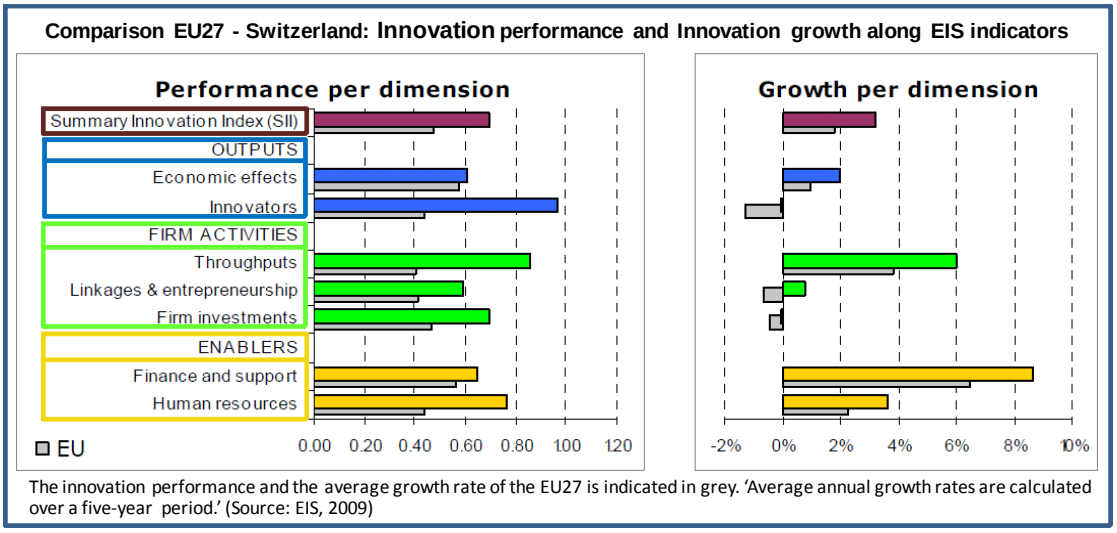
Overall, Switzerland's innovation performance is the best in the EIS 2009 and much better than the EU27 performance. Switzerland's summary innovation index (SII) is about 0.69, while the EU27's is about 0.48 (see Figure 16 and Annex d). Switzerland significantly out-performs the EU27 in most indicator groups. In particular, Switzerland scores much better for innovators, throughputs and human resources. Some of the indicators score about three times higher than the EU average, such as EPO patents, European Community trademarks and public–private co-publications. The only indicator group where scores are at about the same level for Switzerland and the EU27 is economic effects.

### Comparison of the EU27 and Switzerland: innovation growth

Switzerland is improving its performance at a rate that is nearly two times higher than the EU27 (3.3% compared with 1.8% for the EU27). In all indicator groups the growth rate is higher than the EU27 growth rate, in some cases significantly higher (see Figure 16). This applies to throughputs and finance and support. Switzerland's highest improvement is re-lated to venture capital (see Annex d).

However, Switzerland's performance remains at the same level (growth rate = 0.0%) for innovators and firm investments. The EU27 performance is declining in these two indicator groups as well as in linkages and entrepreneurship. For the latter indicator groups, Switzer-land improved its performance slightly.

**Figure 16: Comparison of the EU27 and Switzerland: innovation performance and growth**




**Source:** EIS, 2009.

### Switzerland's policy priorities addressed by the support measures

The top five policy priorities that are addressed by Switzerland's support measures are R&D cooperation (joint projects and PPP with research institutes), policy measures concerning excellence relevance and management of research in universities, support for innovation management and advisory services, stimulation of PhDs, and support to innovative start-ups.[85]

Switzerland spends 59% of its annual budget on strategic research policies (long-term research agendas) (its sixth policy priority), 19% on policy measures concerning excellence relevance and management of research in universities, 15% on R&D cooperation (joint projects and PPP with research institutes) and 4% on direct support of business R&D (grants and loans).[86]

Most of Switzerland's support measures (about 11% of the total number of measures) address nanosciences and nanotechnologies, biotechnology, environment (including climate change), social science and humanities, materials, services, energy and ICT.[87]

### EU27 main innovation policy challenges related to Switzerland

Since Switzerland is significantly leading as regards competitiveness and innovation performance and growth, it is quite difficult to identify any particular innovation policy challenges for the EU27 in order to catch up with Switzerland. However the largest innovation gap relates to innovators and throughputs:

- Improve innovators: Switzerland's performance on innovators is more than two times higher than for the EU27. This includes the SME introducing product or process innovations, SME introducing marketing or organisational innovations and resource efficiency innovators (see Annex d).

[85] EC (2009c), p. 9.

[86] EC (2009c), p. 19.

[87] EC (2009c), p. 19.

- Improve throughputs: For throughputs, the performance of Switzerland is about two times higher than the EU27 average. This group includes EPO patents, community trademarks, community designs and technology balance of payments flows.

**Main findings**

- Switzerland is presently the most competitive country worldwide.
- Switzerland's average innovation performance is the best in Europe.
- Switzerland's annual innovation growth rate is significantly higher than the EU27's average growth rate.
- The EU27 performs better than Switzerland on the indicators new-to-firm products, new-to-market products and KIS exports.

## 2.3. Comparative analysis of selected EU countries

A comparative analysis provides valuable insights into the strengths and weaknesses of the EU27 regarding innovation and industrial growth. However, the European Union is characterised by a high diversity of national innovation systems (for instance, the SII[88] varies between 0.227 for Bulgaria and 0.636 for Sweden) as well as a broad range of socio-economic factors influencing innovations, such as the role of governments, the availability of human resources markets, social and even cultural factors. Countries themselves may show diverse performances between regions. The Regional Innovation Scoreboard showed that all countries have regions with unequal innovation performances, and identified Italy, Spain and the Czech Republic as the most heterogeneous countries. For these countries, the regional performances range from low to medium-high.[89] In order to carry out such regional innovation comparisons it is essential to have better and ideally comparable data. Strategies developed on the basis of country comparison need to take both national and regional aspects into account.[90]

Since innovation performance is very complex, it is probably not possible to identify an optimal innovation policy or the best innovation system for all EU countries and regions. As seen above, strategies for success may be very diverse for different countries and/or regions.[91] Therefore, it is worthwhile to analyse different countries or regions *within* the European Union.

The selected countries represent in each case one example of the four groups of innovation performers in the EU27: Germany: innovation leader, Estonia: innovation follower, Spain: moderate innovator and Bulgaria: catch-up country (see also Figure 1). These EU Member States are analysed as regards competitiveness, innovation performance and innovation growth and compared to the EU27. In addition, policy priorities are introduced. Based on the analysis, innovation policy options for each of these countries are identified to see if there are common challenges which could be used to develop a European innovation policy.

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[88] EIS (2009), p. 63.

[89] See: www.proinno-europe.eu/page/regional-innovation-scoreboard

[90] See: www.proinno-europe.eu/page/regional-innovation-scoreboard

[91] See: www.proinno-europe.eu/page/regional-innovation-scoreboard

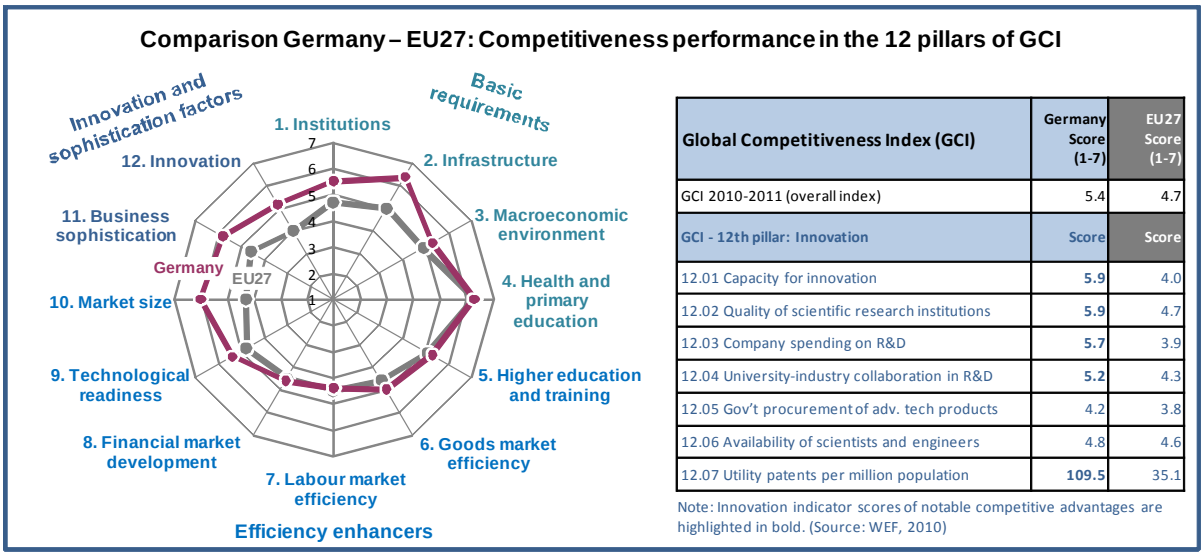
### 2.3.1. Germany

#### Comparison of the EU27 and Germany: competitiveness

Germany is in fifth position worldwide (in the overall GCI 2010–2011 ranking), maintaining its position from 2009-10.[92] Germany's competitive edge is in its infrastructure, market size and business sophistication (see Figure 17). Germany is leading worldwide in relation to capacity for innovation. The main German weaknesses are rigidity of employment, hiring and firing practices, and flexibility of wage determination. However, this inflexibility, and in particular the hiring and firing practices combined with the introduction of reduced work hours in both manufacturing firms and service providers, helped Germany to keep its employment rate quite stable during the crisis and to recover faster than its competition.

Germany leads in nearly all pillars of competitiveness, in some significantly compared to the EU27. The only exception is the labour market efficiency pillar. On financial market development, higher education and training, and health and primary education German performance is quite close to the EU27 average.

**Figure 17: Comparison of the EU27 and Germany: competitiveness**




| Global Competitiveness Index (GCI) | Germany Score (1-7) | EU27 Score (1-7) |
|---|---|---|
| GCI 2010-2011 (overall index) | 5.4 | 4.7 |
| GCI - 12th pillar: Innovation | Score | Score |
| 12.01 Capacity for innovation | **5.9** | 4.0 |
| 12.02 Quality of scientific research institutions | **5.9** | 4.7 |
| 12.03 Company spending on R&D | **5.7** | 3.9 |
| 12.04 University-industry collaboration in R&D | **5.2** | 4.3 |
| 12.05 Gov't procurement of adv. tech products | 4.2 | 3.8 |
| 12.06 Availability of scientists and engineers | 4.8 | 4.6 |
| 12.07 Utility patents per million population | **109.5** | 35.1 |

Note: Innovation indicator scores of notable competitive advantages are highlighted in bold. (Source: WEF, 2010)

**Source:** Own presentation based on WEF (2010).

#### Comparison of the EU27 and Germany: innovation performance

According to the EIS definition,[93] Germany is an innovation leader. Its innovation performance is much better than the EU27 as a whole (see Figure 18) and it ranks in third place in the EU27 (SII 2009). Germany's strength is its outputs with high performance in economic effects and innovators. For the two enablers, finance and support, and human resources, German performance is slightly below the EU27 average. This weakness is characterised by the indicators that are below the EU27 average performance related to S&E and SSH graduates, youth education, venture capital and private credits.

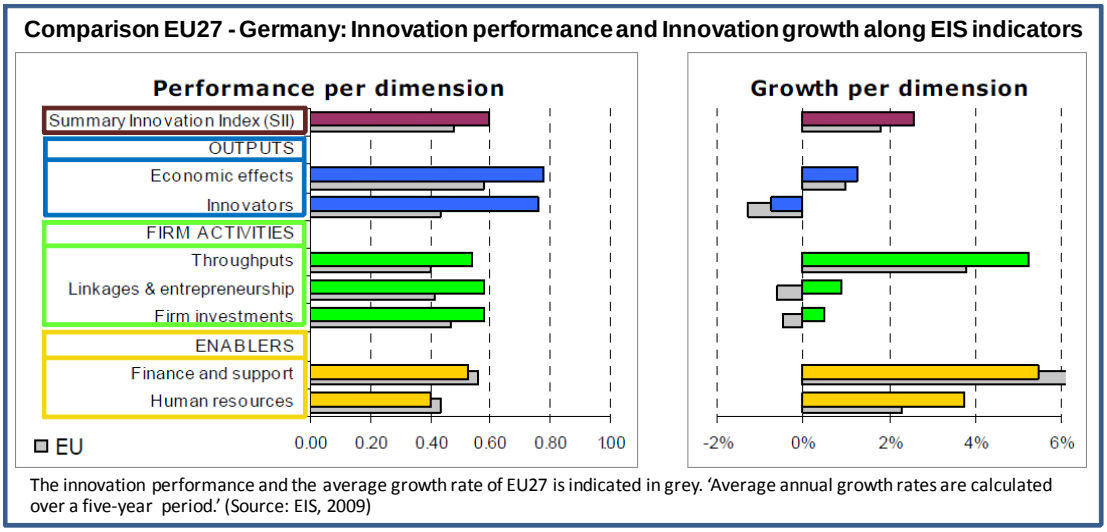
[92] WEF (2010), p. 164.

[93] EIS (2009), p. 3.

### Comparison of the EU27 and Germany: innovation growth

Germany (2.6%) improved its performance at a higher rate than the EU27 as a whole (1.8%), in particular related to firm activities and human resources (see Figure 18). This was due to high growth rates in community trademarks, TBP flows, and Science & engineering and social science and humanities (S&E and SSH) graduates. Although the German growth rate in finance and support was lower than the overall EU27 rate, there were two indicators with considerable growth: venture capital and broadband access by firms. Germany's performance in innovators was declining overall because of a decrease in SME introducing product or process innovations.

**Figure 18: Comparison of the EU27 and Germany: innovation performance and growth**




**Source:** EIS (2009).

### Germany's policy priorities addressed by the support measures

The top five policy priorities that are addressed by Germany's support measures are R&D cooperation (joint projects and PPP with research institutes), strategic research policies (long-term research agendas), knowledge transfer (including intellectual property rights (IPR) in public institutions, public research organisations and cluster framework policies.[94]

With regards to R&D and innovation policy, Germany invests the vast majority of public money in the form of thematic R&D programmes. The thematic R&D programmes are dedicated to specific subjects, such as nanotechnology, research for sustainability, optical technologies, security technologies, services, etc. [95] (See also list below.)

Germany's support measures address the following fields: environment (including climate change), health, ICT, biotechnology, nanosciences and nanotechnologies, social science and humanities, and space.[96]

[94] EC (2009d), p. 29.

[95] EC (2009d), p. 28

[96] EC (2009d), p. 30.

### Germany's main innovation policy challenges

Based on the countries comparison between the Germany and the EU27 on competitiveness and on innovation performance and growth, the following innovation policy challenges could be identified:

- Improve funding of innovation: The financial market in Germany is relative to the country's own worsening performance functioning. Problems exist in relation to financing through local equity market, ease of access to loans, soundness of banks and availability of venture capital.[97] The latter is confirmed by the EIS comparison. Furthermore, availability of private credits (relative low indicator on private credits, see Annex d) is relatively difficult.
- Improve human resources: Germany's performance regarding human resources is below average (see Figure 18), in particular S&E and SSH graduates, youth education and lifelong learning. In addition, the competitiveness comparison (see Figure 17) shows that the availability of scientists and engineers is relatively low.
- Improve the SME product and process innovations: Although the German performance in this area is above the EU27 average, its development is declining (see Annex d). Since SMEs play an important role in the German economy, improvement strategies to foster product and process innovations are needed in order to keep its competitive and innovation position.

### Main findings

- The competitiveness comparison between Germany and the EU27 shows that Germany is one of the top players worldwide (in fifth position). It is competitive in innovator and sophistication factors and basic requirements. However, its weaknesses are efficiency enhancers, in particular labour efficiency and financial market development.
- Germany is an innovation leader with an innovation performance that is well above the EU27 average. Its strength is its output (economic effect and innovators). Its weaknesses are finance and support, and human resources.
- Germany is improving its performance at a higher rate than the EU27 average. In particular, its improvements in human resources are above the EU27 average. This may help to overcome the current weakness in this area.
- Compared with the EU27 average, Germany is in a good position. However, measures must be taken if it is to keep this position. Improvements are necessary in flexibility of wage determination, rigidity of employment, hiring and firing practices, soundness of banks and government debt to improve the country's competitiveness and the environment for improved innovation performance. However, to specifically foster innovation performance and innovation growth, Germany needs a balanced strategy that incorporates aspects related to S&E and SSH graduates, youth education, venture capital, and private credits and their interaction.

[97] WEF (2010), p. 165

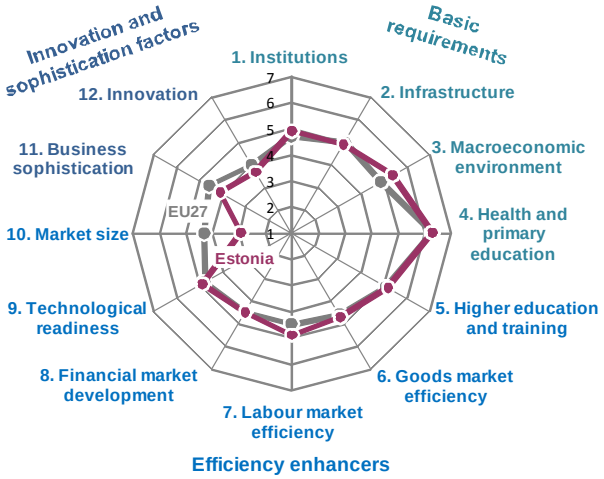
## 2.3.2. Estonia

### Comparison of the EU27 and Estonia: competitiveness

Estonia is in 33rd position worldwide (in the overall GCI 2010–2011 ranking), an increase in position over 2009-10.[98] Estonia's competitive strengths are in labour market efficiency, macroeconomic environment, higher education and training, and technological readiness (see Figure 19). The competitive weaknesses of Estonia are market size, business sophistication and financial market development. Estonia and the EU27 score the same on the innovation pillar. Looking at this pillar in detail, Estonia has a competitive advantage related to quality of scientific research institutions. However, its weakness in this context is in the availability of scientists and engineers.

**Figure 19: Comparison of the EU27 and Estonia: competitiveness**

**Comparison Estonia – EU27: Competitiveness performance in the 12 pillars of GCI**




| Global Competitiveness Index (GCI) | Estonia Score (1-7) | EU27 Score (1-7) |
|---|---|---|
| GCI 2010-2011 (overall index) | 4.6 | 4.7 |
| **GCI - 12th pillar: Innovation** | **Score** | **Score** |
| 12.01 Capacity for innovation | 3.6 | 4.0 |
| 12.02 Quality of scientific research institutions | **4.7** | 4.7 |
| 12.03 Company spending on R&D | 3.3 | 3.9 |
| 12.04 University-industry collaboration in R&D | 4.2 | 4.3 |
| 12.05 Gov't procurement of adv. tech products | 4.1 | 3.8 |
| 12.06 Availability of scientists and engineers | 4.2 | 4.6 |
| 12.07 Utility patents per million population | 2.3 | 35.1 |

Note: Innovation indicator scores of notable competitive advantages are highlighted in bold. (Source: WEF, 2010)

**Source:** Own presentation based on WEF (2010).

### Comparison of the EU27 and Estonia: innovation performance

According to the EIS definition,[99] Estonia is an innovation follower. Its innovation performance is slightly above the EU27 average (see Figure 20). Estonia's strengths are in firm investment, mainly driven by an investment three times higher than average in non-R&D innovation expenditure, linkages and entrepreneurship, and finance and support. Estonia performs worse in throughputs and economic effects. In this context, performance indicators for throughput, such as EPO patents and trademarks, are two or even more times lower than the EU27 average. The same is true for economic effects. All indicators are lower than the EU27 average, apart from new-to-firm sales. On this indicator Estonia outperforms the EU27.

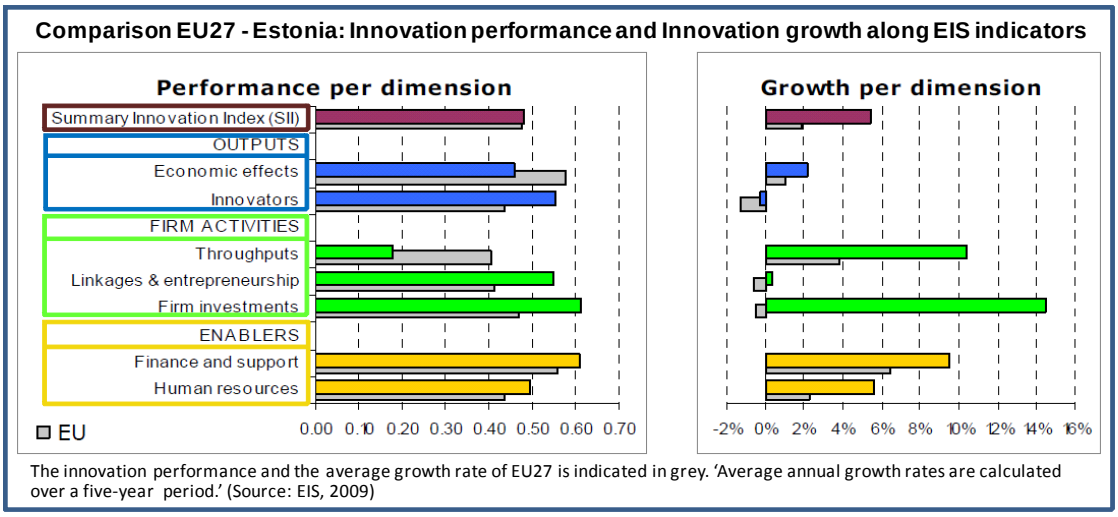
[98] WEF (2010), p. 152.

[99] EIS (2009), p. 3.

### Comparison of the EU27 and Estonia: innovation growth

Estonia's growth rate of 5.5%, as Figure 20 displays, is considerably higher than the EU27 average. Estonia has a quite impressive growth rate in firm investments. This is even more striking since the performance of the EU27 as a whole is declining slightly. Performances in throughputs are also improving greatly. Estonia's performance in economic effects is below the EU27 average, but improving with a higher growth rate. Performance in innovators is declining slightly. However, the decrease of the EU27 in this area is even higher, which will enable Estonia to keep its leading position in innovators. Estonia is also considerably improving its performance in human resources, and finance and support.

### Figure 20: Comparison of the EU27 and Estonia: innovation performance and growth




**Source:** EIS (2009).

### Estonia's policy priorities addressed by the support measures

The top five policy priorities that are addressed by Estonia's support measures are research infrastructures, R&D cooperation (joint projects and PPP with research institutes), public research organisations, policy measures concerning excellence, relevance and management of research in universities, and strategic research policies (long-term research agendas).[100]

Estonia spends 23.3% of its annual budget on R&D cooperation (joint projects and PPP with research institutes), 17% on policy measures concerning excellence relevance and management of research in universities, and 13% on support to risk capital.[101]

Estonia's support measures are aimed at biotechnology, ICT and industrial production.[102]

[100] EC (2009e), p. 29.

[101] EC (2009e), p. 31.

[102] EC (2009e), p. 33.

### Estonia's main innovation policy challenges

Based on the country comparison between Estonia and the EU27 on competitiveness and on innovation performance and growth, the following innovation policy challenges could be identified:

- Improve throughputs (firm activities): Estonia's performance in technology balance of payment flows, community designs and community trademarks is well below the EU27 average (cf. Annex d).
- Improve R&D expenditure: The competitiveness comparison shows a relatively low company spending on R&D (see Figure 19). This is confirmed by the EIS comparison which shows a low value for business R&D expenditure. Although the improvement rate is very high, the gap to the EU27 performance level is significant (cf. Annex d).
- Improve patenting: Estonia's performance on patenting is well below the EU27 average: The number of EPO patents per million population is relatively low (see Annex d). As the competitiveness comparison shows, the utility of patents per million population is also relatively low (see Figure 19).

### Main findings

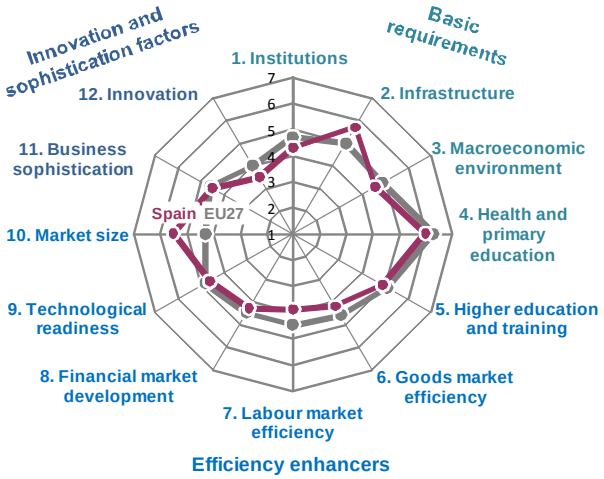
- The comparison between the EU27 and Estonia on competitiveness shows that Estonia is slightly more competitive than the EU27 average, although its market size is very limited. Estonia has a notable competitive advantage regarding quality of scientific research institutions, and disadvantages related to the availability of scientists and engineers and company spending on R&D.
- Estonia is an innovation follower, with an innovation performance that is slightly above the EU27 average. Its strengths are in firm investments, linkages and entrepreneurship, and finance and support. Its main weakness is related to throughputs, and consists of aspects such as EPO patents, community trademarks, community design and TBP flows.
- Estonia has improved its performance impressively over the past few years, particularly in firm investments, throughput, finance and support, and human resources. A high growth rate is needed in throughputs in order to catch up with the EU27 average in this area, and to improve the overall performance. The growth rates in innovators and economic effects are relatively small or even negative, and these areas too need improvement.
- Estonia has caught up with the EU27 average. Overall it is already performing slightly better than the EU27 average. Although Estonia has its strengths, it needs a strategy to address its weaknesses to keep the current pace of improvement.

## 2.3.3. Spain

### Comparison of the EU27 and Spain: competitiveness

Spain is in 42nd position worldwide (in the overall GCI 2010-2011 ranking), a decrease of nine positions over 2009-10. Overall the competitive performance of Spain is similar to the EU27 average (see Figure 21), although most pillars are below the EU27 average apart from market size and infrastructure. Spain's weaknesses are in innovation, labour market efficiency, goods market efficiency, the macroeconomic environment and institutions. Spain's competitive performance with regard to innovations is also below the EU27 average performance. Spain has a notable competitive advantage in utility patents.

**Figure 21: Comparison of the EU27 and Spain: competitiveness**




| Global Competitiveness Index (GCI) | Spain Score (1-7) | EU27 Score (1-7) |
|---|---|---|
| GCI 2010-2011 (overall index) | 4.5 | 4.7 |
| GCI - 12th pillar: Innovation | Score | Score |
| 12.01 Capacity for innovation | 3.4 | 4.0 |
| 12.02 Quality of scientific research institutions | 4.2 | 4.7 |
| 12.03 Company spending on R&D | 3.2 | 3.9 |
| 12.04 University-industry collaboration in R&D | 4.0 | 4.3 |
| 12.05 Gov't procurement of adv. tech products | 3.4 | 3.8 |
| 12.06 Availability of scientists and engineers | 4.4 | 4.6 |
| 12.07 Utility patents per million population | **7.1** | 35.1 |

Note: Innovation indicator scores of notable competitive advantages are highlighted in bold. (Source: WEF, 2010)

**Source:** Own presentation based on WEF (2010).

### Comparison of the EU27 and Spain: innovation performance

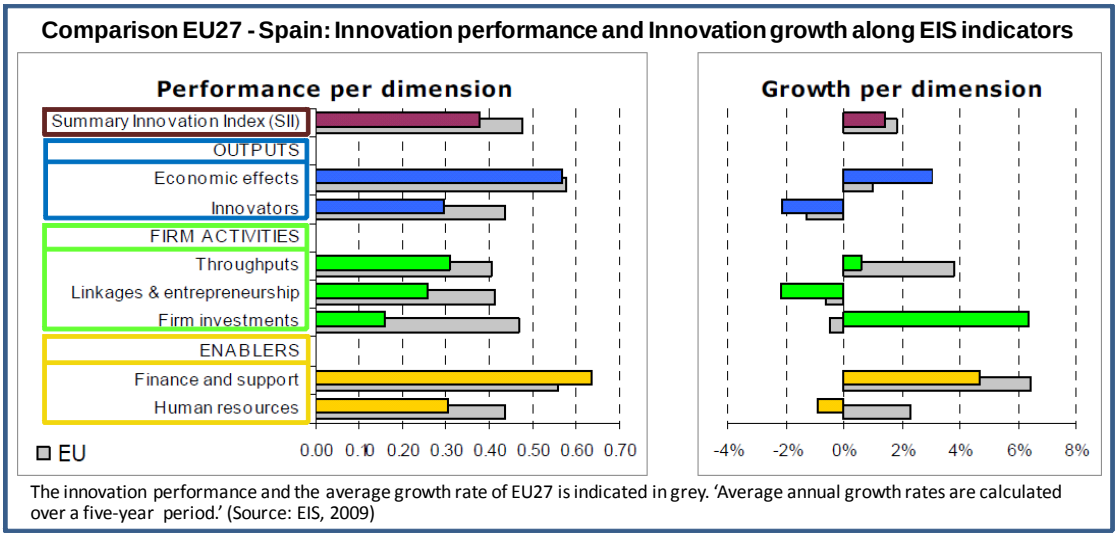
According to the EIS definition,[103] Spain is a moderate innovator, with an innovation performance lower than the EU27 average (see Figure 22). Spain outperforms the EU27 in finance and support. Another relative strength of Spain is economic effects, which scores similarly to the EU27 as a whole. Medium/high-tech manufacturing exports and new-to-market sales are above the EU27 average. Spain's weaknesses are firm investments as well as linkages and entrepreneurship (see Annex d).

### Comparison of the EU27 and Spain: innovation growth

Spain's innovation growth rate is slightly lower than the EU27 average, as Figure 22 shows. If unchanged, this will result in a steady increase in the innovation gap between Spain and the EU27. However, Spain has a quite high growth rate in firm investments, while the EU27 average is slightly declining. This may help Spain to catch up with the EU27 average in this area. The Spanish growth rate for economic effects is also higher than the EU27 average, which is exclusively driven by employment in KIS and new-to-market sales. However, Spain's performance worsened in linkages and entrepreneurship, innovators and human resources (see Annex d).

[103] EIS (2009), p. 3.

**Figure 22: Comparison of the EU27 and Spain: innovation performance and growth**




**Source:** EIS (2009).

### Spain's policy priorities addressed by the support measures

The top five policy priorities that are addressed by Spain's support measures are R&D co-operation (joint projects and PPP with research institutes), knowledge transfer (including IPR in public institutes, horizontal measures in support of financing, research and technology organisation (private, non-profit), and public research organisations.[104]

Spain spends 33.4% of its annual budget on support to organisational innovation, including e-business and new forms of organisation, 26.7% on research infrastructure, 24.2% on public infrastructure, and 8.3% in direct support of business R&D (grants and loans).[105]

Spain's support measures are mainly addressed at food, agriculture and fisheries, biotechnology, transport, and security and defence.[106]

### Spain's main innovation policy challenges

Based on the country comparison between Spain and the EU27 on competitiveness and on innovation performance and growth, the following innovation policy challenges could be identified:

- Improve firm investments (firm activities): The performance of Spain in firm investments is far below the EU27 average. This includes weak performances in non-R&D innovation expenditures, IT expenditures, and business R&D expenditures (cf. the Annex d). This is confirmed by the competitiveness comparison which shows a relatively low company spending on R&D (see Figure 21). Although the improvement rate is very high, the gap to the EU27 performance is significant (see Figure 22).

[104] EC (2009f), p. 27.

[105] EC (2009f), p. 28.

[106] EC (2009f), p. 29.

- Improve linkages (firm activities): Spain's performance in linkages and entrepreneurship is below the EU27 average, particularly in public-private co-publications and innovative SMEs collaborating with others (see Annex d). This is confirmed by relatively low university-industry collaboration (see Figure 21).
- Increase number of educated employees: Spain's performance in human resources is below the EU27 average and has even worsened due to a decreasing number of S&E and SSH doctorate graduates and S&E and SSH graduates (cf. Annex d). As the competitiveness comparison shows, the availability of scientists and engineers is relatively low (see Figure 21). In addition, the quality of the educational system and the quality of maths and science education is considerably lower than the EU27 average.[107]

**Main findings**

- Spain ranks slightly behind the EU27 average in the competitiveness comparison. Spain's main competitive advantage is its market size, but disadvantages are labour market efficiency, goods market efficiency and financial market developments. Spain has a notable competitive advantage in utility patents.
- Spain is a moderate innovator with an innovation performance lower than the EU27 average. Its strengths are in finance and support, and economic effects. Its weaknesses are in firm investments, and linkages and entrepreneurship.
- Spain has improved its innovation performance more slowly than the EU27 average. Its highest growth rate can be observed in firm investments. This suggests that Spain is addressing its weakness in this area. However, the linkages and entrepreneurship aspect is declining by over 2%, and is already a weakness.
- Spain is a moderate innovator, but it seems to be declining further. Therefore, ways have to be explored to foster performance growth in areas related to linkages and entrepreneurship. In addition, Spain needs to stop or at least to slow down its decline in respect to competitiveness, since a number of the factors are also highly relevant for innovation performance.

### 2.3.4. Bulgaria

**Comparison of the EU27 and Bulgaria: competitiveness**

Bulgaria is in 71st position worldwide (in the overall GCI 2010-2011 ranking), an increase of five positions over 2009-10.[108]

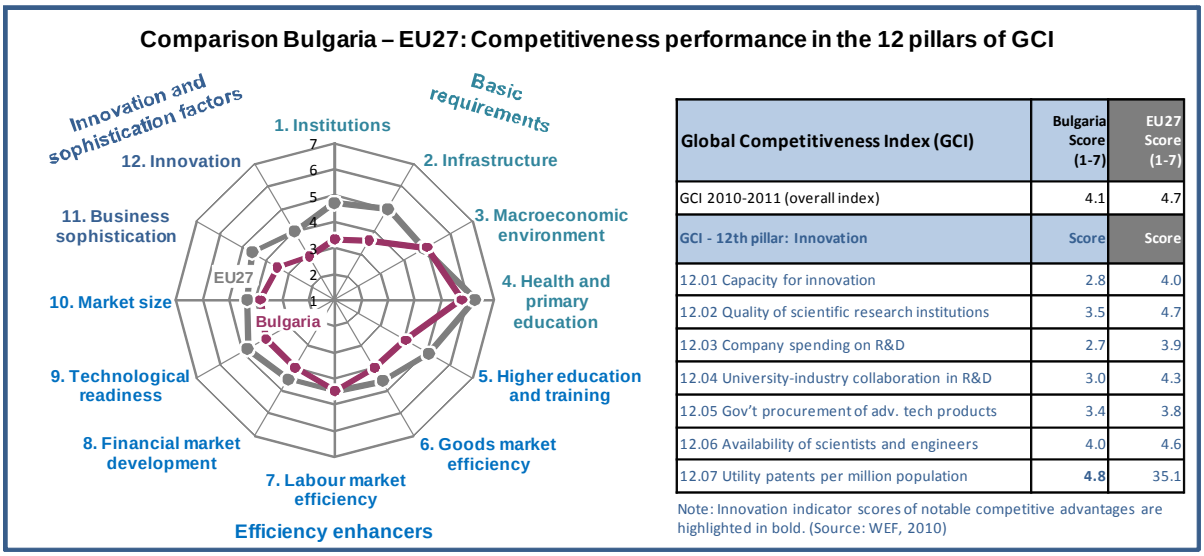
Bulgaria's competitiveness is well below the EU27 average, as Figure 23 shows. However, it outperforms the EU27 in macroeconomic environment, mainly driven by low government debt.[109] Bulgaria is relatively weak in business sophistication, innovation, and infrastructure. In the area of innovation, Bulgaria is particularly weak on university–industry collaboration in R&D and company spending on R&D. All other indicators are lower than the EU27 average.

[107] WEF (2010), p. 305.

[108] WEF (2010), p. 110.

[109] WEF (2010), p. 111.

**Figure 23: Comparison of the EU27 and Bulgaria: competitiveness**




| Global Competitiveness Index (GCI) | Bulgaria Score (1-7) | EU27 Score (1-7) |
|---|---|---|
| GCI 2010-2011 (overall index) | 4.1 | 4.7 |
| GCI - 12th pillar: Innovation | Score | Score |
| 12.01 Capacity for innovation | 2.8 | 4.0 |
| 12.02 Quality of scientific research institutions | 3.5 | 4.7 |
| 12.03 Company spending on R&D | 2.7 | 3.9 |
| 12.04 University-industry collaboration in R&D | 3.0 | 4.3 |
| 12.05 Gov't procurement of adv. tech products | 3.4 | 3.8 |
| 12.06 Availability of scientists and engineers | 4.0 | 4.6 |
| 12.07 Utility patents per million population | **4.8** | 35.1 |

Note: Innovation indicator scores of notable competitive advantages are highlighted in bold. (Source: WEF, 2010)

**Source:** Own presentation based on WEF (2010).

### Comparison of the EU27 and Bulgaria: innovation performance

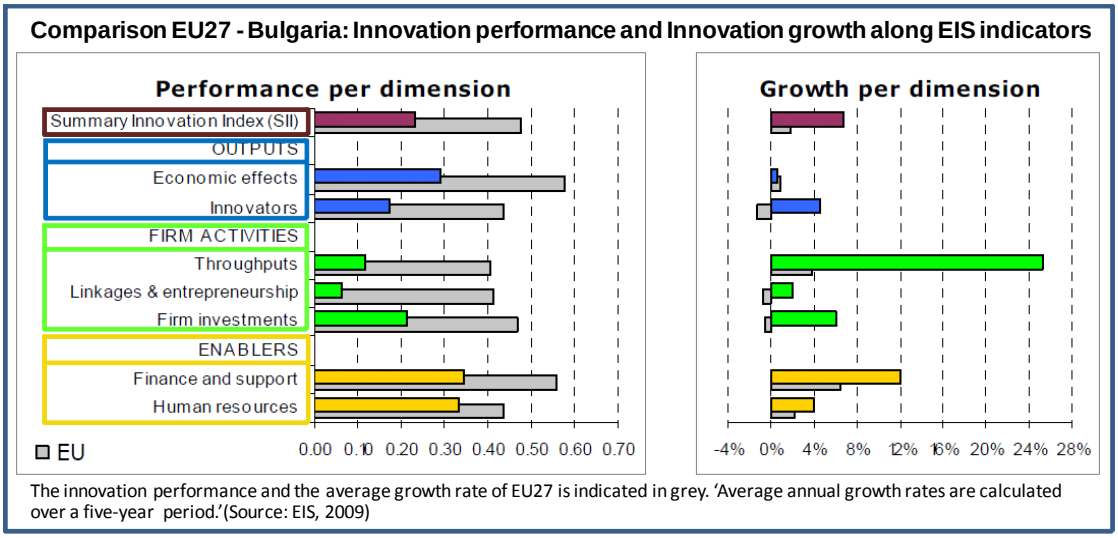
According to the EIS definition,[110] Bulgaria is a catching-up country, with an innovation performance well below the EU27 average (see Figure 24). Bulgaria performs worse than the EU average in all indicators except for youth education and reduced use of materials and energy (see Annex d). Bulgaria's relative strengths are in human resources, finance and support, and economic effects. Its weaknesses are linkages and entrepreneurship and throughput, which are mainly driven by a significantly worse performance than the EU27 average in public–private co-publications, EPO patents and community designs (see Annex d).

### Comparison of the EU27 and Bulgaria: innovation growth

Bulgaria's innovation growth rate of 6.7% (as shown in Figure 24) is nearly four times higher than the EU27 as a whole (1.8%) and the second highest in the European Union, behind Romania. In particular, throughputs are improving at an impressive rate, mainly driven by improvements in community trademarks (69.6%) and community designs (24.1%) (see Annex d). Performance in finance and support has grown notably due to broadband access by firms and private credits. Performance in economic effects is slightly below the EU27 average and has hardly grown. This is because of a decrease in new-to-market sales and new-to-firm sales. The EU27 performance in firm investments, innovators, and linkages and entrepreneurship is decreasing, while Bulgaria's performance is increasing in these areas. It has to be seen whether Bulgaria will be able to keep up these high growth rates, catch up with the EU27 average, and move up to the moderate innovator category.

[110] EIS (2009), p. 4.

**Figure 24: Comparison of the EU27 and Bulgaria: innovation performance and growth**




**Source:** EIS (2009).

### Bulgaria's policy priorities addressed by the support measures

The top five policy priorities that are addressed by Bulgaria's support measures are awareness creating and science education, support to innovation management and advisory services, relation between teaching and research, knowledge transfer (contract research, licences, research and IPR issues in public/academic/non-profit institutes), and horizontal measures in support of financing.[111]

Bulgaria spends 68.1% of its annual budget on horizontal measures in support of financing, 29.6% on support to innovative start-ups, and 1.3% on strategy policy documents (official documents, policy consultation papers, green or white paper programmes of structural funds).[112]

Bulgaria's support measures are addressed at energy, nanosciences and nanotechnologies, biotechnology, and ICT.[113]

### Bulgaria's main innovation policy challenges

Based on the country comparison between Bulgaria and the EU27 on competitiveness and on innovation performance and growth, the following innovation policy challenges could be identified:

- Improve linkages (firm activities): Bulgaria's performance in linkages and entrepreneurship is below the EU27 average, in particular in public-private co-publications, innovative SMEs collaborating with others and SMEs innovating in-house. (cf. Annex d). This is confirmed by quite low university-industry collaboration (see Figure 22).

[111] EC (2009g), p. 31.

[112] EC (2009g), p. 32.

[113] EC (2009g), p. 33.

- Improve firm investments (firm activities): The performance of Bulgaria's in-firm investments is far below the EU27 average. This includes weak performances in non-R&D innovation expenditures, IT expenditures, and significant weak performances in business R&D expenditures (cf. Annex d). Although the improvement rate is very high, the gap to the EU27 performance is significant (see Figure 22).
- Increase the public R&D expenditure: Bulgaria's performance in public R&D expenditure is far below the EU27 average and is declining even further at a relatively high rate (-3.5%, see Annex d).

**Main findings**

- Bulgaria's overall competitiveness is well below the EU27 average, but is increasing. It is relatively weak in business sophistication and innovation. It needs improvements in university–industry collaboration in R&D and company spending on R&D.
- Bulgaria is one of three catching-up countries, with innovation performance well below the EU27 average. Bulgaria's relative strengths are in human resources, finance and support, and economic effects. Its weaknesses are linkages and entrepreneurship, and throughput, which are mainly driven by a notably poor performance in public–private co-publications, EPO patents and community designs.
- Bulgaria's innovation improvements are impressive and far higher than the EU27 average (it had the second highest rate in the EU27). The highest individual rate is in community trademarks, with nearly 70% growth. Compared with the BRIC countries, the main growth rates, which can on occasionally exceed 100%, are related to improvements in broadband access and in private credits. Bulgaria's improvement for both indicators is 'moderate' at around 20%. Bulgaria is improving fastest in throughputs.
- China (a BRIC country) and Bulgaria show high improvements in similar areas, such as patents, trademarks, KIS exports and R&D expenditure. However, China's overall growth rate is higher than Bulgaria's.
- Bulgaria is a catching-up country with continuous improvement in innovation performance, although its performances in business sophistication and innovation, and in particular in economic effects, are still far below the EU27 average. However Bulgaria seems to be on track to improve. It is important to ensure that the high growth rate can be maintained and to address the areas with low growth rate.

## 2.4. Innovation policy observation

This section highlights the main findings regarding innovation policy, and the main differences and similarities between the countries.

**Main innovation policy challenges**

- All countries face the challenge of human resources. Highly qualified employees are required: the foundation is a good youth education, a high number of graduates and doctorate graduates leading to tertiary education and lifelong learning.
- One challenge that most countries face is the impact of the financial crisis, which has resulted in an economic downturn. In this context access to finance is difficult, as well as firm investments.
- In Bulgaria and Spain, raising firm investments, in particular public R&D expenditure, is a major challenge. For Bulgaria the increase of public R&D expenditure is important.
- Another challenge is to foster private-public cooperation. For instance, collaboration between universities and businesses or between SMEs.

**Policy priorities addressed by the support measures**

- All analysed countries have their own policy priorities. The United States, for instance, focuses on public research organisations and R&D cooperation. Japan, in contrast, put its emphasis on innovation strategies and direct support of business R&D. Switzerland focuses on R&D cooperation and on policy measures concerning excellence.
- The four EU Member States studied have the following priorities. Germany (an innovation leader) focuses on R&D cooperation and on strategic research policies. Estonia (an innovation follower) sets its priorities on the research infrastructure and R&D cooperation. Spain (a moderate innovator) focuses on R&D cooperation and knowledge transfer. Bulgaria (a catching-up country) prioritises awareness creation and science education, as well as support for innovation management and advisory services.
- Depending on the innovation stage, the EU Member States focus on different support measures. The higher the innovation stage, the higher the focus on R&D cooperation. Bulgaria as a catching-up country mainly focuses on other support measures, while the R&D cooperation is addressed by only a few support measures.

**Policy priorities addressed by budget and support measures**

- The number of support measures and the annual budget are for most countries not direct linked. An exception is for instance Japan, where the majority of support measures are allocated to the same policy priority as the main annual budget. For most other countries, the majority of support measures address a policy priority to which only a small amount of the annual budget is allocated.

### Innovation Union and options for action

The communication from the Commission states that several issues are required in order to realise the Innovation Union,[114] one of seven flagships initiated under the new EU strategy 2020.[115] These issues partly address the innovation policy challenges as identified in the country comparison:

- Modernisation of the education system
- Easy cooperation between researchers and innovators
- Easy access to EU programmes
- More research must result in innovation, and better cooperation between research and business.

The strategies for the Innovation Union are addressed to all European countries in order to improve the countries' performances. However, as the country comparisons show, the individual EU Member States are in different stages regarding their innovation performance. Therefore, in addition to a European strategy, different strategies tailored to the countries performance are needed to support the improvement of this particular country. For instance, in most countries the framework conditions need to be improved for innovation and industrial development. One option is the move to a demand-driven innovation policy. This means that the policy has to match the needs of important sectors. In economies with a more traditional structure, the policy for traditional sectors is important. In advanced service economies, it is important that innovation and industrial policy are dedicated to the service sectors.

### Concluding remarks

The comparative analysis of the innovation performance and competitiveness of various countries with the EU27 revealed the strengths and weaknesses of the EU27 and of the compared counties. Based on these analyses, main innovation policy challenges for the EU27 were identified which give first input to the development of an innovation policy. However, this alone does not provide enough insight to develop a 'good' strategy for Europe as a whole. It is also necessary to look into the different sectors and industries in detail and to tailor a strategy to the specific needs of the industries. Therefore the integration of innovation policy with industrial policy could contribute to an innovative, competitive European policy.

[114] EC (2010b).

[115] 'Europe 2020 puts forward three mutually reinforcing priorities:
– Smart growth: developing an economy based on knowledge and innovation.
– Sustainable growth: promoting a more resource efficient, greener and more competitive economy.
– Inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.' EC (2010c).

# 3. SECTORAL POTENTIAL AND CONSTRAINTS FOR INNOVATION IN THE LIGHT OF CURRENT AND FUTURE CHALLENGES

## KEY FINDINGS

- The **aim of Chapter 3** is to point out how different EU industrial sectors are prepared to meet the economic, environmental and societal challenges affecting the European Union today and in the next 15 years. According to industrial economic theorists, the features that determined and structured industrial organisation globally over the last 30 years can be summarised as a few substantial forces: globalisation, demography, technology and energy. These features are detailed in the following findings:
- These **global drivers** have changed industrial production processes worldwide and posed major challenges to countries and industries. These drivers were beneficial for countries with globally operating companies, enabling them to make a profit out of global efficiencies, rapid innovation, and highly dynamic and fast-evolving markets.
- The **sector perspective** is very important because industries differ, sometimes substantially, and consequently innovation is driven by many different factors depending on the industry.
- The main **role of industrial policy** in the European Union is to provide the right framework conditions for enterprises and to make the European Union an attractive place for industrial development and job creation. The new Europe 2020 flagship initiative, 'an integrated industrial policy for the globalisation era', aims for a more competitive European industry and is a necessity in an era of globalisation.
- Chapter 3 shows that the **non-R&D** and **non-technological factors** are of growing importance in manufacturing and also in services and in emerging sectors.
- Chapter 3 observes that a number of **challenges affect all sectors** (e.g. knowledge creation/transfer, human resources and financial constraints), while other challenges are **very sector-specific** (e.g. regulation issues, specialist knowledge, in-house R&D, finance).
- The European **automotive sector** is central to Europe's prosperity, employing 12 million people directly and indirectly. Future trends considered as particularly important are scientific and technological (S&T) developments, emerging social demands and the fight against climate change. In line with European climate policy, binding limits for greenhouse gas (GHG) emissions for the new vehicle fleet have been set, but it is highly desirable to establish clear and reliable targets from 2020 onwards.

- The **aerospace industry** is one of the key high-tech sectors in Europe, providing work for about 375,000 people. Besides advances in S&T, increasing income levels worldwide and public procurement are particularly strong drivers for innovation in this sector. In future, more radical innovation is needed to achieve the goals set in context of the climate debate to reduce fuel consumption and noise levels.
- More than 100,000 people are employed in Europe's dedicated **biotech companies** and over 400,000 people in firms partially active in this field. One of the main drivers in this field is the rapid advances in S&T. Europe is at the forefront of global efforts towards a bio-economy with the knowledge-based bio-economy (KBBE) concept, but policy uncertainties are major obstacles to overcome, especially in agricultural biotechnology.
- The **construction sector** is very labour-intensive, providing 14.8 million jobs in the European Union. Entering the 21st century, the construction sector faces substantial changes: climate change, demographic change and resulting changes in the demographics of workforces are only a few of them. The rapid developments that impose stress on this sector call for action, such as quick integration of new technologies to remain competitive on a global level.
- The **electrical engineering industry**, one of the largest industries in the world, employs around 2.8 million people in Europe in about 200,000 enterprises. Advancements, especially in materials science, the S&T convergence, ubiquitous networks and embedded technologies, are driving the field further. The integration of a variety of data sources and the ongoing personalisation of networks, e.g. social networks and systems, are accompanied by privacy and security risks – a future challenge for policy-makers.
- More than 4 million people work in the European **food and drink industry,** comprised of about 310,000 companies. However, the European food and drink industry is facing declining competitiveness on a global scale. One future pressing issue is the blurring border between normal nutrition, prevention of sickness, and medicine, and the definition of regulations at this intersection.
- The **knowledge-intensive business services (KIBS) sector**, employing about 15 million people in the European Union, is based on professional knowledge, which can be either scientific or technological knowledge, or of more administrative and social nature. The main source of current and future innovation for the KIBS sector is ICT. Trade liberalisation is, and will be, of high importance for this sector.
- The labour-intensity of the **retail and wholesale sector** is reflected by nearly 30 million jobs, giving retail and wholesale a unique role in the European economy. As is true for many other sectors, the rapid advancements in ICT have influenced the commerce sector drastically at many different levels. The commerce sector is among the largest investors in ICT equipment. Trade liberalisation, the removal of tariff and non-tariff barriers, and the opening of world markets could help to improve the competitive position of the EU commerce industry.
- The European **textile and clothing industry** employs 2.5 million people in about 220,000 companies. It is believed that Europe's future in the textile and clothing industry will be built on its existing strengths. But how to restructure and reorganise the sector in order to respond to an inexhaustible supply of cheap labour from emerging economies will be an important (policy) question for the future.

## 3.1. Global trends identified for European industry

A recent EC report on *The World in 2025*[116] describes major trends until 2025 (e.g. education, demography, urbanisation, science, culture and macro-economic projections) and highlights the stress on emerging production-consumption patterns and natural resources. By 2025, the world as we know it today, e.g. with its wealth and industrial production, could shift towards Asia. At the same time, the US as well as the EU could lose their technological and scientific edge over Asia. Around 20% of the world's R&D could be accounted for by China and India. Besides the older trend of global fragmentation of value chains and the challenge for European industries of how to benefit from high growth in other regions, research and innovation chains or systems are also globalising.

Within the next 16 years, the world's population could reach 8 billion, the experts in the report say. Most of this population growth (9.7%) will take place in developing countries. The analysis of demographic growth for 2025 indicates that the European population will only contribute 6.5% to the world's population. The financial crisis and global macro-economic instability over the last few years are a challenge, not only for European industries but for the whole EU economy and society at large, for instance in terms of slow growth, unemployment and the restructuring of the welfare state in EU Member States.

Global challenges are major issues, crossing borders and affecting the whole of society. The international political agenda has noticed these global challenges; the need for international collaboration is perceived. Most national governments have recognised their own inability to effectively address overpopulation or environmental degradation on their own. A direct consequence of this is the internationalisation of certain tasks, making them a common issue, e.g. peace-keeping or environmental protection. Nations are working closer together to build an international community. Today's global challenges include, for example, climate change, demographic changes, terrorism and epidemics.[117]

The new Europe 2020 flagship initiative, 'an industrial policy for the globalisation era', is responding to several of the global trends described in the following sections. It deals with the intensifying globalisation, it will provide better transport, communication and energy infrastructure for the European industry, and it plans a new space policy.[118]

### 3.1.1. Globalisation and its impact

'The term "globalisation" has been widely used to describe the increasing internationalisation of financial markets and of markets for goods and services. Globalisation refers, above all, to a dynamic and multidimensional process of economic integration whereby national resources become more and more internationally mobile while national economies become increasingly interdependent.'[119] Globalisation is, therefore, in the first place an economic trend, and it is a major economic challenge to address its economic impact. For EU industries, a major implication is to develop strategies that benefit from the global division of labour and fragmentation of value chains, and to specialise and find niche markets. Similarly, for industrial and innovation policies at EU, national and regional level, a major impact is the need to specialise by finding and strengthening specific competitive advantages, since in a globalising system of research, innovation and production no single region can excel in all fields.

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[116] EC (2009h).

[117] Montalvo et al. (2006).

[118] See: http://ec.europa.eu/enterprise/policies/industrial-competitiveness/industrial-policy/index_en.htm

[119] OECD (2005a).

The debate around globalisation and its impacts centres on certain questions, for example whether globalisation is a good or bad thing, both for individual nations and the world, and when it encompasses a potentially large number of areas.[120] Europe (like the United States) is a great driver of globalisation, and can and should contribute to its shape at the international level.[121]

### 3.1.2. Energy and the availability of natural resources

By 2030, the demand for energy is expected to be considerably higher than today. Gas, besides coal, biomass and other renewable energies, will be of particular increasing importance as states strive to firstly secure energy supplies and secondly to aim for energy independence. It is likely that the majority of the gas will come from only very few regions in the world like the Persian Gulf (Qatar, Iran), Russia, the Arctic and Central Asia or Africa.

Boundary disputes could become linked to energy issues, just like water issues have been in past and will be in future. The EU is critically dependent upon imports of energy and therefore other countries and their political stability.

The increase in global GDP by 2050, likely to be three to six times the GDP of today, will contribute strongly to the unsustainable consumption of ecosystem services. This trend is probably continuing even while the population growth starts to slow and level off in mid-century.[122] There will be various dramatic environmental crises, for example rising ocean levels, habitat destruction, increased disease transmission, declined crop productivity, overfishing, a decline in water availability, increased natural hazards and changed ocean chemistry.[123]

The limitation of natural resources like fresh water and land in combination with the population growth and climate change will have severe implications on the agricultural sector. This sector is already struggling to fulfil the need for food, fuel, fibre and increasingly chemicals, while at the same time reducing the impact on the environment. Future success depends critically on the use of innovative technologies to even use saline water.[124]

### 3.1.3. Demography and its impact

In the year 2029, the world's population will rise to over 8.3 billion people. Six billion of these people are predicted to live within 100 km of the coast and 60% will be urbanised. The highest growth (9.9%) is expected to occur in developing countries. Hence this intense increase is paired with partly severe poverty or at least with economies which indeed permit populations to grow, but which are not adequately prepared to meet the rising expectations.[125, 126, 127]

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[120] OECD (2008a).

[121] Barroso, J.-M. (2010a).

[122] *Millennium Ecosystem Assessment Vision 2050*, www.millenniumassessment.org/en/index.aspx

[123] Sachs, J. (2008), pp. 15, 16, 17, 23, 94, 97, 99, 125, 147, 148, 153, 154, 159, 252, 267, 292.

[124] Fedoroff, N. V. et al. (2010), pp. 833–4.

[125] JOE (2008).

[126] EC (2009i).

[127] OECD (2008a).

However, in the UN 2008 Revision (unlike in the past), growth rates are assumed to decline and eventually to turn negative.[128] In this case, world population will start declining,[129] which constitutes a major change from a pattern that has lasted for centuries. Some projections see the world population in 2100 being back to less than 6 billion.[130]

The implication for firms and economies is that there is a need to adjust strategies to these demographic trends, for example by investing more in human resource development, and anticipating the changing demand for products and services in an ageing society.

### 3.1.4. New developments in technology

New developments in technology are dramatically redefining the way we see and conceptualise the human body, and even life itself. Major drivers for today's economies are (new) technologies which penetrate our society more and more. Meant to facilitate our lives, one could also argue, and in fact many people do, that technology has also negative impacts on our society. Perhaps one of the most important technological trends is the continuing ICT revolution affecting almost all parts of our daily life. Major advances in biotechnologies are redefining the boundaries of humanity itself and calling into question the distinctions between artefact and nature, life and death, organic and inorganic.[131]

The impact of so-called general purpose technologies (GPT), such as ICT, biotechnology, nanotechnology and new materials, is being felt in many sectors. A major task for innovation policy is to promote the diffusion of these technologies to other sectors and other countries, regions and firms, which could absorb and adopt these technologies and develop specific applications. The other side of this coin of globalising flows of knowledge is that it has become more difficult for a firm, industry, country or region to benefit economically (e.g. in terms of production and employment) by developing new technologies. The linear view that investing more in R&D will automatically lead to more innovation and productivity in the same firm, industry, region or country has, in this respect, become less relevant. Linking research and innovation policy by involving both the technology-supplying and technology-demanding actors and sectors through science–industry relations was already a good step, but at the level of the regions, Member States and the European Union as a whole, a logical next step is to integrate research programmes into innovation programmes and to integrate research partnerships into innovation partnerships.

Concentrating research excellence in a few centres in Europe increases the chance of being able to maintain global competitive advantages, whereas fragmentation of research excellence across all regions and countries within the European Union is a major barrier. However, innovation policy is relevant for all regions (and sectors). Cohesion policy, especially with the increasing share of innovation policy, can complement this excellence-based research policy with place-based innovation and industry policy.[132]

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[128] United Nations (2009).

[129] Mainly originating in developing countries where, parallel to what was observed in developed countries, fertility rates are assumed to decline as a result of growing prosperity as well as the education and emancipation of women.

[130] Personal communication of Vasco Cal, May 2010.

[131] OECD (2009a) and OECD (2009b).

[132] Barca, F. (2009).

Recommendations for EU research and innovation policy with respect to the global drivers (globalisation, energy, demography and new technologies):

**Maintain EU leadership in key RTD areas by focusing and concentration**

The European Union should work to maintain its leadership in key RTD areas, such as energy technologies, sustainable development, climate change, food safety and health. More focus and concentration of research efforts in the context of an excellence-based EU research policy is needed to address the fragmentation of excellence in research. Mechanisms for priority setting in European research policy have to be strengthened.

**Europe must not fall behind in R&D**

Experts suggest that Europe becomes a model based on emphasising quality of life, which might involve securing access to global knowledge and setting international standards in science and technology. In order to provide access to global knowledge and linkages with global networks it is necessary for Europe to be an attractive place for incoming researchers and investments as is pointed out in the *World in 2025*.[133]

**From 'brain drain' to 'brain circulation'**

The situation regarding 'brain drain' could shift towards a situation of 'brain circulation'. The number of young researchers which will study abroad is expected to increase even further. It is, for instance, expected that by 2025 more than 600,000 students from China will study abroad, but also the number of students from Europe who will study in China will increase.

**Effective governance is crucial**

Europe needs good policy in order to retain its traditionally strong position in developing cutting-edge innovation that goes beyond incremental improvements of existing technology. Some important governance issues are to be improved. Take for instance the so-called 'Grand Challenges', which are mostly global challenges where the European Union should not merely focus on cooperation among Member States, but at a global level. The Grand Challenges have also changed the approach towards priority setting in research. After many years of addressing the challenge to bridge the gap between Science and Industry, it is widely acknowledged that there is need for even stronger coordination between research policy and innovation policy because of the importance of serving wider societal needs.

**Integrate research and innovation policy with industrial policy**

According to the new industrial policy, all sectors are important. This contrasts with the traditional concept of a more strategic industrial policy, favouring certain industries. With the new EU state-aid rules, support to R&D activities is the only form of state aid allowed to support certain economic activities. Research policy has therefore become a major instrument for a strategic innovation and industrial policy approach.

[133] EC (2009h).

## 3.2. EU industry sectors: addressing current and future challenges

In this chapter particular attention is paid to data from the Community Innovation Survey (CIS) and the studies carried out under the existing Europe INNOVA – Sectoral Innovation Watch (SIW). Statistical data derived in these studies builds upon the NACE classification.[134] The following nine different industry sectors have been selected for review:[135] automotive, aeronautics and space, biotechnology, construction, electrical and optical equipment, food and drink, KIBS, retail and wholesale trade, and textile and clothing. For these nine sectors, comparative information on technological and social trends, competitiveness and innovation is available. Additionally these nine sectors include Europe's most important sectors in terms of employment and turnover (e.g. automotive and KIBS) as well as some of the most innovative sectors, although they comprise fewer companies (e.g. biotech).

### 3.2.1. Automotive

**Status quo**[136]

The European automotive industry is central to Europe's prosperity, accounting for roughly 10% of GDP, employing 2.2 million people directly in 2008 and another 9.8 million indirectly.[137] It is the largest producer of motor vehicles worldwide, investing roughly €33 billion in research and development activities, i.e. one quarter of the total industrial investment. This level of investment has made this sector the largest private investor in R&D in Europe.[138] Statistically, the automotive sector consists of three NACE sub-sectors in the Eurostat classification.[139]

Most of the 17,000 enterprises in the automotive sector are SMEs with fewer than 50 employees, accounting for about 4% of the total value added in the industry. Within Europe two countries dominate production, Germany and France, although Spain, the United Kingdom, Italy and Sweden also have important car manufacturers. Furthermore, a number of new Member States such as Hungary, Czech Republic, Slovakia and Poland have emerged in recent years as important manufacturers. The automotive industry is also characterised by a high degree of globalisation, with increasing investment by European producers in other regions, and by South-east Asian producers in Europe.

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[134] The European Classification of Economic Activities (in French: Nomenclature statistique des activités économiques dans la Communauté européenne), commonly referred to as NACE, is derived from the United Nations' International Standard Industrial Classification of all Economic Activities. This allows comparability at world level of statistics produced on the basis of NACE. 'New Professional and Business-related Services – Status and Prospects', European Parliament Committee on Industry, Research and Energy, IP/A/ITRE/ST/2007-03, March 2008.

[135] The nine sectors have been selected on basis of the NACE classification, NACE Rev. 1.1: Biotechnology (fragmented in NACE Rev. 1.1); Electrical and optical equipment (NACE 30, 31, 32, 33); Automotive (NACE 34); Space and aeronautics (NACE 35.3); Construction (NACE 45); Wholesale and retail trade (NACE 50, 51, 52); Knowledge-intensive services (NACE 72.10, 72.20, 72.30, 72.40, 72.50, 72.60, 72, 73, 73.10, 73.20, 74.2, 74.3); Food & Drink (NACE 15, 16); and Textile (NACE 17, 18).

[136] Much of the information for this section has been drawn from the Europe INNOVA Sectoral Innovation Reports on the Automotive Sector (2008 and 2009).

[137] See: www.acea.be/index.php/news/news_detail/the_auto_industry_in_2008_recession_strikes/

[138] See: http://ec.europa.eu/enterprise/sectors/automotive/index_en.htm

[139] Manufacture of motor vehicles (including cars, trucks and buses) and motor vehicle engines (NACE 34.1), the manufacture of coachwork for motor vehicles, trailers and semi-trailers (NACE 34.2) and the manufacture of parts and accessories for motor vehicles and engines (NACE 34.3).

During the financial crisis, which affected the world economy from 2008 onwards, the automotive industry was badly hit. Although the European automotive industry was less affected by the crisis than for instance the US-automotive industry, nevertheless 8% fewer cars were sold in 2008 than the year before, and a significant number of jobs are still at risk. To address the short-term need for recovery from the crisis, the European Economic Recovery Plan was implemented.[140] For the automobile sector the 'European green cars initiative' was proposed, involving research on many technologies and smart energy infrastructures. In addition the Commission suggested the development of a procurement network to increase the demand for clean buses and other vehicles. The recent Communication 'Responding to the crisis in the European automotive industry' attends to the issue as well. An in-depth analysis of the current competitiveness of the European automobile sector is given in the publication *European Industry in a Changing World*.[141]

**Embracing the future**

The automotive industry benefits greatly from its highly educated engineers, as well as from basic research in fields such as physics and chemistry, and also in technology fields such as ICT, electronics and robotics. The main S&T trends considered as particularly important for the future are energy-related topics (energy storage, (bio)fuels), material science and ICT-based manufacturing. In addition to these more generic S&T drivers, the optimisation of conventional engines, the parallelism of new technologies and safety research are especially worth a mention. Some broad social trends will have a strong impact on the demand for vehicles in the future. These include income levels and distribution, environment and resources, and the price of energy. Organisational inertia and change, globalisation, mobility behaviour and the infrastructure are also strong drivers for innovation.

Another important factor for change is the global fight against climate change and, in particular, the European Union's commitment to reduce its GHG emissions by at least 20% from 1990 levels by the year 2020. To come even close to this ambitious goal, the transport sector, and especially road transport, will have to change significantly. The European Union is seeking to achieve average emission levels for new cars of 120g $CO_2$/km by the year 2015. In fact, the European automotive industry already spends one-third of its overall R&D investment in the development of GHG-emission-reducing technologies. European R&D activities tend to focus on short and medium-term opportunities, for instance optimisation of conventional engines, and not on technologies with a long-term perspective, such as fuel cell vehicles.[142]

Out of these trends and drivers, there arise great potential and also constraints for future innovation. Examples are electric vehicles,[143] new technologies, innovation trade-offs, infrastructure providers, market demand and social structures. The accessibility of transport, and the safety of travellers and bystanders, will also be of great importance in the future.[144] Based on the identified drivers, the following main innovation themes are regarded as highly important for the automotive industry: further advances in internal combustion engines, alternative fuels, hybrid vehicles, electrified powertrains, traffic management systems, drive-by-wire and safety technologies, and resource management.[145, 146]

[140] See: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52008DC0800:EN:NOT

[141] EC(2009j)

[142] Wiesenthal et al. (2010).

[143] Wiesenthal et al. (2010).

[144] DTI (2002).

[145] These innovations themes are in line with a couple of recently published studies on the future of the automotive industry. See for instance FURORE (2006); DT (2004); FuTMaN (2003).

[146] Brown, S. and Whitaker, J. (2007).

The European Union is upgrading its transport infrastructure and services through its Europe 2020 flagship initiative on industrial competitiveness.

### Options for innovation policy

The main objectives of the European Commission with respect to this sector are, first of all, to strengthen its current and future competitiveness.[147] Additionally it is intended to adjust, simplify and complete the internal market regulatory framework,[148, 149] and finally to promote globalisation of the technical regulatory framework through the United Nations Economic Commission for Europe (UNECE).[150,151,152] Several unsolved questions remain which could impact on future successful competitiveness. For example, what are the **innovation themes to gain competitiveness**, and how can competitive advantage be retained over Japan (which has leadership in hybrid technologies) and Asia (with its low-cost production)? There is an issue for discussion on whether R&D should favour the development of specific technologies, such as material research, drive-by-wire or alternative fuels. Should the Commission develop a common strategy in cooperation with the European Automobile Manufacturers' Association (ACEA) for the European automotive industry to determine priorities between alternative technologies?

In line with European climate policy, the path has been set for Europe's future automotive sector with respect to several issues. Giving binding limits for GHG emissions in the new vehicle fleet from 2015 onwards is one important step towards more sustainable road transportation, but **clear and reliable targets from 2020 onwards are highly desirable**. In particular, **developments of long-term vehicle technologies** need to be properly supported since the industry's own efforts are not naturally oriented to these.

## 3.2.2. Aeronautics and space

### Status quo[153]

The aeronautics industry in Europe develops and manufactures a great variety of products including civil and military aircrafts, unmanned aerial vehicles, engines, and also equipment and whole systems. The sector hosts companies for maintenance and service which carry out repair work, technical training or other activities.[154] Aerospace is the commonly used international term referring to companies operating in the space, aeronautics and defence sectors.[155] Even though historically the aerospace sector is treated as a whole (statistically represented by NACE classification 35.3) there are diverging elements between aeronautics and space.

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147 See: http://ec.europa.eu/enterprise/sectors/automotive/index_en.htm

148 See: http://ec.europa.eu/enterprise/enterprise_policy/industry/index_en.htm

149 Roadmap on regulations and standards for the electrification of cars. See: http://ec.europa.eu/enterprise/sectors/automotive/files/pagesbackground/competitiveness/roadmap-electric-cars_en.pdf

150 See: http://ec.europa.eu/enterprise/sectors/automotive/competitiveness-cars21/cars21/index_en.htm

151 See: http://ec.europa.eu/enterprise/sectors/automotive/competitiveness-cars21/energy-efficient/index_en.htm

152 See: http://ec.europa.eu/enterprise/sectors/automotive/competitiveness-cars21/energy-efficient/public_hearing_en.htm

153 Much of the information for this section has been drawn from Hollanders et al. (2008) and Brandes F. and Poel M. (2009).

154 See: http://ec.europa.eu/enterprise/policies/space/index_en.htm

155 See: http://ec.europa.eu/enterprise/sectors/aerospace/index_en.htm

The aerospace industry is one of the key high-tech sectors in Europe, providing work for about 375,000 people in 2008 and generating a turnover of approximately €128 billion.[156] It is world leading in the areas of 'civil aircraft, business jets and helicopters'.[157]

Today the manufacture of large civil aircrafts makes up the largest share of turnover, accounting for over €20 billion per annum. The industry is geographically concentrated in a few countries, most notably the United Kingdom, France, Germany, Italy, Spain, Poland and Sweden.[158]

The European space industry managed to achieve a good overall performance in the years 2008 and 2009 despite the global economic crisis.[159] A survey of management experts shows that the sector could return to pre-crisis growth by late 2012.[160]

**Embracing the future**

The major, generic developments in S&T that are relevant drivers for aeronautics and/or space fall into six categories:[161]

| | |
|---|---|
| IT development and avionics | Alternative propulsions and fuels |
| Artificial intelligence | 3D video conferencing |
| New materials and nanotechnology | IT development and avionics |

On the demand side, increasing income levels worldwide are a particularly strong driver for change in this area. With growing incomes, people spend more time on holidays and travel farther. An increasingly large proportion of the world population is achieving the income level at which people demand air travel. Globalisation requires increasing levels of mobility by firms to manage international production networks and goods. Falling prices due to strong competition caused by deregulation and privatisation of airlines and air traffic management are strongly driving the growth in air travel. But there are also growing environmental concerns and legislation (regarding carbon tax, air quality and noise levels), which are important drivers for developing new technologies. Those societal challenges – referring to environmental degradation, but also climate change, the mobility challenge and a perceived need to improve security – are expected to be a key demand driver for governments to invest in space applications to monitor and measure environmental effects, and increase the effectiveness of policies.[162] Furthermore, capacity issues and low-cost carriers result in more and more point-to-point connections, challenging the traditional hub-and-spoke model that drives small-scale distributed air travel. Other demand-side drivers include safety regulation, public procurement and cuts in military budgets.[163]

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[156] See: http://ec.europa.eu/enterprise/sectors/aerospace/market-data/index_en.htm

[157] See: http://www.europe-innova.eu/c/document_library/get_file?folderId=18089&name=DLFE-1406.pdf

[158] Several European and international aerospace companies frequently publish market outlooks, for example: Airbus Global Market Forecast 2009–2028: See: http://www.airbus.com/en/corporate/gmf; Rolls-Royce Market Outlook 2009: See: http://www.rolls-royce.com/investors/company_profile/market_outlook/= ; Boeing Market Outlook 2009-2028: See: http://www.boeing.com/commercial/cmo/; AeroSpace and Defence Industries Association of Europe, a private association grouping the national aerospace associations in the European Union and other countries as well as major manufacturers, regularly publishes a 'Facts & Figures' booklet: See: www.asd-europe.org/Content/Default.asp?PageID=16

[159] ASD (2009).

[160] Roland Berger (2010).

[161] Applied from Hollanders et al. (2008).

[162] OECD (2005b).

[163] Applied from Hollanders et al. (2008).

Prospective and emerging sectoral innovation activities in aeronautics focus mainly on environmentally friendly air travel, new airframe configurations and new propulsion systems. Small aircraft and personal air transport services, personal and unmanned aerial vehicles and (new) air traffic management are other activities worth mentioning. ACARE,[164] the European Technology Platform for Aeronautics Research,[165] defined the objectives for the deployment of European space technologies within the next ten years to be firstly the extension of the coordination process to all EU Member States and the provision of a long-term vision for R&D in space technology. Other objectives are the implementation at EU level of the 'vision and a coherent cooperation framework for the deployment of space technologies within the European Space Programme'.[166] Further aims are the promotion of actions to reduce European dependence on critical space components, and the enhancement and cross-fertilisation of technology by developing synergies between the European Space Technology Platform (ESTP) and other related technology platforms (e.g. for fuel cells, nanotechnologies, materials) and the promotion of the European industrial base competitiveness on a global level.

Emerging innovation activities in the space sector include Global Navigation Satellite Systems (GNSS) such as Galileo, earth observation, micro satellites, the impact on launchers and services, and the growing field of space travel and tourism.[167]

Potentials and constraints for innovation are particularly found in the knowledge and skill requirements, networks and linkages with other sectors, and organisational and institutional change. Regulatory issues, sources of financing for (radical) innovation, fragmented research efforts across Europe and a tension between safety and environmental regulation are possible barriers to be overcome.[168]

Recent and ongoing EU policy actions in this sector, which also address future challenges, are manifold. They focus on the one hand on agencies, organisations and European platforms, and on the other hand on studies, surveys, competitiveness reports and statistics. The following list gives a sample of ongoing activities:

- Statistical investigation of the sector, e.g. *Statistics in Focus: Manufacture of aerospace equipment in the European Union* - Issue number 7/2006.[169]
- A report on the competitiveness of the EU aerospace industry (with a focus on the aeronautics industry) prepared within the Framework Contract of Sectoral Competitiveness Studies – ENTR/06/054.[170]
- Much of the regulation for the sector is set at international level by the International Civil Aviation Organisation (ICAO).[171]
- The European Aviation Safety Agency (EASA) is central to Europe's civil aviation system. Some of the aims of the agency are giving advice to the EU for designing new legislation, certification of aircrafts and authorisation of third-country operators.[172]

[164] See: www.acare4europe.org/

[165] See: www.acare4europe.com/docs/Towards2050

[166] ESTP (2006).

[167] Applied from Hollanders et al. (2008).

[168] Applied from Brandes F. and Poel M. (2009).

[169] Eurostat (2006).

[170] ECORYS (2009).

[171] See: www.icao.int

[172] See: www.easa.eu.int/ws_prod/index.html

- The Advisory Council for Aeronautics Research in Europe (ACARE) is developing a European Strategic Research Agenda (SRA) for aeronautics.[173]
- The Joint Technology Initiative, Clean Sky, is developing new technologies, for example for green engines, new eco designs and systems for green operations to improve the impact of air transport on the environment.
- ICAO has established a 'balanced approach' concept to better manage aircraft noise.[174]
- The SESAR project aims at modernising the European air traffic infrastructure. The new generation of air traffic management systems should ensure safety and smooth air transport on a global scale for future generations.
- Space policy is one explicit topic in the new Industrial Policy for the Globalisation Era. It is intended to increase the competitiveness of European companies in this field and hence create a solid industrial base.[175]

**Options for innovation policy**[176]

Five topics of high importance for future innovation within the aerospace industry can be identified:

- In many technology segments, a high level of incremental innovation can be observed, which is important for efficiency improvements. However, there is also a **need for more radical innovation** to achieve the goals set in the context of the climate debate to reduce fuel consumption and noise levels. Today's achievements are built on past strategies; there is a need for new innovative strategies.
- **How to improve networks for entrepreneurs and SMEs.** Networks in space favour large, existing players. Entrepreneurs and innovative SMEs have the potential to introduce radical innovation in the sector, which established players often lack, since they are bounded by established commercial interests. Partnerships and collaborative networks for R&D should be fostered, as well as a higher integration of European, national and interdisciplinary research programmes including SMEs.
- **How to stimulate downstream services.** Important emerging markets in space lie together with downstream services exploiting data from space infrastructure. Clusters and specialisation play a key role in the competitiveness of the aerospace sector. New technologies become increasingly important (avionics, composites), which poses the question: to what extent is the geographic clustering of the industry (within Europe, and globally) about to change?
- The aerospace sector is geographically highly clustered in terms of research and production. With the increasing importance of electronics and new materials (e.g. avionics and composites), these pose a potential **impact on the geographic structure of the sector**. Are avionics located in aerospace clusters, or can a shift to 'new' aerospace clusters be observed around avionics?
- How to handle emerging markets and regulatory barriers. For space to develop from an institutional to a commercial sector, legal certainty for investors needs to be assured. How can regulation be simplified? For the further development of personal air transport services and personal aircraft, **regulation needs to be harmonised and simplified** between EU countries.

[173] See: www.acare4europe.org

[174] OJEC (2002).

[175] EC (2010a).

[176] Applied from Brandes F. and Poel M. (2009).

### 3.2.3. Biotechnology

**Status quo**[177]

Biotechnology is a cross-sectional enabling technology used in a variety of industry sectors such as (animal) health, the chemical industry, fuel production, textiles, paper, plastics, food and feed processing.[178] The OECD defines biotechnology as 'the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services'.[179] The main application areas of modern biotechnology can be classified into three groups: healthcare and pharmaceutical products, the agricultural sector and industrial processes.

More than 100,000 people are employed in dedicated biotech companies in Europe, and there are over 400,000 people in firms partially active in this field.[180] According to an Ernst & Young biotechnology report (2010),[181] Europe has 1,790 biotech firms (compared with 1,699 in the United States), most of which are small or medium-sized. However, the United States is the world-leading biotech country in terms of indicators, such as the quality and quantity of biotech-related companies, number of patents applied for and granted, and number of publications. Ernst & Young concludes that 'the US biotech industry employs twice as many people as Europe's, spends three times more on R&D, raises more than twice as much venture capital – raises more than twice as much through equity, raises more than three times as much through debt financing, and generates twice as much revenue in total'.[182] While EU publicly traded biotech companies have revenues of nearly €12 billion, the United States stands out with more than US$56 billion in revenues. The financing gap in Europe is much larger than in the United States, and this is one major obstacle to overcome. The status of the EU biotech sector with respect to the three application fields is very diverse. While the European industry has good positions in the dominant biotech branch, healthcare (with well-filled product pipelines) and industrial biotechnology (with a strong chemical industry), agricultural biotechnology has fallen behind mainly because of acceptance issues, and long and demanding authorisation procedures. This again leads to less investment, slowing growth further. Europe entered the biotech sector later than the United States and has still a long way to go to catch up; there are also fast-emerging new competitors, particularly from the Asia-Pacific region.

**Embracing the future**

The OECD formulates the drastic future impact of biotechnology as follows: 'The application of Biotechnology to primary production, health and industry could result in an emerging "bio economy" where biotechnology contributes to a significant share of economic output.'[183] Some of the main drivers for innovation and sustainable growth in this field are the convergence and rapid advances of technologies, including for example DNA analytics and synthetic biology, and also neighbouring technologies such as nanotechnology and ICT. Great potential for innovation but also for constraint can be found in the financing situation of SMEs, regulation issues and the EU-level harmonisation debate.

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[177] Much of the information for this chapter has been drawn from Gijsbers, G. and van der Valk, T. (2009).

[178] Patel et al. (2008).

[179] See: www.oecd.org/document/42/0,3343,en_2649_37437_1933994_1_1_1_37437,00.html

[180] EC (2009j).

[181] The methodology of the E&Y report differs significantly from the OECD approach, e.g. E&Y mentions only approx. 50,000 employees in EU biotech firms and approx. 100,000 in US biotech firms.

[182] Ernst & Young (2010).

[183] OECD (2009a).

Hence some prospective and emerging innovation activities in this sector are concentrating on new products, processes and technological trajectories. Several scientific topics are expected to become more and more important. Examples are regenerative medicine and tissue engineering, advanced drug delivery systems, pharmacogenomics and biomarker analysis, renewable bioplastics, biofuels biopharming and further development of genetically modified (GM) crops. To be prepared for these emerging fields of science and technology, a further move towards collaborative R&D and open innovation is essential, as is an appropriately educated workforce. The EU states, that 'the main competitiveness factors include access to public and private finance, cluster formation and networking, IPR as a tool to commercialise scientific results, and demand-side factors such as standards, labels, public procurement and market access'.[184] To address these and other far-ranging global trends affecting this sector, such as climate change and energy/resource efficiency, a comprehensive policy approach is needed. Current European biotechnology policy goals deal with issues such as the ageing society, public health, economic growth and the creation of jobs. The protection of the environment is another aim.[185] The European Commission aims for a profound assessment of the European competitiveness situation in the biotechnology sector and so derive policy recommendation to improve today's framework conditions. The Commission's Life Science and Biotechnology Strategy and Action Plan defines the tasks and also the responsibilities. Within the EU 2020 strategy[186] the European Union aims for a transition from a fossil-based to a bio-based economy by 2020, addressing the global trend towards more sustainability and resource efficiency, as well as raw material, energy and food security, and independence from other sources or countries. The KBBE concept[187] includes this idea of turning our society into a sustainable economy, and the European Union is at the forefront of global efforts with this initiative. Other policy actions taken by the European Union are the Lead Market Initiative, the Strategic Energy Technology Plan, various Directives, such as the Biofuel Directive and the Waste Directive, and of course research in the Grand Challenges (of the Lund Declaration). More visionary is a possible future reform of the Common Agricultural Policy (CAP).[188]

### Options for innovation policy[189]

In the future, **developments in agricultural biotechnology**, which are today booming worldwide, are expected to play an ever-increasing role. Currently agricultural biotechnology in the European Union is very limited.[190] This may change, depending on political decisions and their effect on the agricultural sector in the European Union, and whether the EU agricultural industry will be able and willing to take up the opportunities. There will then be **a need for new measures to support EU companies in improving their competitive position** in relation to, for instance, their US counterparts. For the agricultural biotech sector as well as other biotech areas, ongoing communication with the general public is of continuing importance. In several of the innovation themes discerned, especially GMOs, but also biopharming and biofuels, policy developments in the European Union have been uncertain. This **uncertainty with regard to policy developments at EU level** needs to be resolved. At the same time, firms and research institutes working in biotechnology could benefit from **more harmonisation across Member States**, including for example in the field of stem cell research.

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[184] See: http://ec.europa.eu/enterprise/sectors/biotechnology/policies/index_en.htm

[185] See: http://ec.europa.eu/enterprise/sectors/biotechnology/index_en.htm

[186] Barroso, J.-M. (2010b).

[187] See: www.KBBE2010.be

[188] Rute, M. (2010).

[189] Applied from Gijsbers, G. and van der Valk, T. (2009).

[190] Anderson, K. and Jackson, L. A. (2006).

### 3.2.4. Construction

#### Status quo[191]

The European construction sector[192, 193] has been of great importance for many hundreds of years, providing buildings and infrastructure on which all sectors of the economy rely. It is the largest cluster employer in the European Union, accounting for nearly 20% of GDP.[194]

The construction sector is very labour-intensive, providing more employment than any other sector, even though the sector is highly fragmented. Many companies in this sector are very small (with ten or less employees) and self-employment is commonly seen.[195, 196] In 2007, about 14.8 million people, accounting for some 11.5% of the non-financial business economy workforce, were employed in the construction sector, generating an estimated €562 billion of value added.[197] Construction is a sector with relatively low R&D investment and a high degree of regulation, particularly in the areas of energy, environment and safety.[198] To maintain the competitiveness in the construction sector, it is of great importance that market operators should show commitment to sustainable development objectives, research and innovation activities, and nurturing a skilled and well-educated workforce.

#### Embracing the future

Entering the 21st century, the construction industry faces substantial changes. Climate change, demographic change and related changes to the demographics of the workforce, and the declining availability and rising cost of raw materials create pressure on this sector. But the construction industry is very much needed – today and in the future – to provide ever smarter, more energy-efficient houses and generally better living and working conditions. Public procurement and innovative commissioning are important demand-side drivers, as are discrepancies between owners and users, and changes of ownership. On the technology-push side, the major drivers of innovation and change in this sector are particularly ICT and new technologies for energy supply and energy efficiency. Also of importance are advanced manufacturing techniques, nanotechnology, biotechnology and bionics. The sector is slowly changing from a technology-push to a demand-driven industry. This is reflected in the vision of the European Technological Platform for Construction (ETPC): 'in the year 2030, Europe's built environment is designed, built and maintained by a successful knowledge- and demand-driven sector'.

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[191] Much of the information for this chapter has been drawn from Schartinger, D. (2009).

[192] In the NACE statistical classification of economic activities, construction activities fall within Section F (which is the same as NACE Division 45). In NACE, construction is defined according to chronological stages of the construction process, starting with demolition and site preparation (NACE Group 45.1), passing through general construction activities (NACE Group 45.2), and ending with installation (NACE Group 45.3) and completion work (NACE Group 45.4). One final construction activity covers renting by an operator of construction equipment (NACE Group 45.5).

[193] Eurostat (2009a).

[194] ECTP (2005a).

[195] E-CORE (2005).

[196] EC (2007a).

[197] See: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Construction_sector_statistics

[198] See: http://ec.europa.eu/enterprise/sectors/construction/documents/ce-marking/index_en.htm

Out of this prospective and emerging picture, sectoral innovation activities include eco-efficient buildings, smart home technologies and the establishment of an ETPC. Particularly significant potential constraints for innovation are latent skill gaps, regulation and codes for sustainability, and standardisation issues.

The European Union has taken action in the construction sector, and commissioned studies on standards and technical agreements, life-cycle analysis and future qualifications. Labels have been introduced and working groups launched. The following table gives a non-comprehensive overview of recent and ongoing activities.

| | | |
|---|---|---|
| Benchmarking of construction efficiency in the EU Member States[199] | Life cycle costing: a contribution to sustainable construction: towards a common methodology[200] | Analysis/assessment of certain Community policies that impact on the competitiveness of the construction sector[201] |
| New industrial policy[202] | Competitiveness of the European Construction Industry (COM (97) 539) | E-Business Survey 2006: Construction Industry[203] |
| Construction efficiency (CE) marking[204] | Internal market[205] | Defining the attestation of conformity systems[206] |
| Future qualification and skills needs in the construction sector[207] | Eurocodes[208] | Construction Working Groups [209] |
| Voluntary arrangements for collaborative working in the field of construction services[210] | The Essential Requirements[211] | Life-cycle Assessment in Construction[212] |

[199] See: http://ec.europa.eu/enterprise/sectors/construction/competitiveness/benchmarking/index_en.htm

[200] See: http://ec.europa.eu/enterprise/sectors/construction/competitiveness/life-cycle-costing/index_en.htm

[201] See: http://ec.europa.eu/enterprise/sectors/construction/competitiveness/ec-policies-impact/index_en.htm

[202] See: http://ec.europa.eu/enterprise/enterprise_policy/industry/index_en.htm

[203] See: http://www.ebusiness-watch.org/studies/sectors/construction/construction.html

[204] See: http://ec.europa.eu/enterprise/sectors/construction/documents/ce-marking/index_en.htm

[205] See: http://ec.europa.eu/enterprise/sectors/construction/eurocodes/internal-market/index_en.htm

[206] See: http://ec.europa.eu/enterprise/sectors/construction/documents/attestation-of-conformity/index_en.htm

[207] See: http://ec.europa.eu/enterprise/sectors/construction/competitiveness/qualification-and-skills_en.htm

[208] The Eurocodes is a set of 58 common standards containing the European calculation methods to assess the mechanical resistance of structures or parts thereof (See: http://ec.europa.eu/enterprise/sectors/construction/eurocodes/index_en.htm). The codes were finalised, adopted through a formal vote and published before the end of May 2007. The Eurocodes are the Europe-wide means for the structural design of buildings and other civil and engineering works and as such they are of vital importance to the entire European construction sector, including designers, architects, contractors and producers of structural construction products. The 58 parts of the Eurocodes (European Standards) cover 10 design areas (basis of design, actions, steel, concrete, composite steel and concrete, timber, masonry and aluminium, as well as geotechnical design and seismic design).

[209] See: http://ec.europa.eu/enterprise/sectors/construction/documents/construction-working-groups/index_en.htm

[210] See: http://ec.europa.eu/enterprise/sectors/construction/competitiveness/voluntary-arrangements_en.htm

[211] See: http://ec.europa.eu/enterprise/sectors/construction/documents/essential-requirements/index_en.htm

[212] See: http://ec.europa.eu/enterprise/sectors/construction/lead-market-initiative/index_en.htm#h2-2

### Options for innovation policy

The rapid development of technologies places stress on this sector, calling for quick **integration of new technologies** to keep competitive on a global level.

The **role of (private) clients** as a driver for innovations and growth should be further analysed, and the mechanisms for how clients could steer innovation in the construction industry and how client engagement could be stimulated also need a deeper understanding. Networking between clients, industry and the research community should be intensified.

**Supporting SMEs in construction**: As stated above there is a large number of SMEs active in this sector. Policy measures are needed to support these SMEs or in particular the very small firms. Perhaps generic preconditions could be identified, which would account for the successful management of innovation and lead to specifically tailored policy measures.

## 3.2.5. Electrical and optical equipment

### Status quo[213]

The electrical and optical industry provides Europe with a wide range of mostly high-tech products that include computers, switchgears and semiconductors. Goods and services of this sector range from capital goods via intermediate goods to consumer goods. Examples of the first category are transport manufacturing (e.g. motor vehicles and rail equipment) and process manufacturing (e.g. chemicals and plastics). Among the most prominent consumer goods are mobile phones and household appliances, which are found in nearly every house.[214] Statistically, the sector is based on four NACE groups in the Eurostat databases.[215]

The electrical engineering industry, being one of the largest industries in the world, employed around 2.8 million people in Europe in 2007 in about 200,000 enterprises, and contributed a 10% share to EU exports. Most enterprises are small and medium-sized. The world leader in this medium/high-tech sector in terms of value added is the United States, directly followed by Europe, then by Japan and China. Global competition is increasing strongly, and China especially is catching up fast. Overall, Europe has a large trade deficit in the electrical and optical equipment market. Compared with manufacturers in Asia and the United States this sector has competitive disadvantages. According to the *Competitiveness Report 2006*,[216] this applies to standard products as well as to innovative products in which Europe should have a leading role. Asian and American manufacturers have higher R&D expenditure, productivity and net income.

### Embracing the future

Advances, especially in materials science, the convergence of S&T, ubiquitous networks and embedded technologies, will drive the field further. Demand-side drivers are very much focused on personalised applications in various areas. Examples are personalised and integrated healthcare systems, personalised and intelligent transportation systems, and personalised and universal shopping systems.

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[213] Much of the information for this chapter has been drawn from Van den Broek et al. (2009).

[214] Eurostat (2009b).

[215] Manufacturers of office machinery and computers (NACE group 30), Manufacturers of electrical machinery and apparatus (NACE group 31), Manufacturers of radio, television and communication equipment and apparatus (NACE group 32), Manufacturers of medical, precision and optical instruments, watches and clocks (NACE group 33).

[216] Eurostat (2007).

There is also demand for energy-efficient energy supply systems, ubiquitous lifelong learning systems, and personalised and experience-driven culture and entertainment systems.[217]

Innovation potential can be found particularly in the healthcare and transport sectors, in energy consumption and natural resources, and in products, processes and technologies to enhance safety and security. Emerging sectoral innovation activities can be found in ICT research, eco-innovation, convergence of products into services and solutions, and human resources and skills.

The electrical industry provides solutions for pressing issues such as green transportation, a sustainable energy supply and energy-efficiency technologies. Areas to which the electrical industry can contribute while also improving its competitiveness are identified in the 'ELECTRA' communication.[218] Suitable areas with high growth potential include energy supply infrastructure, industrial production and smart technologies.[219]

The vast number of EU initiatives in this field demonstrates the European efforts to remain or become a competitive world leader in this sector. Examples are ICT-related strands within the Seventh Framework Programme on Competitiveness and Innovation Programmes (ICT Policy Support Programme), the i2010 strategy (to develop a European information society for growth and employment, 2005–2009)[220] and the initiative that succeeded i2010, the Digital Agenda within the Europe 2020 strategy.[221] Furthermore, this sector has a long-established legislative framework covering product safety, energy labelling and efficiency requirements. Two Directives[222] cover the regulation of waste from electrical and electronic equipment, while other Directives deal with energy saving and labelling.

### Options for innovation policy

The integration of a variety of data sources and the increasing share of system and network personalisation comes along with **privacy and security risks**.

**Sustainable services and products** are increasingly demanded by the consumer. He wants to contribute to the fight against climate change or the loss of biodiversity. This urges the sector to implement energy-efficient processes and to offer sustainable products, e.g. no consumer wants to invest in old-fashioned energy- and other resource-consuming household appliances. There is a real need for new environmental innovation.

**Standards** for intensively interacting networks and interconnected systems for the future are required and also for the development of convenient and user-friendly consumer applications.

**Radical innovations** require long-term and sizeable investments, and freedom and flexibility in R&D.

**Public procurement** should lead to innovative solutions for societal challenges.

**ICT will be everywhere**: e-skills are essential for everyone.[223]

[217] EC (2009k).

[218] See: http://ec.europa.eu/enterprise/sectors/electrical/competitiveness/electra/index_en.htm

[219] EC (2009k).

[220] See: http://ec.europa.eu/information_society/eeurope/i2010/index_en.htm

[221] EC (2010d).

[222] OJEC (2008a) and OJEC (2008b).

[223] Applied from the Van den Broek et al. (2009).

### 3.2.6. Food and beverages sector

**Status quo**[224]

More than 4 million people work in the European food and drink industry, which comprises about 310,000 companies. An annual turnover of €900 billion and a strong export rate characterise this highly dynamic sector, one of Europe's most important. It faces extremely competitive domestic and international markets. According to the NACE code classification (Revision 1.1), the food and beverages sector falls mainly into category 15, with the sub-sectors 15.1–15.

The food and beverage manufacturing industry is dominated by micro-enterprises with fewer than ten employees, which make up 78.6% of all firms. Yet 0.9% of large companies (250 employees and above) account for more than 50% of the total turnover generated in the food and beverage manufacturing industry. Over 61% of the workforce is employed by SMEs, and the food and beverage manufacturing sector is characterised by a smaller share of higher educated and qualified scientific personnel than in many other sectors.

**Embracing the future**

The food and beverage manufacturing industry profits greatly from R&D that is being conducted in (emerging) S&T fields like chemistry and physics (e.g. in regard to separation techniques), epigenetics, nutrigenomics and neurosciences, miniaturisation, biotechnology and nanotechnology, automation, robotics and ICT, and materials science and intelligent packaging. Apart from these S&T drivers, the demand-side drivers are of growing importance. These focus on food safety and consumer confidence, health consciousness, disease and ageing (nourishment against ailments), and also ethical concerns and sustainability, convenience food and takeaway food/home delivery. According to the Europe-Innova foresight report on the food and beverage sector, the following trajectories are likely to evolve within the next 15 to 20 years:

- New and improved **functional foods** and beverages, in combination with possibilities for personalised diets (at least to a certain degree) will be a likely development within the next 15 to 20 years.
- **Medicinal food** and GMOs for pharmaceutical purposes (although they might become technically feasible within this time frame, they will encounter many more regulatory hurdles and incur much higher costs).
- **Cultured meat**, i.e. meat produced from cell cultivation in the laboratory without the need to raise and slaughter a whole animal, could also become feasible for industrial-scale use to a certain degree within the next 20 years.
- **Food testing methods** and food chain management will certainly improve. ICT, molecular biotechnology and nanotechnology are likely to be welcome in the area of food testing and surveillance, perhaps in contrast to their usage in foodstuffs and beverages themselves.

Potentials and constraints for innovation can be related to structural features of the sector, to the food industry or to policy. One example is the production of food that the consumer likes (e.g. perception or consumer preference) with the right price tag in the right location.

[224] This chapter is mainly based on Leis, M. and Van der Zee (2009).

The introduction of more radical innovation by the food industry (for example types of functional food and GM food) is hampered by the conservatism of consumers and regulatory frameworks. The food industry should learn to team up with consumers to develop interdisciplinary production processes by intensively using, for instance, communication or ICT-solutions.

The European food and drink industry is facing declining competitiveness, as several recent studies clearly show.[225] Therefore in 2005 the European Technology Platform (ETP) Food for Life was initiated to boost the process of innovation, to intensify the transfer of knowledge and to increase competitiveness along the food chain.[226] Against the background of the three scientific pillars of the ETP ('quality and manufacturing', 'food safety' and 'food and the consumer') one possible innovation challenge for the food industry is an analysis of what sorts of technologies are needed and where such technological competition is likely to occur.

In 2009 the High-Level Group on the Competitiveness of the Agro-Food Industry published a roadmap of key initiatives to strengthen the European sectoral industry.[227] The High-Level Group's mandate includes addressing those issues which are responsible for current and future competitiveness of the agro-food industry. Also of importance are the factors and trends influencing the competitive position of the food industry, as well as sustainability issues likely to affect competitiveness in the future. Another mandate is the preparation of recommendations, which are specific for the sector and address policy-makers at the Community level.

In addition to these activities, the European Commission has announced several policy initiatives for a better functioning of the European food supply chain and an intensified constructive dialogue with all relevant stakeholders. Therefore a High-Level Forum for a better functioning of food supply chains was established in 2010.[228] The forum has the mandate to make recommendations on the competitiveness of the agro-food industry and the implementation of initiatives proposed by the Commission.[229] The first meeting of the High-Level Forum took place in November 2010, and aimed at the development of a work programme to foster competitiveness and best practice in this sector.

### Options for innovation policy

The ETP on Food for Life names three major action points in its Strategic Research Agenda 2007–2020 which are found to be crucial for a successful and competitive European agro-industry. These are to improve health, wellbeing and longevity, build consumer trust in the food chain, and support sustainable and ethical production.[230] These fundamental points should be considered for future policy and analysed to determine **how consumer trust could be further increased**. This applies to food safety, and also to novel and functional foods, and other developments in food. Future policy should also address how and whether to transfer into the food and beverage manufacturing industry the **emerging possibilities from S&T** that appear in other areas.

[225] See: http://ec.europa.eu/enterprise/sectors/food/documents/studies/index_en.htm

[226] ETP (2008).

[227] HLP (2009).

[228] OJEC (2010).

[229] EC (2009l).

[230] ETP (2005)

A pressing issue is the blurring border between normal nutrition, prevention of disease, and medicine (and health enhancement). The **definition of regulations at the intersections** and borders is another challenge for future policy. Equally pressing is the increasing demand for bio-energy along with **competition between food and energy**. Finding the right balance between agricultural input for human consumption and the bio-based energy use of land will be a major challenge for policy-makers in the future.

### 3.2.7. Knowledge-intensive services

#### Status quo[231]

Knowledge-intensive business services (KIBS) are professional services for firms and the public sector, and are often seen as the one major milestone towards a knowledge-based economy.[232]

KIBS is strongly dependent on professional knowledge. This can be either technological or scientific knowledge, or more social and administrative knowledge.[233, 234, 235, 236] Although neglected until recently, the KIBS sector employs about 15 million people in the European Union.[237] Based on turnover, value added and persons employed, the main KIBS in Europe are computer services (K72.00), legal, accounting and management services (K74.10), architecture and engineering, technical testing (K74.20 and K74.30), advertising (K74.40) and labour recruitment and provision of personnel (K74.50).[238] The European KIBS sector is characterised by many small and very small firms, as well as a many start-ups.

Micro-enterprises and SMEs in the EU27 contribute around 70% to the value created in business services in general. This fraction is even higher for other areas like management services, accounting, law and technology-related services.[239, 240]

#### Embracing the future

The main source of current and future innovation for the KIBS sector, as well as for other service sectors, is ICT. ICT on the one hand enables the development of new services and increases the efficiency of existing services (such as virtual testing and codification); on the other hand, ICT can alter the way existing knowledge-intensive services are provided. KIBS, such as advisory and counselling services, are characterised by an intense interaction between the client and the service provider. Many types of KIBS are therefore geographically bound and have a strong local character.[241] The great importance and influence of ICT to KIBS is expected to grow further within the next 15 years. Demand-side drivers in the KIBS field are also worth mentioning, most notably the increasing knowledge intensity of KIBS: i.e. the increasing demand for specialised knowledge and open innovation in user industries. Sustainability aspects, the local character of KIBS and the outsourcing of services from client firms are also drivers for innovation in this field.[242]

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[231] Much of the information for this section derives from Dachs B. (2009) and Korte et al. (2008).

[232] Statistically the KIBS sector comprises three divisions of the NACE Revision 1.1. NACE division 72: Computer and related activities, NACE division 73: Research and experimental development, NACE division 74: Other business activities. The broad NACE divisions 70–74 include some subsectors that are not strictly KIBS. Some parts of NACE division 74.6 (Investigation and security activities); 74.7 (Industrial cleaning); 74.82 (Packaging activities), 74.83 (Secretarial and translation activities).

[233] Toivonen, M. (2004).

[234] Kox, H. L. M. (2002).

[235] EMCC (2005a) and EMCC (2005b).

[236] Rijkers-Defrasne et al. (2007).

[237] Hirschfeld, K. (2007a).

[238] Eurostat (2007b).

[239] Hirschfeld, K. (2007b).

[240] Eurostat (2007a).

[241] Dachs, B. (2009).

[242] EMCC (2005a).

Future trends and the resultant emerging sectoral innovation activities focus mainly on ICT-related topics. ICT provides new ways of service provision and new codifications of knowledge. Globalisation and therefore the internationalisation of KIBS firms is important, as is the convergence between KIBS and other sectors, and the emergence of new KIBS, for instance helping to cope with regulations or with complex markets and societies. The increasing internationalisation is a major opportunity and challenge, particularly to smaller enterprises in this sector. Potential customers and labour recruitment services will have the opportunity to tap new resources, recruiting from other Member States. As regulations in Europe are only partially harmonised, internationalisation will provide some challenges in this area that may stimulate the emergence of novel specialised KIBS. Internationalisation also entails the need for better intercultural and language skills, even if they may in part be attenuated by ICT innovations in simultaneous computer translation and remote learning. ICT as a main innovation driver will not only create new services, it will also allow new methods of service provisions and may even change the organisational structure by enabling smaller specialised companies to form virtual service providers with competitive service portfolios.

Several trends carry potential and also constraints for innovation in the KIBS fields. The knowledge economy above all, and also transparency and standardisation in services, and security and capability concerns hold great potential for the transformation of the KIBS sector.

Current policies which also address future needs include the Professional Qualifications Directive 2005/36/EC[243] and the Services Directive 2006/123/EC.[244] The latter is expected to further encourage cross-border trade in services within Europe,[245] and establishes new rules which relate in particular to administrative simplification and cooperation, freedom of establishment and quality of services. The Professional Qualifications directive aims for a free movement of the workforce within the internal markets.

### Options for innovation policy

Further removing barriers to trade in services is of high relevance for the growth of the KIBS sector. Therefore, **trade liberalisation** is and will be of high importance for this sector. An international regulatory framework for KIBS could unify disparate approaches, and global protectionism poses constraints on the free flow of KIBS.

Increasing competition in the area of ICT-related services as well as the KIBS sector in general will require **innovations in the IP regulation system** to better reflect the commercial potential of non-physical goods, both technological and non-technological, and thereby secure investment in their development.

Due to the increasing importance of knowledge and the high mobility of the workforce, the **codification of explicit and tacit knowledge** will become a key to organisational learning and innovation, and enable semantic knowledge-mining methods to assess opportunities and to detect knowledge gaps. Other important policy topics include skills and labour, offshoring and technology.

[243] See http://ec.europa.eu/internal_market/qualifications/future_en.htm#dir

[244] EC (2007b).

[245] Alajkääskö, A. (2007).

### 3.2.8. Retail and wholesale sector

**Status quo**[246]

According to Eurostat, wholesale and retail play a unique role in the European economy and constitute one of the most important sectors in terms of share of value added and employment in the EU27.

The wholesale and retail sector is best characterised by countless micro-enterprises with from two to nine employees and, according to a new survey, around 40% of the workers are employed in such enterprises. Large enterprises are under-represented compared with the cross-sector average.[247] The dynamics and labour intensity of the sector are reflected by 10.4 million jobs in the wholesale sector in 2006 and 18.5 million people in the retail sector, giving retail and wholesale a unique role in the European economy. Many employees are educated to a low level, although the share of those is decreasing and the trend of 'up-skilling' is increasing.[248] The commerce sector accounted for €1,352 billion of value added, or 11.8% of Europe's GDP in 2006.[249]

**Embracing the future**

As is true for many other sectors, the rapid advances in ICT have influenced the commerce sector drastically at many different levels. The commerce sector is among the largest investors in ICT equipment. The introduction of ICT features to the wholesale and retail sector has changed daily operations, marketing, logistics, customer relations and retail channels (for instance through e-commerce, Web 2.0,[250] crowdsourcing and radio frequency identification (RFID)). This is not to say, however, that innovation themes lie mostly on the technology side. Quite the contrary: most innovation themes, new products and processes are related to organisational and service innovation. Some innovations, such as green retailing, convenience and social responsibility, as well as several new ICT services, are a direct response to recent changes in consumer demand. Prospective innovations with regard to IT include data fusion and new tools for better customer profiling, theft prevention and e-commerce.

Other emerging innovation themes are related to internationalisation. The increased power of the consumer, in part due to better information about alternative sources, online shopping and price comparison tools, will continue to shape the retail sector in various ways. In particular, consumer demands for faster and more convenient shopping, for fresher and cheaper goods, and for larger assortments to choose from will fuel transitions. Prospective innovations in organisational structures, such as the globalisation of the big retailers and an increase in hypermarkets, discounters, speciality and convenience stores, will continue.

From several of the aforementioned themes, potentials and constraints for innovation arise. The power of the consumer has been described already, as has the impact of globalisation. In addition, liberalisation efforts and labour laws will be of interest in the future. Opening hours could change consumer lifestyles.

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[246] Much of the information for this chapter has been drawn from Gieseke, S. (2009).

[247] EF (2008).

[248] See: http://ec.europa.eu/social/main.jsp?langId=en&catId=782&newsId=567&furtherNews=yes

[249] EC (2007c).

[250] Basically Web 2.0 applications in retail are associated with a higher degree of participation on the customer's side, and a greater variety of goods (even goods that are seldom requested), making shopping an online experience by use of smart-client technologies the convergence of anywhere, anytime, anyhow supported by the technical convergence of mobile phones, TV and the internet (multi-play). Web 2.0 allows direct contact between producers and consumers.

The integration of traditional commerce services into the IT world entails imminent dangers. The widespread proliferation of data, some of a sensitive or private nature, provides opportunities for its unpredictable application and/or misuse. Consumers are often unaware of the technological possibilities of the information society and freely provide personal data without realising how it could be used. Privacy issues are therefore a major future topic, which need to be addressed.[251]

### Options for innovation policy

**Trade liberalisation**, the removal of tariff and non-tariff barriers, and the opening of world markets could help to improve the competitive position of the EU commerce industry. Today all kinds of barriers restrict the free flow of goods and hamper EU exports. The **harmonisation of global trade regulations,** already promoted by the European Union, for instance through the World Trade Organisation (WTO) and the ongoing Doha Round[252] (of multilateral trade negotiations), could remove certain barriers. In 2007, the European Market Access Strategy was strengthened and a new instrument launched, the Market Access Partnership.[253] The new partnership between the Commission, the Member States and industry in important export markets already has success stories, for example with the removal of export restrictions. Sample topics for future studies include:

- Analysis to see if **EU-wide regulations** could harmonise opening hours, labour relations, skills and training requirements, locations, mergers and acquisitions.
- How can **consumers' privacy** be better protected and how can they be made aware of the precarious consequences of making private data public?
- What will be the **future location of retail**, considering increasing fuel prices, demand for size, assortment and freshness, and time pressure on consumers and the retailer side? Normally retailers tend to cluster in certain locations but the interesting question is whether this is transferable to an EU-wide or even global level. Or is physical location in the future not going to be that important any more, like the interesting trend called 'taking the store to the customer',[254] might suggest.
- Future skill requirements in wholesale and trade will be of growing importance. The ongoing development of new technologies, brand building and efficient customer response are some major trends needing attention.[255]
- The **ageing society** has different needs and demands like appropriate household goods, IT or mobility devices. However, smart IT gadgets are likely to be targeted at rather younger adults than the elderly.
- In spite of product and lifestyle differentiation, is there a **global mainstream** in both? There is already a trend towards lifestyle products and a certain lifestyle could give a product uniqueness to differentiate it from its competitors.

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[251] Giesecke et al. (2007).

[252] See: http://ec.europa.eu/trade/creating-opportunities/eu-and-wto/doha/index_en.htm

[253] http://ec.europa.eu/trade/creating-opportunities/trade-top ics/market-access/index_en.htm

[254] Future of Retail: Taking the Store to the Customer, PSFK, 2010. See: http://www.psfk.com/2010/06/future-of-retail-taking-the-store-to-the-customer.html

[255] EGFSN (2010).

### 3.2.9. Textiles and clothing

**Status quo**[256]

The textile and clothing industry is very labour-intensive. It comprises three main groups: first, the treatment of raw material; second, natural fibres; and third, manmade fibres.[257] The textile industry is heterogeneous and diverse and is an important part of the European manufacturing industry. Because of the many factors, including consumer development, technological advances and environmental issues, the clothing industry is best portrayed as undergoing continuous restructuring. The dynamics are very much influenced by international trade liberalisation, in particular the abolition of textiles and clothing import quotas, and the Doha Round negotiations on tariffs and non-tariff barriers.[258] This restructuring process has led to significant changes in production locations.

In 2006, the European clothing industry consisted of 220,000 companies, provided jobs for 2.5 million people and generated € 3,190 billion of turnover. With this the textile industry accounted for 3% of the total European value added in manufacturing.[259] Most companies are small and medium-sized, with less than 50 employees; in fact more than 90% of the European workforce in this sector is SME-based, producing 60% of the value added.[260] The sector is very much export-oriented, representing 29% of the world exports. This earns the EU clothing industry second position worldwide, behind China with 40% of world exports. The textile industry operates globally, with a high degree of outsourcing to and competition from low-wage environments. All over the world, the trade flows are constantly increasing.

**Embracing the future**

The European textile industry continues to change rapidly. Ongoing transformations are changes in production and distribution and in consumer behaviour. The health-aware society demands new fabrics and intelligent textiles. Internationalisation and international trade are reshaping the European textiles industry. The drivers for these changes and innovations are manifold. From a technological perspective, the textile industry is mostly driven by advances in materials science, such as smart materials, intelligent textiles and clothing. New production technologies and ICT, particularly e-commerce, are also driving forces for changes in the sector. Cost-driven innovations are often based on technological improvements through optimised logistics or lower production costs. From a socio-economic perspective, in particular demographic change, changes in consumer behaviour, for example towards bio-materials, and awareness of sustainability and health issues are transforming the clothing industry. Barriers to the trade development of the European textile and clothing industry include tariff regulations, technical regulations, and also standards and conformity assessments.

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[256] Information in this section derives mainly from Eurostat (2009c) and Zahradnik G. and Dachs B. (2009).

[257] Eurostat (2009c).

[258] More details on the structure and competitiveness of the textiles & clothing sector can be found in EC (2003a).

[259] See: http://ec.europa.eu/enterprise/sectors/textiles/index_en.htm

[260] See: http://ec.europa.eu/enterprise/sectors/textiles/single-market/index_en.htm

The ETP for the Future of Textiles and Clothing believes Europe's future in the textile and clothing industry will be built on its existing strengths.[261] These include innovation in material and processes, flexibility in production and a high quality of products and services. The ETP for the Future of Textile and Clothing was initiated by the European Union, and brings together stakeholders from industry, academia and politics, providing a network of experts. The platform has set up a research agenda and defined innovation priorities for the sustained long-term competitiveness of this sector. The platform's vision[262] for the future encompasses three crucial industrial innovation elements: materials, processes and technology; products and markets; and organisation and management.

In addition to the ETP, the European Union fosters R&D projects in the clothing sector under the Seventh Framework Programme for Research and Technological Development (FP7). Innovation initiatives are supported, particularly in the context of the Competitiveness and Innovation Programme (CIP)[263] and the Europe INNOVA initiative. Further support is given by national and regional authorities through the Structural and Cohesion funds. The ongoing bilateral dialogue between the Commission and third countries regarding industrial policy and regulatory issues is important and constitutes one step towards a competitive future.[264]

### Challenges for innovation policy[265]

The overall prospective innovation challenges for the textile and clothing industry are:[266]

- How to **restructure and reorganise the sector** in order to respond to an inexhaustible supply of cheap labour from emerging economies.
- How to close the **productivity gap** compared with the rest of the European Union, and to become a skill-intensive location option.
- How to move the actors' vision away from a defensive attitude **towards creativity and innovation** within their teams and within the whole supply chain.
- How to open up **public innovation support programmes** for technology transfer as well as non-technological innovation because much of the sector's future strength lies here.
- How to **transform clusters** into cross-national, cross-sectoral networks of knowledge.
- How to be able to **redevelop the industry** in the direction of a renewed orientation towards markets and consumers, and away from low-price strategies in order to fight foreign competition.

[261] See: http://www.textile-platform.eu/textile-platform/?page_name=Vision

[262] See: http://textile-platform.eu/textile-platform/?page_name=Vision

[263] See: http://ec.europa.eu/cip/index_en.htm

[264] See: http://ec.europa.eu/enterprise/sectors/textiles/external-dimension/euro-mediterranean-region/index_en.htm

[265] Applied from Zahradnik G. and Dachs B. (2009).

[266] Based on Zahradnik G. and Dachs B. (2009).

## 3.3. Conclusions of the sector analysis

The analysis of nine European sectors shows, first of all, that these industries differ substantially, and accordingly this is true for their innovation themes and the driving factors. Nevertheless there are some common drivers which seem to be of general importance. Not surprisingly, ICT developments, which are reshaping the whole of society, are heading this list. But, in particular, the non-R&D and non-technological factors are of growing importance, for instance in manufacturing, services and emerging sectors. As with these drivers, certain challenges affect all sectors more or less equally while others are more sector–specific. Knowledge-creation and -transfer or human resources are examples for more general challenges; regulation issues or specialist knowledge are more sector-specific.

As diverse as the sectors are so are the policies, measures and initiatives supporting them. This is a natural consequence of the structure or type of the sector. The automotive industry for instance is characterised by a few large players conducting mainly in-house R&D. The policies tailored for this sector are different from those fostering, for example, the biotech sector. This industry is small in terms of jobs, companies and also company sizes. Collaborations, especially with universities, are essential for this sector as the SMEs can often not afford the very expensive R&D or clinical trial phases. In summary, there is no 'one-size-fits-all (sectors)-model' addressing the issues of the various industries and the interconnection with policies addressing different sectors are often completely lacking.

Some of the nine selected industries were described as innovative, future-oriented; others still work on the achievements of the past. One important policy option is to promote cross-sector diffusion and absorption: converting research on General Purpose Technologies, like ICT and biotech, into innovations in other sectors. Therefore research and innovation support measures must also be an important goal for industrial policy-makers. European industrial policy is about providing the right framework conditions for enterprises and firms to make the European Union an attractive place for industrial development and job creation. The new Europe 2020 flagship initiative, 'an integrated industrial policy for the globalisation era', aims for a more competitive European industry. This is one necessary step in a globalising era but more should follow. Industrial competitiveness and innovation performance are closely interconnected, plotting the course from today's fragmented policies to an integrated perspective.

# 4. POLICY OPTIONS FOR EU INNOVATION AND INDUSTRIAL POLICY

## KEY FINDINGS

- The overall aim of **Chapter 4** is to give insight and concrete advice on how to better integrate innovation, and industrial and research policy. The chapter has shown that individual Member States are at different stages of development: tailored strategies are needed and high-level framework conditions are necessary to make Europe an attractive place to work, study, invest, innovate and grow.
- The discussion of policy concepts and good practices from third countries resulted in the following recommendations:
- **Increase demand-driven innovation with platform-based policies**
  Matching supply and demand for innovation is an interactive process that needs to be organised, for instance through coordination and priority-setting mechanisms, platforms and partnerships. The format of the European Technology Platforms should also be applied to 'low-tech' fields of innovation, 'cross-sector' innovation, innovation in services and public-sector innovation. Structural Funds from the Cohesion Policy should be used to invest in such 'intangible, soft', governance infrastructures oriented at matching supply and demand.
- **Develop strategic approaches which integrate R&D, innovation and industrial policy**
  Traditional industrial policy is no longer an option. EU-level policy instruments such as Lead Market Initiatives are good examples of how to design strategic approaches which integrate innovative competitiveness enhancing policies in a coherent package. At national level, cluster policies can serve as good examples (as the case of Singapore shows). At regional level Smart Specialisation is proposed to construct regional specific advantages in innovative competitiveness. A vision should be developed on how these strategic initiatives can serve as a bottom-up contribution to a priority-setting mechanism for EU research policy.
- **Create European Research Centres**
  Maintain EU leadership in key RTD areas by creating European Research Centres in order to reduce fragmentation in research. As a first step, the setting up of Joint Institutes (after the example of Joint Programming) should be co-funded by the EU. Excellence-based R&D policy should be complemented with place-based (and sector-specific) innovation and industrial policy focusing on diffusion, absorption, and application.
- **Enhance the capacity for strategy development at regional level**
  Within the Structural Funds programme a scheme should be developed (as a follow-up to schemes such as Regional Innovation Strategies and Innovative Actions) to enhance the capacity for developing and implementing Smart Specialisation strategies. Policy intelligence should also be enhanced by asking national governments to increase the sample of the Community Innovation Survey (CIS), in case the current sample is too small to allow for regionalisation.
- **A more coherent EU strategy for innovative competitiveness**
  At EU level, 'the flagships' need a common strategic roadmap, which aligns policy

concepts and programmes from different DGs of the European Commission. Reinforce and improve linkages between existing policy instruments which effect innovative competitiveness.

- **Better coordination between national and regional levels of governance**
  The interaction between policy-makers at different levels of governance needs to be improved. In practice, there is hardly any real interaction between policy-makers from national and regional governments. In many cases, better institutional mechanisms need to be developed to achieve this.
- **Address societal challenges with new instruments**
  Apply the concepts of Lead Markets, Technology Platforms, Innovation Partnerships, Open Innovation and Smart Specialisation to societal challenges. Since many societal challenges are global, the instruments should promote global cooperation.
- **Create a single market for business services**
  The European Union should function as a single research area, innovation system, business environment and community. The market for business services in the European Union is still fragmented and non-transparent. Possibilities for further harmonisation of existing legislation and administrative procedures should be addressed and bureaucratic barriers reduced.
- **Give special attention to ICT in innovation and industrial policy**
  Since the use of Information and Communication Technologies is essential for the innovativeness and competitiveness of every sector or economy and affects every aspect of society, it deserves special attention in terms of governance and policies.
- **Make more use of innovative instruments to finance innovation**
  Innovative solutions should be explored, including schemes co-funded by EU Regional Policy. Good practice examples are the financial schemes which include co-funding from the European Investment Bank in the Structural Funds programme and in cooperation with the Framework Programme (Risk-Sharing Finance Facility).
- **Improve policy learning from 'own practice'**
  Better impact assessments, new performance indicators, policy evaluation and more policy experiments are important for improving policy. Due to the diversity within Europe, the benefits of transferring good practice from elsewhere are limited.

This chapter on the policy options for EU innovation and industrial policy first explores the policy implications of the innovation performance and policy trends identified for European industry. Innovation policy and industrial policy serve a joint goal in the enhancement of the innovative competitiveness of industry. Both are now following a demand-driven approach, and besides promoting competitiveness they are both instrumental in addressing wider societal needs. In this chapter we discuss the mutual benefit and possibilities for integrating the policy fields of innovation policy and industrial policy.

The diversity among innovation systems in Europe calls for a diversity in policy mixes. A second reason why 'one-size-fits-all' policies are no longer appropriate is that, due to globalisation, the competition with regard to innovation has increased (as shown in Chapter 2), which calls for a strategic approach and limits the appropriateness of copying policy strategies from elsewhere.

With the new EU industrial policy (EC, 2010d), industrial policy includes those policies which target innovative competitiveness, but it also notes the importance of considering the competitiveness effects of other policy fields, e.g. concerning transport, energy, consumer-protection, environment, single-market and trade policies. With this broad concept the joint goal of innovation and industrial policy is to **enhance the innovative competitiveness of industry**.

The actual **integration of research, innovation and industrial policy** has several backgrounds, one of them being that, for industrial policy, the options for strategic policy support for selected industries have been reduced, as state aid rules only allow for subsidies of priority R&D activities. Another driver of integration between these two policy fields is that technology, ICT, skills, entrepreneurship and innovation are becoming increasingly important for international competitiveness. The concepts of innovation and industrial policy are converging: both are now following a demand-driven approach, the strategic approach is a common aspect, and both are instrumental for competitiveness and serving or linking other policy fields. Policy drivers for both policy fields include European integration, standardisation, good governance and framework conditions.

Based on the findings of the previous chapters, the first section of this final chapter draws out and recalls some policy conclusions from the analysis in Chapters 2 and 3. Section 4.2 addresses the main recent EU strategies. Section 4.3 highlights some main points of discussion, and the conclusion, Section 4.4, makes some concrete policy recommendations.

## 4.1. Policy conclusions from the analysis of countries and sectors

### 4.1.1. Policy conclusions regarding innovation performance and policy trends

The strategies for the Innovation Union are addressed equally to all European countries in order to improve the countries' performance. The three main aims of the Innovation Union Plan are:

- To lift Europe's science performance into the world-class league;
- To develop Innovation Partnerships as a new approach to cooperation between public and private sectors;
- Remove bottlenecks: innovation barriers such as the high costs of patenting, market fragmentation, slow standard setting and skill shortages.[267]

However, as the country comparison in Chapter 2 shows, the individual EU Member States are at different stages in their innovation performance. Therefore, in addition to a European strategy, different strategies tailored to each country's performance are needed to support the improvement.

[267] http://ec.europa.eu/research/innovation-union (28.12.2010)

For instance, in most countries the framework conditions for innovation and industrial development need to be improved. One option is a move to a demand-driven innovation policy. This means that the policy has to match the needs of important sectors. In economies with a more traditional structure, policies that increase the innovative competitiveness of traditional sectors are particularly important. In advanced service economies, it is especially important that the innovation and industrial policy also addresses these service sectors.

All countries face the challenge of human resources. Highly qualified employees are required. Besides good primary and secondary education, a high number of graduates and doctorates, lifelong learning, avoiding brain-drain and encouraging skilled immigrants are required.

Another common challenge is the impact of the financial crisis, which resulted in an economic downturn. In this context it is difficult for firms to access finance and make investments.

A third common challenge is to foster private–public cooperation, for instance collaboration between universities and businesses, and between SMEs.

A fourth common challenge relates to the fact that most countries are challenged by international competition to speed up their pace of innovation or to better convert their research into innovations.

Regarding the diversity in innovation and industrial policy needs and options among Member States and regions, Chapter 2 concluded that:

- The EU27 as a whole addresses 27% of its policy measures to R&D cooperation, 16% to strategic research policies (long-term agendas), and 16% to support innovative start-ups. The policy priorities to follow are policy measures concerning excellence and the like, public research organisations, and direct support of business R&D.
- All the countries analysed also have their own priorities. The United States, for instance, focuses on public research organisation and R&D cooperation. Japan in contrast puts its emphasis on innovation strategies and direct support of business R&D. Switzerland focuses on R&D cooperation and on policy measures concerning excellence, and so on.
- The four EU Member States selected for in-depth analysis have the following priorities. Germany (an innovation leader) focuses on R&D cooperation. Estonia (an innovation follower) sets its priorities on research infrastructure and R&D cooperation. Spain (a moderate innovator) focuses on R&D cooperation and knowledge transfer. Bulgaria (a catching-up country) prioritises awareness creation and science education, as well as support for innovation management and advisory services.

Chapter 2 concluded that depending on their innovation stage, EU Member States focus on different support measures. The higher the innovation stage, the higher the focus on R&D cooperation. In Bulgaria and Spain, raising firm investments, and in particular public R&D expenditure, is a major challenge. For Bulgaria the increase of public R&D expenditure is important.

### 4.1.2. Policy conclusions regarding sectoral potential

In Chapter 3 we identified elements of diversity in innovation and industrial policy needs and options among sectors, as well as some common cross-sector generic issues and trends.
The sector perspective is very important because industries differ, sometimes substantially, and consequently innovation is driven by many different factors depending on the industry.

The main role of industrial policy in the European Union is to provide high-level framework conditions for entrepreneurial development and to make Europe an attractive place to work, live, study, invest, innovate and grow. The new Europe 2020 flagship initiative: 'An integrated industrial policy for the globalisation era' aims for a more competitive European industry, and is a necessity in an era of globalisation.

Chapter 3 shows that the non-R&D and non-technological factors are of growing importance in manufacturing and also in services and in emerging sectors. Moreover, non-technological and social innovations are also very important in the public sector.

Chapter 3 also observed that a number of challenges affect all sectors: knowledge creation/transfer, human resources, financial constraints, remaining barriers in the European Union as a single market (especially for services), the importance of ICT for innovation and competitiveness, and the importance of cross-sector linkages for innovation. Some challenges are very sector-specific (e.g. regulation issues, specialist knowledge, in-house R&D, finance).

### 4.1.3. Policy conclusions at EU level regarding global trends[268]

The global drivers (globalisation, energy, demography and new technologies) presented in Section 3.2 have posed new challenges for industries and countries. Regarding EU research and innovation policy, we can recall from Chapter 3 the following policy conclusions:

#### Maintain EU leadership in key RTD areas by focusing and concentration

The European Union should work to maintain its leadership in key RTD areas, such as energy technologies, sustainable development, climate change, food safety and health. More focus and concentration of research efforts in the context of an excellence-based EU research policy is needed to address the fragmentation of excellence in research. Mechanisms for priority setting in European research policy have to be strengthened.

#### Europe must not fall behind in R&D

Experts suggest that Europe becomes a model based on emphasising quality of life, which might involve securing access to global knowledge and setting international standards in science and technology. In order to provide access to global knowledge and linkages with global networks it is necessary for Europe to be an attractive place for incoming researchers and investments as is pointed out in the *World in 2025*.[269]

#### From 'brain drain' to 'brain circulation'

The situation regarding 'brain drain' could shift towards a situation of 'brain circulation'. The number of young researchers which will study abroad is expected to increase even further. It is, for instance, expected that by 2025 more than 600,000 students from China will study abroad, but also the number of students from Europe who will study in China will increase.

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[268] EC (2009h).

[269] EC (2009h).

### Effective governance is crucial

Europe needs good policy in order to retain its traditionally strong position in developing cutting-edge innovation that goes beyond incremental improvements of existing technology. Some important governance issues are to be improved. Take for instance the so-called 'Grand Challenges', which are mostly global challenges where the European Union should not merely focus on cooperation among Member States, but at a global level. The Grand Challenges have also changed the approach towards priority setting in research. After many years of addressing the challenge to bridge the gap between Science and Industry, it is widely acknowledged that there is need for even stronger coordination between research policy and innovation policy because of the importance of serving wider societal needs.

### Integrate research and innovation policy with industrial policy

According to the new industrial policy, all sectors are important. This contrasts with the traditional concept of a more strategic industrial policy, favouring certain industries. With the new EU state-aid rules, support to R&D activities is the only form of state aid allowed to support certain economic activities. Research policy has therefore become a major instrument for a strategic innovation and industrial policy approach.

## 4.2. Recent EU strategies

### 4.2.1. EU Strategy 2020

In June 2010, the European Commission brought out the Europe 2020 Strategy.[270] It was designed to move forward from the economic crisis. Three main drivers are identified for sustainable growth which shall be implemented through actions at different levels (national, EU-level): 'smart growth (fostering knowledge, innovation, education and the digital society), sustainable growth (making production more resource-efficient while boosting competitiveness) and inclusive growth (raising participation in the labour market, the acquisition of skills and the fight against poverty)'.[271] With the proposal of a new Europe 2020 agenda based on several so-called flagship initiatives, the Commission intends to accomplish these goals. But the implementation of these tasks requires acting jointly on all levels, e.g. Member States, the EU-level and local authorities.

**Figure 25: EU Strategy 2020**

<table>
<tr><th colspan="3">HEADLINE TARGETS</th></tr>
<tr><td colspan="3">– Raise the employment rate of the population aged 20-64 from the current 69% to at least 75%.<br>– Achieve the target of investing 3% of GDP in R&D in particular by improving the conditions for R&D investment by the private sector, and develop a new indicator to track innovation.<br>– Reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30% if the conditions are right, increase the share of renewable energy in our final energy consumption to 20%, and achieve a 20% increase in energy efficiency.<br>– Reduce the share of early school leavers to 10% from the current 15% and increase the share of the population aged 30-34 having completed tertiary education from 31% to at least 40%.<br>– Reduce the number of Europeans living below national poverty lines by 25%, lifting 20 million people out of poverty.</td></tr>
<tr><th>SMART GROWTH</th><th>SUSTAINABLE GROWTH</th><th>INCLUSIVE GROWTH</th></tr>
<tr><td>INNOVATION<br>EU flagship initiative "Innovation Union" to improve framework conditions and access to finance for research and innovation so as to strengthen the innovation chain and boost levels of investment throughout the Union.</td><td rowspan="2">CLIMATE, ENERGY AND MOBILITY<br>EU flagship initiative "Resource efficient Europe" to help decouple economic growth from the use of resources, by decarbonising our economy, increasing the use of renewable sources, modernising our transport sector and promoting energy efficiency.</td><td rowspan="2">EMPLOYMENT AND SKILLS<br>EU flagship initiative "An agenda for new skills and jobs" to modernise labour markets by facilitating labour mobility and the development of skills throughout the lifecycle with a view to increase labour participation and better match labour supply and demand.</td></tr>
<tr><td>EDUCATION<br>EU flagship initiative "Youth on the move" to enhance the performance of education systems and to reinforce the international attractiveness of Europe's higher education.</td></tr>
<tr><td>DIGITAL SOCIETY<br>EU flagship initiative "A digital agenda for Europe" to speed up the roll-out of high-speed internet and reap the benefits of a digital single market for households and firms.</td><td>COMPETITIVENESS<br>EU flagship initiative "An industrial policy for the globalisation era" to improve the business environment, especially for SMEs, and to support the development of a strong and sustainable industrial base able to compete globally.</td><td>FIGHTING POVERTY<br>EU flagship initiative "European platform against poverty" to ensure social and territorial cohesion such that the benefits of growth and jobs are widely shared and people experiencing poverty and social exclusion are enabled to live in dignity and take an active part in society.</td></tr>
</table>

**Source:** EC (2010c), p.30.

While all of the seven flagship initiatives are measures to support innovation, there are two with a specific focus on innovation policy.

[270] http://ec.europa.eu/eu2020/index_en.htm

[271] See: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/225

### 4.2.2. Innovation Union

The European Commission's 'Innovation Union',[272] issued in October 2010, is one of the seven flagship initiatives. It commits the Commission to increase investment in research and to make Europe an attractive place to innovate. National governments are asked to promote cooperation between universities and industry, and to increase the number of graduates in science and engineering. According to the EC Innovation Union, obstacles to overcome for more innovation in Europe are **unfavourable framework conditions** and **fragmented efforts**. The player of the different innovation systems are still working in parallel at best which also results in higher costs due to duplicated work. The Innovation Union intends to better pool the efforts and focus on excellence, to create a true ERA, and to 'rebuild broken links in the chain between research and bringing innovations to the market'.[273]

Overall, the Innovation Union suggests 'a set of structures, practices, processes and objectives to which all Member States can aspire, especially when considered alongside the high-level aspirations of the EU 2020 strategy as a whole'.[274]

With an implementation schedule of only one year, ten key goals have been expressed by the Innovation Union:[275]

- 'European Innovation Partnerships will mobilise stakeholders. […]
- A pilot Partnership on active and healthy ageing. […]
- A new indicator will be developed on the share of fast-growing innovative companies in the economy and an independent ranking system for universities. […]
- Measures to improve access to finance. […]
- Measures to complete the European Research Area. […]
- A major research programme on public sector and social innovation, and a pilot European Public Sector Innovation Scoreboard. […]
- Public procurement of innovative products and services. […]
- Legislative proposals to speed up interoperability to foster innovation. […]
- Modernisation of Europe's IP regime. […]
- Review of structural funding and state aid frameworks to boost innovation.'[276]

[272] EC (2010b).

[273] http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=why

[274] EC (2010e).

[275] EC (2010b).

[276] See: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/1288&format=HTML&aged=0&language=EN&guiLanguage=en

### 4.2.3. Industrial policy for the globalisation era

The Communication adopted by the European Commission in 2010 on 'an integrated industrial policy for the globalisation era'[277], one of the flagship initiatives of the Europe 2020 strategy, presents a new way to promote jobs and accelerate growth in Europe. The initiative aims for a strong, competitive and also sustainable industrial base with a lower carbon footprint providing well-paid employment in Europe. Every year the performance of the Member States with respect to their competitiveness will be evaluated in a report.[278]

It is recognised that integrated and coordinated European policy concepts are needed, overcoming the ideas of national sectors or industries. The following main initiatives for the improvement of Europeans competitiveness have been announced for industrial policy:

- A fresh approach to industrial policy;
- Improvement of framework conditions for industry (smart regulation plus access to finance);
- Developing the single market (competition policy plus infrastructure plus standardisation);
- A new industrial (skills-based) innovation policy;
- Exploitation of options from globalisation;
- Promotion of industrial modernisation (corporate social responsibility);
- Targeting sector-specific dimensions (space, energy-intensive industries, sustainable mobility and societal challenges).

### 4.2.4. ERA Vision 2020

The European Research Area is aiming for a coherent and united research area, allowing researchers and workers to move around freely. The concept is comparable with the single currency, the Euro, which we have today. To come closer to the vision of one single research frame in Europe, support is given for coordinative tasks and coordination of researchers and also for 'the convergence of research and innovation policies, at national and EU levels'.[279]

The ERA Vision 2020 forecasts that:

'by 2020, all players will fully benefit from the "fifth freedom"[280] across the ERA: free circulation of researchers, knowledge and technology. The ERA provides attractive conditions and effective and efficient governance for carrying out research and investing in R&D-intensive sectors in Europe. It creates significant added value by fostering healthy Europe-wide scientific competition while ensuring the appropriate level of cooperation and coordination. It is responsive to the needs and ambitions of citizens, and contributes effectively to the sustainable development and competitiveness of Europe.'[281]

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[277] EC (2010a).

[278] See: http://ec.europa.eu/enterprise/newsroom/cf/itemlongdetail.cfm?item_id=3908&lang=en

[279] See: ec.europa.eu/research/era

[280] The 'Fifth Freedom' is derived from European Union law, where the Four Freedoms is a common term for a set of treaty provisions, secondary legislation and court decisions, protecting the ability of goods, capital, services, people and labour to move freely within the internal market of the European Union. More precisely, they are: the free movement of goods; the free movement of capital; the free movement of services; the free movement of persons.

[281] ERA (2010).

## 4.3. Discussion on policy concepts and good practice

The *European Innovation Progress Report 2009* makes it clear that innovation policy is very often (mis)interpreted as being the socio-economic application of publicly funded research; the creation, adaptation and adoption of new products, processes or services; a means to demand new products and services; as being a form of new 'industrial policy'; or even a means to cope with 'societal challenges' (the financial crisis, poverty, ageing or climate change). 'Innovation policy' is a term that is often poorly defined and understood to mean many things by different stakeholders within and across the Member States (and within European institutions).[282] The same is true for the term 'industrial policy'.

According to the *European Innovation Progress Report 2009*, the main trend in recent innovation policy measures across Europe is a continuation of existing measures[283] instead of novel, exciting policy measures. There is also a trend of policy convergence, in the sense that some policy instruments, such as Innovation Voucher schemes[284], can by now be found in most Member States.

The next section discusses some policy concepts and options for future direction. These are policy instruments where aspects of both innovation policy and industrial policy are integrated.

### 4.3.1. Classical industrial policy versus new holistic policy concepts

Selective industrial policy can be carried out successfully by competent governments – sometimes spectacularly well – but it can also fail.[285] Examples of both success and failure can be found throughout the world.

**Singapore** is one example of the successful achievement of high and sustained economic growth in different industrial sectors through strong and clear political intervention. Singapore's overall research intensity has been growing steeply since 1978, as have the number of research scientists, patenting activities and the export rate of high technologies. This success is based on policies that fostered free trade and flow of investments, a strong export orientation and a well-educated workforce. Singapore's foreign investment policy placed high emphasis on foreign multinational companies to assimilate new technologies and secure efficient technology transfer.[286] Nowadays this economic model is no longer unique, as several other countries have adopted the general idea. However, the phase of investment-driven growth has ended and Singapore is on the way to innovation-driven growth.[286] The city-state has interpreted innovation policy in a broader sense than only providing financial incentives.[287] The general idea of Singapore's innovation policy was to secure the flow of highly trained personnel to become 'techno-entrepreneurs'. Entrepreneurs are significant drivers of innovation; they play a vital role in economic growth and development.[288] Singapore´s Technopreneurship 21 Initiative is still one of the most important national topics.[289]

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[282] Pro Inno Europe (2009d).

[283] Such as, for instance, innovation and R&D funds as direct response to the economic downturn; Funding of cooperation between private and public R&D sectors; Funding of start-ups and SMEs; Specific sectoral programmes; Tax reductions; Innovation vouchers.

[284] Innovation vouchers are given to SMEs who can 'cash' their Voucher at a knowledge institute of their own choice and receive services or answers to a knowledge question. See also: DG (2009).

[285] Ha-Joon Chang (2009).

[286] Chia Siow Yue (2005).

[287] Mani, S. (2004).

[288] Naudé, W. (2010).

[289] Chan, L. (2010).

Worldwide industrial policy was believed to be an endangered species at the end of the 1980s, but it was revived and ever-increasing interest was shown in it in the late 1990s in the light of globalisation and faster technological progress. The new industrial policy shows significant differences compared to those from the past. Industrial policy priorities have to be set, and there are several policy options for smart growth (linking innovation policy and industrial policy) which can be used to address grand social and environmental challenges. Industrial policy has changed and should further develop into a more systemic approach integrating innovation, education and competition policy. The current European industrial policy stresses the role of lead entrants. A good example of a policy instrument that integrates both innovation and industrial policy is the **Lead Market Initiative** (LMI), which includes various instruments, such as 'the legal and regulatory framework, fostering of open-innovation mechanisms, standards, public procurement practices, intellectual property protection, or the availability of venture capital'.[290] The lead markets approach is holistic in the sense that it can involve any relevant kind of innovation support, but be applied to a very specific prioritised 'market'.

### 4.3.2. Regional cluster policy versus national cluster policy

The importance of regions as a focus for innovation and economic wealth has grown substantially over the last few decades. National and regional policies are becoming increasingly popular as instruments for the creation and development of innovative regions, especially for political stakeholders and business development agencies. Cluster policy is also a good example of a policy instrument where innovation and industrial policy are integrated.

The strength of Singapore in biotech is a good example of a national cluster policy.

The proximity of world-class knowledge institutions and enterprises is an important driver of innovation and cluster formation.[291] Those clusters that today demonstrate the highest innovation capacity should prove to be the clusters with the highest growth rates in employment and productivity in the future.[292]

Since the late 1980s the phenomenon of regional agglomerations[293] has been studied extensively, and the triple helix approach – that is, university–industry–government relations[294, 295] – is now widely used as a reference for the design of policies supporting innovative activities. One attribute of most cluster theories is the phenomenon of 'localised knowledge spill-over'. The accumulation of knowledge to generate innovations in firms is based on the circulation and 'spill-over' of knowledge. This applies especially to tacit knowledge: non-formalisable knowledge, which is best transmitted face-to-face and is genuinely local.

Cluster policy is still at an early stage, and most European countries did not start to develop cluster programmes until the 1990s. Cluster programmes are mainly focused at a national level; fewer programmes are developed on the regional level.[296] But despite substantial policy efforts and mixes, for instance of innovation policy, industrial policy and regional policy, at regional, national and also EU level the results are lagging behind expectations.

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[290] EC (2007d), p. 7-8.

[291] EIU (2009).

[292] Blohm Graversen, A. and Rosted, J. (2009).

[293] Innovative Firms concentrate on comparably few regions worldwide.

[294] Etzkowitz, H. and Leydesdorff, L. (2000).

[295] JRC (2009).

[296] Europe Innova (2009).

Some studies have made it very clear that 'even cluster enthusiasts find it enormously difficult to point to any examples of deliberate cluster promotion programs that have been unambiguously successful'.[297] This calls for impact assessment and better policy evaluation.

One good-practice example of a national cluster initiative is the biotechnology cluster contest **BioRegio**[298] run by the German Federal Ministry of Education and Research (BMBF), which was initiated in the 1990s. This contest is believed to be the starting point for the commercialisation of biotechnology in Germany. BioRegio is one of the most prominent examples of its kind, and it shows clearly that the participating regions benefited from the contest in terms of a number of spin-offs, knowledge transfers and R&D activities. This is exceptional because many cluster initiatives had until then concentrated either on underdeveloped regions or on science and education.

Interestingly it was not necessarily winning but participation in this contest that was one of the crucial factors for success. However, the BioRegio contest alone was not sufficient to create and sustain innovative regional biotech clusters. Some of the common success factors of the top bioregions can be summarised as follows:

- Integration of national policy with regional policies or programmes at the *Länder* (German regional) level.
- Regional policies focused on the traditional strengths and industries within the region.
- The accompanying regional policies were more successful when using a systemic approach, for example to compensate for the shortcomings of national policies (such as an emphasis on government-backed venture capital (VC) funds for early stage funding).
- Support for spin-offs. Instruments in this area include providing infrastructure (e.g. technology parks), business plan competitions and especially the (re-)vitalisation of the public and private VC sector.
- Strong cluster management. The installation of an individual who is strong, well-known, has excellent cross-linkages (within the region, the companies and among scientists) and is in general highly capable has been shown in several cases, such as Bavaria, to be of the utmost importance.
- Stimulated orientation of the cluster towards global cooperation, markets and research.

The Bavarian biotech cluster in Munich, a world-class cluster, was later also one of the winners of Germany's Leading-Edge cluster competition. The orientation towards cluster excellence, cluster management, smart specialisation and the creation of world-class clusters is of increasing importance and widely discussed at EU level.[299, 300]

Certainly the national and regional cluster policy has to be fitted to the specifics of the country and the regions, and the involved sector(s). The key components that root a specific cluster in one region are highly variable.[301]

[297] Martin R. and Sunley P. (2003).

[298] BMBF (2006).

[299] Gröbner (2010).

[300] ECPG (2008) and ECPG (2010).

[301] Wolfe (2008).

Over time the concept of cluster policy has broadened into an umbrella instrument which links various multi-actor, multi-user innovation and industrial policies targeting the competitiveness of the clusters, which are mostly sector-specific.

The vision on the future of cluster policy and the roles of governance at European, national, regional and sector levels is not clear. Discussions on future cluster policy in Europe are also made difficult because several related new policy concepts arise (such as competitiveness poles, competence centres, centres of excellence, campus of open innovation, sectoral innovation systems and smart specialisation). Many other innovation and industrial policy instruments also relate to or are effective within clusters, either integrated or existing next to each other. This also makes it complex to assess the impact of cluster policy, and to assess what kind of interlinked package of policy instruments is most appropriate. What is, for instance, the complementarity or overlap at European level of technology platforms, LMI and cluster policy?

### 4.3.3. National versus transnational policy concepts

'Globalising' markets and the 'Europeanisation', both on the political and the socio-economic level, are vehemently stirring up the currently known innovation and political systems. In Europe meanwhile, 'innovation policy initiatives are pursued in parallel on the national, the transnational and the regional level and this layer structure has left open a governance gap of poor integration and coordination'.[302] Therefore sharing knowledge is one of the fundamental prerequisites for the efficient and systematic cooperation on various levels which Europe is in need of on the way to the design of a coherent research and innovation agenda. This should be a 'creative and entrepreneurial' policy-making process.

Many innovation problems and challenges should be addressed together, providing customised solutions for different socio-economic challenges. Following the EU 'Competitiveness Council' (December 2008), the former vision that EU countries should combine activities through 'joint programming' is becoming a successful reality. The concept of **Joint Programming** must not be reduced to simply finding the lowest common denominator, but should rather strive to merge different perspectives. Here is a clear link with the Lund Declaration,[303] which stipulates: *The identification of major challenges must involve the relevant stakeholders, including European institutions, business, public sector, NGOs and the scientific community, and foresee the interaction with international partners.*[304]

Again it is unclear what the linkage is between the various policy concepts such as clusters, lead markets, joint programming and innovation partnerships. One reason for the lack of a clear vision on the linkages between these concepts is the fact that these concepts often originate from different DGs of the European Commission. It has also not been worked out enough how bottom-up processes of joint programming among a few Member States can develop into or be linked to policies at the EU27 level. In theory, voluntary partnerships at international level could serve as a multi-level mechanism to come to EU-wide policies. In this respect it is unclear how the prioritisation of the European Commission, for instance in selecting the pilot for innovation partnerships, should be organised. This is one example that shows how improvements have to be made in vertical coordination, between governance at different levels.

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[302] Kuhlmann S. and Edler J. (2002).

[303] The Lund Declaration (SE) (See: http://www.vr.se/lunddeclaration), adopted on 9 July 2009 at the 'New Worlds – New Solutions' conference, stipulates that the EU must identify the major challenges for which public and private research need to develop sustainable solutions.

[304] Pauili, A. (2009).

### 4.3.4. Sector-specific versus cross-sectoral policy concepts

Enhancing the general innovative climate, promoting a stimulating environment and providing good framework conditions are beneficial to competitiveness and the performance of all industries in Europe. Besides generic innovation policy, Member States and the European Union as a whole have defined priorities in terms of technological domains, themes or sectors. For industrial policy there are also generic policy measures benefiting all sectors and industries, and sector-specific priorities or specialisations.

The options to support certain sectors or industries more than others have decreased, as a result of changes to state aid regulations and agreements about the internal market in the European Union, and also because of international agreements. Besides subsidies for R&D and innovation, the options for traditional industrial policy, which favours or protects certain industries and sectors, are limited. In this respect, the less generic and more strategic research and innovation policy has become the new, smart, industrial policy at the level of the European Union, Member States and regions.

One example of a good policy concept for innovation on a European scale for very distinct sectoral levels is the **European Technology Platforms** (ETP). They bring together the most sector-relevant stakeholders (industry, public research, finance, (end)users, policy-makers and regulatory authorities) in order to address specific innovation challenges and to create a coherent action plan to optimise the benefits for all actors in the technology sector.[305] ETPs focus on areas which are of industrial relevance, covering the complete value chain and thus activating national and regional authorities. The ETPs have shown to be important players in the design of research policies, especially by representing the needs of the industry.

The following technology platforms are good examples of an innovative and forward-looking sector-specific approach:

- European Biofuels TP (EBTP);
- European Construction TP (ECTP);
- European Steel TP (ESTEP);
- Forest-based sector TP (FTP);
- European Photovoltaic TP;
- European TP on Sustainable Mineral Resources (ETP SMR);
- Sustainable Nuclear Energy TP (SNE-TP);
- European Wind Energy TP (TPWind);
- Water Supply and Sanitation European TP (WSSTP).

In contrast to well-functioning sector-specific innovation approaches, the concept of '**Grand Challenges**' is an example for **cross-sectoral** engagement in innovation.

[305] EC (2003b).

The ERA Expert Group 'Rationales for the European Research Area' suggested the concept of Grand Challenges, aiming for a more efficient public research system in Europe by preparing for several Grand Challenges.[306] These Challenges might be of an economic, scientific or social nature but most importantly they have to be highly relevant for Europe and they have to show a clear research dimension suitable for shared community efforts.

Identifying Grand Challenges for support demands strict criteria, as the limited resources mean there can only be a small number. The core criteria are:

- relevance demonstrated by contribution to European-added value through transnationality, subsidiarity and the need for a minimum critical effort;
- a research dimension to ensure the buy-in of the research community and the potential to induce improvements in efficiency and effectiveness;
- feasibility as an economic or social investment in terms of research and industrial capability and a viable implementation path.

### 4.3.5. Discipline-oriented versus interdisciplinary concepts

Science and (higher) education are the foundation for a well-trained workforce and one key factor for an innovation-driven, knowledge-based economy. Scientists, employees and entrepreneurs of the 21st century face new and demanding challenges. They need to be knowledgeable about a broad range of disciplinary approaches, from the natural sciences and social sciences to humanities; knowledge across borders creates value.[307, 308] The boundaries can be between scientific disciplines, but there can also be social boundaries that are used to structure our knowledge. Examples include government bodies, different branches of a company and industrial sectors. Interdisciplinary innovation is essential in the knowledge economy, where 'it is often the case that the right knowledge to solve a problem is in a different place to the problem itself'.[309]

This is, for instance, also reflected in the ongoing convergence of science and technology, or the creation of new scientific developments at the interface of existing disciplines. The process of convergence may lead to the development of new knowledge and technologies with great potential for the economy and society as a whole. Well-known examples include bioinformatics (at the interface of biology and informatics) and nanobiotechnology (at the interface of nanotechnology and biotechnology). This is also reflected in the importance of cross-sector innovations and smart specialisation,[310] and it plays an essential role in social innovation, demand-driven and user-driven innovation, and innovation in services.

In an era of interdisciplinarity and instantaneous communication on a global scale, science and education policies must acknowledge these trends; support for integrated education, research and communication as well as cross-intellectual capacity-building is imperative. The importance of the knowledge triangle (education–research–innovation) is now widely accepted. The European Union supports this triangle with various policies and instruments, such as the Framework Programmes. The Framework Programme already stresses the importance of interdisciplinary approaches across different natural sciences, but the integration with social sciences and humanities could be further intensified.

[306] ERA (2008).

[307] DEA/FBE (2008).

[308] Miller M. and Boix Mansilla V. (2004).

[309] Blackwell et al. (2009).

[310] Wintjes, R. and H. Hollanders (2010).

The importance of interdisciplinarity is also evident in horizontal governance for innovation, which links the (policy-making) disciplines of different DGs at European Commission level, and between ministries at national level; and it is seen too in the main EU policy programmes, for example between the Framework Programme and the Structural Funds. Mere co-funding or obligatory paragraphs in policy reports stating that 'their' programme is aligned with the programmes of others is not enough. New mechanisms for interactive, horizontal policy-making (similar to 'joint programming' but between disciplines) should be developed.

Regarding programmes for integrated science and education, a good 'third country' example is **Canada**. Canadian initiatives include the **Integrated Sciences Program** of the University of British Columbia, Carleton University in Ottawa, and the iSci program of McMaster University, Ontario.[311] One part of the Canadian innovation strategy is the creation of partnerships between centres of excellence, notably industry, universities, government and non-profit institutes. These research networks are multidisciplinary and link research with industrial expertise and financial investment in selected priority areas.[312] Additionally, the Collaborative Research and Training Experience Program initiated in 2009 aims to improve the linkage between academia and other sectors, and help researchers to broaden their skills for future careers in business or academia, and contribute to the innovation process. The National Research Council of Canada (NRC) in general focuses on R&D excellence, and in parallel on multidisciplinary integration.[313]

### 4.3.6. High-tech versus demand-oriented policy concepts

Discussions within the last years centred a lot on technology and its importance for innovation and competitiveness, and on the understanding of the processes and institutions involved in technological progress. The consistent finding was that the distance to the technological frontier matters for innovation, and the failure of many EU Member States to deliver the Lisbon goals has also been traced back to the fact that 'EU manufacturing remains specialised in medium-tech sectors and has not taken advantage of the fast growth of certain high-tech sectors'.[314]

An example of good practice in using high-tech concepts as a formula to competitiveness is the **German high-tech strategy**. Germany, with its very good innovation performance, is mainly based on sectors with very limited future growth potential, like automotives, chemicals or machinery. But in high-tech sectors like health, biotechnology, ICT or nanotechnology, which promise rapid growth, change and spillover to other sectors, Germany lagged behind. Therefore in 2006, the Federal High-tech Strategy was initiated and implemented. This includes the funding of 17 priority fields of technology (such as ICT, health, biotechnology, environmental technologies or nanotechnology), and consists of certain specific measures for innovation projects which are allocated under a tendering system. To further support excellence in basic research, several activities like the 'Initiative for Excellence' and the 'Pact for Research and Innovation' were launched.

However, with the implementation of initiatives such as Joint Programming and the Lead Market Initiative (LMI), 'there is now a clear policy shift in the recognition of the need for effective supply-demand matching in research and for the particular role of demand-driven innovation for growth, welfare and well-being'.[315]

[311] Colgoni, A. and Eyles, C. (2010).

[312] Liljemark, T. (2004).

[313] EC (2009m).

[314] EC (2007d).

[315] Soete, L. (2010), p. 2.

For a long time innovation policy-makers have favoured high-tech, but innovation is also important for low-tech industries, and innovation policy is also important for regions and countries with less high-tech industries.

In line with the EU innovation strategy, the European Commission started the LMI in 2006. The idea is to strengthen selected markets by developing them into innovation-friendly and eventually innovation-driven markets. The framework conditions are to be modified in such a manner that they allow for a quick transfer of technological innovation into services and products. The European LMI is based on a number of different demand-oriented innovation policy instruments. Official evaluations of the LMI[316] suggest, however, that it is accompanied by rising coordination costs and institutional limits to new coordination procedures, and that EU Member States vary greatly in their adaptation to this European innovation policy concept (for instance, in the 'absorptive capacity' needed to adopt European policy frameworks, and their institutional conditions for the implementation of demand-oriented policies).

### 4.3.7. Options for improvement of policy aiming at innovative competitiveness

A weak element of the proposals put forward by the European Commission, and also of some Member States, is the lack of transparent procedures of selecting the key RTD areas. Selecting such areas – for instance, determining how to select the topics for innovation partnerships – is to a large degree a political process which should become more democratic, involving a range of stakeholders at multiple levels. The links between the various instruments at various levels are also not clear. Without clear linkages and avoidance of overlap in a clear policy-mix approach, the introduction of new concepts and words could even lead to more fragmentation of policy efforts. For example, what is the difference and what are, or should be, the linkages between lead markets, innovation partnerships, cluster policy, centres of excellence and competence, Joint Programming and Innovation Programmes and Smart Specialisation?

In view of the global challenges ahead, the relevant research and innovation processes have long been understood as a linear sequence of organisationally discrete development steps, each of which is technically and chronologically dependent on the preceding one, from basic scientific work to the ultimate implementation of new products or production processes. As the current EU activities on the EU Strategy 2020, the Innovation Union and the New Industrial Policy demonstrate, innovation policy concepts are nowadays increasingly viewed as an interactive process which takes knowledge from different sources and links it in new ways – with an orientation towards technologies crucial for coping with new societal developments (such as demographic change and the resulting ageing of society, new health concerns, environmental sustainability and security). It would, however, have been desirable to see the current EU activities (at least the two flagship initiatives, the Innovation Union and the New Industrial Policy) embedded into a systemic, coordinated and sustainable policy concept.

Initial practical experience shows that while the conscious attempt to bring together actors out of different (policy) arenas leads to misunderstandings and conflicts, it also holds considerable creative potential. European innovation and industrial policy has major roles to play in this context and is well poised to forge the favourable conditions under which economic actors can develop business activities that can compete both locally and globally.

[316] Cunningham, P. (2009).

Many horizontal innovation and industrial (policy) topics have yet to find a platform. Important political arenas such as research policy, healthcare policy and agriculture policy remain disconnected. The 'linear', supply-driven innovation model still dominates many established innovation policy concepts. Widespread institutional fragmentation and mutual obstruction among the many different political agencies prevent exchange, binding cooperation and joint learning.

A systemic innovation policy demands new flexibilities and learning abilities on the part of policy-makers and their partners in society, business and science, in order to cut across traditional boundaries. In particular, this includes the promotion of different innovation and competitiveness paths, a broad portfolio of technologies and the assurance of variety. Prerequisites for this include the strengthening of communication and exchange, the management of interfaces, reinforcement of user–manufacturer partnerships, support for the establishment of new networks and the elimination of encrusted structures.

The innovation potential of overarching departments and levels of coordination is far from exhausted yet, and the institutional complexity of the Innovation Union suggests that 'the performance of respective public interventions heavily depends at least on an appropriate instrumental mix, the existence of a differentiated organisational structure within the innovation system, and the implementation of horizontal and vertical coordination mechanism which do not produce excessive coordination costs'.[317]

Two questions involving the innovation and competitiveness potential of the **current Innovation Union** have to be considered. How effective and efficient is the institutional environment in which the Innovation Union will be implemented, and what particular commitments do specific actor constellations and coordination procedures give for its successful design and implementation?[318]

Systems of innovation, at both national and regional levels, provide distinct and diverse institutional conditions for demand-oriented policies. It is therefore quite unlikely that one-size-fits-all policy concepts will be able to raise demand articulation for new knowledge or technological innovations. What is needed are approaches that promote closer interaction, not only among the sectors but also among the Member States that have been formally responsible up until now – so that strategic and operative improvement potential lingers there, too – and that also spread the responsibility for innovation to the other departments.

European innovation policy should therefore be coordinated (consolidated) more horizontally and oriented more systemically. It should operate from a broad interdisciplinary perspective. To that end, major actors and institutions must cooperate better. Explicit channels to articulate the demand for innovations must be created so opportunities beyond any immediate policy arena can be realised.

[317] Kaiser R. and Kripp M., (2010), p. 19.

[318] Kaiser R. and Kripp M., (2010), p. 19.

## 4.4. Recommendations for innovation and industrial policy in the European Union

### 1. Increase demand-driven innovation with platform-based policies

Although the importance of demand-driven and business oriented innovation policy is acknowledged in most strategic documents, many current policies still follow a supply-driven approach (supporting the public research sector in the hope that it will result in innovations for which a market can be developed). In order to better match supply and demand for technologies and innovations, it is important to organise platforms where users and producers can meet and discuss. Implementing demand-driven policies therefore calls for appropriate coordination and priority-setting mechanisms. European Technology Platforms are good examples of such mechanisms at EU level. Matching supply and demand for innovations is important for all sectors, and not only for 'high-tech' sectors. The format of the European Technology Platforms should therefore also be applied to 'low-tech' fields of innovation (e.g. in service industries like tourism) and public sector innovation. Another suggestion is to set up 'cross-sector' innovation platforms: for instance matching the supply of ICT with the demand of the wholesale sector, or linking the biotech to the food sector. Also the lack of governance mechanisms for matching supply and demand for innovation in the less R&D-intensive countries and regions needs to be addressed, e.g. by allowing the use of Structural Funds from the Cohesion Policy for investments to set up such platforms or similar governance infrastructures.

### 2. Develop strategic approaches which integrate R&D-, innovation- and industrial policy

Traditional industrial policy, which favours or protects specific industries, is no longer an option, e.g. due to state-aid rules. Because it is allowed to give priority to certain fields of research, integrating the policy fields of R&D-, innovation- and industrial policy creates opportunities for strategic policy approaches. The Lead Market Initiative is a good example at EU level of a strategic approach which integrates innovative competitiveness-enhancing policies in one coherent package. At national level, cluster policies can serve as good examples (as the case of Singapore shows). At regional level Smart Specialisation is the strategic approach proposed in the new cohesion policy to construct regional specific advantages in innovative competitiveness.

A vision should be developed on how these strategic initiatives (Lead Markets, cluster policy, Smart Specialisation, but also Innovation Partnerships, Joint Programming and European Technology Platforms) can serve to select priorities for EU research policy.

### 3. Address societal challenges with new instruments

Apply the concepts of Lead Markets, Technology Platforms, Innovation Partnerships, Open Innovation and Smart Specialisation to societal challenges. At EU level, it is recommended to develop new instruments to address societal challenges, such as social challenge innovation platforms, public sector Lead Markets, and EU-wide clusters.[319] Since many societal challenges are global, the instruments should promote global cooperation.

[319] DG (2010).

### 4. Develop a coherent EU strategy for innovative competitiveness

At EU level, 'the flagships' need a common strategic roadmap which aligns policy concepts and programmes from different DGs of the European Commission. It is recommended to reinforce and improve linkages between existing policy instruments which affect innovative competitiveness. Using a common language and commonly defined definitions and concepts is an important, concrete step towards a coherent vision and strategic framework to encourage innovative competitiveness. In this respect it is good to develop new indicators, even a single one (e.g. the share of fast growing innovative firms in the economy). This indicator can serve to show 'innovative competitiveness', and as such it could be used to set targets and assess the impact of both innovation and industrial policy.

### 5. Create European Research Centres

With many national research institutes and centres of excellence in every EU Member State, and limited differentiation among universities, the fragmentation of research excellence in Europe might be a threat to Europe's innovative competitiveness[320]. Setting up the European Research Council (ERC) and the European Institute of Technology (EIT) may not be sufficient in reducing this fragmentation. With the increased global competition, more focus and concentration of research efforts is needed to maintain EU leadership in key RTD areas.

When it is not feasible in the short term to set up European Research Institutes, setting up Joint Institutes (after the example of Joint Programming), co-funded by the EU, could be a concrete first step. Existing cross-border cooperation could function as a pioneer for such transnational research institutes.

Research policy support for the development of European Centres, which operate at the technological frontier where new General Purpose Technologies are developed, should be complemented with region-specific (and sector-specific) innovation and industrial policy, focusing on the diffusion, absorption, transfer and application of new technologies.

### 6. Enhance the capacity for strategy development at regional level

It is necessary for policy-makers to invest in strategy development in cooperation with relevant stakeholders. Since the sub-national, regional policy level is of high importance for innovation and competitiveness-enhancing policy activities, it is important to support policy intelligence and the development of Smart Specialisation strategies. This is recognised in the communication 'Regional Policy contributing to smart growth in Europe 2020', but without specifying how the development of such strategies can be supported and which policy instruments could be relevant to implement them. It is therefore suggested to develop a scheme (within the Structural Funds programme, as a follow-up to schemes such as Regional Innovation Strategies and Innovative Actions) to enhance the capacity for developing and implementing Smart Specialisation strategies. Another concrete suggestion is to enhance policy intelligence by asking national governments to increase the sample of the Community Innovation Survey (CIS), in case the current sample is too small to allow for regionalisation.

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[320] See Foray, D. and B. Van Ark (2007). For other policy briefs of the 'Knowledge for Growth' Expert Group, see: http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm

### 7. Improve coordination between national and regional levels of governance

The interaction between policy-makers at different levels of governance needs to be improved. The Lisbon Monitoring Platform of the Committee of the Regions has for instance shown that in many cases there has not been that much real interaction between regional and national policy-makers. In several cases, better institutional mechanisms need to be developed to achieve this. One way to organise interaction between different parts or levels of government is by co-funding.

### 8. Create a single market for business services

The European Union should function as a single research area, innovation system, business environment and community. The market for business services in the European Union is still fragmented and non-transparent. Also, as the sector-cases have shown, a single market for business-related services is needed to enhance innovative competitiveness. Possibilities for further harmonisation of existing legislation and administrative procedures should be addressed and bureaucratic barriers reduced.

### 9. Give special attention to ICT in innovation and industrial policy

ICT is vital for every societal and economic challenge, not as an industry but as a general-purpose technology. Since Information and Communication Technologies are essential for the innovativeness and competitiveness of every sector, and affects every aspect of society, it deserves special attention in terms of governance and policies.

### 10. Make more use of innovative instruments to finance innovation

Credit availability is still not back to normal and financial markets remain risk averse. Given the current, significant deterioration in the state of public finances in several Member States, new and innovative solutions should be explored, including schemes co-funded by EU Regional Policy. Good practice examples are the financial schemes with co-funding from the European Investment Bank in the Structural Funds programme (JASPERS, JEREMIE, JESSICA) and in cooperation with the Framework Programme (Risk-sharing Finance Facility). This last scheme is a good example of debt financing, which has been evaluated as very successful.[321]

### 11. Improve policy learning from 'own practice'

Better impact assessments, new performance indicators, more policy evaluations and more policy experiments are recommended. Policy learning should go beyond the transfer of good practice from elsewhere. Because of the difference in context, the best way to learn and improve innovation policy is to learn from one's own experience. Learning-by-doing in innovation policy calls for more attention to policy evaluation and impact assessment. For many years the European Commission has focused mainly on 'learning from others' by organising the exchange of good practice between Member States. Policy experiments are often not supported. Improvement and renewal of innovation policy, or the search for better policy solutions, should be mainly a demand-driven and user-driven, trial and error process. Monitoring, evaluation and impact assessments are therefore essential.

[321] See also Soete (2010).

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# ANNEX: INFORMATION ON INDICATORS

## Annex a: EIS indicators used for the comparisons between the EU27 and the US and Japan

| | Data source | Reference year |
|---|---|---|
| **ENABLERS** | | |
| * S&E graduates per 1000 population aged 20-29 | Eurostat | 2007 |
| Population with tertiary education per 100 population aged 25-64 | Eurostat | 2007 |
| * Researchers per 1000 population | OECD (MSTI database) / Eurostat | 2007 (2006 for US) |
| Public R&D expenditures (% of GDP) | Eurostat | 2007 |
| Venture capital (% of GDP) | EVCA / Eurostat | 2008 (no data for JP) |
| Private credit (relative to GDP) | IMF | 2008 |
| * Broadband subscribers per 1000 population | World Bank (World Development Indicators) | 2006 |
| **FIRM ACTIVITIES** | | |
| Business R&D expenditures (% of GDP) | Eurostat | 2007 |
| IT expenditures (% of GDP) | EITO / Eurostat | 2006 |
| Public-private co-publications per million population | Thomson Reuters / CWTS | 2007 |
| EPO patents per million population | Eurostat | 2005 |
| * PCT patents per million population | OECD | 2005 |
| * Trademarks per million population, average of: | | |
| • Community trademarks per million population | OHIM / Eurostat | 2007 |
| • Trademark applications (residents) per million population | World Bank (World Development Indicators) | 2007 |
| Technology Balance of Payments flows (% of GDP) | World Bank (World Development Indicators) | 2007 |
| **OUTPUTS** | | |
| Employment in medium-high & high-tech manufacturing (% of workforce) | Eurostat / OECD | 2006 (2003 for JP) |
| Employment in knowledge-intensive services (% of workforce) | Eurostat / OECD | 2006 (2003 for JP) |
| Medium and high-tech manufacturing exports (% of total exports) | Eurostat | 2007 |
| Knowledge-intensive services exports (% of total services exports) | Eurostat | 2007 |

The indicators highlighted with an * are not identical to but proxies for the EIS indicators.

**Source:** EIS (2009).

## Annex b: EIS indicators used for the comparisons between the EU27 and the BRIC countries

| | Data source | Reference year |
|---|---|---|
| **ENABLERS** | | |
| Share of labour force with tertiary education | World Bank (World Development Indicators - WDI) | 2007 |
| Researchers per million 1000 population | World Bank (WDI) | 2006 |
| R&D expenditures (% of GDP) | World Bank (WDI) | 2006 |
| Private credit (relative to GDP) | IMF | 2007 |
| **FIRM ACTIVITIES** | | |
| ICT expenditures (% of GDP) | World Bank (WDI) | 2007 |
| Public-private co-publications per million population | Thomson Reuters / CWTS | 2007 |
| Patent applications by residents per million population | World Bank (WDI) | 2007 |
| Trademark applications by residents per million population | World Bank (WDI) | 2006 |
| Technology Balance of Payments flows (% of GDP) | World Bank (WDI) | 2008 |
| **OUTPUTS** | | |
| High-tech manufacturing exports (% of total exports) | World Bank (WDI) | 2007 |
| Knowledge-intensive services exports (% of total services exports) | United Nations Service Trade Statistics Database | 2007 |

**Source:** EIS (2009).

## Annex c: EIS indicators used for the comparisons between the EU27 and selected European countries

| | | |
|---|---|---|
| **ENABLERS** | | |
| | **Human resources** | |
| 1.1.1 | S&E and SSH graduates per 1000 population aged 20-29 (first stage of tertiary education) | Eurostat (2007) |
| 1.1.2 | S&E and SSH doctorate graduates per 1000 population aged 25-34 (second stage of tertiary education) | Eurostat (2007) |
| 1.1.3 | Population with tertiary education per 100 population aged 25-64 | Eurostat (2008) |
| 1.1.4 | Participation in life-long learning per 100 population aged 25-64 | Eurostat (2008) |
| 1.1.5 | Youth education attainment level | Eurostat (2008) |
| | **Finance and support** | |
| 1.2.1 | Public R&D expenditures (% of GDP) | Eurostat (2008) |
| 1.2.2 | Venture capital (% of GDP) | EVCA / Eurostat (2008) |
| 1.2.3 | Private credit (relative to GDP) | IMF (2008) |
| 1.2.4 | Broadband access by firms (% of firms) | Eurostat (2008) |
| **FIRM ACTIVITIES** | | |
| | **Firm investments** | |
| 2.1.1 | Business R&D expenditures (% of GDP) | Eurostat (2008) |
| 2.1.2 | IT expenditures (% of GDP) | EITO / Eurostat (2006) |
| 2.1.3 | Non-R&D innovation expenditures (% of turnover) | Eurostat (2006) |
| | **Linkages & entrepreneurship** | |
| 2.2.1 | SMEs innovating in-house (% of SMEs) | Eurostat (2006) |
| 2.2.2 | Innovative SMEs collaborating with others (% of SMEs) | Eurostat (2006) |
| 2.2.3 | Firm renewal (SME entries plus exits) (% of SMEs) | Eurostat (2005) |
| 2.2.4 | Public-private co-publications per million population | Thomson Reuters / CWTS (2007) |
| | **Throughputs** | |
| 2.3.1 | EPO patents per million population | Eurostat (2006) |
| 2.3.2 | Community trademarks per million population | OHIM / Eurostat (2008) |
| 2.3.3 | Community designs per million population | OHIM / Eurostat (2008) |
| 2.3.4 | Technology Balance of Payments flows (% of GDP) | World Bank (2008) |
| **OUTPUTS** | | |
| | **Innovators** | |
| 3.1.1 | SMEs introducing product or process innovations (% of SMEs) | Eurostat (2006) |
| 3.1.2 | SMEs introducing marketing or organisational innovations (% of SMEs) | Eurostat (2006) |
| 3.1.3 | Resource efficiency innovators, calculated as the average of: | |
| | • Share of innovators where innovation has significantly reduced labour costs (% of firms) | Eurostat (2006) |
| | • Share of innovators where innovation has significantly reduced the use of materials and energy (% of firms) | Eurostat (2006) |
| | **Economic effects** | |
| 3.2.1 | Employment in medium-high & high-tech manufacturing (% of workforce) | Eurostat (2008) |
| 3.2.2 | Employment in knowledge-intensive services (% of workforce) | Eurostat (2008) |
| 3.2.3 | Medium and high-tech manufacturing exports (% of total exports) | UN (2008) |
| 3.2.4 | Knowledge-intensive services exports (% of total services exports) | UN / Eurostat (2007) |
| 3.2.5 | New-to-market sales (% of turnover) | Eurostat (2006) |
| 3.2.6 | New-to-firm sales (% of turnover) | Eurostat (2006) |

**Source:** EIS (2009).

## Annex d: EIS scores for the EU27 and selected European countries

| | Innovation performance | | | | | | | Innovation growth | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EIS indicators** | **EU27** | **Switzer-land** | **Germany** | **Estonia** | **Spain** | **Bulgaria** | | **EU27** | **Switzer-land** | **Germany** | **Estonia** | **Spain** | **Bulgaria** |
| **OUTPUT** | | | | | | | | **0.5** | **1.7** | **0.7** | **1.4** | **1.6** | **0.9** |
| **ECONOMIC EFFECTS** | | | | | | | | **1.0** | **2.0** | **1.2** | **2.1** | **3.1** | **0.6** |
| New-to-firm products | 6.28 | 5.8 | 10.11 | 5.43 | 8.48 | 3.59 | | 0.1 | 0.0 | 0.2 | 5.2 | -4.0 | -3.1 |
| New-to-market products | 8.6 | 4.9 | 9.12 | 7.19 | 7.37 | 6.70 | | 4.1 | 0.0 | 4.8 | 0.4 | 17.7 | -5.7 |
| KIS exports | 48.8 | 39.8 | 55.9 | 69.1 | --- | 19.1 | | 1.2 | 11.2 | 2.0 | 7.0 | --- | 5.8 |
| Medium/high-tech manufacturing exports | 47.4 | 63.6 | 62.9 | 50.9 | 51.8 | 24.2 | | -0.4 | 0.3 | -0.8 | -2.1 | -0.7 | 3.3 |
| Employment in knowledge-intensive services | 14.9 | 19.87 | 15.87 | 16.35 | 14.99 | 8.35 | | 1.3 | 0.4 | 2.1 | 3.0 | 4.1 | 0.9 |
| Medium/high-tech manufacturing employment | 6.6 | 7.11 | 10.89 | 5.24 | 4.78 | 5.13 | | -0.3 | 0.3 | -0.8 | -0.4 | -0.4 | 2.7 |
| **INNOVATORS** | | | | | | | | **0.5** | **0.0** | **-0.7** | **-0.3** | **-2.1** | **4.5** |
| Resource efficiency innovators | 27.6 | --- | 24.6 | 29.5 | 50.9 | 29.1 | | --- | --- | --- | --- | --- | --- |
| SME marketing or organisatinal innovations | 40.0 | --- | 68.1 | 84.4 | 29.5 | 15.7 | | --- | --- | --- | --- | --- | --- |
| SME product or process innovations | 33.7 | 52.9 | 52.8 | 45.8 | 29.5 | 17.8 | | -1.3 | 0.0 | -0.7 | -0.3 | -2.1 | 4.5 |
| **FIRM ACTIVITIES** | | | | | | | | **1.0** | **2.1** | **2.5** | **7.7** | **1.1** | **12.0** |
| **THROUGHPUTS** | | | | | | | | **-1.3** | **6.0** | **5.2** | **10.4** | **0.6** | **25.2** |
| Technology Balance of Payments flows | 1.0 | --- | 0.57 | 0.34 | 0.25 | 0.21 | | 4.5 | --- | 8.2 | 16.9 | -7.2 | 7.8 |
| Community designs | 120.3 | 301.1 | 244.5 | 26.1 | 95.3 | 12.5 | | 4.2 | 6.5 | 5.3 | 3.8 | 2.9 | 24.1 |
| Community trademarks | 122.4 | 366.1 | 188.8 | 65.6 | 151.7 | 36.2 | | 5.2 | 9.4 | 6.2 | 14.5 | 2.2 | 69.6 |
| EPO patents | 114.9 | 430.7 | 290.9 | 7.1 | 33.4 | 3.5 | | 1.3 | 2.2 | 1.4 | 6.9 | 4.9 | 8.2 |
| **LINKAGES & ENTREPRENEURSHIP** | | | | | | | | **-0.6** | **0.8** | **0.9** | **0.4** | **-2.2** | **2.0** |
| Public-private co-publications | 31.1 | 198.5 | 49.2 | 17.5 | 13.5 | 1.3 | | 1.5 | 1.2 | 1.7 | 14.6 | 2.3 | 0.9 |
| Firm renewal (SMEs entries + exits) | 4.9 | 3.8 | --- | 5.2 | 4.1 | --- | | -4.4 | 2.2 | --- | -12.2 | -5.9 | --- |
| Innovative SMEs collaborating with others | 9.5 | 12.1 | 9.0 | 18.1 | 5.0 | 3.8 | | 1.0 | 0.0 | 1.0 | 3.1 | -3.0 | 5.0 |
| SMEs innovating in-house | 30.0 | 34.3 | 46.3 | 37.1 | 24.6 | 15.1 | | -0.5 | 0.0 | 0.1 | -2.1 | -1.8 | 0.0 |
| **FIRM INVESTMENTS** | | | | | | | | **-0.4** | **0.0** | **0.5** | **14.5** | **6.4** | **6.1** |
| Non-R&D innovation expenditures | 1.03 | 0.92 | 1.07 | 3.36 | 0.49 | 0.79 | | -2.4 | 0.0 | 0.0 | 29.3 | 13.4 | 5.0 |
| IT expenditures | 2.7 | 3.7 | 2.9 | 2.9 | 1.4 | 2.0 | | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 7.5 |
| Business R&D expenditures | 1.21 | 2.14 | 1.84 | 0.56 | 0.74 | 0.15 | | 1.1 | 0.0 | 1.4 | 14.1 | 6.3 | 5.7 |
| **ENABLERS** | | | | | | | | **4.1** | **5.8** | **4.5** | **7.1** | **1.6** | **7.1** |
| **FINANCE AND SUPPORT** | | | | | | | | **6.5** | **8.6** | **3.7** | **5.7** | **-0.9** | **12.2** |
| Broadband access by firms | 81.0 | 85.0 | 84.0 | 88.0 | 92.0 | 62.0 | | 15.2 | 0.0 | 11.7 | 6.7 | 6.3 | 22.0 |
| Private credit | 1.27 | 1.68 | 1.08 | 0.99 | 1.98 | 0.74 | | 5.0 | 1.5 | -0.9 | 12.8 | 12.2 | 19.8 |
| Venture capital | 0.118 | 0.17 | 0.061 | --- | 0.112 | --- | | 5.1 | 37.8 | 10.4 | --- | -5.3 | --- |
| Public R&D expenditures | 0.67 | 0.68 | 0.79 | 0.71 | 0.61 | 0.33 | | 1.2 | -0.4 | 1.3 | 9.2 | 6.2 | -3.5 |
| **HUMAN RESOURCES** | | | | | | | | **2.3** | **3.6** | **5.5** | **9.5** | **4.7** | **4.1** |
| Youth education | 78.5 | 81.2 | 74.1 | 82.2 | 60.0 | 83.7 | | 0.5 | 0.8 | 0.9 | 0.6 | -0.5 | 2.4 |
| Life-long learning | 9.6 | 26.8 | 7.9 | 9.8 | 10.4 | 1.4 | | 0.8 | -1.6 | 1.6 | 11.2 | -0.2 | 1.9 |
| Tertiary education | 24.3 | 33.7 | 25.4 | 34.3 | 29.2 | 22.8 | | 2.8 | 4.6 | 0.5 | 2.1 | 2.6 | 1.5 |
| S&E and SSH doctorate graduates | 1.03 | 2.38 | 1.55 | 0.62 | 0.65 | 0.40 | | 2.4 | 9.6 | 3.9 | 9.2 | -3.2 | 12.5 |
| S&E and SSH graduates | 40.5 | 51.3 | 27.8 | 41.2 | 26.1 | 34.5 | | 5.1 | 5.0 | 12.2 | 5.5 | -2.9 | 2.7 |
| **Summary Innovation Index (SII)** | **0.478** | **0.694** | **0.596** | **0.481** | **0.377** | **0.231** | | **1.8** | **3.3** | **2.6** | **5.5** | **1.4** | **4.1** |

**Source:** EIS (2009).

## Annex e: The global competitiveness index in detail

| | INDICATOR | RANK/139 |
|---|---|---|
| | **1st pillar: Institutions** | |
| 1.01 | Property rights | 116 |
| 1.02 | Intellectual property protection | 101 |
| 1.03 | Diversion of public funds | 58 |
| 1.04 | Public trust of politicians | 63 |
| 1.05 | Irregular payments and bribes | 68 |
| 1.06 | Judicial independence | 88 |
| 1.07 | Favoritism in decisions of government officials | 65 |
| 1.08 | Wastefulness of government spending | 53 |
| 1.09 | Burden of government regulation | **20** |
| 1.10 | Efficiency of legal framework in settling disputes | 59 |
| 1.11 | Efficiency of legal framework in challenging regulations | 56 |
| 1.12 | Transparency of government policymaking | **49** |
| 1.13 | Business costs of terrorism | 51 |
| 1.14 | Business costs of crime and violence | 56 |
| 1.15 | Organized crime | 82 |
| 1.16 | Reliability of police services | 57 |
| 1.17 | Ethical behavior of firms | 58 |
| 1.18 | Strength of auditing and reporting standards | 83 |
| 1.19 | Efficacy of corporate boards | **47** |
| 1.20 | Protection of minority shareholders' interests | 82 |
| 1.21 | Strength of investor protection* | **15** |
| | **2nd pillar: Infrastructure** | |
| 2.01 | Quality of overall infrastructure | 78 |
| 2.02 | Quality of roads | 81 |
| 2.03 | Quality of railroad infrastructure | 109 |
| 2.04 | Quality of port infrastructure | 100 |
| 2.05 | Quality of air transport infrastructure | 58 |
| 2.06 | Available airline seat kilometers* | 113 |
| 2.07 | Quality of electricity supply | 90 |
| 2.08 | Fixed telephone lines* | 88 |
| 2.09 | Mobile telephone subscriptions* | **22** |
| | **3rd pillar: Macroeconomic environment** | |
| 3.01 | Government budget balance* | 110 |
| 3.02 | National savings rate* | 106 |
| 3.03 | Inflation* | 57 |
| 3.04 | Interest rate spread* | 76 |
| 3.05 | Government debt* | 92 |
| 3.06 | Country credit rating* | 88 |
| | **4th pillar: Health and primary education** | |
| 4.01 | Business impact of malaria | 1 |
| 4.02 | Malaria incidence* | 1 |
| 4.03 | Business impact of tuberculosis | **7** |
| 4.04 | Tuberculosis incidence* | **36** |
| 4.05 | Business impact of HIV/AIDS | **2** |
| 4.06 | HIV prevalence* | **1** |
| 4.07 | Infant mortality* | 61 |
| 4.08 | Life expectancy* | **40** |
| 4.09 | Quality of primary education | 58 |
| 4.10 | Primary education enrollment rate* | 85 |
| | **5th pillar: Higher education and training** | |
| 5.01 | Secondary education enrollment rate* | 91 |
| 5.02 | Tertiary education enrollment rate* | 91 |
| 5.03 | Quality of the educational system | 54 |
| 5.04 | Quality of math and science education | 62 |
| 5.05 | Quality of management schools | 85 |
| 5.06 | Internet access in schools | 69 |
| 5.07 | Local availability of research and training services | 94 |
| 5.08 | Extent of staff training | 55 |

| | INDICATOR | RANK/139 |
|---|---|---|
| | **6th pillar: Goods market efficiency** | |
| 6.01 | Intensity of local competition | 113 |
| 6.02 | Extent of market dominance | 63 |
| 6.03 | Effectiveness of anti-monopoly policy | 109 |
| 6.04 | Extent and effect of taxation | **39** |
| 6.05 | Total tax rate* | 84 |
| 6.06 | Number of procedures required to start a business* | **23** |
| 6.07 | Time required to start a business* | **9** |
| 6.08 | Agricultural policy costs | 90 |
| 6.09 | Prevalence of trade barriers | **49** |
| 6.10 | Trade tariffs* | **44** |
| 6.11 | Prevalence of foreign ownership | 66 |
| 6.12 | Business impact of rules on FDI | 53 |
| 6.13 | Burden of customs procedures | 82 |
| 6.14 | Degree of customer orientation | 62 |
| 6.15 | Buyer sophistication | 98 |
| | **7th pillar: Labor market efficiency** | |
| 7.01 | Cooperation in labor-employer relations | **42** |
| 7.02 | Flexibility of wage determination | 64 |
| 7.03 | Rigidity of employment* | 64 |
| 7.04 | Hiring and firing practices | **21** |
| 7.05 | Redundancy costs* | 89 |
| 7.06 | Pay and productivity | **16** |
| 7.07 | Reliance on professional management | 82 |
| 7.08 | Brain drain | 107 |
| 7.09 | Female participation in labor force* | 87 |
| | **8th pillar: Financial market development** | |
| 8.01 | Availability of financial services | 128 |
| 8.02 | Affordability of financial services | 113 |
| 8.03 | Financing through local equity market | 137 |
| 8.04 | Ease of access to loans | 90 |
| 8.05 | Venture capital availability | 107 |
| 8.06 | Restriction on capital flows | **50** |
| 8.07 | Soundness of banks | 107 |
| 8.08 | Regulation of securities exchanges | 131 |
| 8.09 | Legal rights index* | **6** |
| | **9th pillar: Technological readiness** | |
| 9.01 | Availability of latest technologies | 90 |
| 9.02 | Firm-level technology absorption | 92 |
| 9.03 | FDI and technology transfer | 74 |
| 9.04 | Internet users* | 55 |
| 9.05 | Broadband Internet subscriptions* | 79 |
| 9.06 | Internet bandwidth* | 59 |
| | **10th pillar: Market size** | |
| 10.01 | Domestic market size index* | 99 |
| 10.02 | Foreign market size index* | 116 |
| | **11th pillar: Business sophistication** | |
| 11.01 | Local supplier quantity | 112 |
| 11.02 | Local supplier quality | 109 |
| 11.03 | State of cluster development | 123 |
| 11.04 | Nature of competitive advantage | 95 |
| 11.05 | Value chain breadth | 129 |
| 11.06 | Control of international distribution | 52 |
| 11.07 | Production process sophistication | 64 |
| 11.08 | Extent of marketing | **42** |
| 11.09 | Willingness to delegate authority | 76 |
| | **12th pillar: Innovation** | |
| 12.01 | Capacity for innovation | 100 |
| 12.02 | Quality of scientific research institutions | 128 |
| 12.03 | Company spending on R&D | 91 |
| 12.04 | University-industry collaboration in R&D | 138 |
| 12.05 | Gov't procurement of advanced tech products | 63 |
| 12.06 | Availability of scientists and engineers | 124 |
| 12.07 | Utility patents per million population* | 90 |

Notes: Ranks of notable competitive advantages are **highlighted**. An asterisk (*) indicates that data are from sources other than the World Economic Forum. For further details and explanation, please refer to the section "How to Read the Country/Economy Profiles" at the beginning of this chapter.

**Source:** WEF (2010).

EUROPEAN PARLIAMENT

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

# POLICY DEPARTMENT A
## ECONOMIC AND SCIENTIFIC POLICY

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