CORDIS focus

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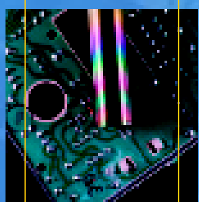
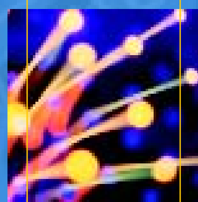
European Innovation Scoreboard 2003



CORDIS focus Supplement

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This CORDIS *focus* supplement includes the Commission Staff Working Paper "2003 European Innovation Scoreboard", SEC (2003) 1255, and a technical paper on "Indicators and Definitions". Both documents and more technical papers are available from: www.cordis.lu/trendchart

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Preface

The European Innovation Scoreboard

The EIS was developed at the request of the Lisbon European Council in 2000. It provides indicators for tracking progress towards the EU's strategic goal of becoming the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion. The scoreboard is updated annually.

The EIS is part of a package of Commission documents, together with the "Enterprise Scoreboard" and the "European Competitiveness Report"[1]. The importance of innovation as a cornerstone of European industrial competitiveness policy has been emphasised in the Communication of the Commission "Industrial Policy in an Enlarged Europe"[2].

The European Trend Chart on Innovation

The EIS is one of the three strands of the European Trend Chart on Innovation, together with the *Innovation Policy Review Workshops* and the *Survey of Innovation Policy Measures*.

These three complementary strands of the Trend Chart build a comprehensive picture of innovation policies across Europe and implement the "open co-ordination approach" laid down by the Lisbon Council in 2000.

The *Survey of Innovation Policy Measures* is carried out on a permanent basis. The information collected is available from the Trend Chart database, which contains several hundreds of policy measures in all Member States.

The *"Innovation Policy Review Workshops"* offer the opportunity to compare and analyse in depth innovation policies and support schemes of the Member States. The aim of these reviews is not "scoring" the quality of schemes but facilitating the trans-national exchange of experience between policy makers and scheme managers who are active in the same segment of innovation policy.

In addition to the EIS, the main products of the Trend Chart are as follows:

- the database of policy measures across Europe;
- the "who is who?" of agencies and government departments involved in innovation;
- country reports for all countries covered;
- comparative trend reports on themes of common interest;
- workshop reports;
- a news service and thematic papers;
- annual reports.

The website of the Trend Chart provides access to all Trend Chart publications and to the database: **www.cordis.lu/trendchart.**

The "Technical Papers"

The EIS 2003 is accompanied by six technical papers. These papers report on ongoing research under the Trend Chart and offer information that is complementary to the European Innovation Scoreboard. All technical papers are available from the Trend Chart website.

- Technical Paper No 1: Indicators and definitions. This paper includes full definitions and graphs for all indicators.
- Technical Paper No 2: Analysis of national performances. This paper includes detailed results per country (current and trend data, innovation leaders, relative strengths and weaknesses) as well as other country specific information.
- Technical Paper No 3: Regional innovation performances. This paper includes current regional data for 173 regions in 13 Member States as well as detailed results for innovation leaders and two different regional summary innovation indexes.
- Technical Paper No 4: Sectoral Innovation Scoreboard. This paper explores innovation performances in high, medium-high, medium-low and low-tech manufacturing sectors.
- Technical Paper No 5: National Innovation System Indicators. This paper explores some of the background conditions for innovation. It includes nine structural and 14 socio-cultural-institutional indicators for all EU Member States.
- Technical Paper No 6: Methodology report. This paper describes the methodology underlying the EIS, including different methods for calculating the Summary Innovation Index.

1 SEC(2003) 1278
2 COM(2002) 714

european innovation scoreboard 2003

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Executive Summary

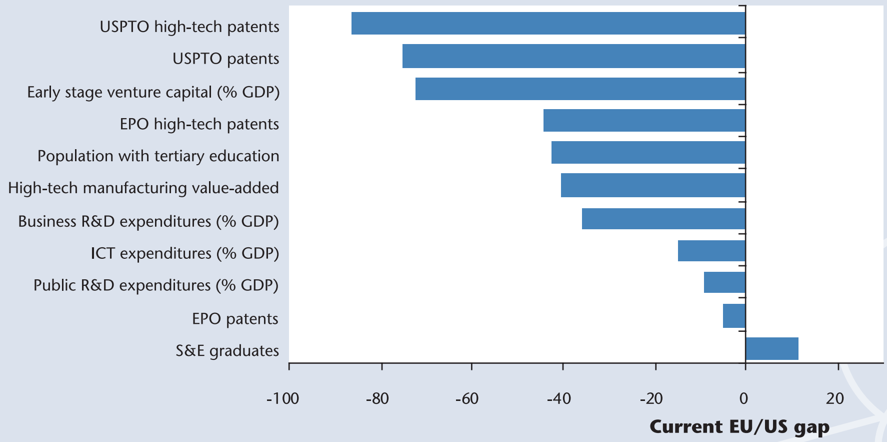
Better and more recent data

This is the fourth edition of the *European Innovation Scoreboard* (EIS), prepared by the European Commission as part of the Lisbon strategy. The EIS 2003 includes innovation indicators and trends for 15 EU Member States, 10 Acceding countries, 3 Candidate countries, 3 Associate countries and the US and Japan. It offers several improvements over the 2002 edition. All indicators have been updated, some of them using most recent Eurostat estimations (e.g. figures for R&D). For the first time since the existence of the EIS, new figures from the Community Innovation Survey have become available. This allowed updating of those core indicators of the EIS picturing the diffusion of innovation. Coverage of innovation in services has also been substantially improved. The EIS 2003 is accompanied by in-depth research presented in six technical papers.

The EU-15's innovation performance continues to lag behind the US

The EIS 2003 explores in detail the development of the EU/US gap for those indicators for which comparable data are available. As last year, the US leads the EU for the vast majority of these indicators (10 out of 11, see Figure I). At the current rates of change, none of the current EU/US gaps would be closed before 2010. The gap for business R&D shows some weak signs of recovery but, since 2001, a new and increasing gap appeared in public R&D (GERD minus BERD). Early stage venture capital improves slowly but the gap remains huge. With regard to human resources the large gap in tertiary education persists. The EU weakness in education is further illustrated by the worrisome decline of the EU trend in lifelong learning (no comparable US data available). The only advance of the EU is in S&E graduates. Only two indicators justify a more positive note. Albeit very slow, a catching-up process can be observed in high-tech manufacturing value added. And a long lasting catching-up process exists in ICT expenditures (EU/US gap cut by half since 1996).

Figure I. The EU/US gap is large and persists



Gaps are calculated as percentage differences (EU/US – 1)*100. A positive value indicates an EU lead, while a negative value indicates that the EU lags behind the US.

Specific European weakness in patenting

The EIS 2003 confirms the specific European weakness in patenting: the gaps for all four patent indicators remain negative. This means that the US is patenting more actively in Europe than Europe itself. The situation is even worse for high-tech patents, which is the most important segment for innovation. The future implementation of the EU patent will facilitate patenting in Europe. But it may not be sufficient to overcome the underlying patenting weaknesses in many Member States. This European weakness could justify a concerted EU effort to boost European patenting in Europe and, more importantly, in the US. The trend analyses show that, without active measures, Europe is unlikely to catch up in patenting in the foreseeable future.

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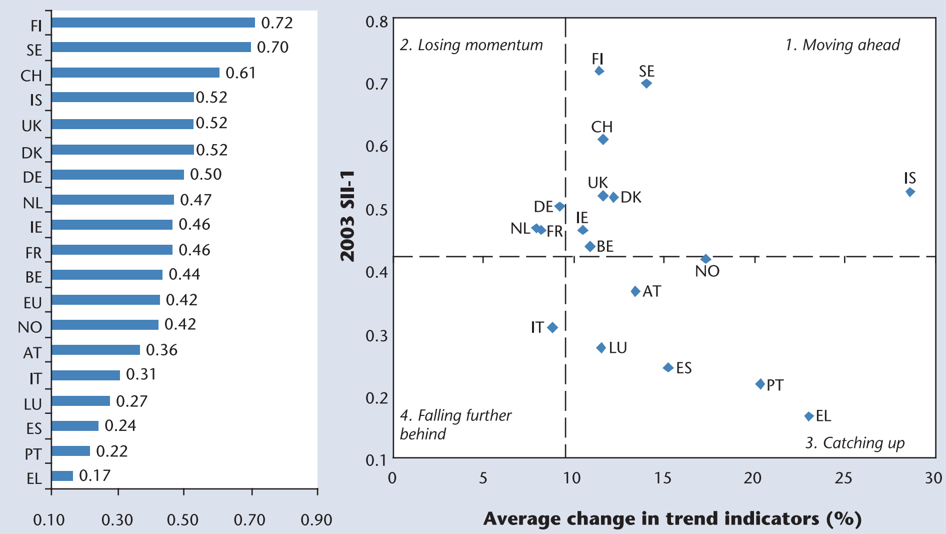
Catching up of Cohesion countries

With new data from the Community Innovation Survey it is again possible to offer a Summary Innovation Index (SII; not directly comparable to the one in the EIS 2001). The SII offers insight into the relative performances of individual countries, bearing in mind that, let alone by their size, countries are not directly comparable. Figure II gives the SII-1 on the vertical axis and the average trend performance on the horizontal axis. Countries above the horizontal dotted line have a current innovation performance above the EU average, while the trend for countries to the right of the vertical line improved faster than the average EU trend. Sweden and Finland confirm their EU leadership and Cohesion countries show signs of catching up.

Figure II. Overall country trends by Summary Innovation Index (SII-1)



EU innovation leaders ahead of the US

Looking at individual Member States, the EU leaders are ahead of the US for eight indicators and ahead of Japan for seven indicators. Sweden and Finland rank with the US and Japan as the most innovative of the 33 countries in the EIS. This lead is likely to continue. The trend performance of Sweden exceeds that of both the US and Japan, while the trend performance of Finland exceeds that of the US and is equivalent to Japan. In 2001 the EIS sent the message that "world innovation leaders come from Europe". Policy-makers worldwide use the experience of these countries for "transnational policy learning". However, awareness is growing that "good policy practices" cannot be copied but must be fully understood in their original context before any transfer attempt. The 2002 EIS and the accompanying technical papers offer new insight into the diversity of national "innovation paths" in the enlarging Europe.

The "catching-up" of Acceding countries may not be sustainable

A second SII limited to 12 widely available indicators shows an overall positive "catching-up" pattern for Acceding countries. But this picture should not hide the existence of serious problems. Even if the Czech Republic, Hungary and Slovenia rank higher than some of the EU-15 Member States and most Acceding countries show a stronger growth performance than the EU, a large part of this growth is due to the fact that these countries have started from very low starting values for several indicators. Moreover, both public and private R&D spending is falling in several Acceding countries, even though current performance is far below the EU-15 average. Consequently, the positive trends for the Acceding countries may not be sustainable in the near future.

Need for proactive innovation policies in Acceding countries

In the EU-15 the trend for employment in medium-high and high-tech manufacturing sectors fell by 3.7%. This reflects the long-term decline in manufacturing employment. With an increase in related employment in Hungary, Latvia, Slovenia, and Slovakia, part of the decline in EU-15 may also be due to the transfer of certain high-tech production activities to the Acceding countries. Acceding countries (and some of the "neighbouring" countries of the EU) should continue to grasp the transfer of production activities as an opportunity for

continued ➔

upgrading their national innovation systems. However, the current pattern of dependence on FDI for increases in living standards will eventually reach an upper limit, unless there is an improvement in the innovative capabilities of domestic firms. These serious problems in the innovation performance of the Acceding countries must be addressed.

Innovation excellence "trickles down" from high-tech to low and medium-tech sectors

The analysis of innovation performance in four manufacturing classes (high, medium-high, medium-low, and low technology) shows that the overall innovation leaders Finland, Sweden and Denmark are also the most innovative countries in low and medium-low technology sectors. In other words, innovation performance in high technology manufacturing is positively correlated with performance in low technology manufacturing. This suggests that countries with innovative high and medium-high technology sectors benefit from a faster rate of diffusion and adoption of innovation across the economy. For countries with an industrial structure dominated by low and medium-low technology manufacturing, such as Spain and Portugal, this finding would justify policy efforts to develop their still limited high-tech sectors. However such a strategy should also stimulate the diffusion or "trickling-down" of innovation capabilities from high-tech to low and medium-low tech industries and between Member States.

The most innovative EU regions are in Sweden, Finland, Germany and the Netherlands

The 2003 EIS offers more detailed regional analysis using more indicators at a more differentiated regional level. The analysis confirms the positive relationship between regional innovation and GDP performance. Two groups of leading innovative regions are identified in the EU. The regions in the first group, including Uusimaa (Finland), Stockholm and Sydsverige (both Sweden) have the best educated workforces and a relative orientation towards services. The second group, including Noord-Brabant (the Netherlands), Stuttgart and Oberbayern (both Germany), have the best patent performance and a relative orientation towards manufacturing but per capita incomes in these regions are below those of the first group.

Converging messages from the EIS, the enterprise scoreboard and the competitiveness report

The EIS is one of the policy instruments of the Commission in the framework of its enterprise and industrial policy. The EIS and the *Enterprise Policy Scoreboard*[1] cover complementary policy areas. Several indicators in both scoreboards are identical and both 2003 scoreboards highlight that, in their respective areas, the Lisbon goals are unlikely to be met without additional effort. As every year, the 2003 edition of the European Competitiveness Report (ECR)[2] analyses the competitiveness of the Union, including the negative impact of the Union's specific innovation weaknesses on its competitiveness. This year, the competitiveness report and the EIS come to similar conclusions in two major areas. Firstly, reaping the benefits of the positive trend in ICT investment depends on Europe's ability to accelerate and deepen organisational innovation. Secondly, adjustment strategies in Acceding countries should rely on innovation and not on current cost advantages.

National objectives and target setting needed to implement the conclusions of the Council

The European Spring Council 2003 requested the establishment of a "framework of common objectives for strengthening innovation in the EU" and "an assessment mechanism for taking stock of the progress achieved". In May 2003 the Competitiveness Council invited the Member States and Acceding countries to "define policy objectives in the field of innovation, reflecting the specificity of their respective innovation systems, and views of the most appropriate route to achieving improved innovation performance" and *"to set their own quantitative and/or qualitative targets on a voluntary basis."*[3]

There is an urgent need to further implement these Council conclusions. Quite clearly, the "assessment of progress made" will be impossible without clear and specific national objectives. The EIS 2003 and the six technical papers that come with it offer new insight into the performances and specificities of national innovation systems. Together with the other policy instruments under the *European Trend Chart on Innovation* (analysis of national innovation policies and benchmarking workshops) this should support the Member States with defining measurable innovation policy objectives that are complementary to the initiative "Investing in Research: An Action Plan for Europe".[4]

1 SEC(2003)
2 SEC(2003)
3 Council document 9341/03
4 COM(2003)226

1 Introduction

The European Innovation Scoreboard (EIS) was developed at the request of the Lisbon European Council in 2000[5]. It provides indicators for tracking progress towards the EU's strategic goal of becoming the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion.

The Communication of the Commission "Industrial Policy in an Enlarged Europe"[6] emphasised the importance of innovation as a cornerstone of European industrial policy. Going into greater detail, the Communication "Innovation Policy: Updating the Union's approach in the context of the Lisbon strategy"[7] stressed "entrepreneurial innovation" and those forms of innovation that are based on organisational change and technology diffusion.

In spring 2003, the European Council responded positively to the Commission's innovation policy Communication. It requested the establishment of a *"**framework of common objectives** for strengthening innovation in the EU"* and *"an **assessment mechanism** for taking stock of the progress achieved".*

Since 2000 the EIS and the *European Trend Chart on Innovation* have provided part of this assessment mechanism. In combination, the EIS, the continuous analysis of national innovation policies and the innovation benchmarking workshops of the Trend Chart offer the tools for "intelligent" policy benchmarking. The EIS points to the strengths and weaknesses of aggregate national innovation performances. The Trend Chart policy database and country reports provide comparable information on national policy measures. The workshops offer a learning environment to draw lessons on specific issues of common interest.

In order to proceed with implementing the required "assessment mechanism" the Competitiveness Council invited the Member States and Acceding countries to:

- **"define policy objectives in the field of innovation**, reflecting the specificity of their respective innovation systems, and views of the most appropriate route to achieving improved innovation performance; and
- improve indicators within the context of an upgraded European innovation scoreboard and to **set their own quantitative and/or qualitative targets** on a voluntary basis."[8]

Despite some notable exceptions (e.g. the current overhaul of the national innovation policy frameworks in the UK and the Netherlands) most Member States have not yet made much progress in the definition of national objectives and targets in the area of innovation. The EIS 2003 and the accompanying six technical papers that will be available from the Trend Chart website[9] offer new insight into the European diversity of "innovation paths". The chapter on national "strengths and weaknesses" is expanded in Technical Paper No 2. Technical Paper No 4 examines national innovation performances for four manufacturing classes: high, medium-high, medium-low, and low technology. Technical Paper No 5 analyses structural and socio-cultural-institutional factors shaping the *National Innovation Systems* and influencing national innovation capabilities. This information should support the Member States with grasping the *"specificity of their respective innovation systems",* in order to make progress towards setting "their own quantitative and/or qualitative targets".

The EIS mainly uses Eurostat data[10]. Six of the now 20 EIS indicators[11] are drawn from the EU Structural Indicators. Eight indicators are also used by DG Research under the "Investing in Research" Action Plan for Europe[12]. The EIS is one of the policy instruments of the Commission in the framework of its enterprise and industrial policy. The EIS and the *Enterprise Policy Scoreboard* cover complementary policy areas. Several indicators in both scoreboards are identical, highlighting similar developments under different angles. The European Competitiveness Report (ECR) looks, among other aspects, at the negative impact of EU innovation weaknesses on competitiveness.

5 A first provisional EIS was published in September 2000: COM(2000) 567. The first full version of the EIS was published in October 2001: SEC(2001) 1414. The second full version was published in December 2002: SEC(2002) 1349.

6 COM(2002) 714

7 COM(2003) 112

8 Council document 9341/03

9 www.cordis.lu/trendchart or www.trendchart.org

10 The EIS covers 32 countries: the Member States, the Acceding and Candidate countries (ACC) and the Associate countries Norway, Iceland, Switzerland, as well as the US and Japan. Israel could not be included because of missing data. All indicators use the most recent data available as of September 23, 2003. 2002 data are Eurostat estimations.

11 The 20 main indicators of the 2003 EIS summarise the main drivers and outputs of innovation. These indicators are divided into four groups: Human resources for innovation (5 indicators); the Creation of new knowledge (4 indicators); the Transmission and application of knowledge (3 indicators); and Innovation finance, output and markets (8 indicators). Table A in the annexes provides a brief definition and the source of each indicator. Full definitions of each indicator are available in Technical Paper No 1: Indicators and definitions. Tables D and E in the annexes show the most recent years available. Reduced accuracy can occur where comparisons have to be made between data from different years due to a lack of data for a particular indicator or country.

12 SEC(2003) 489.

2 The innovation performance of the Union

Figure 1 shows that large gaps with the US and Japan continue. The EU leads the US for only one of the twelve indicators for which US data are available (S&E graduates). All other gaps remain negative.

With regard to human resources the large gap in tertiary education persists and there is no improvement over time in the EU lead for S&E graduates. Business R&D shows some signs of recovery but, since 2001, a new increasing gap appeared in public R&D (GERD minus BERD). Early stage venture capital in the EU has grown slowly but the gap remains huge.

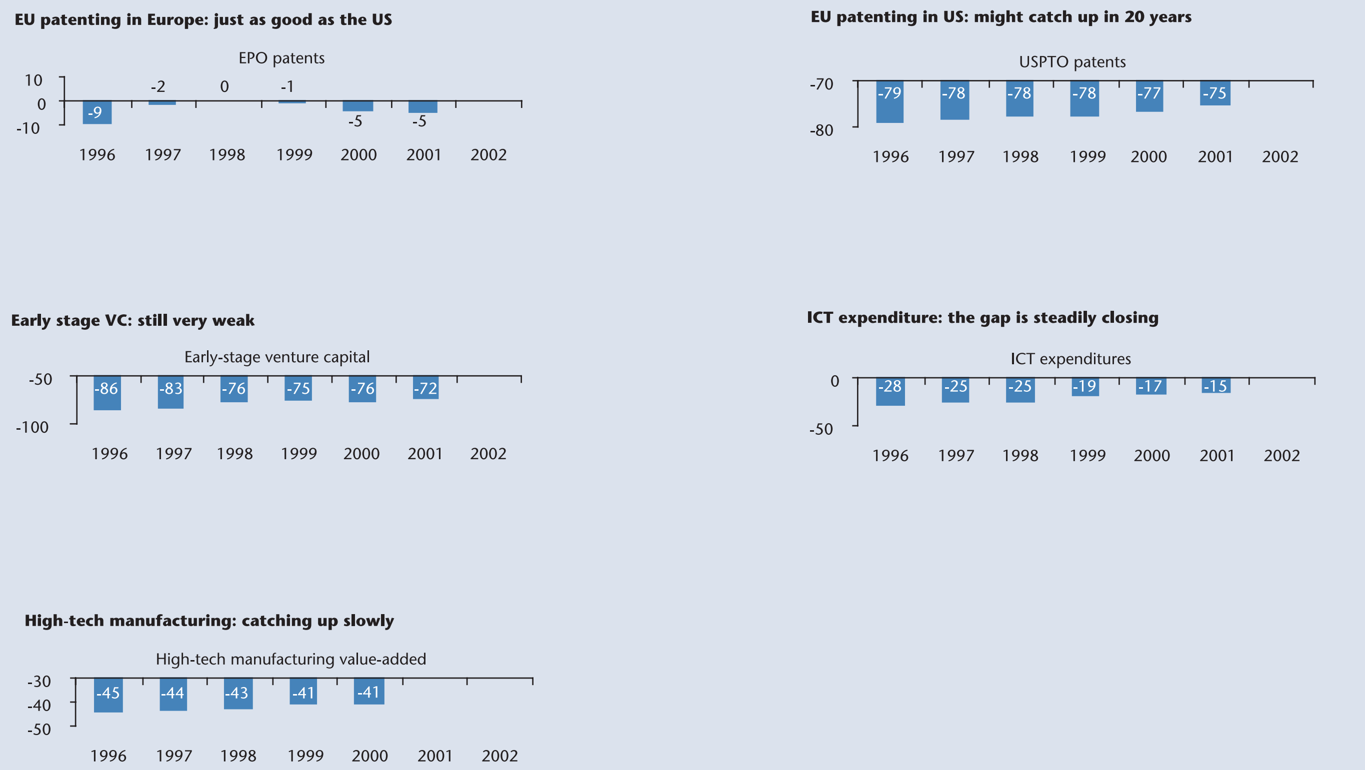
The specific European weakness in patenting is confirmed: the gaps for all four patent indicators remain negative. This means that the US is patenting more actively in Europe than Europe itself. This unbalanced situation is worse for high-tech patents than for all patents. The future implementation of the EU patent will facilitate patenting in Europe. European weakness could justify a concerted EU effort to boost European patenting in Europe and, more importantly, in the US. The trend analyses show that, without active measures, Europe is unlikely to catch up in patenting in the foreseeable future.[13]

In 2002 the EIS sent the moderately optimistic message that *"overall positive trend results suggest that the EU may be catching up with its main competitors."* This year, the most recent figures and an indicator-by-indicator analysis of the EU / US gaps entail a less optimistic adjustment of this picture.

Figure 1. EU / US gap for 11 innovation indicators

13 The Trend Chart workshop "the challenge of strategic patenting" explored differences in EU/US patenting behaviour, see http://trendchart.cordis.lu/Benchmarking/index.cfm?fuseaction=Benchmarking15

Figure 1. (continued) EU/US gap for 11 innovation indicators



Gaps are calculated as percentage differences (EU/US – 1)*100. A positive value indicates an EU lead, while a negative value indicates that the EU lags behind the US.

The only encouraging example of a long lasting catching-up process is in ICT expenditures (gap cut by 50% since 1996). Reaping the full benefits of this positive trend would require acceleration of organisational innovation following investment in ICT hardware.[14]

The overall EU-15 lag with Japan is comparable to the gap with the US. The EU is lagging in all ten indicators that are available for Japan. The largest gap is in patenting in the US where Japan does significantly better than the EU. For business R&D expenditures Japan performs over 50% above the EU-15 average. For more detailed figures see Tables 1 and 2 below.

14 Hence the focus of the Communication on “non-technical innovation”. For Finland and three other EU countries the 2003 competitiveness report provides evidence on the close relationship between ICT-linked organisational change and productivity growth.

3 The 2003 Summary Innovation Index

Figure 2. The 2003 SII-1

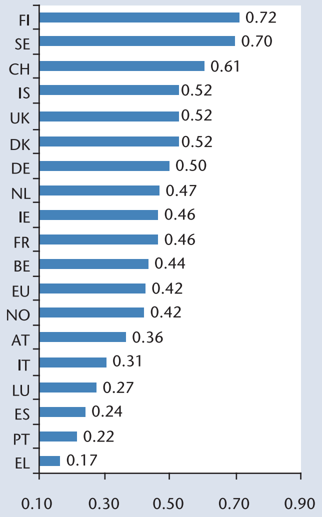
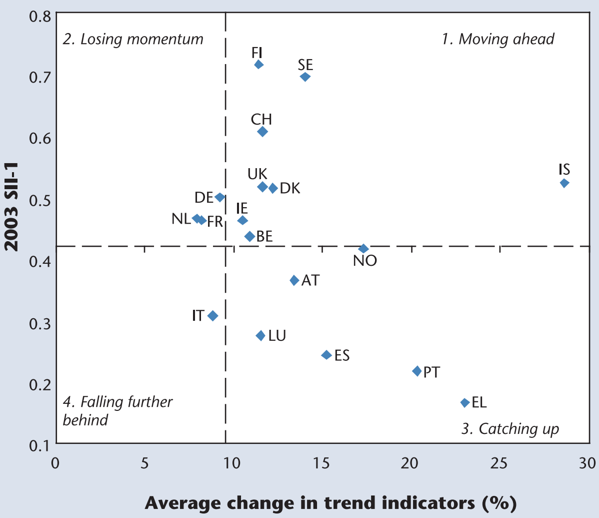


Figure 3. Overall country trend by SII-1



The Summary Innovation Index (SII) offers insight into the relative performances of individual countries, bearing in mind that, let alone by their size, countries are not directly comparable (hence the detailed analysis of "innovation paths" below and in the technical papers). With new data from the Community Innovation Survey (CIS), the EIS 2003 again includes an SII.[15] However, there are marked differences in data availability across countries. Data are missing for many indicators for the Acceding and Candidate countries, Switzerland, the US and Japan. Therefore two synthesis indicators have been calculated. The SII-1 uses all indicators and covers the EU-15 Member States, Iceland, Norway and Switzerland. The SII-2 uses only the twelve most widely available indicators[16] but it covers all countries.

Both indicators position countries consistently but the SII-2 should be used with greater care, due to its more limited database. Figure 2 shows the results for the 2003 SII-1. Finland and Sweden have by far the highest SII-1 and are confirmed as the European innovation leaders. Spain, Portugal and Greece show the weakest innovation performance. Compared to the 2001 SII, Germany and Italy show the strongest *short-term* improvement, increasing respectively from seventh to fifth and from thirteenth to eleventh position[17] .

Figure 3 graphs current performance on the SII-1 (vertical axis) against the *medium-term* trend performance[18] (horizontal axis). Greece, Portugal and Spain are the best examples of countries catching up from low current values. Sweden, Finland and Iceland are moving ahead, with above average current and trend performance. The Netherlands, France and Germany are in danger of losing momentum. Although their current performance is above the EU average, their average trends lag behind other countries. In comparison with the SII 2001, Portugal shifted from a "falling behind" to a "catching up" situation.

Figure 4 shows the SII-2 results for all countries[19] . Sweden and Finland, as in the more detailed SII-1, are the innovation leaders within Europe. The "moving ahead" position of the US and Japan analysed in chapter 2 is also confirmed by this analysis. Of note, several ACC countries, such as the Czech Republic, Estonia, Slovenia and Hungary, perform remarkably well. However, the overall positive "catching-up" picture for Acceding countries should not hide the existence of serious problems. Even if most Acceding countries show a stronger growth performance than the EU, a large part of this growth is due to the fact that for several indicators these countries have started from very low starting values. Moreover, public and private R&D spending is falling in several Acceding countries, even though current performance is far below the EU-15 average. Consequently, the positive trends for the Acceding countries may not be sustainable in the near future.

15 The method of calculating the 2003 SII has been improved compared to the 2001 EIS. For a brief explanation see Annex A.4, details in Technical Paper No 6. The new method does not influence the ranking.

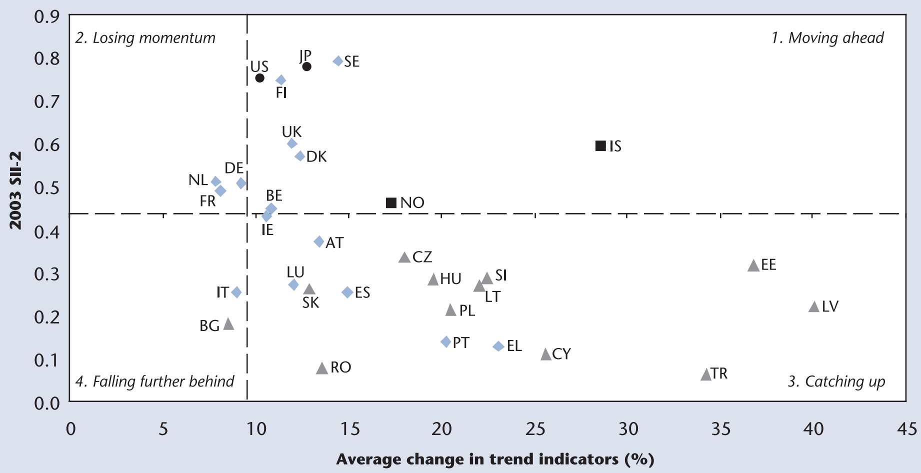
16 These are all five human resources indicators, all six knowledge creation indicators and ICT expenditures. Full details are available in Technical Paper No 2.

17 This improvement is not due to the changed methodology in calculating the SII. Germany's rank improvement is fully explained by the change in the set of indicators. Italy's rank improvement is fully explained by a *real* improvement as shown by a direct comparison between the 2001 SII and a 2003 SII using only those indicators used in the 2001 EIS.

18 Trend calculations compare the latest available year with the average of three previous years after a one year lag (see Technical Paper No 6). All trend results are presented in Tables F and G in the annex. Cf. Annexes A.1 and A.2 for definitions of indicator trends and average country trend.

19 Switzerland and Malta are not included as these countries have less than 6 trend results.

Figure 4. Overall country trend by SII-2



In the EU-15 the trend for employment in medium-high and high-tech manufacturing sectors fell by 3.7%. This reflects the long-term decline in manufacturing employment. With an increase in related employment in Hungary, Latvia, Slovenia, and Slovakia, part of the decline in EU-15 may also be due to the transfer of certain high-tech production activities to the Acceding countries. Acceding countries (and some of the "neighbouring" countries of the EU) should continue to grasp this opportunity for upgrading their national innovation systems. The 2003 competitiveness report elaborates on the Acceding countries' current dependence on FDI for growth that will eventually reach an upper limit, unless there is an improvement in the innovative capabilities of domestic firms. These serious problems in the innovation performance of the Acceding countries must be addressed.

4 Innovation performance and trends by countries

As seen above, the Acceding and Candidate countries (ACC), as a group, lag behind the EU for almost all indicators, although several of them perform above the EU average. For half of the indicators, at least one ACC country is above the EU mean. This is true for all education indicators, employment in medium/high-tech manufacturing, the percentage of SMEs innovating in-house and involved in innovation co-operation, ICT expenditures, and high-tech manufacturing value-added. The Czech Republic, Estonia, Hungary, Lithuania and Slovenia are the most innovative Acceding countries[21] .

The Associate countries (AC), Norway, Iceland and Switzerland, perform above the EU mean for almost all indicators. For seven indicators, the best Associate country outperforms even the EU leader: tertiary education, lifelong learning, public R&D, USPTO patents, SMEs innovating in-house, internet access/use, and ICT expenditures.

Table 2 identifies the three EU trend leaders, the three ACC trend leaders and the AC trend leader[22]. Greece, Spain and Portugal all lead trends in at least five indicators[23] . Part of the explanation for this is that they are improving from very low starting points.

For the ACC, three countries are leading in three indicators and five countries leading in two indicators[24] . Slovenia, Cyprus, Hungary and Turkey are trend leaders in four indicators each.

The Associate countries show an above EU trend performance in almost all indicators. Iceland shows an increase of over 100% in USPTO patents (due to a highly specialised “niche” strategy focused on biotechnology innovation) and Norway in both EPO patent indicators. Trend leadership is almost equally shared by Iceland and Norway, and for five indicators at least one Associate country is growing faster than the EU trend leader.

Table 1 offers more detailed analyses by indicators and countries. It identifies the three leading EU Member States, the three leading Acceding and Candidate countries, the leading Associate country and the results for the US and Japan. As expected, the Nordic countries of Finland, Sweden and Denmark take up half of the leading slots. Of the larger EU countries, Germany and the UK are ahead of France and Italy.[20] Of note, the EU leaders are ahead of the US for eight indicators and ahead of Japan for seven indicators.

20 The full ranking in descending order is: FI (19); SE (15); DE (9); DK (8); UK (6); NL, PT (both 4); BE, ES, IT (all 3), EL, FR, IE (all 2); LU (1) and AT (0).

21 Data availability for the ACC countries is too different to give a reliable ranking for the number of leading slots. Cf. Technical Paper No 1 for more details.

22 All trend results are presented in Tables F and G in the annex.

23 The full ranking is: EL, PT (both 6); ES (5); DK, DE, IE (all 4); SE (3); LU, AT, FI (all 2); BE, IT, NL, UK (all 1) and FR (0).

24 The full ranking is: CY, HU, SI, TR (all 4); EE , LV, RO (all 3); BG, LT, MT, PL, SK (all 2) and CZ (1).

Table 1. Innovation leaders

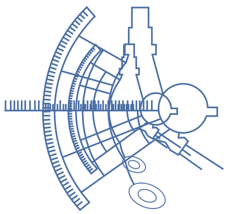
No	Indicator	EU mean	EU leaders			ACC* leaders			AC** leader	US	JP
1.1	S&E graduates / 20-29 years	11.3	21.7 (IE)	19.6 (FR)	19.5 (UK)	13.1 (LT)	8.2 (SI)	7.9 (BG)	9.1 (IS)	10.2	—
1.2	Population with tertiary education	21.5	32.4 (FI)	29.4 (UK)	28.1 (BE)	44.0 (LT)	29.6 (EE)	29.1 (CY)	34.2 (NO)	37.2	33.8
1.3	Participation in lifelong learning	8.4	22.3 (UK)	18.9 (FI)	18.4 (DK)	9.0 (SK)	8.4 (LV)	6.0 (CZ)	23.5 (IS)	—	—
1.4	Employment in med/high-tech manufacturing	7.41	11.36 (DE)	7.39 (FI)	7.37 (IT)	9.28 (SI)	8.94 (CZ)	8.50 (HU)	7.75 (CH)	—	—
1.5	Employment in high-tech services	3.57	5.23 (SE)	4.74 (DK)	4.74 (FI)	3.09 (CZ)	3.06 (MT)	3.06 (HU)	4.81 (IS)	—	—
2.1	Public R&D / GDP	0.69	1.02 (FI)	0.96 (SE)	0.83 (NL)	0.69 (SI)	0.57 (HU)	0.53 (EE)	1.33 (IS)	0.76	0.81
2.2	Business R&D / GDP	1.30	3.31 (SE)	2.47 (FI)	1.76 (DE)	0.94 (SI)	0.78 (CZ)	0.45 (SK)	1.95 (CH)	2.04	2.28
2.3.1	High-tech EPO patents / population	31.6	136.1 (FI)	100.9 (SE)	68.8 (NL)	8.6 (SI)	4.3 (HU)	2.6 (CY)	49.6 (NO)	57.0	44.9
2.3.2	High-tech USPTO patents / population	12.4	47.3 (SE)	41.6 (FI)	22.7 (DK)	2.6 (MT)	0.6 (CY)	0.5 (SI)	21.5 (IS)	91.9	80.0
2.4.1	EPO patents / population	161.1	366.6 (SE)	337.8 (FI)	309.9 (DE)	40.7 (SI)	19.0 (HU)	14.5 (CY)	327.1 (CH)	169.8	174.7
2.4.2	USPTO patents / population	80.1	213.7 (SE)	156.1 (FI)	147.4 (DE)	13.1 (SI)	7.3 (HU)	5.1 (MT)	230.8 (CH)	322.5	265.2
3.1	SMEs innovating in-house – manufacturing [a]	37.4	55.1 (DE)	46.2 (BE)	42.5 (NL)	39.1 (EE)	26.0 (LT)	25.8 (CZ)	58.0 (CH)	—	—
3.1	SMEs innovating in-house – services [a]	28.0	43.9 (DE)	39.6 (LU)	37.6 (PT)	33.5 (EE)	22.7 (CZ)	14.9 (LT)	50.1 (CH)	—	—
3.2	Innovation co-operation – manufacturing SMEs [a]	9.4	22.0 (FI)	18.9 (DK)	14.1 (SE)	12.1 (LT)	11.8 (EE)	8.4 (SI)	13.0 (CH)	—	—
3.2	Innovation co-operation – services SMEs [a]	7.1	18.3 (FI)	12.8 (SE)	12.7 (DK)	12.7 (LT)	11.6 (EE)	5.2 (CZ)	12.1 (NO)	—	—
3.3	Innovation expenditures – manufacturing [a]	3.45	6.42 (SE)	4.92 (BE)	4.71 (DE)	8.80 (SK)	4.20 (SI)	3.65 (LV)	4.29 (CH)	—	—
3.3	Innovation expenditures – services [a]	1.83	19.11 (SE)	2.66 (PT)	1.64 (DE)	7.50 (SK)	2.60 (SI)	1.66 (LV)	2.81 (CH)	—	—
4.1	High-tech venture capital share	45.4	71.2 (IT)	70.7 (FR)	57.5 (FI)	17.5 (PL)	1.6 (HU)	— 59.4	(NO) —	—	
4.2	Early stage venture capital / GDP	0.037	0.098 (SE)	0.087 (FI)	0.080 (DK)	0.019 (CZ)	0.018 (PL)	0.015 (HU)	0.048 (IS)	0.218	—
4.3.1	Sales “new to market” products – manufacturing [a]	10.5	27.2 (FI)	18.7 (IT)	16.0 (PT)	—	—	—	4.6 (NO)	—	—
4.3.1	Sales “new to market” products – services [a]	7.4	17.9 (EL)	13.7 (ES)	12.2 (FI)	—	—	—	3.0 (NO)	—	—
4.3.2	Sales “new to firm” products – manufacturing [a]	28.6	40.3 (DE)	32.1 (SE)	31.1 (FI)	—	—	—	20.7 (CH)	—	—
4.3.2	Sales “new to firm” products – services [a]	18.8	37.1 (EL)	26.4 (ES)	23.7 (SE)	—	—	—	20.4 (CH)	—	—
4.4	Internet access/use	0.51	0.97 (SE)	0.93 (DK)	0.76 (FI)	0.44 (MT)	0.33 (SI)	0.27 (CY)	1.00 (IS)	0.73	0.88
4.5	ICT expenditures / GDP	7.0	9.8 (SE)	8.6 (UK)	8.3 (NL)	9.6 (EE)	9.5 (CZ)	8.9 (HU)	10.2 (CH)	8.2	9.0
4.6	High-tech manufacturing value-added share	14.1	30.6 (IE)	24.9 (FI)	18.8 (UK)	22.4 (MT)	22.3 (LT)	15.9 (SI)	22.7 (CH)	23.0	18.7
4.7	Volatility rates – manufacturing	12.7	16.0 (UK)	14.2 (ES)	13.3 (PT)	—	—	—	—	—	—
4.7	Volatility rates – services	16.6	20.4 (DK)	20.2 (UK)	18.5 (NL)	—	—	—	—	—	—

a Only those countries for which CIS 3 results are available qualify as a potential leader. CIS 3 results for CZ, EE, LT, LV, SI and SK are non-harmonised and thus not directly comparable to those of the EU-15, Iceland and Norway. Cf. Technical Paper No 1 for more details.
* ACC = Acceeding and Candidate countries.
** AC = Associate countries

Table 2. Trend leaders

No	Indicator	EU mean	EU trend leaders			ACC* leaders			AC** leader	US	JP
1.1	S&E graduates / 20-29 years	9.1	46.5 (SE)	35.1 (ES)	33.3 (PT)	153.8 (MT)	71.1 (EE)	63.2 (PL)	67.4 (CH)	-3.3	—
1.2	Population with tertiary education	3.3	18.5 (AT)	16.3 (IE)	15.4 (ES)	21.0 (CY)	14.9 (BG)	14.8 (TR)	14.2 (NO)	6.1	9.9
1.3	Participation in lifelong learning	0.6	16.9 (NL)	10.7 (UK)	9.1 (EL)	29.8 (CY)	22.2 (RO)	21.4 (SI)	11.9 (IS)	—	—
1.4	Employment in med/high-tech manufacturing	-3.7	15.6 (LU)	3.0 (DE)	2.1 (FI)	154.8 (LV)	20.0 (SK)	8.1 (SI)	20.9 (IS)	—	—
1.5	Employment in high-tech services	11.5	30.9 (AT)	18.3 (DE)	17.9 (ES)	21.5 (CY)	7.5 (LV)	7.4 (HU)	17.3 (IS)	—	—
2.1	Public R&D / GDP	2.0	34.0 (EL)	8.6 (ES)	7.6 (PT)	42.0 (RO)	36.5 (HU)	17.4 (CZ)	5.3 (IS)	13.4	-2.8
2.2	Business R&D / GDP	4.8	73.7 (PT)	46.0 (EL)	28.4 (DK)	119.4 (LT)	85.8 (TR)	82.4 (LV)	55.2 (IS)	2.7	10.1
2.3.1	High-tech EPO patents / population	63.6	241.1 (EL)	173.9 (IE)	96.9 (PT)	309.3 (SI)	286.9 (CY)	226.0 (HU)	294.7 (NO)	76.6	52.1
2.3.2	High-tech USPTO patents / population	43.9	116.4 (ES)	95.7 (SE)	77.1 (DK)	—	—	—	94.6 (NO)	41.9	21.6
2.4.1	EPO patents / population	25.3	70.3 (PT)	52.1 (IE)	39.9 (DK)	99.3 (EE)	93.8 (SI)	93.5 (LT)	151.6 (NO)	30.9	41.8
2.4.2	USPTO patents / population	28.1	90.7 (PT)	68.7 (LU)	66.7 (IE)	534.4 (EE)	284.8 (MT)	126.1 (TR)	178.1 (IS)	13.3	16.2
4.2	Early stage venture capital / GDP	10.4	531.6 (DK)	85.1 (SE)	83.3 (EL)	—	—	—	76.0 (NO)	188.7	—
4.5	ICT expenditures / GDP	15.5	21.2 (EL)	18.3 (DE)	17.8 (IT)	40.5 (PL)	38.9 (SK)	34.7 (RO)	18.6 (CH)	4.9	14.7
4.6	High-tech manufacturing value-added share	12.0	19.1 (FI)	17.6 (DE)	16.0 (BE)	30.6 (TR)	27.0 (BG)	18.3 (HU)	9.0 (NO)	7.0	12.0

The calculation method for trends is described in annex A.3.
* ACC = Acceeding and Candidate countries.
** AC = Associate countries



5 Relative strengths and weaknesses

Table 3 summarises the relative strengths and weaknesses of each country. The results are limited to a maximum of the three best and three weakest values of current indicators or trends[25]. This extensive identification of relative strengths and weaknesses is offered to support Member States with the definition of national objectives (see reference to Council request in the introductory chapter above). More details can be found in Technical Paper No 2.

Table 3. Relative strengths and weaknesses

	Major relative strengths	Major relative weaknesses
Belgium	Current and trend for tertiary education (1.2); trend for lifelong learning (1.3); innovation expenditures in manufacturing (3.3)	Trend for EPO high-tech patents (2.3.1); innovation expenditures in services (3.3); trend for early-stage venture capital (4.2)
Denmark	Current lifelong learning (1.3); current and trend for USPTO high-tech patents (2.3.2); current and trend for early-stage venture capital (4.2)	Trend for lifelong learning (1.3); SMEs innovating in-house (3.1); innovation expenditures (3.3)
Germany	Current and trend for med/high-tech manufacturing employment (1.4); current EPO high-tech patents (2.3.1); current patents (2.4.1 and 2.4.2)	Trend for education (1.1 and 1.2); current education (1.1 and 1.3); sales of new-to-market products in manufacturing (4.3.1)
Greece	Trend for public and business R&D (2.1 and 2.2); trend for EPO high-tech patents (2.3.1); sales of new-to-market products in manufacturing (4.3.1)	Current high-tech patents (2.3.1 and 2.3.2); current patents (2.4.1 and 2.4.2); internet access/use (4.4)
Spain	Trend for education (1.1 and 1.2); trend for public business and R&D (2.1 and 2.2); trend for USPTO high-tech patents (2.3.2); sales of new-to-market products in manufacturing (4.3.1)	Current high-tech patents (2.3.1 and 2.3.2); current patents (2.4.1 and 2.4.2); trend for manufacturing high-tech value-added (4.6)
France	Current S&E graduates (1.1); trend for tertiary education (1.2); high-tech venture capital (4.1)	Current lifelong learning (1.3); trend for USPTO high-tech patents (2.3.2); sales of new-to-market products in manufacturing (4.3.1)
Ireland	Trend for tertiary education (1.2); trend for EPO high-tech patents (2.3.1); current manufacturing high-tech value-added (4.6)	Current and trend for USPTO high-tech patents (2.3.2); trend for early-stage venture capital (4.2); trend for ICT expenditures (4.5)
Italy	Trend for education (1.1 and 1.2); high-tech venture capital (4.1); sales of new-to-market products (4.3.1)	Trend for lifelong learning (1.3); current and trend for EPO and USPTO high-tech patents (2.3.1 and 2.3.2); innovation co-operation (3.2)
Luxembourg	Trend for S&E graduates (1.1); trend for med/high-tech manufacturing employment (1.4); current and trend for USPTO patents (2.4.2)	Current S&E graduates (1.1); current public R&D (2.1); current manufacturing high-tech value-added (4.6)
The Netherlands	Trend for tertiary education (1.2); current and trend for lifelong learning (1.3); current high-tech patents (2.3.1 and 2.3.2)	Current S&E graduates (1.1); trend for USPTO high-tech patents (2.3.2); innovation expenditures in services (3.3); trend for early-stage venture capital (4.2)

25 Only current indicator values and trend results more than 20% above or below the EU mean are taken into account. These are then ranked in descending/ascending order to determine the three best or worst performing indicators. For determining best and worst trends, trend results have first been re-scaled (cf. Technical Paper No 6 for definitions and Technical Paper No 2 for full results).

Table 3. (continued) Relative strengths and weaknesses

	Major relative strengths	Major relative weaknesses
Austria	Trend for tertiary education (1.2); trend for USPTO high-tech patents (2.3.2); trend for early-stage venture capital (4.2)	Trend for lifelong learning (1.3); early stage venture capital (4.2); trend for manufacturing high-tech value-added (4.6)
Portugal	Trend for S&E graduates (1.1); trend for business R&D (2.2); trend for patents (2.4.1 and 2.4.2)	Current business R&D (2.2); current high-tech patents (2.3.1 and 2.3.2); current patents (2.4.1 and 2.4.2)
Finland	Current high-tech patents (2.3.1 and 2.3.2); innovation co-operation (3.2); sales of new-to-market products in manufacturing (4.3.1)	Trend for EPO high-tech patents (2.3.1); innovation expenditures in services (3.3); trend for ICT expenditures (4.5)
Sweden	Current high-tech patents (2.3.1 and 2.3.2); current patents (2.4.1 and 2.4.2); innovation expenditures in services (3.3); current and trend for early-stage venture capital (4.2)	Trend for tertiary education (1.2); trend for med/high-tech manufacturing employment (1.4); sales of new-to-market products in manufacturing (4.3.1); trend for manufacturing high-tech value-added (4.6)
United Kingdom	Current and trend for education (1.1 and 1.3); trend for EPO high-tech patents (2.3.1); trend for early-stage venture capital (4.2)	Trend for med/high-tech manufacturing employment (1.4); trend for USPTO high-tech patents (2.3.2); SMEs innovating in-house (3.1)
Switzerland	Trend for S&E graduates (1.1); current lifelong learning (1.3); current patents (2.4.1 and 2.4.2)	Current S&E graduates (1.1); trend for public R&D (2.2); trend for USPTO high-tech patents (2.3.2)
Iceland	Current lifelong learning (1.3); trend for business R&D (2.2); trend for USPTO high-tech patents (2.3.2)	Current med/high-tech manufacturing employment (1.4); trend for early-stage venture capital (4.2); sales of new-to-market and new-to-firm products (4.3.1 and 4.3.2)
Norway	Current and trend for tertiary education (1.2); current and trend for all EPO patents (2.3.1 and 2.4.1); trend for USPTO high-tech patents (2.4.1)	Trend for public R&D (2.1); sales of new-to-market products (4.3.1); trend for ICT expenditures (4.5); current manufacturing high-tech value-added (4.6)
Bulgaria	Trend for education (1.1 and 1.2); trend for manufacturing high-tech value-added (4.6)	Current business R&D (2.2); current high-tech patents (2.3.1 and 2.3.2); current and trend for patents (2.4.1 and 2.4.2)
Cyprus	Trend for education (1.2 and 1.3); trend for EPO high-tech patents (2.3.1); trend for patents (2.4.1 and 2.4.2)	Current med/high-tech manufacturing employment (1.4); current business R&D (2.2); all current patents (2.3.1, 2.3.2, 2.4.1 and 2.4.2)
Czech Republic	Trend for education (1.1 and 1.2); trend for public R&D (2.1); current and trend for ICT expenditures (4.5)	Current and trend for EPO high-tech patents (2.3.1); current patents (2.4.1 and 2.4.2)

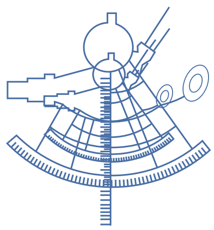


Table 3. (continued) Relative strengths and weaknesses

	Major relative strengths	Major relative weaknesses
Estonia	Trend for S&E graduates (1.1); trend for business R&D (2.2); trend for EPO high-tech patents (2.3.1); trend for patents (2.4.1 and 2.4.2)	Trend for lifelong learning (1.3); current EPO high-tech patents (2.3.1); current patents (2.4.1 and 2.4.2)
Hungary	Trend for R&D expenditures (2.1 and 2.2); trend for EPO high-tech patents (2.3.1); current and trend for ICT expenditures (4.5)	Trend for S&E graduates (1.1); USPTO high-tech patents (2.3.2); high-tech venture capital (4.1); internet access/use (4.4)
Lithuania	Current education (1.1 and 1.2); trend for business R&D (2.2); trend for EPO patents (2.4.1)	Trend for med/high-tech employment (1.4 and 1.5); all current patents (2.3.1, 2.3.2, 2.4.1 and 2.4.2); internet access/use (4.4)
Latvia	Trend for med/high-tech manufacturing employment (1.4); trend for business R&D (2.2); trend for EPO patents (2.4.1)	Current EPO high-tech patents (2.3.1); current and trend for USPTO patents (2.4.2); internet access/use (4.4)
Malta	Trend for S&E graduates (1.1); trend for USPTO patents (2.4.2); internet access/use (4.4)	Current S&E graduates (1.1); current and trend for EPO high-tech patents (2.3.1); current patents (2.4.1 and 2.4.2)
Poland	Trend for education (1.1 and 1.2); trend for EPO patents (2.4.1); trend for ICT expenditures (4.5)	All current patents (2.3.1, 2.3.2, 2.4.1 and 2.4.2); internet access/use (4.4)
Romania	Trend for education (1.2 and 1.3); trend for public R&D (2.1); trend for USPTO patents (2.4.2)	Trend for business R&D (2.2); all current patents (2.3.1, 2.3.2, 2.4.1 and 2.4.2)
Slovenia	Trend for lifelong learning (1.3); current and trend for med/high-tech manufacturing employment (1.4); trend for all EPO patents (2.3.1 and 2.4.1)	Trend for tertiary education (1.2); current USPTO high-tech patents (2.4.2); SMEs innovating in-house in services (3.1)
Slovakia	Trend for S&E graduates (1.1); trend for EPO high-tech patents (2.3.1); innovation expenditures (3.3)	Trend for public R&D (2.1); current USPTO high-tech patents (2.3.2); current and trend for USPTO patents (2.4.2)
Turkey	Trend for tertiary education (1.2); trend for business R&D (2.2); trend for USPTO patents (2.4.2)	Current med/high-tech manufacturing employment (1.4); all current patents (2.3.1, 2.3.2, 2.4.1 and 2.4.2)

6 Innovation in EU regions

Table 4. Leading innovation regions per country

Country	No of regions	% regions > country mean	Leading regions (RSII)		
Austria	9	11%	Wien (.57)	Steiermark (.43)	Tirol (.40)
Belgium	3	67%	Brussels (.42)	Vlaams Gewest (.41)	Région Wallonne (.34)
Germany	40	33%	Oberbayern (.91)	Stuttgart (.79)	Karlsruhe (.73)
Greece	13	15%	Attiki (.21)	Kentriki Makedonia (.15)	Voreio Aigaio (.09)
Spain	18	28%	Comunidad De Madrid (.45)	País Vasco (.38)	Comunidad Foral De Navarra (.37)
France	23	13%	Île de France (.64)	Midi-Pyrénées (.49)	Rhône-Alpes (.45)
Finland	6	17%	Uusimaa (Suuralue) (.95)	Etelä-Suomi (.63)	Pohjois-Suomi (.62)
Ireland	2	50%	Southern and Eastern (.48)	Border, Midland and Western (.31)	
Italy	20	25%	Lazio (.40)	Piemonte (.37)	Friuli-Venezia Giulia (.36)
Netherlands	12	33%	Noord-Brabant (.80)	Flevoland (.64)	Utrecht (.57)
Portugal	7	14%	Lisboa e Vale do Tejo (.21)	Centro (.14)	Alentejo (.12)
Sweden	8	50%	Stockholm (1.00)	Västsverige (.77)	Sydsverige (.75)
United Kingdom	12	33%	South East (.73)	Eastern (.68)	South West (.59)

As last year, only a reduced number of indicators are available at the regional level.[26] Compared to the 2002 EIS the regional analysis includes more indicators for diffusion-based innovation, although the analysis is still biased towards R&D-based innovation.

The calculation of a "*Regional Summary Innovation Index" (RSII)*[27] shows that, in most countries, less than one third of the regions performs above the country mean. This confirms that national innovative capabilities tend to be concentrated in a few regions. The leading innovative regions in the EU are Stockholm and Västsverige (SE), Uusimaa (FI), Oberbayern and Stuttgart (DE) and Noord-Brabant (NL).

Table 4 shows the leading regions for each Member State. The bias towards R&D-based innovation due to the availability of regional indicators could explain why regions with high diffusion-oriented innovation capabilities such as Emilia-Romagna or others are not among the leaders. Correlation analyses demonstrate a positive relationship between a region's innovative performance, measured by its RSII, and per capita income. However, the analysis of statistical similarities between regions identified two different types of leading regions. The first includes three regions with the best-educated workforce and a relative orientation towards services: Uusimaa (FI), Stockholm and Sydsverige (SE). This group has the highest per capita income of all innovation leaders. The second group includes three regions with the best patent performance and a relative orientation towards manufacturing: Stuttgart, Oberbayern (DE) and Noord-Brabant (NL)[28]. The per capita income of this group is above average but below that of the first group.

26 These are the following 13 indicators: Population with tertiary education, lifelong learning, employment in medium/high-tech manufacturing, employment in high-tech services, public R&D expenditures, business R&D expenditures, EPO high-tech patent applications, all EPO patent applications, and five indicators using CIS-2 data: the share of innovative enterprises in both manufacturing and services, innovation expenditures as a percentage of turnover in both manufacturing and services, and the share of sales of new-to-the-firm products in manufacturing. For most countries data at NUTS2 have been used. Because of data limitations the analysis is limited to NUTS1 for Belgium and the UK. The ACC and Associate countries are not included in the regional analysis. For full details see Technical Paper No 3.

27 See calculations in Technical Paper 3. The RSII is calculated using re-scaled values of the indicators. Direct comparisons with the 2002 RSII are therefore not possible.

28 For full details and definitions see Technical Paper No 3: Regional innovation performances.

7 National innovation “paths”

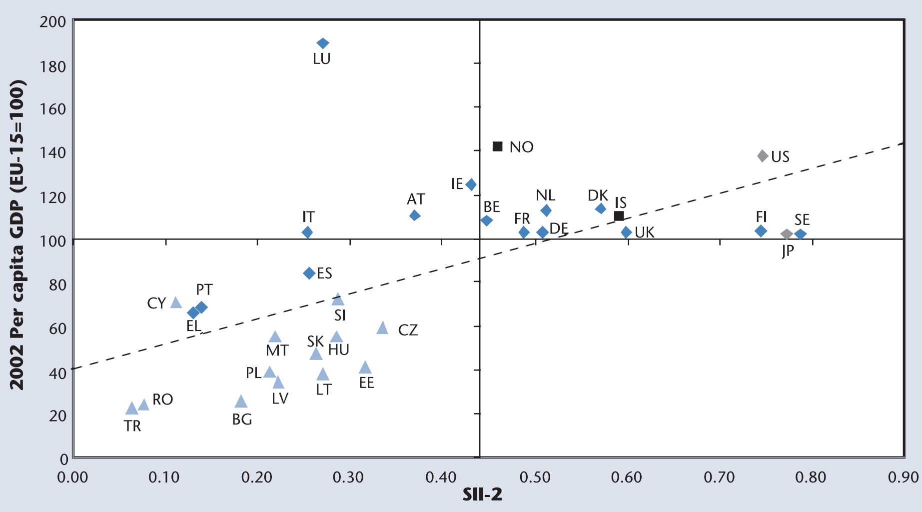
In 2001 the EIS stated that both the need and the conditions for transnational policy learning in the EU are exceptional, due to the strong differences in national innovation performances and the existence of world innovation leaders in the EU. But the 2001 EIS underlined also that *“copying policies of the leaders would be a misuse of the scoreboard; there is no ‘one best way’ in innovation policy. A better understanding of the existing ‘paths’, their priorities and internal logic is necessary. To compare innovation performances and, even more, to assess the transferability of ‘good practices’, it is essential to understand the specific environments behind these performances and policy practices.”*

The recent Council conclusions confirmed that more target setting should take place at the national level. The Council also insisted that this would require a deeper understanding of the Member States of the “*specificity of their respective innovation systems, and views of the most appropriate route to achieving improved innovation performance”.* Making progress with a better understanding of national innovation “paths” has therefore been one of the priorities under the Trend Chart. Since 2001, new research under the Trend Chart has been focusing on a number of issues: the importance of innovation in services, the link between innovation and per capita income, innovation as an R&D-based versus diffusion-based process, and the general background conditions that influence national innovation systems.

7.1 Innovation vs GDP

Innovation is regarded as one of the key drivers of economic welfare. Figure 5 suggests a weak positive correlation between the SII-2 and per capita GDP (in PPS[29]) in 2002[30]. However, Figure 5 also clearly shows that *innovation is not the only way to achieve high per capita income* levels. Luxembourg shows the potential of a niche specialisation in financial services and Norway benefits from the existence of vast natural resources. Similarly, a high SII does not always guarantee a high per capita income level as shown by Finland, Sweden and Japan. A similar exercise using levels of labour productivity per employee confirms these conclusions[31].

Figure 5. Weak correlation of innovation and per capita GDP



29 Purchasing Power Standards.

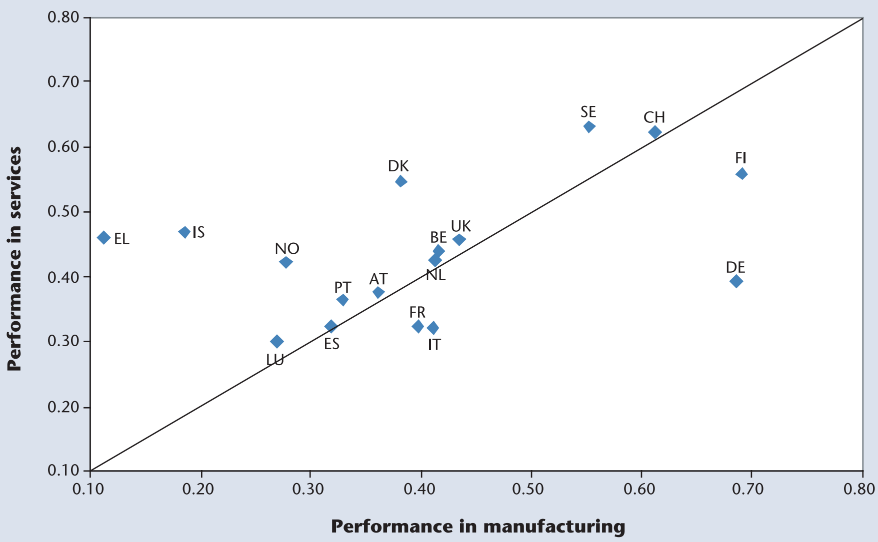
30 This positive correlation is quite sensitive to the choice of countries. For example, a similar graph for the Member States only would not show this correlation. This problem is similar to that discussed in the background paper for the February 2003 Trend Chart workshop “The Future of the Innovation Scoreboard”. Porter and Stern (“National Innovative Capacity”, 2002) correlated an index of national innovative capacity against per capita GDP in 2000. There is a strong positive correlation (R2 = 0.83) when about 70 countries, including many developing countries, are entered into the correlation along with the OECD countries. However, there is only a very weak relationship (R2 = 0.05) between per capita GDP and innovative capacity among high-income OECD countries. If the US is excluded, the relationship is negative (R2 = -0.12).

31 Similar exercises using relative growth rates of per capita GDP show no relation at all between the level of the SII and relative economic growth.

7.2 Innovation in services

The latest Community Innovation Survey made valuable new data available on innovation in the service sector. This opened the way to extending research into comparing innovativeness in the service and the manufacturing sectors. Figure 6 demonstrates differences between innovativeness in manufacturing and in services for fourteen EU countries and the three Associate countries[32]. The vertical axis gives a composite index for services and the horizontal axis gives the index for manufacturing. Both use re-scaled data for eight indicators[33]. Countries above the dotted line perform relatively better in services, those below perform relatively better in manufacturing. Of note, there is a positive correlation between performance in manufacturing and services. This is probably due to spillovers in knowledge and expertise between these major sector groups. However, there is a clear difference between countries that build their innovation performance mainly on services (Sweden and Greece) while others, such as Germany and Italy, perform best in manufacturing.

Figure 6. Innovation in services and manufacturing



The importance of services to overall value-added and employment is an indicator for economic progress and the overall shape of any national innovation system. The relative contribution of services to business R&D is another discriminator. In many EU countries, increasing R&D expenditure in services has driven growth in business R&D as a whole. For the EU the share of services in business R&D has increased from 8% in 1992 to 13% in 1999. In the US services take up an even bigger share of business R&D, increasing from 24% in 1992 to 34% in 2000. Japan presents a contrasting picture with services accounting for 0.2% of R&D in 1992 and a 2% share in 2000.

32 For Ireland available data is insufficient for analysing differences between manufacturing and services.

33 For manufacturing these are indicators: 1.4, *2.2.1* (manufacturing R&D expenditures) and the manufacturing sub-indicators of 3.1, 3.2, 3.3, 4.3.1, 4.3.2 and 4.7. For services these are indicators: 1.5, *2.2.2* (services R&D expenditures) and the services sub-indicators of 3.1, 3.2, 3.3, 4.3.1, 4.3.2 and 4.7.

7.3 Innovation in high, medium and low-tech sectors

The EIS has been designed with a strong focus on innovation in high-tech sectors. Although these sectors are very important engines of technological innovation, they are only a relatively small part of the economy as measured in their contribution to GDP and total employment. The larger share of low and medium-tech sectors in the economy and the fact that these sectors are important users of new technologies merits a closer look at their innovation performance. This could help national policy makers with focusing their innovation strategies on existing strengths and overcome areas of weakness.

Technical Paper 4 evaluates the innovative performance of four broadly-defined manufacturing sectors; high, medium-high, medium-low, and low technology. The work is largely exploratory and dependent on the availability of data at the sector level. For these reasons the analyses are mostly limited to the EU Member States. The paper calculates a Sectoral Performance Index (SPI) for each of the four manufacturing sectors. The SPI uses up to ten innovation indicators, of which eight are equivalent to EIS indicators. The indicators cover knowledge creation, the transmission and diffusion of knowledge, and innovation outputs[34]. The SPI also includes two indicators that capture the productivity enhancing effect of innovation: total investment per employee, and value-added per employee. Unfortunately, no indicators are available for human resources at the sector level.

The method permits two types of comparisons: across countries for the same sector, and across sectors within the same country. The latter can identify areas of sectoral specialisation in innovation within each country. Cross-country comparisons must be treated cautiously because the number of available indicators varies between Member States.

In general, countries that do well on the EIS, such as Finland and Sweden, tend to do well in all four manufacturing sectors. The reason for this effect is unknown, but a plausible explanation is that there is a faster rate of diffusion and adoption of new ideas in countries with innovative high and medium-high technology sectors. Some countries also show remarkably high innovation performances in certain sectors, such as Austria and Greece for medium-low technology and France for medium-high technology.

34 The eight EIS indicators include business R&D expenditures, EPO and USPTO patenting, SMEs innovating in-house, SMEs involved in innovation co-operation, total innovation expenditures, sales of new-to-the-firm products, and sales of new-to-the-market products.

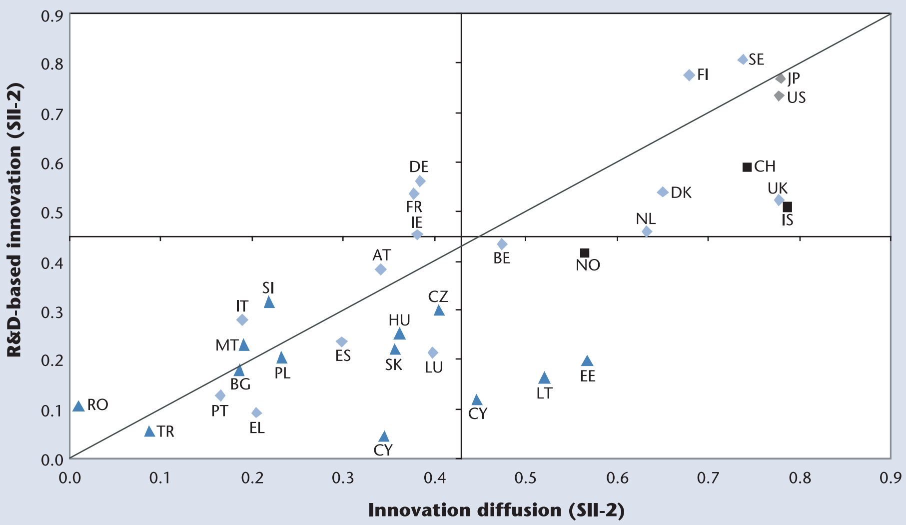
7.4 R&D-based vs diffusion-based innovation

Countries performing well in diffusion may have a lower SII due to the fact that the SII gives a greater emphasis to R&D-based innovation[35]. Two separate composite indices were constructed to explore possible differences between countries.

The R&D-based innovation index[36] and the diffusion innovation index[37] are shown in Figure 7, which suggests that, with some notable exceptions, countries ranking high on R&D-based innovation will also rank high on their overall SII score. Most of the ACC countries are doing much better on the diffusion than on the creation of innovation. Of the ACC leaders, only Slovenia does relatively better on the creation of innovation[38].

Countries differ in their relative performance in “R&D based” innovation versus “diffusion-based” innovation. Larger and economically more developed countries might do better on R&D-based innovation as they can benefit from economies of scale in R&D. Smaller or economically less developed countries might perform better on the diffusion of innovation.

Figure 7. R&D-based innovation compared to innovation diffusion



35 The number of indicators related to R&D-creation is about twice the number of indicators related to diffusion.

36 The *R&D-based innovation index* includes the following indicators (weight in brackets): S&E graduates (1), med/high-tech manufacturing employment (1), high-tech services employment (1), public R&D (1), business R&D (1), high-tech patents (0.5 for EPO and 0.5 for USPTO), all patents (0.5 for EPO and 0.5 for USPTO), SMEs innovating in-house (0.5 for manufacturing and 0.5 for services), SMEs involved in innovation co-operation (0.25 for manufacturing and 0.25 for services), innovation expenditures (0.25 for manufacturing and 0.25 for services), high-tech venture capital (1), early-stage venture capital (1), sales of new-to-market products (0.5 for manufacturing and 0.5 for services) and the share of high-tech manufacturing value-added (1).

37 The *diffusion innovation index* includes the following indicators (weight in brackets): population with tertiary education (1), lifelong learning (1), SMEs involved in innovation co-operation (0.25 for manufacturing and 0.25 for services), innovation expenditures (0.25 for manufacturing and 0.25 for services), sales of new-to-firm products (0.5 for manufacturing and 0.5 for services), internet access/use (1), ICT expenditures (1) and volatility rates (0.5 for manufacturing and 0.5 for services).

38 One should keep in mind that the results for the US, Japan, Switzerland and the ACC countries are less reliable than those for the EU Member States as due to limited data availability less indicators could be used for creating the R&D-based composite innovation index and the innovation diffusion composite index. Both indexes are similar to SII-2 as they only cover twelve indicators, with an even stronger focus on “creation indicators” than in the Member States analysis. Cf. Technical Paper No 6 for more details.

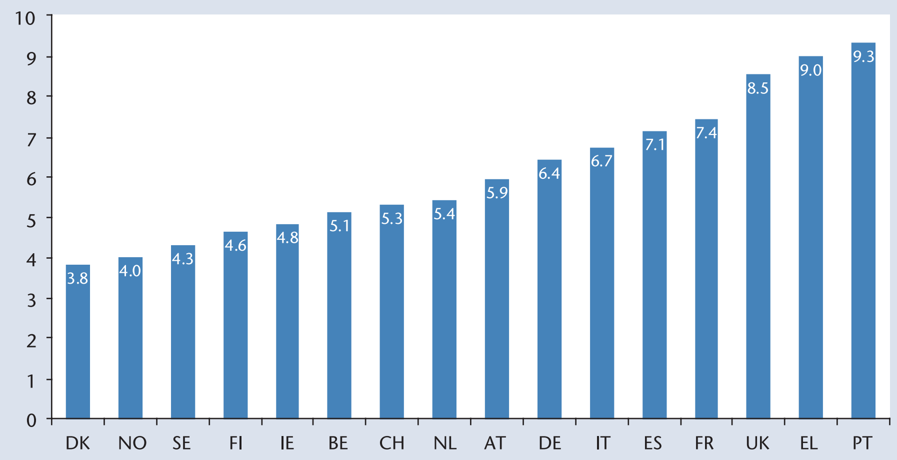
7.5 Context indicators

Any national innovation system (NIS) is characterised by a huge number of parameters that influence innovative capabilities. These include structural, economic characteristics, such as the distribution of economic activity by sector, or the economic weight of SMEs within the economy. Socio-cultural and institutional (SCI) conditions may also influence innovation capabilities. They could encourage individuals, entrepreneurs and employees to actively look for opportunities for innovation, and to acquire the tools to successfully implement them. In their entirety, these parameters could influence the innovation trajectory open to a country and consequently the most appropriate policy options.

Among the wide range of possible indicators, preliminary research identified nine structural indicators and 14 SCI indicators[39]. The structural indicators measure demand for innovative products, industry structure, and the openness of the economy. There are six categories of SCI indicators: the financial system, social creativity, social equity, the labour market system, entrepreneurial attitudes, and social capital.

Figure 8 gives an example for the type of data used under the ongoing research for relevant context indicators. The diagram presents time-to-take-off in years (average time between product introduction on the national market and sales take-off). Countries are ordered by increasing time-to-take-off. The shorter the time-to-take-off, the faster consumers accept innovative products. The research covered the adoption of 10 different consumer durables in 16 European countries with time series going back to 1950 in certain cases.

Figure 8. Response time of markets to innovative products (in years)



Source: Tellis, G.J., Stremersch S., Yin E. (2003), The international take-off of new products: the role of economics, culture and country innovativeness, *Marketing Science* 22: 188-208.

The response times of national markets to innovative products are considerably different and it is striking to see that, for this typical diffusion indicator, the Nordic countries form a distinct group of leaders similar to the indicators for R&D based innovation. There are many possible reasons for this: one of them could be that "innovativeness" is a pervasive cultural phenomenon. Obviously, income and product specific factors are also of influence.

As mentioned in the recent Communication of the Commission on innovation policy, different countries can be "lead markets" for different products. The identification of potential EU synergies coming from this phenomenon will require more in-depth research along the above lines. In the future, the analyses of context indicators could also assist policy makers in transnational learning. For example, policy makers could look first at policy solutions that have been developed in other countries with similar structural or SCI conditions.

39 Technical paper No 5 provides the details of this exploratory research.

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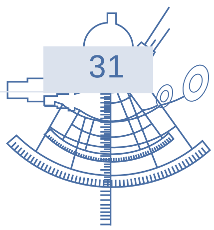


Annex Table A: European Innovation Scoreboard 2003 – Indicators and Sources

No	Short definition of indicator / Source	2002 EIS	Notes
1.	Human resources		
1.1	S&E graduates (‰ of 20–29 years age class) / EUROSTAT: Education statistics	Identical	Structural indicator II.4.1
1.2	Population with tertiary education (% of 25–64 years age class) / EUROSTAT (LFS)	Identical	Included in SIS
1.3	Participation in lifelong learning (% of 25–64 years age class) / EUROSTAT (LFS)	Identical	Structural indicator I.5.1; Included in SIS
1.4	Employment in medium-high and high-tech manufacturing (% of total workforce) / EUROSTAT (LFS)	Identical	
1.5	Employment in high-tech services (% of total workforce) / EUROSTAT (LFS)	Identical	
2.	Knowledge creation		
2.1	Public R&D expenditures (GERD – BERD) (% of GDP) / EUROSTAT: R&D statistics; OECD	Identical	Same as SEC(2003) 489 ind. 1&3
2.2	Business expenditures on R&D (BERD) (% of GDP) / EUROSTAT: R&D statistics; OECD	Identical	Same as SEC(2003) 489 ind. 1&3; Incl. in SIS
2.3.1	EPO high-tech patent applications (per million population) / EUROSTAT	Identical	SEC(2003) 489 indicator 13
2.3.2	USPTO high-tech patent applications (per million population) / USPTO	Identical	SEC(2003) 489 indicator 13
2.4.1	EPO patent applications (per million population) / EUROSTAT	New	Str. ind. II.5.1; SEC(2003) 489 ind. 12; Incl. in SIS
2.4.2	USPTO patents granted (per million population) / EUROSTAT	New	Str. ind. II.5.2; SEC(2003) 489 ind. 12; Incl. in SIS
3.	Transmission and application of knowledge		
3.1	SMEs innovating in-house (% of manufacturing SMEs and % of services SMEs) / EUROSTAT: CIS	Extended	SEC(2003) 489 indicator 17; Included in SIS
3.2	SMEs involved in innovation co-operation (% of manuf. SMEs and % of services SMEs) / EUROSTAT: CIS	Extended	SEC(2003) 489 indicator 18; Included in SIS
3.3	Innovation expenditures (% of all turnover in manufacturing and % of all turnover in services) / EUROSTAT: CIS	Extended	SEC(2003) 489 indicator 16; Included in SIS
4.	Innovation finance, output and markets		
4.1	Share of high-tech venture capital investment / EVCA	Adapted	SEC(2003) 489 indicator 15 *but 2-year average*
4.2	Share of early stage venture capital in GDP / EUROSTAT	New	Structural indicator II.6.1; SEC(2003) 489 indicator 14 *but 2-year average*
4.3.1	Sales of “new to market” products (% of all turnover in manufacturing and % of all turnover in services) / EUROSTAT: CIS	Extended	Included in SIS
4.3.2	Sales of “new to the firm but not new to the market” products (% of all turnover in manufacturing and % of all turnover in services) / EUROSTAT: CIS	New	Included in SIS
4.4	Internet access/use / EUROSTAT	Extended	*Composite indicator* using a.o. Structural indicator II.3.1
4.5	ICT expenditures (% of GDP) / EUROSTAT	Identical	Structural indicator II.7.1 + II.7.2
4.6	Share of manufacturing value-added in high-tech sectors / EUROSTAT: SBS	Adapted	Includes also NACE 33
4.7	Volatility-rates of SMEs (% of manufacturing SMEs and % of services SMEs) / EUROSTAT: BDS	New	

1 SEC(2003) 489: Commission Staff Working Paper “Investing in Research: an Action Plan for Europe”, Brussels, April 30, 2003; [2] SIS: Sectoral Innovation Scoreboard.

Annex Table B: European Innovation Scoreboard 2003 – Member States, US and Japan[1]

		EU15 [2]	BE	DK	DE	EL	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	US	JP
1.1	S&E grads	11.3	10.1	11.1	8.0	—	11.3	19.6	21.7	5.7	1.8	6.1	7.2	6.4	16.0	12.4	19.5	10.2	—
1.2	Work pop w 3rd educ	21.5	28.1	27.4	22.3	17.6	24.4	23.5	25.4	10.4	18.6	24.9	16.9	9.4	32.4	26.4	29.4	37.2	33.8
1.3	Lifelong learning	8.4	6.5	18.4	5.2	1.2	5.0	2.7	7.7	4.6	5.3	16.4	7.5	2.9	18.9	18.4	22.3	—	—
1.4	Emp h-tech manuf	7.41	6.59	6.33	11.36	2.20	5.35	6.82	6.89	7.37	2.03	4.49	6.59	3.33	7.39	7.28	6.72	—	—
1.5	Emp h-tech services	3.57	3.77	4.74	3.33	1.76	2.50	4.06	4.30	3.02	2.66	4.40	3.47	1.45	4.74	5.23	4.47	—	—
2.1	Public R&D exp	0.69	0.57	0.75	0.73	0.48	0.46	0.83	0.37	0.54	0.13	0.83	0.65	0.57	1.02	0.96	0.65	0.76	0.81
2.2	Business R&D exp	1.30	1.60	1.65	1.76	0.19	0.50	1.37	0.87	0.56	1.58	1.08	1.13	0.27	2.47	3.31	1.19	2.04	2.28
2.3.1	EPO h-tech pats	31.6	23.4	42.1	48.8	2.1	3.6	30.3	30.7	6.5	10.9	68.8	18.8	0.7	136.1	100.9	35.6	57.0	44.9
2.3.2	USPTO h-tech pats	12.4	13.9	22.7	16.4	0.4	1.4	14.0	6.1	4.1	4.6	18.6	8.1	0.1	41.6	47.3	15.1	91.9	80.0
2.4.1	EPO patents	161.1	151.8	211.0	309.9	7.7	24.1	145.3	85.6	74.7	211.3	242.7	174.2	5.5	337.8	366.6	133.5	169.8	174.7
2.4.2	USPTO patents	80.1	93.3	106.0	147.4	3.4	8.7	76.5	49.1	32.7	115.6	98.5	82.6	1.9	156.1	213.7	77.2	322.5	265.2
3.1	SMEs innov in-hse manuf	37.4	46.2	16.7	55.1	16.8	29.1	33.5	—	34.9	38.8	42.5	35.5	35.5	40.9	35.5	24.8	—	—
3.1	SMEs innov in-hse serv	28.0	31.8	15.4	43.9	21.3	16.6	23.9	—	20.0	39.6	28.1	36.4	37.6	34.9	35.6	18.7	—	—
3.2	SMEs innov co-op manuf	9.4	11.7	18.9	10.9	4.9	3.2	12.3	—	2.8	—	11.1	7.4	6.1	22.0	14.1	9.6	—	—
3.2	SMEs innov co-op serv	7.1	7.7	12.7	8.4	12.4	1.9	5.4	—	3.5	—	8.5	10.1	9.2	18.3	12.8	7.6	—	—
3.3	Innov exp manuf	3.45	4.92	0.95	4.71	2.22	1.87	3.08	—	2.96	2.08	3.07	2.83	2.86	3.91	6.42	2.96	—	—
3.3	Innov exp serv	1.83	0.92	0.36	1.64	1.60	0.65	1.57	—	0.84	1.18	0.79	0.92	2.66	0.96	19.11	1.39	—	—
4.1	High-tech VC	45.4	53.5	31.0	—	27.9	30.2	70.7	54.1	71.2	—	35.1	55.7	45.9	57.5	44.2	30.5	—	—
4.2	Early stage VC	0.037	0.041	0.080	0.042	0.017	0.016	0.035	0.027	0.015	—	0.044	0.017	0.011	0.087	0.098	0.047	0.218	—
4.3.1	New-to-mark prods manuf	10.5	6.9	14.3	7.1	4.4	11.9	9.5	—	18.7	—	—	8.4	16.0	27.2	3.5	9.5	—	—
4.3.1	New-to-mark prods serv	7.4	7.4	7.5	3.7	17.9	13.7	5.5	—	11.6	2.7	—	4.3	9.5	12.2	9.3	—	—	—
4.3.2	New-to-firm prods manuf	28.6	15.8	24.2	40.3	18.4	25.8	17.5	—	30.1	13.6	23.8	23.1	21.6	31.1	32.1	—	—	—
4.3.2	New-to-firm prods serv	18.8	23.5	18.4	16.4	37.1	26.4	17.1	—	20.5	9.0	13.9	12.8	16.1	18.8	23.7	—	—	—
4.4	Internet access/use	0.51	0.58	0.93	0.66	0.05	0.25	0.50	0.55	0.38	0.59	0.74	0.68	0.25	0.76	0.97	0.53	0.73	0.88
4.5	ICT expenditures	7.0	7.3	7.4	6.9	5.1	4.4	7.4	5.3	5.2	8.0	8.3	6.3	5.4	6.8	9.8	8.6	8.2	9.0
4.6	VA h-tech manuf	14.1	13.1	15.0	11.9	6.3	6.5	18.3	30.6	9.9	3.2	12.1	11.5	6.5	24.9	15.9	18.8	23.0	18.7
4.7	Volatility manuf	12.7	10.7	12.7	—	—	14.2	—	—	12.8	12.8	12.8	—	13.3	12.5	10.3	16.0	—	—
4.7	Volatility serv	16.6	16.8	20.4	—	—	17.1	—	—	17.2	—	18.5	—	14.7	15.8	13.2	20.2	—	—

1 Data in italics are not directly comparable with those originating from Eurostat as these were either taken from national sources or involve (small) differences in definitions. Technical Paper No 2 provides more details. [2] For indicator 1.1 the EU mean is calculated as a weighted average using population shares of 20-29 years of age. For the CIS-indicators the EU mean is calculated as a weighted average using GDP shares.

Annex Table C: European Innovation Scoreboard 2003 – Associate, Acceding and Candidate countries[1]

		EU15 [2]	CH	IS	NO	BG	CY	CZ [3]	EE [3]	HU	LT [3]	LV [3]	MT	PL	RO	SI [3]	SK [3]	TR
1.1	S&E grads	11.3	7.6	9.1	8.6	7.9	3.3	5.6	7.3	3.7	13.1	7.6	3.3	7.4	4.9	8.2	7.4	—
1.2	Work pop w 3rd educ	21.5	25.2	25.6	34.2	21.1	29.1	11.8	29.6	14.1	44.0	19.6	—	12.2	10.0	14.8	10.8	8.9
1.3	Lifelong learning	8.4	*18.2*	23.5	13.3	1.3	3.7	6.0	5.2	3.3	3.3	8.4	4.4	4.3	1.1	5.1	9.0	—
1.4	Emp h-tech manuf	7.41	7.75	2.02	4.60	5.34	1.11	8.94	3.41	8.50	2.64	1.97	7.14	7.54	5.50	9.28	8.21	*1.19*
1.5	Emp h-tech services	3.57	3.97	4.81	4.11	2.66	1.90	3.09	2.87	3.06	1.69	2.26	3.06	—	1.57	2.35	2.83	—
2.1	Public R&D exp	0.69	0.68	1.33	0.65	0.37	0.22	0.52	0.53	0.57	0.49	0.28	—	0.43	0.15	0.69	0.22	0.36
2.2	Business R&D exp	1.30	1.95	1.78	0.97	0.10	0.05	0.78	0.26	0.38	0.20	0.16	—	0.24	0.25	0.94	0.45	0.27
2.3.1	EPO h-tech pats	31.6	—	31.0	49.6	0.4	2.6	0.7	1.5	4.3	0.7	0.4	*1.5*	0.2	0.1	8.6	1.1	0.2
2.3.2	USPTO h-tech pats	12.4	21.2	21.5	8.3	0.1	0.6	—	—	0.3	0.3	—	*2.6*	0.1	—	0.5	0.2	0.0
2.4.1	EPO patents	161.1	327.1	117.2	288.8	2.1	14.5	10.7	11.0	19.0	2.4	7.6	10.2	2.5	0.8	40.7	6.1	1.1
2.4.2	USPTO patents	80.1	230.8	84.7	67.9	0.6	2.6	3.0	2.2	7.3	1.4	0.8	5.1	1.1	0.5	13.1	0.7	0.4
3.1	SMEs innov in-hse manuf	37.4	58.0	44.8	32.3	—	—	25.8	39.1	—	26.0	19.1	*15.4*	*4.1*	—	22.0	14.1	*24.6*
3.1	SMEs innov in-hse serv	28.0	50.1	48.4	26.3	—	—	22.7	33.5	—	14.9	11.2	—	—	—	12.7	10.0	—
3.2	SMEs innov co-op manuf	9.4	13.0	11.1	12.6	—	—	5.8	11.8	—	12.1	4.1	*4.9*	—	—	8.4	4.4	*18.0*
3.2	SMEs innov co-op serv	7.1	6.5	—	12.1	—	—	5.2	11.6	—	12.7	3.8	—	—	—	4.4	1.6	—
3.3	Innov exp manuf	3.45	4.29	0.85	2.06	—	—	1.50	2.70	—	3.13	3.65	—	*4.10*	—	4.20	8.80	—
3.3	Innov exp serv	1.83	2.81	2.29	1.03	—	—	0.70	0.65	—	0.76	1.66	—	—	—	2.60	7.50	—
4.1	High-tech VC	45.4	50.3	51.2	59.4	—	—	—	—	1.6	—	—	—	17.5	—	—	—	—
4.2	Early stage VC	0.037	—	0.048	0.036	—	—	0.019	—	0.015	—	—	—	0.018	0.004	—	0.012	—
4.3.1	New-to-mark prods manuf	10.5	—	1.8	4.6	—	—	—	—	—	—	—	—	—	—	—	—	—
4.3.1	New-to-mark prods serv	7.4	—	1.0	3.0	—	—	—	—	—	—	—	—	—	—	—	—	—
4.3.2	New-to-firm prods manuf	28.6	20.7	8.9	18.4	—	—	—	—	—	—	—	—	—	—	—	—	—
4.3.2	New-to-firm prods serv	18.8	20.4	3.0	11.2	—	—	—	—	—	—	—	—	—	—	—	—	—
4.4	Internet access/use	0.51	—	1.00	0.71	—	0.27	0.13	0.11	0.00	0.01	0.00	*0.44*	0.08	—	0.33	—	—
4.5	ICT expenditures [4]	7.0	10.2	9.3	5.7	3.8	—	9.5	*9.6*	8.9	*5.9*	*7.9*	*4.1*	5.9	2.2	4.7	7.5	3.6
4.6	VA h-tech manuf	14.1	22.7	—	8.0	*5.9*	—	—	—	*14.9*	*22.3*	—	*22.4*	—	—	*15.9*	—	*6.6*
4.7	Volatility manuf	12.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4.7	Volatility serv	16.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

1 Data in italics are not directly comparable with those originating from Eurostat as these were either taken from national sources or due to (small) differences in definitions. Technical Paper No 2 provides more details.
2 For indicator 1.1 the EU mean is calculated as a weighted average using population shares of 20-29 years of age. For the CIS-indicators the EU mean is calculated as a weighted average using GDP shares.
3 CIS3 data for CZ, EE, LT, LV, SI and SK are not to be considered as completely comparable with the MS data since the methodology in some cases is different and the data processing has not been harmonised.
4 Data for CH, BG, CZ, HU, PL, RO, SI, SK and TR were taken from WITSA/IDC.

Annex Table D: European Innovation Scoreboard 2003 – Most recent years used (Member States, US and Japan) **

		EU15	BE	DK	DE	EL	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	US	JP
1.1	S&E grads	2000	2001	2000	2001	—	2001	2000	2001	2000	2000	2001	2001	2001	2000	2001	2001	2000	—
1.2	Work pop w 3rd educ	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2001	2001
1.3	Lifelong learning	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	—	—
1.4	Emp h-tech manuf	2002	2002	2002	2002	2002	2002	2002	2002	2002	2000	2002	2002	2002	2002	2002	2002	—	—
1.5	Emp h-tech services	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	—	—
2.1	Public R&D exp	2002	2001	2001	2001	1999	2001	2002	2001	2000	2000	2000	1998	2001	2002	2001	2002	2002	2001
2.2	Business R&D exp	2002	2001	2001	2001	1999	2001	2002	1999	2001	2000	2001	1998	2001	2002	2001	2002	2002	2001
2.3.1	EPO h-tech pats	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001
2.3.2	USPTO h-tech pats	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1997	2000	2000	2000	2000	2000
2.4.1	EPO patents	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001
2.4.2	USPTO patents	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001
3.1	SMEs innov in-hse manuf	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	—
3.1	SMEs innov in-hse serv	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	—
3.2	SMEs innov co-op manuf	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	—	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	—
3.2	SMEs innov co-op serv	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	—	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	—
3.3	Innov exp manuf	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	—
3.3	Innov exp serv	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	—	—
4.1	High-tech VC	2001*	2001*	2001*	—	2001	2001*	2001*	2001*	2001*	—	2001*	2001*	2001*	2001*	2001*	2001*	—	—
4.2	Early stage VC	2002*	2002*	2002*	2002*	2002*	2002*	2002*	2002*	2002*	—	2002*	2002*	2002*	2002*	2002*	2002*	2001*	—
4.3.1	New-to-mark prods manuf	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	—	—	CIS3	CIS3	CIS3	CIS3	CIS3	—	—
4.3.1	New-to-mark prods serv	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	CIS3	—	CIS3	CIS3	CIS3	CIS3	—	—	—
4.3.2	New-to-firm prods manuf	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	—	—
4.3.2	New-to-firm prods serv	CIS3**	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	CIS3	—	—	—
4.4	Internet access/use	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2001	2001
4.5	ICT expenditures	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001
4.6	VA h-tech manuf	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2000	2000
4.7	Volatility manuf	2000*	2000*	2000*	—	—	2000*	—	—	2000*	—	2000*	—	2000*	2000*	2000*	2000*	—	—
4.7	Volatility serv	2000*	2000*	2000*	—	—	2000*	—	—	2000*	—	2000*	—	2000*	2000*	2000*	2000*	—	—

* Average of indicated year and previous year.
** CIS3 results are for 2000, unless a specific year is mentioned. CIS3 EU means are calculated using GDP weights.

Annex Table E: European Innovation Scoreboard 2003 – Most recent years used (Associate, Acceding and Candidate countries) **

		EU15	CH	IS	NO	BG	CY	CZ	EE	HU	LT	LV	MT	PL	RO	SI	SK	TR
1.1	S&E grads	2000	2001	2001	2001	2001	2000	2001	2001	2000	2001	2001	2001	2001	2001	2001	2001	—
1.2	Work pop w 3rd educ	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	—	2002	2002	2002	2002	2001
1.3	Lifelong learning	2002	1999	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	—
1.4	Emp h-tech manuf	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2001	1999	2002	2002	2002	2000
1.5	Emp h-tech services	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2001	—	2002	2002	2002	—
2.1	Public R&D exp	2002	2000	2002	2001	2001	2001	2001	2001	2001	2001	2001	—	2001	2001	2001	2000	1999
2.2	Business R&D exp	2002	2000	2002	2001	2001	2001	2001	2001	2001	2001	2001	—	2001	2001	2001	2000	2000
2.3.1	EPO h-tech pats	2001	—	2001	2001	2001	2001	2001	2001	2001	2001	2001	2000	2001	2001	2001	2001	2001
2.3.2	USPTO h-tech pats	2000	2000	2000	2000	1998	2000	—	—	2000	1998	—	2001	2000	—	2000	1999	1997
2.4.1	EPO patents	2001	1998	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001
2.4.2	USPTO patents	2001	2000	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001	2001
3.1	SMEs innov in-hse manuf	CIS3**	CIS3: 2002	CIS3	CIS3	—	—	CIS3: 2001	CIS3	—	CIS3: 2001	CIS3: 2001	CIS2: 1998	CIS2: 1999	—	CIS3	CIS3: 2001	CIS2: 1997
3.1	SMEs innov in-hse serv	CIS3**	CIS3: 2002	CIS3	CIS3	—	—	CIS3: 2001	CIS3	—	CIS3: 2001	CIS3: 2001	—	—	—	CIS3	CIS3: 2001	—
3.2	SMEs innov co-op manuf	CIS3**	CIS3: 2002	CIS3	CIS3	—	—	CIS3: 2001	CIS3	—	CIS3: 2001	CIS3: 2001	CIS2: 1998	—	—	CIS3	CIS3: 2001	CIS2: 1997
3.2	SMEs innov co-op serv	CIS3**	CIS3: 2002	—	CIS3	—	—	CIS3: 2001	CIS3	—	CIS3: 2001	CIS3: 2001	—	—	—	CIS3	CIS3: 2001	—
3.3	Innov exp manuf	CIS3**	CIS3: 2002	CIS3	CIS3	—	—	CIS3: 2001	CIS3	—	CIS3: 2001	CIS3: 2001	—	CIS2: 1999	—	CIS3	CIS3: 2001	—
3.3	Innov exp serv	CIS3**	CIS3: 2002	CIS3	CIS3	—	—	CIS3: 2001	CIS3	—	CIS3: 2001	CIS3: 2001	—	—	—	CIS3	CIS3: 2001	—
4.1	High-tech VC	2001*	2001*	2001*	2001*	—	—	—	—	2001*	—	—	—	2001*	—	—	—	—
4.2	Early stage VC	2002*	—	2002*	2002*	—	—	2001*	—	2001*	—	—	—	2001*	2001*	—	—	—
4.3.1	New-to-mark prods manuf	CIS3**	—	CIS3	CIS3	—	—	—	—	—	—	—	—	—	—	—	—	—
4.3.1	New-to-mark prods serv	CIS3**	—	CIS3	CIS3	—	—	—	—	—	—	—	—	—	—	—	—	—
4.3.2	New-to-firm prods manuf	CIS3**	CIS3: 2002	CIS3	CIS3	—	—	—	—	—	—	—	—	—	—	—	—	—
4.3.2	New-to-firm prod serv	CIS3**	CIS3: 2002	CIS3	CIS3	—	—	—	—	—	—	—	—	—	—	—	—	—
4.4	Internet access/use	2002	—	2001	—	—	2001	2001	2001	2000	2001	2001	2002	2001	—	2001	—	—
4.5	ICT expenditures	2001	2001	2001	2001	2001	—	2001	2001	2001	2000	2000	2000	2001	2001	2001	2001	2001
4.6	VA h-tech manuf	2001	2001	—	1999	2000	—	—	—	2000	1999	—	1998	—	—	1999	—	2000
4.7	Volatility manuf	2000*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4.7	Volatility serv	2000*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Average of this year and previous year.
** CIS3 results are for 2000, unless a specific year is mentioned. CIS3 EU means are calculated using GDP weights.

Annex Table F: European Innovation Scoreboard 2003 – Trends (Member States, US and Japan)

		EU15	BE	DK	DE	EL	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	US	JP
1.1	S&E grads	9.1	—	26.9	-9.4	—	35.1	8.9	-1.8	20.4	28.6	3.4	-0.7	33.3	7.1	46.5	29.1	-3.3	—
1.2	Work pop w 3rd educ	3.3	8.0	5.9	-4.7	4.6	15.4	12.8	16.3	11.0	1.8	8.8	18.5	3.6	4.8	-7.9	5.7	6.1	9.9
1.3	Lifelong learning	0.6	7.7	-8.6	-2.5	9.1	3.4	0.0	—	-12.7	4.6	16.9	-13.8	-8.4	6.4	—	10.7	—	—
1.4	Emp h-tech manuf	-3.7	-8.2	-3.8	3.0	-3.3	-2.1	-4.6	-5.7	-3.3	15.6	-8.9	-0.4	-7.1	2.1	-11.9	-11.4	—	—
1.5	Emp h-tech services	11.5	7.2	3.5	18.3	13.4	17.9	8.1	8.7	10.5	-9.1	13.0	30.9	14.3	7.1	9.9	9.2	—	—
2.1	Public R&D exp	2.0	4.9	0.2	-1.6	34.0	8.6	2.1	5.4	4.7	—	-10.7	—	7.6	3.5	7.5	4.9	13.4	-2.8
2.2	Business R&D exp	4.8	17.4	28.4	9.5	46.0	13.3	0.5	-6.9	8.2	—	-1.9	—	73.7	13.1	22.0	-2.4	2.7	10.1
2.3.1	EPO h-tech patents	63.6	39.5	68.8	65.9	241.1	64.5	51.3	173.9	23.2	49.5	73.9	80.9	96.9	39.4	58.7	87.2	76.6	52.1
2.3.2	USPTO h-tech patents	43.9	44.4	77.1	49.9	—	116.4	24.2	28.2	25.3	—	23.5	64.3	—	68.1	95.7	35.7	41.9	21.6
2.4.1	EPO patents	25.3	14.5	39.9	25.3	13.1	18.5	18.8	52.1	18.3	31.4	34.7	32.6	70.3	31.8	25.0	32.3	30.9	41.8
2.4.2	USPTO patents	28.1	24.5	19.3	33.6	51.2	25.9	17.6	66.7	21.1	68.7	19.9	36.2	90.7	32.8	49.8	23.5	13.3	16.2
4.2	Early stage VC	10.4	-43.1	531.6	2.9	83.3	10.3	2.9	-36.2	-18.7	—	-38.9	73.7	-22.2	57.2	85.1	58.4	188.7	—
4.5	ICT expenditures	15.5	14.0	5.7	18.3	21.2	10.2	14.7	-1.9	17.8	3.7	11.7	17.7	9.5	7.8	13.3	13.1	4.9	14.7
4.6	VA h-tech manuf	12.0	16.0	12.1	17.6	0.1	-6.1	11.1	0.3	9.7	6.5	8.9	1.8	6.7	19.1	-10.6	12.5	7.0	12.0
	Country average [1]	9.5	10.9	12.2	9.2	23.0	15.2	8.2	10.5	8.8	11.5	7.9	13.4	20.3	11.4	14.0	11.6	10.2	12.8

1 Country averages are calculated as a weighted average. Indicators 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 4.5 and 4.6 have a weight of 1, indicators 2.3.1, 2.3.2, 2.4.1 and 2.4.2 have a weight of 0.25. Indicator 4.2 is not included in this country average. Technical Paper No 6 gives more details.

Annex Table G: European Innovation Scoreboard 2003 – Trends (Associate, Acceding and Candidate countries)

		EU15	CH	IS	NO	BG	CY	CZ	EE	HU	LT	LV	MT	PL	RO	SI	SK	TR
1.1	S&E grads	9.1	67.4	30.0	11.7	31.7	-15.4	30.2	71.1	-26.7	47.2	19.4	153.8	63.2	3.5	8.4	55.2	—
1.2	Work pop w 3rd educ	3.3	7.1	12.3	14.2	14.9	21.0	7.0	0.3	2.0	4.8	11.2	—	9.6	12.4	-2.6	6.5	14.8
1.3	Lifelong learning	0.6	—	11.9	0.0	—	29.8	—	-17.0	6.5	-1.5	—	—	—	22.2	21.4	—	—
1.4	Emp h-tech manuf	-3.7	-3.8	20.9	-3.5	-5.3	-0.7	1.4	-13.4	2.1	-25.7	154.8	—	—	-3.1	8.1	20.0	2.0
1.5	Emp h-tech services	11.5	5.5	17.3	9.1	5.4	21.5	-0.4	2.4	7.4	-25.6	7.5	—	—	6.1	4.1	-1.7	—
2.1	Public R&D exp	2.0	-15.0	5.3	-9.7	-13.8	10.9	17.4	0.0	36.5	6.0	-16.6	—	-0.1	42.0	0.7	-25.3	4.4
2.2	Business R&D exp	4.8	1.0	55.2	4.9	-14.8	20.1	1.2	73.0	36.1	119.4	82.4	—	-19.0	-35.0	19.8	-30.3	85.8
2.3.1	EPO h-tech patents	63.6	—	59.6	294.7	72.8	286.9	29.6	132.8	226.0	13.4	30.4	9.6	44.1	40.1	309.3	176.3	76.4
2.3.2	USPTO h-tech patents	43.9	22.2	—	94.6	—	—	—	—	—	—	—	—	—	—	—	—	—
2.4.1	EPO patents	25.3	29.8	36.7	151.6	-23.9	62.3	19.8	99.3	47.9	93.5	74.7	28.3	53.5	-16.0	93.8	31.4	32.5
2.4.2	USPTO patents	28.1	6.7	178.1	42.0	1.2	96.6	5.4	534.4	26.2	43.2	-58.6	284.8	-2.3	120.2	52.4	-60.1	126.1
4.2	Early stage VC	10.4	3.8	-80.3	76.0	—	—	—	—	—	—	—	—	—	—	—	—	—
4.5	ICT expenditures	15.5	18.6	—	-8.4	17.5	—	33.8	13.8	32.2	30.5	—	—	40.5	34.7	22.6	38.9	1.9
4.6	VA h-tech manuf	12.0	5.6	—	9.0	27.0	—	—	—	18.3	—	—	-5.6	—	—	—	—	30.6
	Country average [1]	9.5	11.6	28.6	17.3	8.6	25.6	13.5	36.8	19.4	22.0	40.0	— [2]	20.5	13.6	22.4	12.9	29.4

1 Country averages are calculated as a weighted average. Indicators 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 4.5 and 4.6 have a weight of 1, indicators 2.3.1, 2.3.2, 2.4.1 and 2.4.2 have a weight of 0.25. Indicator 4.2 is not included in this country average. Technical Paper No 6 gives more details.

2 No country trend as the number of trend results is less than 6.

Technical Annex

A.1 Technical Papers

The European Innovation Scoreboard is accompanied by six technical papers:

- Technical Paper No 1: Indicators and definitions; Full definitions and graphs for all indicators.
- Technical Paper No 2: Analysis of national performances; Detailed EIS results for current and trend data, innovation leaders, relative strengths and weaknesses per country, and country pages with both current and trend graphs.
- Technical Paper No 3: Regional innovation performances; Detailed results for current data, innovation leaders, a revealed regional summary innovation index, and cluster analysis for 173 regions in 13 Member States using 13 regional innovation indicators.
- Technical Paper No 4: Sectoral Innovation Scoreboards; Replicates the EIS for four classes of manufacturing sectors.
- Technical Paper No 5: National Innovation System Indicators; Includes nine structural and 14 socio-cultural-institutional indicators that shape the background conditions for innovative activity in each EU Member State.
- Technical Paper No 6: Methodology report; Describes the methodology underlying the EIS, including different methods for calculating a Summary Innovation Index.

All technical papers are available from the Trend Chart website (**www.cordis.lu/trendchart**).

A.2 Calculating averages

For most indicators the EU mean is a weighted average supplied by Eurostat. For the following indicators based on Eurostat data an EU average was not directly available: for indicator 1.1 the EU mean was calculated as a weighted average using shares of population 20-29 years of age and for all CIS-indicators the EU mean was calculated as a weighted average using GDP shares.

A.3 Calculating trend data

Trends are calculated as the percentage change between the last year for which data are available and the average over the preceding three years, after a one-year lag. The three-year average is used to reduce year-to-year variability; the one-year lag is used to increase the difference between the average for the three base years and the final year and to minimise the problem of statistical/sampling variability. For example, when the most recent data are for 2002, the trend is based on the percentage change between 2002 and the average for 1998 to 2000 inclusive. The results for 2001 are excluded in order to provide a one-year lag. There are several exceptions to this rule due to a lack of adequate data. Technical Paper No 2 provides the specific years used to calculate the trends for each indicator per country.

The aggregate trend per country is calculated as a weighted average of the trend values of the various indicators. The following weights were used for calculating average country and EU-15 trends:

- 1 for indicators 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 4.5 and 4.6.
- 0.25 for indicators 2.3.1, 2.3.2, 2.4.1 and 2.4.2.

The trend data for indicator 4.2 (share of early-stage venture capital) were excluded. Technical Paper No 6 provides a more detailed explanation.

A.4 Summary Innovation Index

Both SII-1 and SII-2 are calculated using re-scaled values of the indicators, where the highest value is set to 1 and the lowest value to 0. The SII is then calculated as the average value of all re-scaled values and is by definition between 0 and 1. The following weights were used for calculating the averages SII scores:

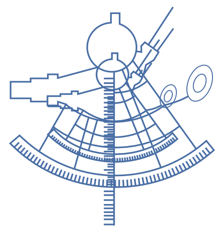
- 1 for indicators 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 4.1, 4.2, 4.4, 4.5 and 4.6.
- 0.5 for indicators 2.3.1, 2.3.2, 2.4.1, 2.4.2 and the manufacturing and services sub-indicators of indicators 3.1, 3.2, 3.3, 4.3.1, 4.3.2 and 4.7.

Technical Paper No 6 provides a more detailed explanation.

A.5 Definition of RRSII

The Revealed Regional Summary Innovation Index tries to take into account both a region's innovative performance relative to the EU mean and a region's relative performance within the country. The RRSII is thus calculated as the average of the following two indexes (using re-scaled values of the two composite indicators) (cf. Technical Paper No 3):

- The average of the re-scaled indicator values using only regions within each particular country (RNSII: regional national summary innovation index).
- The average of the re-scaled indicator values using all regions within the EU (REUSII: regional European summary innovation index).



Definitions of indicators

1 Human Resources

1.1 S&E graduates (‰ of 20 - 29 years age class)

Definition

Numerator: S&E (science and engineering) graduates are defined as all post-secondary education graduates (ISCED classes 5a and above) in life sciences (ISC42), physical sciences (ISC44), mathematics and statistics (ISC46), computing (ISC48), engineering and engineering trades (ISC52), manufacturing and processing (ISC54) and architecture and building (ISC58).

Denominator: The reference population is all age classes between 20 and 29 years inclusive.

Source: EUROSTAT: *Structural indicator II.4.1. (Total tertiary graduates in science and technology per 1000 of population aged 20-29).*

Interpretation

The indicator is a measure of the supply of new graduates with training in science and technology. Due to problems of comparability for educational qualifications across countries, this indicator uses broad educational categories. This means that it covers everything from graduates of one-year diploma programmes to PhDs. A broad coverage can also be an advantage, since graduates of one-year programmes are of value to incremental innovation in manufacturing production and in the service sector.

1.2 Population with tertiary education (% of 25 - 64 years age class)

Definition

Numerator: Number of persons in age class with some form of post-secondary education (ISCED 5 and 6).

Denominator: The reference population is all age classes between 25 and 64 years inclusive.

Source: EUROSTAT: Labour Force Survey.

Interpretation

This is a general indicator of the supply of advanced skills. It is not limited to science and technical fields because the adoption of innovations in many areas, particularly in the service sectors, depends on a wide range of skills. Furthermore, it includes the entire working age population, because future economic growth could require drawing on the non-active fraction of the population. International comparisons of educational levels, however, are notoriously difficult due to large discrepancies in educational systems, access, and the level of attainment that is required to receive a tertiary degree. Therefore, differences among countries should be interpreted cautiously.

1.3 Participation in lifelong learning (% of 25 - 64 age class)

Definition

Numerator: Lifelong learning is defined as participation in any type of education or training course during the four weeks prior to the survey. Education includes both courses of relevance to the respondent's employment and general interest courses, such as in languages or arts. It includes initial education, further education, continuing or further training, training within the company, apprenticeship, on-the-job training, seminars, distance learning, and evening classes.

Denominator: The reference population is all age classes between 25 and 64 years inclusive.

Source: EUROSTAT: *Structural indicator I.5.1*.

Interpretation

A central characteristic of a knowledge economy is continual technical development and innovation. Under these conditions, individuals need to continually learn new ideas and skills - or to participate in lifelong learning. All types of learning are valuable, since it prepares people for "learning to learn". The ability to learn can then be applied to new tasks with social or economic benefits. The limitation of the indicator to a brief window of four weeks could reduce comparability between countries due to differences in adult education systems. Little is known at this time about such differences, but differences in the timing of national holidays, preferred times for adult education courses, the average length of adult courses, and other unknown factors could influence the results and reduce comparability. Technical Paper No 5 of the 2002 EIS further elaborates on the issue of "Lifelong Learning for Innovation".

1.4 Employment in medium-high and high-tech manufacturing (% of total workforce)

Definition

Numerator: Number of employed persons in the medium-high and high-technology manufacturing sectors. These include chemicals (NACE 24), machinery (NACE 29), office equipment (NACE 30), electrical equipment (NACE 31), telecommunications and related equipment (NACE 32), precision instruments (NACE 33), automobiles (NACE 34), and aerospace and other transport (NACE 35).

Denominator: The total workforce includes all manufacturing and service sectors.

Source: EUROSTAT: Labour Force Survey.

Interpretation

The percentage of employment in medium-high and high-technology manufacturing sectors is an indicator of the share of the manufacturing economy that is based on continual innovation through creative, inventive activity. The use of total employment gives a better indicator than using the share of manufacturing employment alone, since the latter will be affected by the hollowing out of manufacturing in some countries.

1.5 Employment in high-tech services (% of total workforce)

Definition

Numerator: Number of employed persons in the high-technology services sectors. These include post and telecommunications (NACE 64), information technology including software development (NACE 72), and R&D services (NACE 73).

Denominator: The total workforce includes all manufacturing and service sectors.

Source: EUROSTAT: Labour Force Survey.

Interpretation

The high-technology services both provide services directly to consumers, such as telecommunications, and provide inputs to the innovative activities of other firms in all sectors of the economy. The latter can increase productivity throughout the economy and support the diffusion of a range of innovations, particularly those based on ICT.

2 Knowledge creation

2.1 Public R&D expenditures (GERD - BERD) (% of GDP)

Definition

Numerator: Difference between GERD (Gross domestic expenditure on R&D) and BERD (Business enterprise expenditure on R&D). Both GERD and BERD according to Frascati-manual definitions, in national currency and current prices. This definition is a proxy of public R&D expenditures as it also includes the R&D expenditures from the Private Non Profit (PNP) sector.
Denominator: Gross domestic product as defined in the European System of Accounts (ESA 1995), in national currency and current prices.

Source: EUROSTAT: R&D Statistics. OECD: Main Science and Technology Indicators.

Note: This indicator is identical to the difference between indicators 1 and 3 in "Investing in Research: an Action Plan for Europe" (SEC(2003): 489).

Interpretation

In addition to the production of basic and applied knowledge in universities and higher-education institutions, publicly funded research offers several other outputs of direct importance to private innovation: trained research staff and new instrumentation and prototypes.

2.2 Business expenditures on R&D (BERD) (% of GDP)

Definition

Numerator: All R&D expenditures of the business sector (manufacturing and services), according to Frascati-manual definitions, in national currency and current prices.
Denominator: Gross domestic product as defined in the European System of Accounts (ESA 1995), in national currency and current prices.

Source: EUROSTAT: R&D Statistics. OECD: Main Science and Technology Indicators.

Note: This indicator is identical to indicator 3 in "Investing in Research: an Action Plan for Europe" (SEC(2003): 489).

Interpretation

The indicator captures the formal creation of new knowledge within firms. It is particularly important in the science-based sectors (pharmaceuticals, chemicals and some areas of electronics) where most new knowledge is created in or near R&D laboratories.

2.3.1 EPO high-tech patent applications (per million population)

Definition

Numerator: Number of patents applied for at the European Patent Office (EPO), by date of filing. The national (and regional) distribution of the patent applications is assigned according to the address of the inventor. The high-technology patent classes include: 1) Computer and Automated Business Equipment: B41J, G06, G11C; 2) Micro-organism, genetic engineering: C12M, C12N, C12P, C12Q; 3) Aviation: B64; 4) Communications: H04; 5) Semiconductors: H01L; 6) Laser: H01S (See Annex A for a full list of IPC subclasses).
Denominator: Total population as defined in the European System of Accounts (ESA 1995).

Source: EUROSTAT.

Note: This indicator is identical to indicator 13 in "Investing in Research: an Action Plan for Europe" (SEC(2003): 489).

Interpretation

This indicator complements indicator 2.2 on business R&D in that patenting captures new knowledge created anywhere within a firm and not just within a formal R&D laboratory. The indicator also measures specialisation of knowledge creation in fast-growing technologies. For some countries the absolute numbers of high-tech patent applications are so small that the relative level of performance is both close to zero and highly unstable over time. For these countries overall patent performance (cf. indicator 2.4.1) might be a better proxy for relative performance.

2.3.2 USPTO high-tech patent applications (per million population)

Definition

Numerator: Number of patents applied for at the US Patent and Trademark Office (USPTO), by date of filing. The high-technology patent classes include: 1) Computer and Automated Business Equipment: B41J, G06, G11C; 2) Micro-organism, genetic engineering: C12M, C12N, C12P, C12Q; 3) Aviation: B64; 4) Communications: H04; 5) Semiconductors: H01L; 6) Laser: H01S (See Annex A for a full list of IPC subclasses).
Denominator: Total population as defined in the European System of Accounts (ESA 1995).

Source: USPTO. USPTO patent data are, according to US patent law, for patents granted. High-tech patent data are, by exception, for patent applications, following the objectives of the Trilateral Corporation (established in 1983 by the European Patent Office (EPO), the Japanese Patent Office (JPO) and the US Patent and Trademark Office (USPTO)).

Note: This indicator is identical to indicator 13 in "Investing in Research: an Action Plan for Europe" (SEC(2003): 489).

Interpretation

Indicator 2.3.1 on EPO patent applications favours European versus American and Japanese firms. This indicator provides the equivalent for American firms and measures US patenting activity by European inventors. For some countries the absolute numbers of high-tech patent applications are so small that the relative level of performance is both close to zero and highly unstable over time. For these countries overall patent performance (cf. indicator 2.4.2) might be a better proxy for relative performance.

2.4.1 EPO patent applications (per million population)

Definition

Numerator: Number of patents applied for at the European Patent Office (EPO), by date of filing. The national distribution of the patent applications is assigned according to the address of the inventor.
Denominator: Total population as defined in the European System of Accounts (ESA 1995).

Source: EUROSTAT: *Structural indicator II.5.1*.

Note: This indicator is identical to indicator 12 in DG Research's "Investing in Research: an Action Plan for Europe" (SEC(2003): 489).

Interpretation

This indicator covers all patent applications at the EPO. This indicator complements indicator 2.3.1 on high-tech patenting.

2.4.2 USPTO patents granted (per million population)

Definition

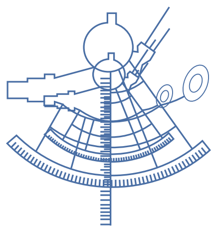
Numerator: Number of patents granted by the US Patent and Trademark Office (USPTO), by date of publication. Patents are allocated to the country of the inventor, using fractional counting in the case of multiple inventor countries.
Denominator: Total population as defined in the European System of Accounts (ESA 1995).

Source: EUROSTAT: *Structural indicator II.5.2*.

Note: This indicator is identical to indicator 12 in "Investing in Research: an Action Plan for Europe" (SEC(2003): 489).

Interpretation

This indicator covers all patents granted by the USPTO. This indicator complements indicator 2.3.2 on high-tech patenting.



3 Transmission and application of knowledge

3.1 SMEs innovating in-house (% of manufacturing SMEs and % of services SMEs)

Definition

Numerator: Sum of all manufacturing/services SMEs with in-house innovation activities. Innovative firms are defined as those who introduced new products or processes either 1) in-house or 2) in combination with other firms.

Denominator: Total number of manufacturing/services SMEs. Manufacturing refers to section D of NACE, services to sections G+I+J+K of NACE.

Source: EUROSTAT: CIS-3.

Note: This indicator does not include new products or processes developed by other firms. SMEs include all enterprises with 10-249 employees. As CIS-2 covered enterprises with 20-249 employees only, a direct comparison with the results in older Scoreboard publications is not possible.

Interpretation

Description: This indicator measures the degree to which manufacturing/services SMEs, that have introduced any new or significantly improved products or production processes during the period 1998-2000, have innovated in-house. The indicator is limited to SMEs because almost all large firms innovate and because countries with an industrial structure weighted to larger firms would tend to do better.

3.2 SMEs involved in innovation co-operation (% of manufacturing SMEs and % of services SMEs)

Definition

Numerator: Sum of all manufacturing/services SMEs with innovation co-operation activities. Firms with co-operation activities are those that had any co-operation agreements on innovation activities with other enterprises or institutions in the three years before the survey.

Denominator: Total number of manufacturing/services SMEs. Manufacturing refers to section D of NACE, services to sections G+I+J+K of NACE.

Source: EUROSTAT: CIS-3.

Note: SMEs include all enterprises with 10-249 employees. As CIS-2 covered enterprises with 20-249 employees only, a direct comparison with the results in older Scoreboard publications is not possible.

Interpretation

Description: This indicator measures the degree to which manufacturing SMEs are involved in innovation co-operation. Complex innovations, particularly in ICT, often depend on the ability to draw on diverse sources of information and knowledge, or to collaborate on the development of an innovation. This indicator measures the flow of knowledge between public research institutions and firms and between firms and other firms. The indicator is limited to SMEs because almost all large firms are involved in innovation co-operation. This indicator also captures technology-based small manufacturing firms, since most are involved in co-operative projects. However, the indicator will miss high-technology firms with no product sales, such as many biotechnology firms, because these firms are assigned to the service sector.

3.3 Innovation expenditures (% of all turnover in manufacturing and % of all turnover in services)

Definition

Numerator: Sum of total innovation expenditure for all manufacturing/services enterprises. Innovation expenditures includes the full range of innovation activities: in-house R&D, extramural R&D, machinery and equipment linked to product and process innovation, spending to acquire patents and licences, industrial design, training, and the marketing of innovations.

Denominator: Total turnover for manufacturing/services. This includes firms that do not innovate, whose innovation expenditures are zero by definition. Manufacturing refers to section D of NACE, services to sections G+I+J+K of NACE.

Source: EUROSTAT: CIS-3.

Note: All enterprises with 10 or more employees are included. As CIS-2 covered enterprises with 20 or more employees only, a direct comparison with the results in older Scoreboard publications is not possible.

Interpretation

Description: This indicator measures the total innovation expenditure as a percentage of total turnover. Several of the components of innovation expenditure, such as investment in equipment and machinery and the acquisition of patents and licences, measure the diffusion of new production technology and ideas. Overall, the indicator measures total expenditures on many different activities of relevance to innovation. The indicator partly overlaps with indicator 2.2 on R&D expenditures. A better version would exclude R&D, but concerns over data reliability have prevented this option.

4 Innovation finance, output and markets

4.1 Share of high-tech venture capital investment

Definition

Numerator: High-tech venture capital includes the following sectors: computer-related fields, electronics, biotechnology, medical/health, industrial automation, financial services.

Denominator: Venture capital is defined as the sum of early stage capital (seed and start-up) plus expansion capital. In order to reduce volatility, this indicator is based on a two-year average of the figures for 2000 and 2001.

Source: EVCA's (European Private Equity & Venture Capital Association) "Mid-Year Survey of Pan-European Private Equity & Venture Activity".

Note: This indicator is similar to indicator 15 in "Investing in Research: an Action Plan for Europe" (SEC(2003): 489), which uses the same data but without calculating a two-year average.

Interpretation

One of the main barriers to innovation is the ability of new technology-based firms to raise adequate funding. This indicator measures the relative supply of private venture capital to these firms. The total supply of capital will be higher because of bank and private-placement financing. The main disadvantage is that there are many alternative methods of financing new technology-based start-up firms that are not covered by this indicator. Firms can also go abroad to raise venture capital. An additional concern is the lack of information on the accuracy of the venture capital data.

4.2 Share of early-stage venture capital in GDP

Definition

Numerator: Venture capital investment is defined as private equity raised for investment in companies. Management buyouts, management buyins, and venture purchase of quoted shares are excluded. Early-stage capital includes seed and start-up capital. *Seed* is defined as financing provided to research, assess and develop an initial concept before a business has reached the start-up phase. *Start-up* is defined as financing provided for product development and initial marketing, manufacturing, and sales. Companies may be in the process of being set up or may have been in business for a short time, but have not yet sold their product commercially.

Denominator: Gross domestic product as defined in the European System of Accounts (ESA 1995), in national currency and current prices. In order to reduce volatility, this indicator is based on a two-year average of the figures for 2000 and 2001.

Source: EUROSTAT: *Structural indicator II.6.1.*

Note: This indicator is similar to indicator 14 in "Investing in Research: an Action Plan for Europe" (SEC(2003): 489), which uses the same data but without calculating a two-year average.

Interpretation

The amount of early-stage venture capital is a proxy for the relative dynamism of new business creation.

4.3.1 Sales of "new to market" products (% of all turnover in manufacturing and % of all turnover in services)

Definition

Numerator: Sum of total turnover of new or significantly improved products for all manufacturing/services enterprises.

Denominator: Total turnover for manufacturing/services. Manufacturing refers to section D of NACE, services to sections G+I+J+K of NACE.

Source: EUROSTAT: CIS-3.

Note: All enterprises with 10 or more employees are included. As CIS-2 covered enterprises with 20 or more employees only, a direct comparison with the results in older Scoreboard publications is not possible.

Interpretation

This indicator measures the turnover of new or significantly improved products, which are also new to the market, as a percentage of total turnover. The product must be new to the firm, which in many cases will also include innovations that are world firsts. The main disadvantage is that there is some ambiguity in what constitutes a "new to market" innovation. Smaller firms or firms from less developed countries could be more likely to include innovations that have already been introduced onto the market elsewhere.

4.3.2 Sales of "new to the firm but not new to the market" products (% of all turnover in manufacturing and % of all turnover in services)

Definition

Numerator: Sum of total turnover of new or significantly improved products to the firm but not to the market for all manufacturing/services enterprises.

Denominator: Total turnover for manufacturing/services. Manufacturing refers to section D of NACE, services to sections G+I+J+K of NACE.

Source: EUROSTAT: CIS-3.

Note: All enterprises with 10 or more employees are included. As CIS-2 covered enterprises with 20 or more employees only, a direct comparison with the results in older Scoreboard publications is not possible.

Interpretation

CIS-2 results have shown that, in manufacturing, 31% of turnover is from products "new or improved for the firm", while only 7% is from products that were "new or improved to the market" (EUROSTAT, Community Innovation Survey 1997/1998: Innovating Enterprises. Statistics in Focus, Theme 9 - 2/1999). The difference of 24% shows the importance of innovation as diffusion versus innovation as creation.

4.4 Internet access/use

Definition

This is a composite indicator using the average of the re-scaled values for the following two indicators:

- Home internet access (% of all households)

Numerator: Number of households who have internet access at home. All forms of use are included. Population considered is equal to or over 15 years old.

Denominator: The number of households.

Source: EUROSTAT: *Structural indicator II.3.1.*

- Share of SMEs with own website

Numerator: Number of SMEs with own website.

Denominator: Number of manufacturing/services SMEs.

Source: EUROSTAT.

4.5 ICT expenditures (% of GDP)

Definition

Numerator: Total expenditures on information and communication technology (ICT). ICT includes office machines, data processing equipment, data communication equipment, and telecommunications equipment, plus related software and telecom services.

Denominator: Gross domestic product as defined in the European System of Accounts (ESA 1995), in national currency and current prices.

Source: EUROSTAT: *Structural indicators II.7.1 and II.7.2.*

Interpretation

ICT is a fundamental feature of knowledge based economies and the driver of current and future productivity improvements. An indicator for ICT investment is crucial for capturing innovation in knowledge-based economies, particularly due to the diffusion of new IT equipment, services, and software. One disadvantage of this indicator is that it is ultimately obtained from private sources (IDC), with a lack of good information on the reliability of the data. Another disadvantage is that some expenditures are for final consumption and may have few productivity or innovation benefits. It would be preferable to have data on ICT investment rather than ICT expenditure, but reliable investment data are not yet available.

4.6 Share of manufacturing value-added in high-tech sectors

Definition

Numerator: Total value added in manufacturing in five high-technology industries: pharmaceuticals (NACE 24.4), office equipment (NACE 30), telecommunications and related equipment (NACE 32), instruments (NACE 33) and aerospace (NACE 35.3).

Denominator: Value added of total manufacturing sector, in national currency and current prices.

Source: EUROSTAT: Structural Business Statistics.

Interpretation

Value-added is the best measure of manufacturing output, whereas other indicators such as total production can be biased by "screwdriver" plants with little value-added. The requirement for good data on value added creates a lag of two or more years longer than for GDP and other economic data. The main disadvantage of the main indicator is that a hollowing-out of manufacturing, as in the UK, can lead to relatively good results, if low and medium technology industries no longer survive.

4.7 **Volatility-rates** of SMEs (% of manufacturing SMEs and % of services SMEs)

Definition

Numerator: Volatility rates are defined as the sum of birth and death rates. "A birth (death) amounts to the creation (dissolution) of a combination of production factors with the restriction that no other enterprises are involved in the event. Births (deaths) do not include entries into/exits from the population due to mergers, break-ups, split-off (take-overs) or restructuring of a set of enterprises. It does not include entries into (exits from) a sub-population resulting only from a change of activity" (EUROSTAT, Business demography in 9 Member States: Results for 1997-2000. Statistics in Focus, Theme 4 - 9/2003).

Denominator: Number of manufacturing/services SMEs.

Source: EUROSTAT: Business Demography Statistics.

Interpretation

Accelerated destruction and creation of companies (and jobs) has been highlighted as a major driver of innovation in the US. As less innovative and efficient companies die or contract, more innovative companies take their place. "Volatility rates indicate entrepreneurial dynamism, both births and deaths of firms can contribute to higher productivity. Especially in times of technological change as at present, where the diffusion of new technologies (ICT) requires innovation and on condition that death rates are similar or lower than birth-rates, high volatility rates indicate primarily an economy's ability to adapt to change" (SEC(2002), 1213).

Annex A: High-tech patent classes

The high-technology patent classes include pharmaceuticals, biotechnology, information technology, and aerospace. The following IPC subclasses are included:

- Computer and Automated Business Equipment:
- B41J: typewriters; selective printing mechanisms, i.e. mechanisms printing other than from a form; correction of typographical errors
- G06C: digital computers in which all the computation is effected mechanically
- G06D: digital fluid-pressure computing devices
- G06E: optical computing devices
- G06F: electric digital data processing
- G06G: analogue computers
- G06J: hybrid computing arrangements
- G06K: recognition of data; presentation of data; record carriers; handling record carriers
- G06M: counting mechanisms; counting of objects not otherwise provided for
- G06N: computer systems based on specific computational models
- G06T: image data processing or generation, in general
- G11C: static stores
- Micro-organism, Genetic Engineering:
- C12M: apparatus for enzymology or microbiology
- C12N: micro-organisms or enzymes; compositions thereof; propagating, preserving, or maintaining micro-organisms; mutation or genetic engineering; culture media
- C12P: fermentation or enzyme-using processes to synthesise a desired chemical compound or composition or to separate optical isomers from a racemic mixture
- C12Q: measuring or testing processes involving enzymes or micro-organisms
- Aviation:
- B64B: lighter-than-air aircraft
- B64C: aeroplanes; helicopters
- B64D: equipment for fitting in or to aircraft; flying suits; parachutes; arrangements or mounting of power plants or propulsion transmissions
- B64F: ground or aircraft-carrier-deck installations
- B64G: cosmonautics; vehicles or equipment therefore
- Communications:
- H04B: transmission
- H04H: broadcast communication
- H04J: multiplex communication
- H04K: secret communication; jamming of communication
- H04L: transmission of digital information, e.g. telegraphic communication
- H04M: telephonic communication
- H04N: pictorial communication, e.g. television
- H04Q: selecting
- H04R: loudspeakers, microphones, gramophone pick-ups or like acoustic electromechanical transducers; deaf-aid sets; public address systems
- H04S: stereophonic systems
- Semiconductors:
- H01L: semiconductor devices; electric solid state devices not otherwise provided for
- Laser:
- H01S: devices using stimulated emission

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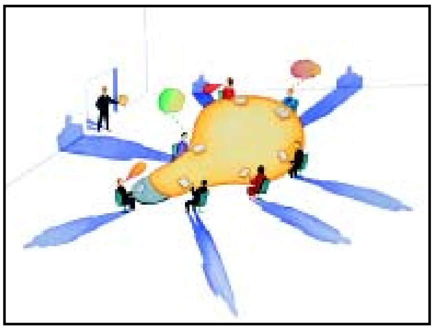

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