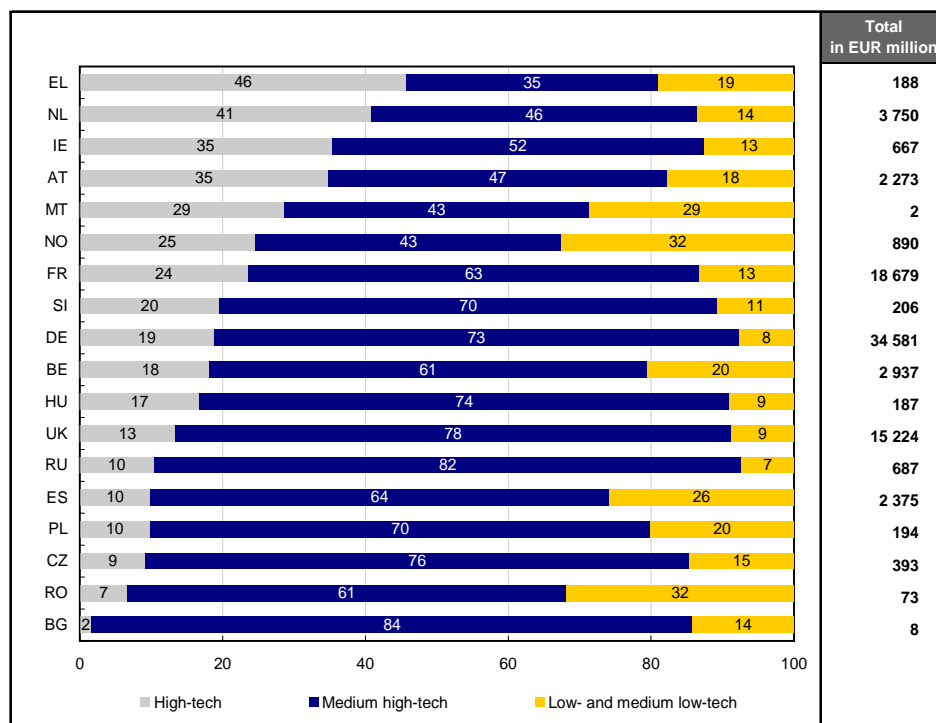


# R&D in enterprises

## Pharmaceuticals: Most R&D-intensive sector in Europe

Figure 1: Business enterprise R&D expenditure in manufacturing by technological intensity<sup>(1)</sup>, EU-25 and selected countries — 2003



Source: Eurostat: High-tech statistics

<sup>(1)</sup> Due to the unavailability of business R&D expenditure by NACE (level 2), it was not possible to calculate data by technological intensity for all Member States.

Exceptions to the reference year:

- SI and BE: 2004;
- HU, MT, AT and BG: 2002.

### Main findings

- More than 90% of business R&D expenditure performed in total manufacturing was in the high-tech and medium high-tech sectors in Germany, Hungary, the United Kingdom and Russia.
- Manufacturing took the lion's share with an EU-25 average of 81% of total business R&D expenditure. In Germany an even higher proportion of business R&D expenditure goes to manufacturing (91%).
- The services sector generally displayed higher annual growth rates in business R&D expenditure than manufacturing but lower absolute values.
- R&D intensity in the *pharmaceuticals* industry was highest in the United Kingdom (58.1%), followed by the Netherlands (36.5%) and Denmark (32.5%). In *computer and related activities* Denmark invested most with 16.4%, followed by Ireland and Finland with 15.6% and 10.9% respectively.
- The highest shares of R&D personnel in total employment in the *pharmaceuticals* industry were observed in Denmark (28.9%), followed by Belgium (25.6%) and Sweden (22.7%).

## Statistics in focus

### SCIENCE AND TECHNOLOGY

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Author

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Figure 1 shows business enterprise R&D expenditure in manufacturing broken down by technological intensity for the EU Member States and selected countries.

The highest share of business R&D expenditure taken by high-tech manufacturing was recorded by Greece with 46%, followed by the Netherlands on 41%.

In Russia 93% of business R&D expenditure was spent in high-tech and medium high-tech manufacturing.

Among the EU Member States, Germany led in terms of total business R&D expenditure with 92% spent in high-tech and medium high-tech manufacturing. Hungary and the United Kingdom followed close behind with 91%.

At the other end of the scale, a considerable share of R&D was performed in low-tech and medium low-tech industries in Romania (32%), and also in Norway (32%), Malta (29%) and Spain (26%).

### Most of the business R&D expenditure spent in manufacturing

Figure 2 illustrates business R&D expenditure, broken down between manufacturing, services and "other" activities.

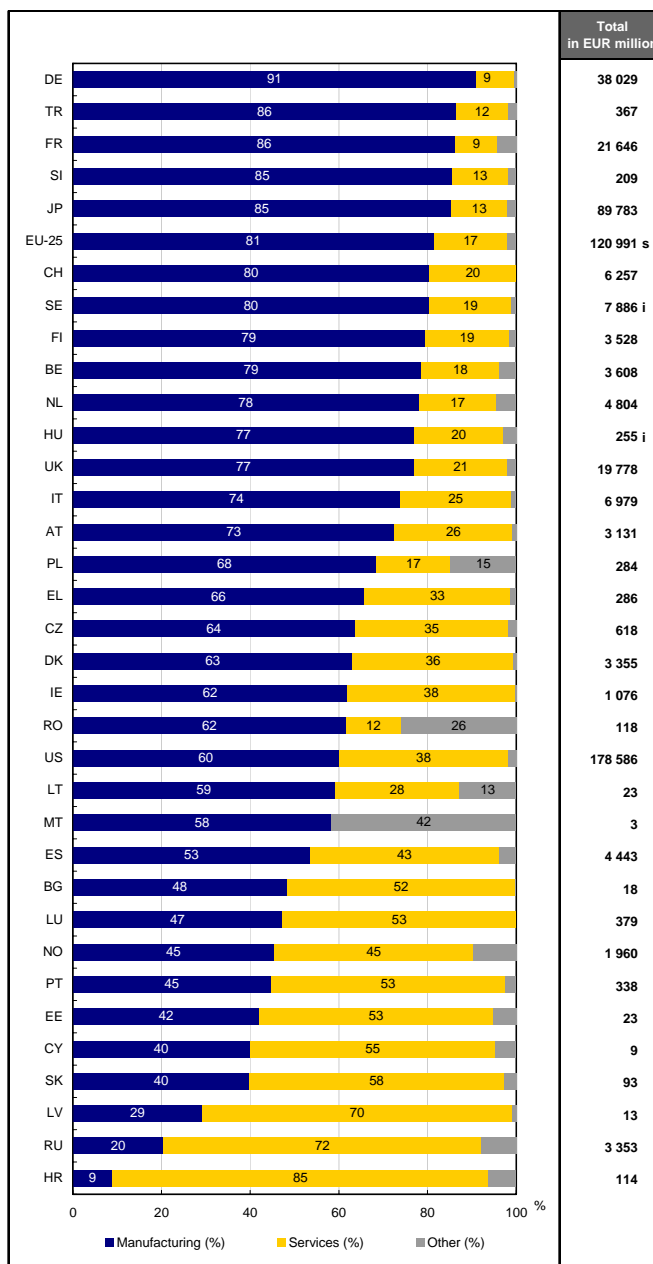
In absolute terms, the United States was the leader for business R&D expenditure with EUR 179 billion, almost 50% higher than the EU-25 total of EUR 121 billion, with Japan next on EUR 90 billion.

The main European R&D players - Germany, France and the United Kingdom - trailed behind. The highest business R&D expenditure was in Germany with less than EUR 38 billion, twice as much as in France.

Manufacturing took the lion's share with an EU-25 average of 81% of total business R&D expenditure. In relative terms, Germany spent most in manufacturing (91%), followed by Turkey (86%) and France (85%).

Within the group of non-Community business R&D spenders, Japan and Switzerland put higher shares into manufacturing, with 85% and 80% respectively, whereas the United States recorded relatively high R&D expenditure in services which took almost 40% of the total.

**Figure 2: Business R&D expenditure in EUR million and by sector<sup>(1)</sup> of activity as a percentage, EU-25 and selected countries — 2003**



Source: Eurostat - R&D statistics, OECD

<sup>(1)</sup> "Other" consists of the remaining sectors not classified as "manufacturing" or "services", i.e. agriculture, hunting and forestry (A), fishing (B), mining and quarrying (C), electricity, gas and water supply (E) and construction (F). The value for "Other" is indicated only if higher than 10%.

Exceptions to the reference year:

AT, MT, TR: 2002;

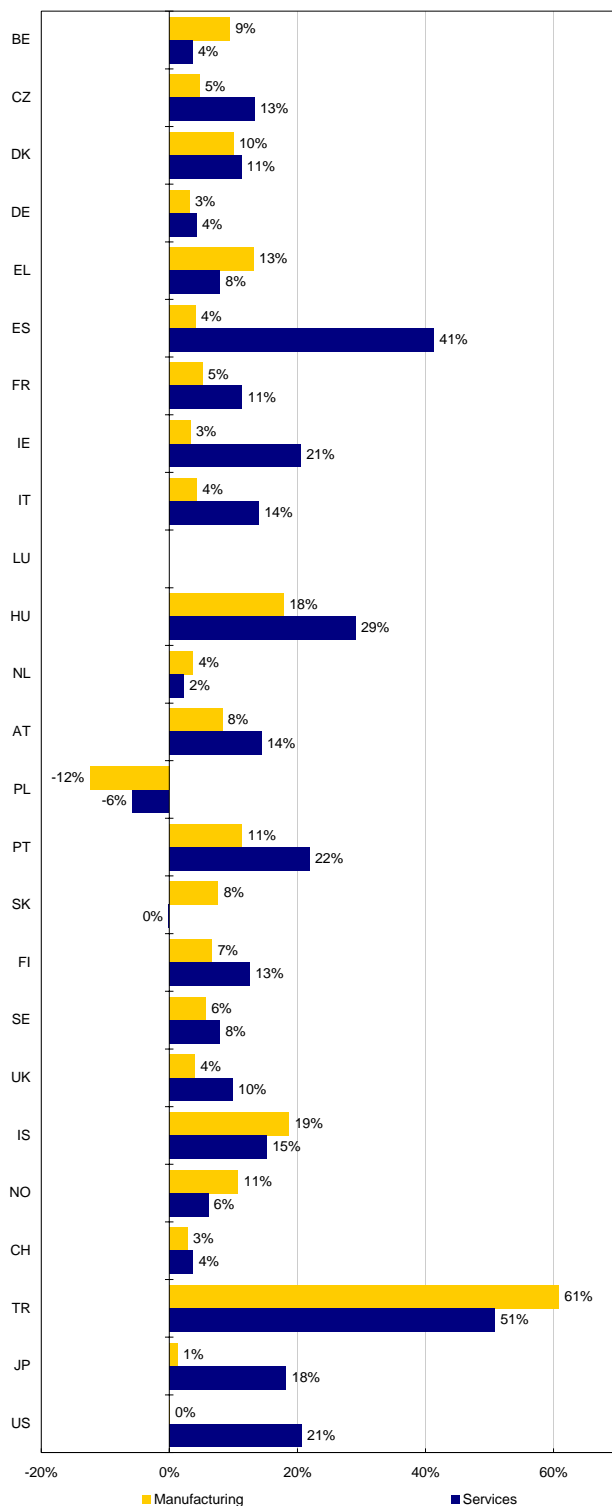
CH: 2004.

SE: Underestimated or based on underestimated data.

HU: The sum of the breakdown does not add up to the total.

RU: Excluding most or all capital expenditure.

**Figure 3: Annual average growth rate of business R&D expenditure in manufacturing and services, as a percentage, EU-25 and selected countries – 1999 to 2003**



Source: Eurostat - R&D statistics, OECD

Exceptions to the reference period:  
 FR, AT, BE, TR: 1998-2002;  
 US: 1996-2001;  
 CH: 1996-2000.

This ratio was also high in Latvia, where the share of R&D expenditure in services totalled 70%, followed by Slovakia (58%) and Cyprus (55%). With the exception of Spain, the European countries with larger shares of business R&D expenditure in services were of similar size: smaller countries generally had higher R&D expenditure in services.

### Highest growth of R&D expenditure in services in Turkey and Spain

Figure 3 compares the annual average growth rates of business R&D expenditure in manufacturing and services over the period 1999-2003.

Often the annual average growth rate in manufacturing was only half the growth rate for services. Only 7 out of 24 countries showed a higher annual increase of R&D expenditure in manufacturing than in services.

The highest annual average growth rates were observed in Turkey for both manufacturing (61%) and services (51%). Yet R&D expenditure in manufacturing accounted for 86% of total business R&D expenditure in Turkey (see Figure 2).

By contrast, Poland was the exception to the increase in R&D expenditure in Europe, displaying negative growth rates for both manufacturing and services, the former (-12%) doubling the latter (-6%).

The United States, Ireland and Spain showed high growth rates for R&D expenditure in services, often well above those in manufacturing.

In the large EU Member States - France, Germany and the United Kingdom, for example - R&D expenditure grew slightly faster in services than in manufacturing. This trend was even more pronounced in Japan and the United States, where R&D expenditure in manufacturing remained stable between 1999 and 2003.

In smaller countries, however, the changes were more mixed. While in the Czech Republic, for example, R&D expenditure increased more in services than in manufacturing, the opposite was the case in Slovakia.

## R&D intensity highest in the *pharmaceutical* industry

Tables 4 and 5 show the R&D efforts in selected sectors of the economy, in terms of both expenditure and personnel.

In *manufacturing*, the biggest contributor to total R&D expenditure, the European average R&D intensity was 6.4%.

However, the EU average hides wide variations at national level. In fact R&D intensity in manufacturing in EU-25 ranged from 0.5% in Poland to 9.6% in Finland. This last was followed by France and Germany with 9.1% and 8.4% respectively.

Focusing on sub-sectors, R&D intensity was highest in the *pharmaceutical* industry, where the best performance was in the United Kingdom with 58.1%, followed by the Netherlands (36.5%) and Denmark (32.5%).

In the *chemical* industry as a whole the ranking was different. Denmark (27.2%) and the United Kingdom (25.4%) were the only Member States registering R&D intensity higher than 20%. They were followed by France (17.2%) and Germany (15.5%).

The highest values for R&D intensity in services were recorded for the sub-sector *computer and related activities*, where Denmark ranked top with 16.4%, followed by Ireland (15.6%) and Finland (10.9%).

By contrast, in all business services the best performances were recorded by Slovakia, Finland and Luxembourg with 5.4%, 5.0% and 4.9% respectively. R&D intensity in business services was low in Poland (0.1%), Malta (0.3%) and Hungary (0.4%).

Apart from Denmark, the champion for high-tech services and third in the ranking for *pharmaceuticals*, and Finland, first in *manufacturing* and third in *pharmaceuticals*, no other country appeared in the top three twice.

**Table 4: R&D intensity (R&D expenditure/value added) as a percentage, by selected sector of economic activity, EU-25 and selected countries — 2003**

	Mining and Quarrying (C)	Manufacturing (D)			Electricity, Gas & Water Supply (E)	Construction (F)	Services (G to Q)	
		Total (D 15 to 37)	Chemicals & Chemical Products (DG 24)	Pharmaceuticals (DG 24.4)			Real Estate, Renting & Business Activities (K 70 to 74)	Computer & Related Activities (K 72)
EU-25	:	6.4 s	:	26.4 s	:	0.1 s	1.4 s	:
BE	2.1	6.2	13.2	21.3	0.6	0.6	1.8	7.4
CZ	0.1	2.1	3.7	7.5	0.0	0.2	2.8	5.5
DK	:	8.3	27.2	32.5	0.4 i	0.1	3.4 i	16.4
DE	0.4	8.4	15.5	28.4	0.2	0.1	1.2	4.5
EE	:	0.7	5.4	0.0	0.0	0.3	0.8	3.3
EL	:	:	:	:	:	:	:	:
ES	0.6	2.1	6.6	15.2	0.4	0.1	1.9	3.7
FR	4.8	9.1	17.2	26.0	1.6	0.2	0.8	4.6
IE	:	1.7	1.3	6.1	:	0.0	3.7	15.6
IT	0.4	2.6	5.2	7.0	0.2	0.0	1.4	1.5
CY	:	0.4	3.9	:	0.0	0.0	:	4.4
LV	:	0.3	4.7	:	:	0.0	1.6	1.6
LT	2.2	0.8	10.2	:	0.3	:	1.0	2.2
LU	:	7.3	:	:	0.0	:	4.9	:
HU	0.1	1.4	7.1	10.4	0.1	0.0	0.4	0.9
MT	0.0	0.2	0.0	0.0	0.3	0.0	0.3	2.5
NL	1.6	6.9	12.1	36.5	0.6	0.1	1.0	3.3
AT	0.4	6.1	10.2	16.7	0.3	0.1	3.4	4.1
PL	0.4	0.5	1.8	4.9	0.0	0.3	0.1	0.5
PT	0.2	0.8	:	:	0.1	0.1	1.6	4.5
SI	3.5	3.3	10.4	14.5	0.0	0.0	2.1	0.2
SK	0.0	0.8	5.2	:	0.0	0.0	5.4	0.1
FI	2.0	9.6	14.1	:	0.3	0.7	5.0	10.9
SE	:	:	:	:	:	:	3.7	8.2
UK	0.3	7.5	25.4	58.1	0.4	0.1	1.1	4.4
IS	:	:	:	:	:	:	:	:
NO	0.5	5.0	7.8	13.6	:	0.4	4.8	10.4
CH	:	:	:	:	:	:	:	:
BG	0.0	0.4	2.1	3.7	0.0	0.0	1.0	0.6
HR	:	:	:	:	:	:	:	:
RO	6.2	1.1	1.3	:	0.3	0.1	0.8	2.5
TR	:	:	:	:	:	:	:	:
RU	:	:	:	:	:	:	:	:

Note (i):

DK: including other classes.

Exceptions to the reference period:

AT, MT, TR: 2002;

CH: 2004; for value added the reference year is 2002.

Source: Eurostat – R&D and SBS statistics

## Highest proportion of R&D personnel in the pharmaceutical industry

Table 5 shows the total R&D personnel as a proportion of the persons employed in selected sectors of the economy.

In *manufacturing* the values ranged from 0.2% to 6.7%, with Finland, Sweden and the Netherlands in the lead with 6.7%, 5.1% and 4.9% of all persons employed in manufacturing working on R&D respectively.

In relative terms, the *pharmaceutical* industry employed the most R&D personnel. The highest concentration of R&D personnel was reported in Denmark (28.9%), followed by Belgium (25.6%) and Sweden (22.7%). The ranking for the whole *chemical* sector is not very different.

Most of the new Member States employed relatively more R&D personnel in services than in manufacturing, explaining the high shares taken by services in business R&D expenditure (see Figure 2), which are also due to the proportion of labour costs in total R&D expenditure.

In *computer and related activities* Ireland led with R&D personnel accounting for 18.2% of employment in this sector, followed by Denmark (13.8%) and Finland (13.1%), both of which showed high R&D intensity in expenditure as well.

**Table 5: R&D personnel intensity (R&D personnel/Number of persons employed) as a percentage, by sector of activity, EU-25 and selected countries — 2003**

	Mining and Quarrying (C)	Manufacturing (D)			Electricity, Gas & Water Supply (E)	Construction (F)	Services (G to Q)	
		Total (D 15 to 37)	Chemicals & Chemical Products (DG 24)	Pharmaceuticals (DG 24.4)			Real Estate, Renting & Business Activities (K 70 to 74)	Computer & Related Activities (K 72)
BE	2.6	4.2	12.9	25.6	1.1	0.4	1.7	8.4
CZ	0.1	0.9	3.0	5.0	0.0	0.1	1.7	4.0
DK	:	4.7	21.0	28.9	1.0 i	0.1	3.5 i	13.8
DE	0.4	4.1	9.2	14.7	0.4	0.1	0.7	3.3
EE	:	0.4	2.4	0.0	0.5	0.0	1.3	6.4
EL	:	:	:	:	:	0.0	:	:
ES	0.4	1.7	5.9	10.7	1.1	0.1	1.2	4.2
FR	:	:	:	:	:	:	:	:
IE	:	3.1	4.2	8.1	:	0.0	2.7	18.2
IT	0.9	1.2	3.9	5.8	0.3	0.0	0.6	1.2
CY	:	0.6	5.7	:	0.3	0.0	:	7.9
LV	:	0.2	4.2	:	:	0.0	1.2	2.3
LT	0.2	0.2	1.3	:	0.0	:	0.4	0.7
LU	:	4.1	:	:	0.0	:	2.5	:
HU	0.3	0.7	7.0	13.1	0.4	0.0	0.3	0.7
MT	:	:	:	:	:	:	:	:
NL	5.5	4.9	12.5	22.5	1.1	0.2	1.0	3.5
AT	0.7	3.7	8.7	13.0	0.7	0.1	2.5	4.2
PL	0.4	0.5	2.1	5.3	0.1	0.1	0.0	0.0
PT	0.2	0.5	:	:	0.2	0.0	1.0	6.6
SI	1.3	1.7	7.6	13.0	0.0	0.0	1.2	0.1
SK	0.0	0.3	1.3	:	:	:	3.6	0.3
FI	1.8	6.7	12.6	:	1.1	0.6	4.6	13.1
SE	1.0	5.1	14.5	22.7	1.6	:	1.4	2.9
UK	:	:	:	:	:	:	:	:
IS	:	:	:	:	:	:	:	:
NO	3.1	3.8	8.3	15.7	:	0.4	4.4 p	9.6
CH	:	:	:	:	:	:	:	:
BG	0.0	0.2	1.5	3.1	0.0	0.0	0.5	0.5
HR	:	:	:	:	:	:	:	:
RO	0.8	0.6	1.5	0.0	0.2	0.1	0.4	1.0
TR	:	:	:	:	:	:	:	:
RU	:	:	:	:	:	:	:	:

Exceptions to the reference period:  
R&D personnel head count: AT and SI 2002;  
Number of persons employed: AT, SE and SI 2002.

Source: Eurostat – R&D and SBS statistics

Note (i):

DK: including other classes.

## United Kingdom, the top R&D spender on the *pharmaceutical* industry and on *computer and related activities*

Table 6 charts the trend in R&D expenditure in two sectors, chosen for their high technology and knowledge content - the pharmaceutical industry and computer and related activities.

A general overview of the sectoral data available for 2003 confirms that R&D in these two sectors is concentrated heavily on the three biggest spenders: the United Kingdom, Germany and France. In the *pharmaceutical* industry these three countries spent 30%, 20% and 19% of the EU-25 total R&D expenditure. Similarly, for *computer and related activities*, the countries ranked in the same order spending 27%, 19% and 13% respectively of the EU-25 total R&D expenditure, leaving a wider margin.

In terms of trends over the last three years, both sub-sectors increased their R&D expenditure. However, there was no clear overall picture.

France and Germany, in particular, saw an expansion of R&D in both sectors, more marked in Germany. France recorded a higher growth rate in *computer and related activities* than in *pharmaceuticals* and vice versa for Germany. Ireland achieved very good R&D performances in both sectors with high annual growth rates in each.

However, there were a few exceptions, the most striking being the United Kingdom with a noticeable reduction in R&D expenditure in *pharmaceuticals*, largely counterbalanced, however, by an increase in R&D on *computer and related activities*. For the Netherlands the situation was the opposite, with R&D expenditure in *computer activities* decreasing. Slovenia, on the other hand, increased its R&D spending in *pharmaceuticals*. The Czech Republic concentrated its R&D effort heavily on *computer and related activities*.

**Table 6: R&D expenditure in *pharmaceuticals* (DG 24.4) and *computer and related activities* (K 72), in EUR million, EU-25 and selected countries — 2001 to 2003**

	Pharmaceuticals (DG 24.4)			Computer & related activities (K 72)		
	2001	2002	2003	2001	2002	2003
<b>EU-25</b>	:	:	<b>15 647 s</b>	:	:	<b>6 981 s</b>
BE	706	704	778	158	241	244
CZ	14	21	19	12	20	52
DK	:	710 b	714	:	448 b	473
DE	2 277	2 490	3 059	1 047	:	1 338
EE	:	0	:	2	3	2
EL	:	:	3	:	:	60
ES	:	403	461	:	260	279
FR	:	2 796	2 993	:	825	907
IE	71	:	190	252	:	369
IT	:	:	483	:	:	235
CY	1	1	2	1	1	3
LV	1	:	:	0	0	1
LT	:	:	:	:	:	1
LU	:	:	:	:	:	:
HU	86	94	87	6	9	6
MT	:	:	:	:	1	:
NL	:	382	455	:	297	224
AT	:	143	:	:	104	:
PL	:	44	37	:	:	6
PT	:	:	:	26	27 e	29
SI	55	66	83	3	0	0
SK	7	:	:	1	:	0
FI	:	:	:	:	229	235
SE	:	:	1 439	:	:	493
UK	:	5 254	4 683	:	1 412	1 912
IS	:	:	9	:	:	19
NO	:	:	53	:	241	264
BG	:	6	3	1	0	0
HR	:	3	4	:	:	16
RO	:	:	:	0	2	7
TR	10	16	:	13	13	:
RU	3	:	2	18	:	12

Source: Eurostat - R&D statistics

RU: excluding most or all capital expenditure.

## ➤ ESSENTIAL INFORMATION – METHODOLOGICAL NOTES

### Research and experimental development — R&D

Research and experimental development — R&D — activities comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and use of this stock of knowledge to devise new applications.

### Institutional classifications

Internal expenditure and R&D personnel are broken down by the four institutional sectors in which the R&D takes place.

### The business enterprise sector — BES

With regard to R&D, the business enterprise sector includes all firms, organisations and institutions whose primary activity is market production of goods or services (other than higher education) for sale to the general public at an economically significant price and the private non-profit institutions mainly serving them — *Frascati Manual*, § 163.

### R&D indicators:

#### R&D personnel

All persons employed directly on R&D should be counted, as well as those providing direct services such as R&D managers, administrators and clerical staff. Those providing indirect services, such as canteen and security staff, should be excluded — *Frascati Manual*, § 294-296.

#### Personnel by number of individuals — HC

The number of individuals who are employed mainly or partly on R&D — *Frascati Manual*, § 326-330.

### NACE classification

Data presented by sector of economic activity are based on the statistical classification of economic activities in the European Community, NACE Rev.1.1., designed to categorise data relating to "statistical units" or unit of activity, for example an individual plant or group of plants constituting an economic entity such as an enterprise.

The following sectors and sub-sectors are considered in this issue:

Section / sub-section	Description	NACE Rev 1.1 codes	Section / sub-section	Description	NACE Rev 1.1 codes
C	Mining and quarrying	10 to 14			
D	Manufacturing	15 to 37	DL	Manufacture of electrical and optical equipment	30 to 33
DA	Manufacture of food products, beverages and tobacco	15 to 16	DM	Manufacture of transport equipment	34 to 35
DB	Manufacture of textiles and textile products	17 to 18	DN	Manufacturing n.e.c.	36 to 37
DC	Manufacture of leather and leather products	19	E	Electricity, gas and water supply	40 to 41
DD	Manufacture of wood and wood products	20	F	Construction	45
DE	Manufacture of pulp, paper and paper products; publishing and printing	21 to 22	G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	50 to 52
DF	Manufacture of coke, refined petroleum products and nuclear fuel	23	I	Transport, storage and communication	60 to 64
DG	Manufacture of chemicals, chemical products and man-made fibres	24		Post and telecommunications	64
	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	24.4		Telecommunications	64.2
DH	Manufacture of rubber and plastic products	25	K	Real estate, renting and business activities	70 to 74
DJ	Manufacture of basic metals and fabricated metal products	27 to 28		Computer and related activities;	72
DK	Manufacture of machinery and equipment n.e.c.	29		Research and development	73

### Classification of manufacturing by technological intensity

The classification of manufacturing by technological intensity is based on the Eurostat/OECD's classification — itself based on the ratio of R&D expenditure to GDP (R&D intensity). The aggregations are made as follows:

<i>High-technology manufacturing</i>	NACE Rev. 1.1 codes: 30 Manufacture of office machinery and computers; 32 Manufacture of radio, television and communication equipment and apparatus; 33 Manufacture of medical, precision and optical instruments, watches and clocks
<i>Medium-high-technology manufacturing</i>	NACE Rev. 1.1 codes: 24 Manufacture of chemicals and chemical products; 29 Manufacture of machinery and equipment n.e.c.; 31 Manufacture of electrical machinery and apparatus n.e.c.; 34 and 35 Manufacture of transport equipment
<i>Medium-low-technology manufacturing</i>	NACE Rev. 1.1 codes: 23 Manufacture of coke, refined petroleum products and nuclear fuel; 25 to 28 Manufacture of rubber and plastic products; basic metals and fabricated metal products; other non-metallic mineral products.
<i>Low-technology manufacturing</i>	NACE Rev. 1.1 codes: 15 to 22 Manufacture of food products, beverages and tobacco; textiles and textile products; leather and leather products; wood and wood products; pulp, paper and paper products, publishing and printing; 36 to 37 Manufacturing n.e.c.

This issue of Statistics in Focus shows the data available in Eurostat's reference database in October 2006.

## ***Further information:***

Data: [EUROSTAT Website/Home page/Science and technology/Data](#)

 **Science and technology**

 **Research and development**

 **Statistics on research and development**

 **R&D expenditure at national and regional level**

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Eurostat set up with the members of the 'European statistical system' a network of support centres, which will exist in nearly all Member States as well as in some EFTA countries.

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