Statistics in focus

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Contents

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R&D activities and costs

Experimental development in enterprises, basic research in universities

Within the EU-27, each sector is more or less specialised in a particular type of R&D activity: the business enterprise sector in experimental development, the higher education sector in basic research and, to a lesser extent, the government sector in applied research.

Both Japan and the United States spend more than Europe on experimental development

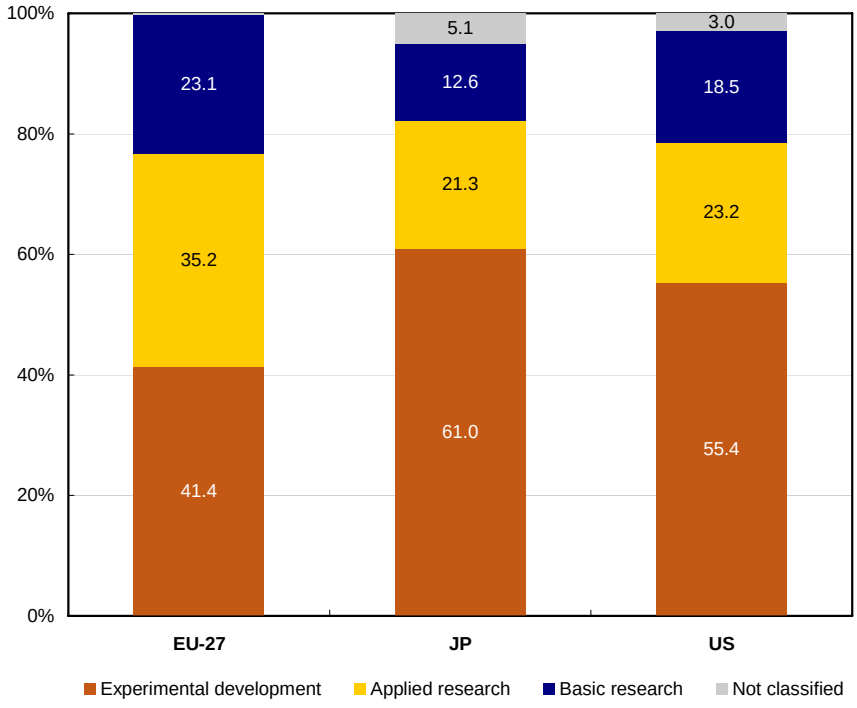
Experimental development, directed at the production of new materials, products and devices or the introduction of new processes, systems and services, accounted for the largest share of R&D expenditure by the world's three biggest economies.

In Japan, R&D expenditure allocated to experimental development reached 61.0% of the total in 2003. In the United States, too, it accounted for over half (55.4%) of total R&D expenditure. The same did not apply, however, to the EU-27 (41.4%).

Of the world's three main economies, it was the EU-27 that recorded the highest shares of R&D expenditure devoted to applied and basic research with 35.2% and 23.1% respectively.

Although applied research both in Japan and in the United States accounted for over 20% of total R&D expenditure, basic research did not reach that level.

Figure 1: R&D expenditure by type of activity as a percentage, all sectors, EU-27, Japan and United States — 2003



Source: Eurostat – R&D statistics, OECD MSTI

EU-27: Distribution by type of activity is estimated on the basis of available Member States; 0.2% of EU-27 total R&D expenditure is not elsewhere classified by type of activity.
JP: Underestimated or based on underestimated data.
US: Provisional data

Table 2: R&D expenditure in EUR million and by type of activity as a percentage, all sectors, EU-27 and selected countries — 2003

	Total	Applied research	Basic research	Experimental development	Not classified
EU-27	**188 973 s**	**35.2 s**	**23.1 s**	**41.4 s**	**0.2 s**
BE	5 177	:	:	:	:
BG	89	46.9	37.3	15.8	0.0
CZ	1 013	30.0	25.1	44.9	:
DK	4 855	27.0	17.9	55.1	:
DE	54 539	:	:	:	:
EE	67	28.2	36.4	35.3	0.0
IE	1 607 e	32.2 e	19.9 e	48.0 e	:
EL	978	:	:	:	:
ES	8 213	:	:	:	:
FR	34 569	36.2	24.1	39.7	:
IT	14 769	:	:	:	:
CY	41	58.6	18.5	22.9	0.0
LV	38	45.1	32.1	22.8	:
LT	111	38.0	35.5	26.5	:
LU	426	:	:	:	:
HU	693 i	30.1	31.1	33.7	5.2
MT	11	:	:	:	:
NL	8 376	:	:	:	:
AT	5 250	36.3 i	17.5 i	44.3 i	1.9
PL	1 036	22.0 i	33.1 i	30.4 i	14.5
PT	1 020	39.9	25.4	34.7	:
RO	203	51.4 i	22.4 i	14.5 i	11.7
SI	328	62.4	11.7	25.9	0.0
SK	169	44.8 e	37.2 e	18.1 e	:
FI	5 005	:	:	:	:
SE	10 642 i	:	:	:	:
UK	28 658	:	:	:	:
IS	274	53.1	16.2	30.7	:
NO	3 411	33.8	18.2	48.0	:
CH	8 486	33.3	28.7	38.0	:
HR	292	33.5	36.4	30.2	:
JP	119 748	21.3 i	12.6 i	61.0 i	5.1
RU	4 899	14.8 i	14.3 i	65.8 i	5.1
US	258 519 ip	23.2 p	18.5 p	55.4 p	3.0

Source: Eurostat – R&D statistics, OECD MSTI

Exceptions to the reference year:
2004: AT and CH
EU-27: Distribution by type of activity is estimated on the basis of available Member States.
AT, SE and JP: Underestimated or based on underestimated data.
PL, RO and RU: Excludes most or all capital expenditure.

As shown in Table 2, the breakdown of R&D expenditure in EU-27 by type of activity hides differences at the national level.

In Bulgaria, Estonia, Latvia, Lithuania, Hungary, Poland and Slovakia, more than 30% of R&D expenditure was devoted to basic research, while the European average was only 23.1%. This can partly be explained by the preponderance of the public sector in total R&D activities in these countries.

By contrast, basic research in Slovenia accounted for only 11.7% of R&D expenditure, which was the lowest percentage of all the Member States.

On the other hand, of all the Member States, Slovenia allocated the highest share of R&D expenditure to applied research, with 62.4%. Applied research also accounted for over half of all R&D expenditure in Cyprus, Romania and Iceland.

At the other end of the scale, Poland, Denmark and Estonia devoted less than 30% of R&D expenditure to this type of activity.

Denmark, with 55.1%, was the Member State that allocated the largest share of R&D expenditure to experimental development and was also the only one exceeding 50%. High percentages were also found in Ireland (48.0%) and to a lesser extent in the Czech Republic (44.9%) and in Austria (44.3%).

However, even the highest European shares were still below those of Japan (61.0%) and the United States (55.4%).

The absolute leader in terms of the share of R&D expenditure allocated to experimental development was Russia (65.8%). However, in Russia, R&D expenditure was under EUR 5 billion. In absolute terms, Russia spent less on R&D than, for example, Finland or Belgium.

BASIC research vs APPLIED research

Basic research is driven by a scientist's curiosity or interest in a scientific question. The main motivation is to expand man's knowledge, not to create or invent something. There is no obvious commercial value to the discoveries that result from basic research.

Applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge for knowledge's sake. One might say that the goal of the applied scientist is to improve the human condition.

Most scientists believe that a basic, fundamental understanding of all branches of science is needed in order for progress to take place. In other words, basic research lays down the foundation for the applied science that follows.

The distinction between basic and applied research is not always clear. It sometimes depends on your perspective or point of view. One way to look at it is to ask the following question "How long will it be before some practical application results from the research?":

- If a practical use is only a few years away, then the work can be defined as strictly **applied research**.
- If a practical use cannot be envisioned in the foreseeable future, then the work can be described as purely **basic research**.

More information available on: 5Hhttp://www.lbl.gov/Education/ELSI/research-main.html

Source: Lawrence Berkeley National Laboratory.

Business sector devoted almost its entire expenditure to experimental development and applied research

Figure 3 shows business R&D expenditure broken down by type of activity.

It will be noticed that the business enterprise sector specialised in experimental development and, to a lesser extent, in applied research. At EU-27 level, 57% of business R&D expenditure is allocated to experimental development, 37% to applied research, and only 5% to basic research. This seems logical since the aim of both experimental development and applied research is to produce new goods or, at least, to create the expectation of a practical use in the near future.

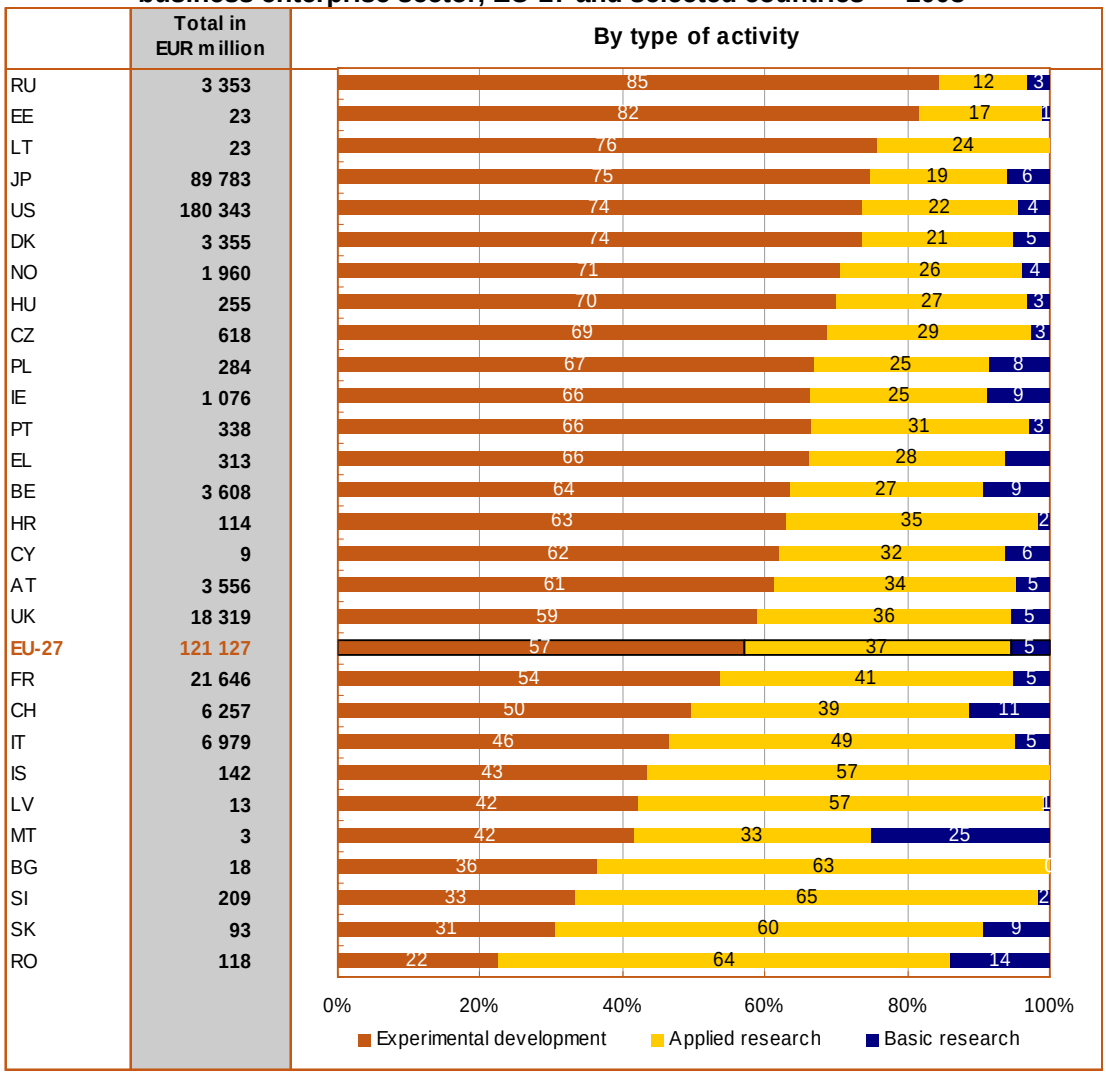
On average, a business enterprise in the EU-27 was less focused on experimental development (57%) than some of its global competitors, such as in Russia (85%), Japan (75%) or the United States (74%).

Within the European Union, the highest share of business R&D expenditure allocated to experimental development was held by Estonia (82%), followed by Lithuania (76%).

At EU-27 level, 37% of business R&D expenditure was allocated to applied research.

Although the average European enterprise allocated only a small share (5%) of its R&D expenditure to basic research, some countries recorded quite large shares, including Malta (25%), Romania (14%) and Switzerland (11%). In the case of Switzerland, this can be partly explained by the fact that it has an important worldwide chemical and life-sciences industry which invests considerable funds not only in applied research and in experimental development, but also in basic research.

Figure 3: R&D expenditure in EUR million and by type of activity as a percentage, business enterprise sector, EU-27 and selected countries — 2003



Source: Eurostat – R&D statistics, OECD MSTI

Exceptions of the reference year:
2002: MT 2004: AT and CH
EU-27: Distribution by type of activity is estimated on the basis of available Member States.
US: Excludes most or all capital expenditure.
PL, RO, UK, RU and US: The sum of "type of activity" does not match the total.

Higher education sector specialised in basic research

Table 4 shows R&D expenditure broken down by type of activity in the government and higher education sectors.

While almost EUR 25 billion were allocated in the government sector, more than EUR 40 billion were committed to research in the higher education sector.

At EU-27 level, both of these sectors are more or less specialised in one type of activity. However, with more than 70% of R&D expenditure allocated to basic research, the higher education sector was much more specialised than the government sector was in applied research (46.1%).

Of course, the European averages mask differences at the national level, especially in the government sector where, for example, basic research was the main activity in most of the new Member States (2004 and 2007 enlargements).

Bulgaria, Cyprus and Slovenia were the exceptions; applied research was the principal activity in the higher education sector in these countries.

For all other Member States, basic research was the main type of activity in the higher education sector, accounting for over 80% in France, Malta and Slovakia.

As has already been noted in relation to the business enterprise sector, it seems that the government sector and, to a lesser extent, the higher education sector in Japan, Russia and the United States are more focused on experimental development than is the case in EU-27.

Table 4: R&D expenditure in EUR million and by type of activity as a percentage, government and higher education sectors, EU-27 and selected countries — 2003

	Government sector					Higher education sector				
	Total	Applied research	Basic research	Experimental development	Not classified	Total	Applied research	Basic research	Experimental development	Not classified
EU-27	**24 605 s**	**46.1 s**	**30.9 s**	**22.3 s**	**0.4 s**	**41 251 s**	**21.7 s**	**72.8 s**	**5.6 s**	**0.0 s**
BE	354	:	:	:	:	1 150	:	:	:	:
BG	62	38.1	51.8	10.1	0.0	9	76.2	9.0	14.8	0.0
CZ	236	24.9	67.6	7.4	:	155	42.1	50.5	7.5	:
DK	340	60.9	16.7	22.5	:	1 127	33.7	54.9	11.4	:
DE	7 307	:	:	:	:	9 202	:	:	:	:
EE	11	26.0	68.6	5.5	0.0	32	34.3	51.6	14.2	0.0
IE	127	62.3	22.8	14.9	:	404 e	42.5 e	48.1 e	9.3 e	:
EL	198	:	:	:	:	457	:	:	:	:
ES	1 262	:	:	:	:	2 492	:	:	:	:
FR	5 767	45.9	21.6	32.5	:	6 693	11.4	86.4	2.2	:
IT	2 582	47.7	44.1	8.2	:	5 000	:	:	:	:
CY	16	76.2	12.6	11.2	0.0	13	52.0	34.7	13.4	0.0
LV	9	32.1	53.5	14.3	:	16	42.6	45.7	11.9	:
LT	29	39.8	52.7	7.4	:	58	42.6	41.0	16.5	:
LU	45	:	:	:	:	2 e	:	:	:	:
HU	217 i	31.6 i	57.2 i	11.2 i	:	185	38.5	44.8	16.7	:
MT	0.6	53.7	46.3	0.0	:	7.5	0.0	100.0	0.0	:
NL	1 213 b	:	:	:	:	2 356	:	:	:	:
AT	270	37.4 i	21.9 i	4.3 i	36.4	1 402	41.6	49.0	9.4	:
PL	421	23.3 i	38.3 i	26.8 i	11.6	329	20.8 i	48.8 i	11.9 i	18.5
PT	172	56.1	7.9	36.1	:	392	40.6	47.1	12.3	:
RO	65	49.9 i	39.0 i	7.1 i	4.0	19	23.6 i	28.1 i	7.3 i	41.1
SI	72	62.2	27.6	10.2	0.0	45	49.8	33.2	16.9	0.0
SK	53 i	30.5 ie	67.1 ie	2.4 ie	:	22	14.2 e	82.8 e	3.0 e	:
FI	485	:	:	:	:	962	:	:	:	:
SE	371 i	:	:	:	:	2 344	:	:	:	:
UK	2 935	47.7	33.3	18.0	:	6 436	:	:	:	:
IS	68	59.0	21.2	19.8	:	58	41.2	43.6	15.3	:
NO	515	60.9	17.1	21.9	:	937	36.0	49.0	15.0	:
CH	91 i	92.9 i	3.6 i	3.6 i	:	1 943	14.3	80.2	5.5	:
HR	64	27.8	68.0	4.1	:	114	34.7	53.4	12.0	:
JP	11 149	29.6 i	30.0 i	37.4 i	2.9	16 358	23.8 i	36.6 i	6.3 i	33.3
RU	1 239	17.3 i	40.2 i	35.2 i	7.2	297	35.2 i	36.2 i	27.1 i	1.4
US	32 028 ip	24.4 ip	12.3 ip	32.2 ip	31.1	35 514 ip	:	:	:	:

Source: Eurostat – R&D statistics, OECD MSTI

Exceptions of the reference year:
2004: MT, AT and CH
EU-27: Distribution by type of activity is estimated on the basis of available Member States.
HU, SK: Defence excluded (all or mostly).
AT, SE and JP: Underestimated or based on underestimated data.
PL, RO and RU: Excludes most or all capital expenditure.
CH: Federal or central government only.

Capital expenditure most important in the government sector

Figure 5 shows the R&D expenditure of the business enterprise sector broken down by current and capital expenditure.

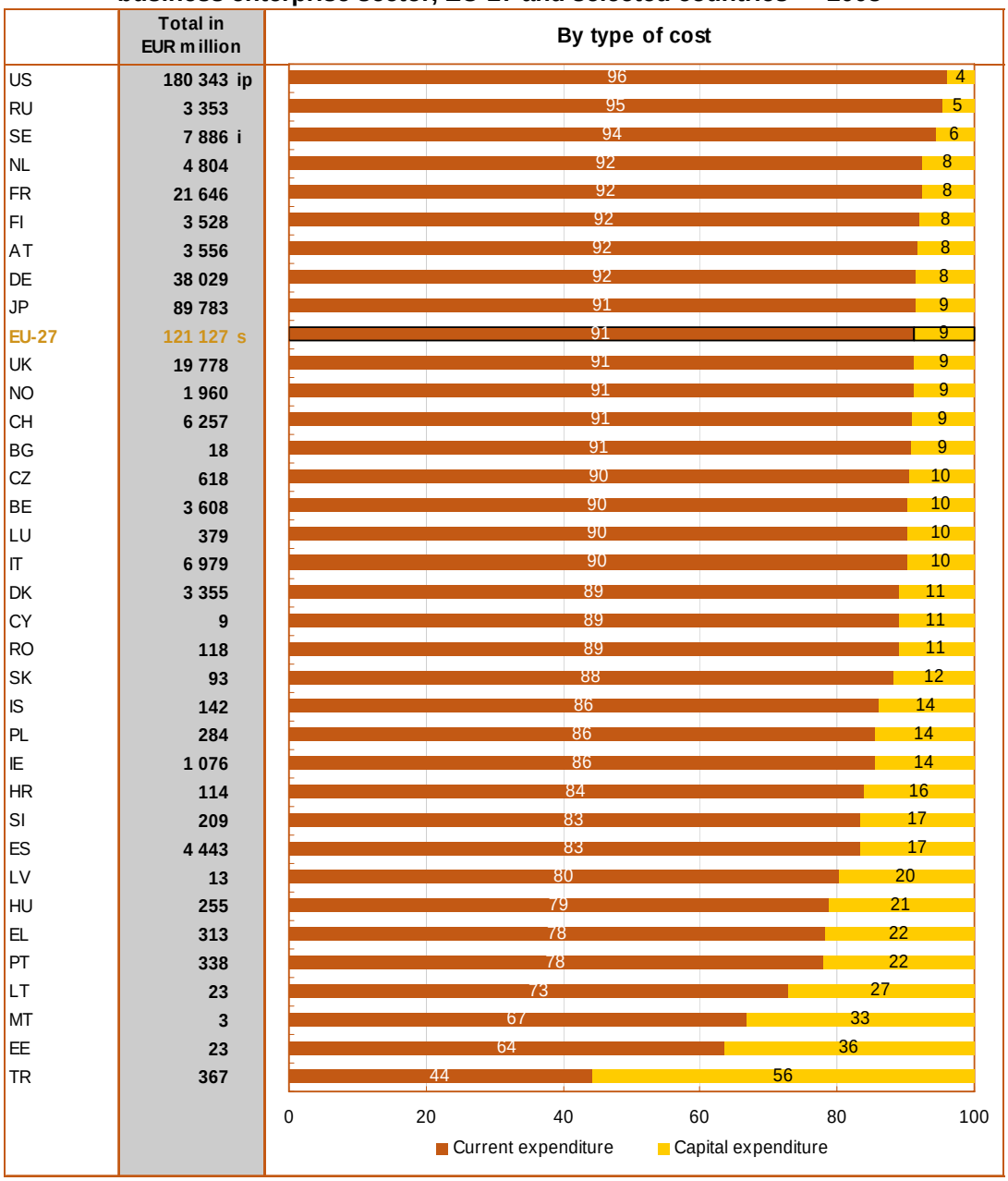
At the EU-27 level, current expenditure — which includes labour costs — accounted for over 90% of total R&D expenditure.

Of the other two major global economies, Japan had a similar distribution to the EU, while in the United States current expenditure was even higher.

However, for some individual EU Member States and candidate countries, current expenditure accounted for a less significant part of business R&D expenditure. This was especially true in Lithuania (73%), Estonia (64%), Malta (67%) and particularly in Turkey, where current expenditure accounted for under half (44%) of business R&D expenditure.

Part of the explanation for this might lie in the fact that, in some of these countries, labour costs are lower and therefore current costs make up a smaller share of business R&D expenditure.

Figure 5: R&D expenditure in EUR million and by type of cost as a percentage, business enterprise sector, EU-27 and selected countries — 2003



Source: Eurostat – R&D statistics, OECD MSTI

Exceptions of the reference year:
2002: MT and TR 2004: AT and CH
EU-27: Distribution by type of cost is estimated on the basis of available Member States.
SE: Underestimated or based on underestimated data.
US: Excludes most or all capital expenditure.

Table 6 illustrates the distribution between current and capital expenditure for the government and higher education sectors.

At European level, capital expenditure accounted for a larger share of the total in the government sector (15.4%) than in the higher education sector (8.8%), where the distribution is much closer to that of the business enterprise sector.

By comparison, in Japan capital expenditure accounted for over 20% of R&D expenditure in the government sector.

Of the Member States, only the United Kingdom (31.2%) and Ireland (25.4%) posted higher figures than Japan for capital expenditure in the government sector.

In the higher education sector, it was Romania (41.1%), Luxembourg (25.3%) and Spain (20.6%) that displayed the highest shares of capital expenditure.

In the EU-27, labour costs accounted for almost 60% of current costs in the higher education sector, although only reaching 45.8% in the government sector.

Table 6: R&D expenditure in EUR million and by type of cost as a percentage, government and higher education sectors, EU-27 and selected countries — 2003

	Government sector				Higher education sector			
	Total	Capital expenditure	Current expenditure		Total	Capital expenditure	Current expenditure	
			Total	Of which Labour costs			Total	Of which Labour costs
EU-27	24 605 s	15.4 s	84.6 s	45.8 s	41 251 s	8.8 s	91.2 s	59.9 s
BE	354	11.6	88.4	56.4	1 150	3.5	96.5	69.5
BG	62	3.4	96.6	50.0	9	3.7	96.2	60.2
CZ	236	15.6	84.4	38.2	155	9.5	90.5	38.1
DK	340	7.4	92.5	62.5	1 127	4.2	95.8	51.9
DE	7 307	14.8	85.2	54.0	9 202	7.0 i	92.7 i	61.1
EE	11	15.2	84.8	48.9	32	11.9	88.1	49.6
IE	127	25.4	74.6	:	404 e	7.1	92.9	69.5
EL	198	10.2	89.8	62.9	457	6.4	93.6	65.7
ES	1 262	20.5	79.5	50.8	2 492	20.6	79.4	63.3
FR	5 767	12.6	87.4	45.4	6 693	12.0	88.0	71.3
IT	2 582	15.2	84.8	53.2	5 000	4.6	95.4	74.5
CY	16	13.0	87.0	65.8	13	3.4	96.6	70.4
LV	9	5.2	94.7	45.5	16	6.9	93.1	43.9
LT	29	8.0	92.0	61.5	58	6.4	93.6	58.1
LU	45	4.0	96.0	:	2 e	25.2	74.8	:
HU	217 i	15.2 i	84.8 i	51.6 i	185	12.9	87.1	59.8
MT	0.8	11.4	88.6	67.7	7.1	6.6	93.4	61.8
NL	1 213 b	7.0 b	93.0 b	66.5 b	2 356	12.0	88.0	53.5
AT	270	8.4	91.6	54.4	1 402	8.6	91.4	44.5
PL	421	11.6	88.4	49.9	329	18.5	81.5	36.1
PT	172	9.6	90.4	71.2	392	3.9	96.1	84.7
RO	65	4.0	96.0	54.5	19	41.1	58.9	36.4
SI	72	7.7	92.3	62.2	45	11.0	89.0	55.0
SK	53 i	8.9 i	91.1 i	53.8 i	22	14.0	86.0	53.6
FI	485	5.0	95.0	60.0	962	1.9	98.1	60.5
SE	371 i	4.7 i	95.3 i	53.6 i	2 344	6.8	93.2	:
UK	2 906	31.2	68.8	:	6 437	:	:	:
IS	68	6.9	93.1	62.9	58	13.6	86.4	56.6
NO	515	4.9	95.1	59.6	937	11.1	88.9	48.7
CH	91 i	7.1 i	92.9 i	75.0 i	1 943	4.8	95.2	67.3
HR	64	13.0	87.0	54.4	114	20.2	79.8	54.9
TR	90	28.5	71.5	52.7	823	7.8	92.2	49.6
JP	11 149	22.0	78.0	30.6	16 358	16.9	83.1	45.5
RU	1 239	7.2	92.8	50.3	297	1.4	98.6	58.7
US	35 583 i	:	:	:	39 324 i	:	:	:

Source: Eurostat – R&D statistics, OECD MSTI

Exceptions of the reference year:
2004: AT and CH
2002: TR and US
EU-27: Distribution by type of cost is estimated on the basis of available Member States.
DE: The sum of the breakdown does not add to the total
HU, SK: Defence excluded (all or mostly).
SE, CH and US: Federal or central government only.

➢ ESSENTIAL INFORMATION – METHODOLOGICAL NOTES

Research and experimental development

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

Type of activity

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Applied research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

Institutional classifications

Internal expenditure and R&D personnel are broken down with reference to 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, organizations and institutions whose primary activity is the 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*.

The government sector (GOV)
In the field of R&D, the government sector includes: all departments, offices and other bodies which furnish but normally do not sell to the community those common services, other than higher education, which cannot otherwise be conveniently and economically provided, and administer the state and the economic and social policy of the community (public enterprises are included in the business enterprise sector) as well as PNPs controlled and mainly financed by government — *Frascati Manual, § 184*.

The higher education sector (HES)
This sector comprises: all universities, colleges of technology and other institutes of post-secondary education, whatever their source of finance or legal status. It also includes all research institutes, experimental stations and clinics operating under the direct control of or administered by or associated with higher education establishments — *Frascati Manual, § 206*.

The private non-profit sector (PNP)
This sector covers: non-market, private non-profit institutions serving households (i.e. the general public) and private individuals or households — *Frascati Manual, § 194.*

Type of cost

Current costs
Current costs are composed of labour costs and other current costs

Labour costs of R&D personnel comprise annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, holiday pay, contributions to pension funds and other social security payments, payroll taxes, etc. The labour costs of persons providing indirect services which are not included in the personnel data should be excluded and included in other current costs.

Other current costs comprise non-capital purchases of materials, supplies and equipment to support R&D performed by the statistical unit in a given year. Costs for on-site consultants should be included in other current costs. Administrative and other overhead costs should also be included. All costs for indirect services should be included.

Capital expenditure
Capital expenditures are the annual gross expenditures on fixed assets used in the R&D programmes of statistical units. They should be reported in full for the period when they took place and should not be registered as an element of depreciation.

Sources

Eurostat - R&D statistics (data for US and JP through OECD Main Science and Technology Indicators).

General abbreviations

e	estimated value
p	provisional value
s	Eurostat estimate
b	break in series
i	more information in metadata
:	not available

Reference manual

Standard method proposed for research and experimental development surveys — Frascati Manual, OECD, 2002.

Data presented in this Statistics in Focus reflects the data availability in Eurostat's reference database as of 1st of June 2007.

Further information:

Data: **EUROSTAT Website/Home page/Science and technology/Data**

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