

# Senior human resources in science and technology

## Statistics in focus

### SCIENCE AND TECHNOLOGY

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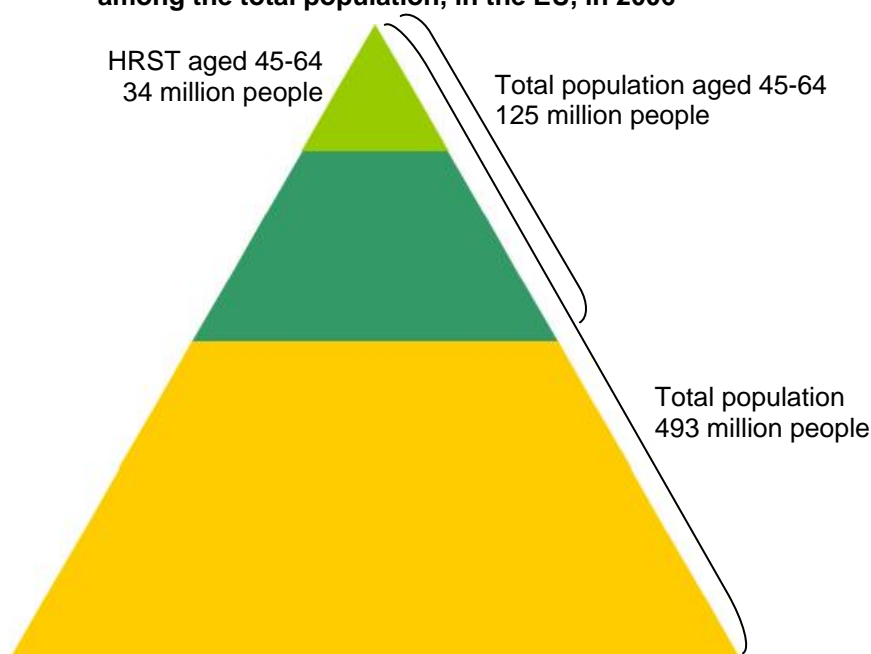
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For many years now, EU Member States and other developed countries have been experiencing significant ageing of their populations. In regards to this, special attention has to be paid to human resources in science and technology (HRST) to ensure that their hard-earned knowledge is conserved.

In the EU there were 34 million senior HRST in 2006, or 27% of the EU population aged 45-64. This Statistics in Focus concentrates on this specific population aged 45-64 by detailing some features of these highly qualified seniors in terms of gender, mobility and unemployment rate.

### Senior human resources in S&T aged 45-64

Figure 1: Human resources in science and technology aged 45-64 among the total population, in the EU, in 2006



Source: Eurostat HRST and Population statistics

Total population from the table "Population by sex and age on 1<sup>st</sup> January of each year" in Eurostat Population statistics.

The EU population is getting older. The impact of this labour force ageing needs to be closely monitored, in particular regarding the highly qualified section of the labour force, to ensure knowledge transfer. The stock of human resources in science and technology (HRST) is one way of measuring this. HRST are people who have successfully completed education at tertiary level or are employed in an S&T occupation (see methodological notes on page 7).

At EU level, Figure 1 shows the share of people aged 45-64 among the total population. In absolute numbers, HRST aged 45-64 in the EU amounted to 34 million in 2006. Compared to the total population in the same age group, they represented 27%. From a broader viewpoint, of the EU's 493 million people, 7% were HRST aged 45-64.



## 40% of the EU's human resources in S&T were aged 45-64

**Figure 2: Distribution of HRST, by age groups, in the EU and selected countries, 2006**



Eurostat estimate: EU-27.

Exceptions to the reference year: BE, IE, IS and NO 2005.

Source: Eurostat HRST statistics

Figure 2 illustrates national disparities when looking at the proportion of HRST aged 45-64 among the total HRST population aged 25-64.

In 2006, the share of HRST aged 45-64 fluctuated between around 30% and 50%. Of the 85 million HRST aged 25-64 in the EU, almost 40% were in the 45-64 age group.

In national terms, Bulgaria comes top, with the largest share of senior HRST – 46%, or 495 000 persons, which means that almost half of the Bulgarian HRST population was aged 45-64 in 2006.

Finland, Germany and Sweden followed closely, with the proportion of senior HRST also being around 46%. These are also countries with a relatively old HRST population, and it is generally acknowledged that the ageing in these countries is mainly due to the large post-war generation of baby boomers growing old.

At the other end of the scale, Spain and Ireland had a much lower proportion of senior HRST compared to the other countries. In fact, these two Member States have a relatively high number of young HRST in the 25-34 age group. One reason is the general national age distributions, as both Spain and Ireland have larger shares of 25-34 year olds than the EU-average (17% compared to 14% in 2006). But that is only a partial explanation.

### Extracts from the Annual Report on the Promotion of Science and Technology in Japan, 2002

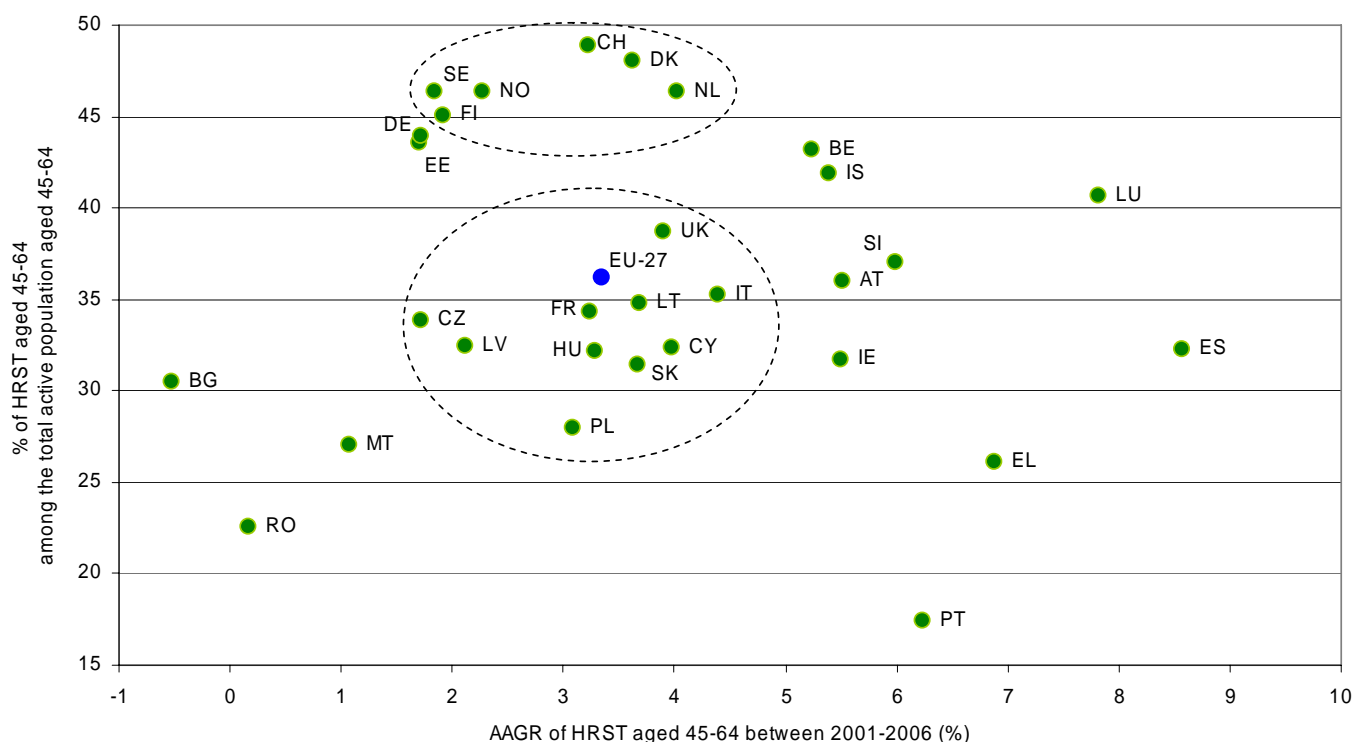
“Amid the rapid aging of Japanese society as a whole, the proportion of the middle and higher aged has also become higher among the workers engaged in professional and technical professions. This trend will continue in the future.” As forecast, “the number of researchers and engineers will decrease rapidly, both in numbers and in proportion to the total population, due to the trend of fewer children and aging population.”

“In order to secure excellent HRST amid the progress of fewer children and aging population, it is also expected that aged researchers who have retired from the forefront of research will display their creativity. [...] According to the results of a questionnaire survey of industry, academic and government research institutions, they think it desirable to treat the middle aged and older researchers in a way allowing them to continue researches. For example, researchers at universities and colleges may possibly concentrate on basic education such as lessons and lectures to students, or make social contributions such as technology transfer.”

Source: Annual Report on the Promotion of Science and Technology, June 2003, Ministry of Education, Culture, Sports, Science and Technology, Japan  
Internet website: <http://www.mext.go.jp>

## Spain had the highest growth in senior HRST in the EU between 2001 and 2006

**Figure 3: Annual average growth rates 2001-2006 of HRST aged 45-64 and their proportion among the total active population aged 45-64, in the EU and selected countries, 2006**



Eurostat estimate: EU-27.

Exceptions to the reference year: BE, IE, IS and NO 2005.

Break in series for all countries except BE and LU in 2006.

Source: Eurostat HRST statistics

Figure 3 illustrates the stock evolution of highly qualified human resources aged 45-64 in 2006. It compares the share of these senior HRST aged 45-64 among the active population of the same age group and their annual average growth rate (AAGR) between 2001 and 2006.

When analysing Figure 3, comparisons with Figure 2 are useful. In Spain, for example, of the active population aged 45-64 there is a low share of HRST. At the same time, the stock of senior HRST has grown dramatically. It may therefore seem that HRST in Spain are rapidly ageing, but Figure 2 reveals that Spain still has a very young HRST stock.

The EU average for HRST aged 45-64 among the total active population of that same age group was 36%. This highly qualified population increased between 2001 and 2006 at an AAGR of 3.3%.

Nevertheless, the situation varies widely from one country to another. Six countries had high shares (above 45%) of HRST among the labour force aged 45-64 (Switzerland, Denmark, the Netherlands, Sweden, Norway and Finland), with an AAGR between 2% and 4%. It is interesting that all these

countries have comparably old HRST populations, as Figure 2 shows.

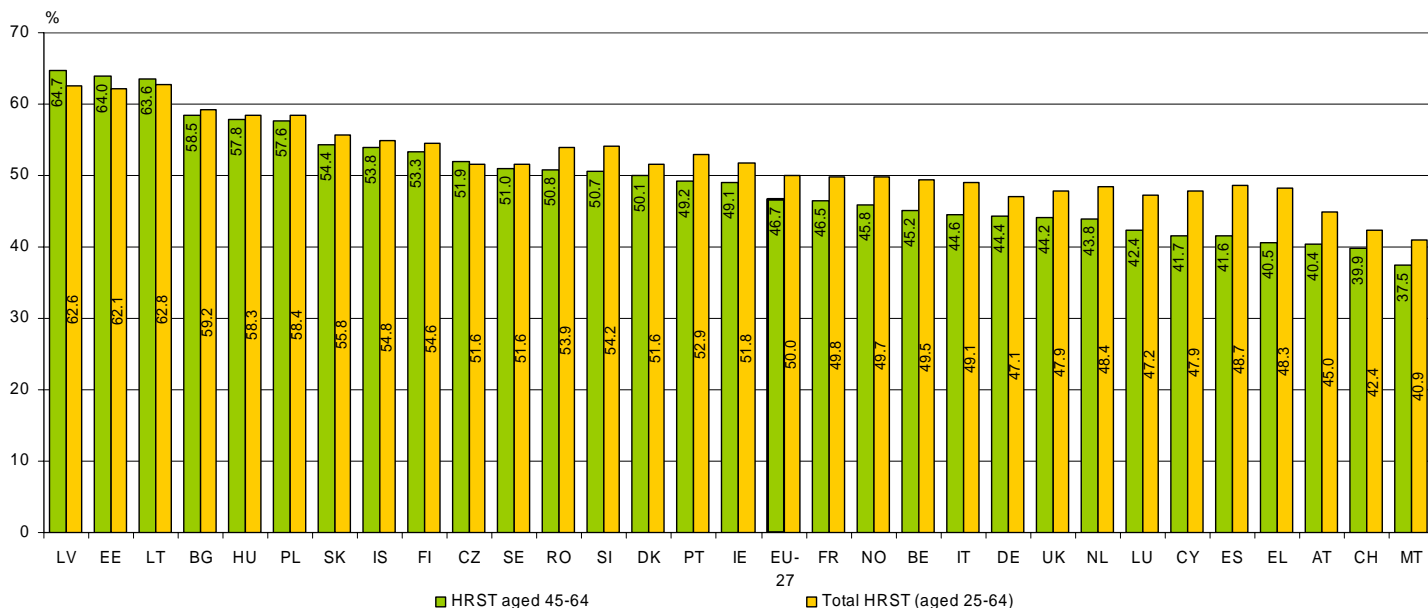
Portugal contrasts strongly, with a share of senior HRST among the total active population aged 45-64 of only 17%. The AAGR between 2001 and 2006 for HRST in this age group was relatively high (6.2%). Only three other EU Member States demonstrated a higher AAGR: Greece (6.9%), Luxembourg (7.8%) and Spain (8.6%). In these countries the share of senior HRST among the total active population aged 45-64 was fairly diverse however. For example, in Luxembourg 41% of active seniors were HRST while Greece had 26%.

In addition, even if Spain and Ireland had the lowest proportions of senior HRST (Figure 2), they also had some of the highest EU growth rates in the senior HRST stock between 2001 and 2006 (Figure 3).

Finally, Bulgaria was the EU Member State with the highest share of senior HRST (Figure 2). But looking at the evolution through 2001-2006, it is the only EU Member State with a decline in senior HRST (-0.5%). However, all Bulgarian HRST age groups declined during this period.

## In the EU in 2006, 47% of senior HRST were female

Figure 4: Share of female HRST, by age group, in the EU and selected countries, 2006



Eurostat estimate: EU-27.

Exceptions to the reference year 2006: BE, IE, IS and NO 2005.

Source: Eurostat HRST statistics

Figure 4 illustrates gender disparities and compares senior HRST (aged 45-64) with the HRST population aged 25-64.

The proportion of females among senior HRST was 46.7% in the EU in 2006. The proportion was higher for HRST aged 25-64, at 50.0%. This shows that the share of females is higher for HRST in the under-45 age group. In addition, the gap between males and females has decreased over time. In 2001, 48.3% of HRST aged 25-64 were female while the proportion was only 44.3% in the 45-64 age group.

Malta is at the end of the scale with the lowest female share of senior HRST in 2006, at 37.5%. Among the HRST population aged 25-64, nearly 41% of Maltese HRST were female.

However, in all of the observed countries apart from Estonia, Latvia, Lithuania and the Czech Republic, the share of female HRST was lower in the 45-64 age group compared to the 25-64 age group. In 2006 the three Baltic countries (Latvia, Estonia and Lithuania) also registered the highest shares of female HRST for both 45-64 year olds and 25-64 year olds.

### Projected change 2005–2050 in the working-age population and the share of older people (55–64) in the working-age population

“In the longer term, and in purely demographic terms, the impact on Member States of changes in the size and structure of the working-age population up to 2050 are likely to be most problematic for the Czech Republic, Estonia, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Slovenia, Slovakia and Spain (...). They will suffer substantial declines in the working-age population of the order of 20–30% by 2050, and almost all will also see a marked rise (...) in the share of older workers in that population.”

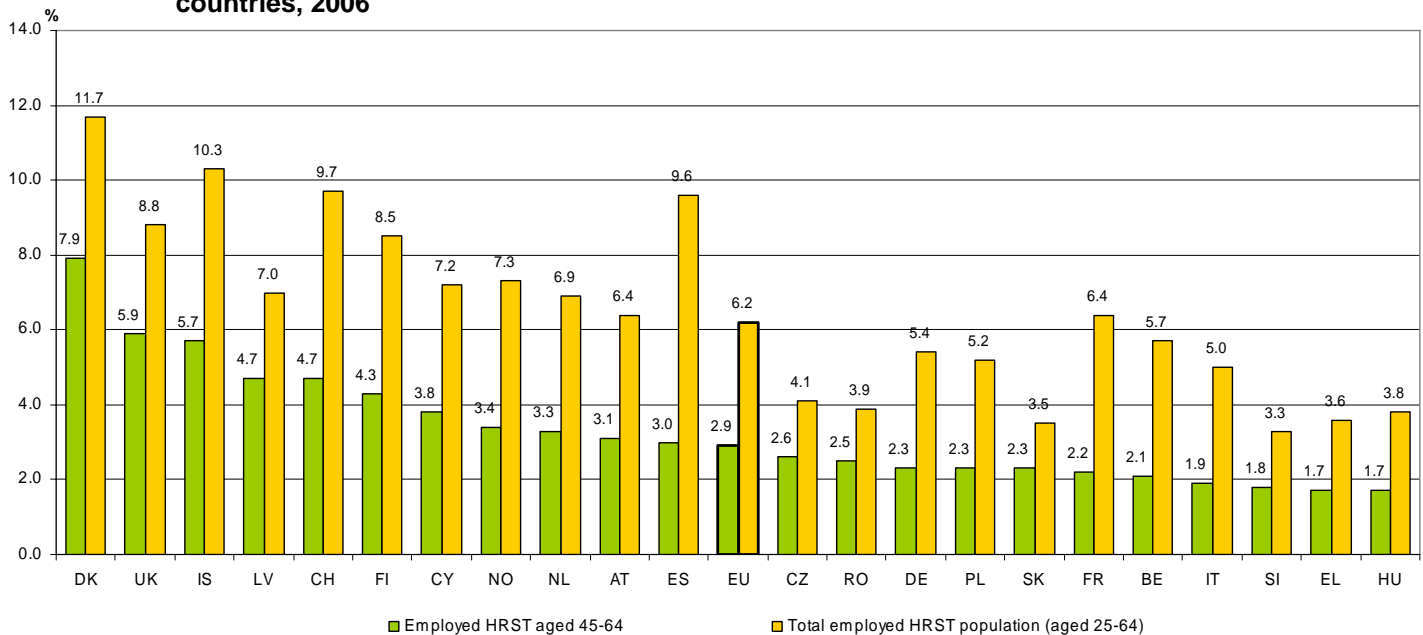
		Change in the size of the working age population			
		Increase	Limited decline (<10%)	Medium decline (10-20%)	Strong decline (>20%)
Increase in the share of older people aged 55-64 in the working-age population	Low (<2%)	SE	DK	FI	
	Moderate (2–5%)	LU, MT	BE, FR, NL, UK		IT
	Medium (5–10%)	CY, IE		AT	CZ, DE, EE, EL, ES, LV, HU, PT, SI
	Strong (>10%)				LT, PL, SK

“Sweden is in the fortunate position of expecting growth in the working-age population combined with only a very limited increase in the share of people aged 55–64, although this partly reflects the fact that currently the share in Sweden (20%) is the highest of all Member States.”

Source: European Commission, *Employment and Social Affairs, Employment in Europe Report 2007, chapter 2, p.57*  
Internet website: [http://ec.europa.eu/employment\\_social/employment\\_analysis/employ\\_2007\\_en.htm](http://ec.europa.eu/employment_social/employment_analysis/employ_2007_en.htm)

## Senior employed HRST aged 45-64 were less mobile than younger employed HRST

**Figure 5: Job-to-job mobility as a percentage of employed HRST, by age group, in the EU and selected countries, 2006**



Eurostat estimate excluding BG, EE, IE, LT, LU, MT, PT and SE: EU. Exceptions to the reference year: CH 2000, BE, IS and NO 2005. LV and SI: data lack reliability due to reduced sample size for employed HRST aged 45-64 results.

Source: Eurostat HRST statistics

Job-to-job mobility shows the movement of employed HRST from one job to another in the same country within a one-year period. Mobile HRST in a country can be considered to be a way of stimulating a country's economy as this result in a valuable knowledge transfer. Figure 5 compares the proportions of job-to-job mobile employed HRST aged 25-64 with employed HRST aged 45-64 among the total employed HRST for the two age groups.

Clearly, the senior HRST (aged 45-64) were less mobile than the rest of the employed HRST between 2005 and 2006. Even if the mobility rate for employed HRST aged 25-64 was not particularly large in general, all of the observed countries scored an even smaller rate when looking at the 45-64 age group. At EU level, the job-to-job mobility rate for all employed HRST was 6.2%. The corresponding share was only 2.9% for employed HRST aged 45-64.

Denmark had the highest job-to-job mobility, at 11.7% for HRST aged 25-64, and 7.9% for HRST aged 45-64. Iceland had the second largest proportion of job-to-job mobility for total employed HRST (10.3%) and the third largest for senior employed HRST (5.7%) after the United Kingdom (5.9%).

These results may be due to the flexible labour market as developed by Denmark and the United Kingdom. The Danish "flexicurity" model is one example of how to "promote flexibility combined with employment security and reduce labour market

segmentation, having due regard to the role of the social partners"<sup>1</sup>, which is one of the European Commission's guidelines for growth and jobs.

Spain, which had the smallest proportion of senior HRST among the total population aged 25-64 in 2006 (Figure 2), had the fourth highest mobility rate among total employed HRST aged 25-64 at 9.6%. However, Spain had a much lower mobility rate for senior HRST and is the Member State with the biggest difference between the two compared age groups.

Among the EU Member States, the lowest mobility rates for senior HRST were found in Hungary, Greece and Slovenia. These three countries had rates below 2% for employed HRST aged 45-64 and below 4% for employed HRST aged 25-64.

In conclusion, as expected, job-to-job mobility for HRST tends to decrease with age. When approaching the end of a career, people often feel comfortable with what they have and are not willing to risk that by changing their work environment. But as seen in Denmark and the United Kingdom labour force policies may encourage mobility.

<sup>1</sup> Source: European Commission, *Growth and jobs, Integrated guidelines for growth and jobs (2005-2008)*, p.32

Internet website:  
[http://ec.europa.eu/growthandjobs/pdf/integrated\\_guidelines\\_en.pdf](http://ec.europa.eu/growthandjobs/pdf/integrated_guidelines_en.pdf)



## The EU unemployment rate for senior HRST was 2.2% in 2006

**Table 6: Senior scientists and engineers aged 45-64, in thousands and as a percentage of scientists and engineers aged 25-64, in the EU and selected countries, 2006**

	Scientists and Engineers aged 45-64	
	in 1 000s	as % of all Scientists and Engineers
EU-27	3 905 s	38.1 s
BE	108	32.8
BG	43	44.8
CZ	66	40.2
DK	66	40.5
DE	861	40.0
EE	11 u	42.3 u
IE	40	29.9
EL	77	39.7
ES	295	32.4
FR	484	38.1
IT	300	42.1
CY	5	31.3
LV	16	43.2
LT	29 u	44.6 u
LU	3	30.0
HU	67	41.6
MT	u	u
NL	169	37.3
AT	36	30.5
PL	282	36.1
PT	46	31.5
RO	155	42.2
SI	18	36.0
SK	26	38.8
FI	60	36.1
SE	113	38.7
UK	529	38.6
IS	4	40.0
NO	49	40.2
CH	110	38.5

Eurostat estimate: EU-27. Source: Eurostat HRST statistics  
 Exceptions to the reference year: BE, IE, IS and NO 2005.

An HRST sub-group of special interest consisting of scientists and engineers (SE) is shown in Table 6. SE are considered to be persons able to use or create scientific knowledge and engineering principles (UNESCO definition).

In 2006, 3.9 million EU scientists and engineers were aged 45-64, corresponding to a share of 38.1% of all SE which can be compared to 39.7% for all HRST (Figure 2). More than one in five senior SEs in the EU worked in Germany.

The proportion of senior SE was highest in Bulgaria (44.8%). By contrast, senior SE did not exceed 30% in Ireland and Luxembourg.

However, in general the proportion of senior SE is similar to that of senior HRST (Figure 2).

Finally, Table 7 shows HRST unemployment by age breakdown.

Clearly, the unemployment rate of senior HRST was lower than the total HRST unemployment rate in 2006. At EU level, the unemployment rate was 2.2% for senior HRST aged 45-64 compared to 2.9% for the total HRST population aged 25-64.

Only three EU Member States, the Czech Republic, Germany and the Netherlands, have higher unemployment rates for senior HRST than for the HRST population aged 25-64. In Germany, 3.6% of senior HRST were unemployed while this rate was 2.7% for the HRST population aged 25-64.

Germany was the EU Member State with the highest unemployment rate for senior HRST (3.6%). Italy had the lowest rate at 0.4%.

**Table 7: Unemployed HRST aged 45-64 and 25-64, in thousands and as a share of the total respective labour force, in the EU and selected countries, 2006**

	Unemployed HRST			
	aged 45-64		aged 25-64	
	in 1 000s	Unemployment rate (%)	in 1 000s	Unemployment rate (%)
EU-27	645 s	2.2 s	2 273 s	2.9 s
BE	16	2.3	56	2.9
BG	12 u	2.9 u	30	3.2
CZ	6	1.0	15	0.9
DK	9	1.8	29	2.4
DE	251	3.6	424	2.7
EE	u	u	u	u
IE	u	u	11	1.7
EL	7	1.7	72	5.3
ES	53	2.5	374	5.0
FR	108	3.1	452	4.6
IT	12	0.4	172	2.2
CY	1 u	1.3 u	4	2.9
LV	u	u	9	2.5
LT	u	u	10 u	1.8 u
LU	u	u	2	1.9
HU	5	1.1	18	1.5
MT	u	u	u	u
NL	25	1.9	59	1.7
AT	5 u	1.0 u	17	1.3
PL	30	1.9	162	3.5
PT	u	u	39	3.7
RO	7 u	0.9 u	35	1.8
SI	1 u	1.1 u	7	1.9
SK	4	1.3	10	1.4
FI	13	2.6	29	2.6
SE	18	2.0	56	2.8
UK	62	1.5	181	1.7
IS	u	u	u	u
NO	u	u	16	1.6
CH	8	1.1	26	1.4

Eurostat estimate: EU-27. Source: Eurostat HRST statistics  
 Exceptions to the reference year: BE, IE, IS and NO 2005.

## ➤ ESSENTIAL INFORMATION – METHODOLOGICAL NOTES

### 1. HRST concepts

Human Resources in Science and Technology (HRST) can be divided into different sub-populations using characteristics of educational achievement and occupation following the guidelines of the OECD *Canberra Manual* (see figure below).

This publication shows results for the following HRST categories:

#### • HRST — Human Resources in Science and Technology

Individuals who fulfil at least one of the following conditions:

- having successfully completed tertiary-level education (ISCED '97 version levels 5a, 5b or 6) and/or
- working in an S&T occupation as professionals or technicians (ISCO '88 COM codes 2 or 3).

#### • Scientists and Engineers — SE

Employed in “physical, mathematical and engineering” occupations (ISCO '88 COM code 21); or “life sciences and health” occupations (ISCO '88 COM code 22).

#### • Unemployed HRST — HRSTU

Individuals who have successfully completed education at tertiary level (ISCED '97 version levels 5a, 5b or 6) and are unemployed.

### 2. Other concepts

#### • Job-to-job mobility of employed HRST

Job-to-job mobility illustrates the ability of employed HRST to move between different jobs and is based on length of stay with the same employer. The indicator is formed by considering the number of HRST employed in years *t* and *t-1* who have

changed jobs during the past 12-month period. Job-to-job mobility does not include inflows into the labour market from unemployment or inactivity.

Employed HRST are those who:

- have successfully completed tertiary-level education and are employed in any type of occupation, or
- are not formally qualified as stated above but are employed in an S&T occupation.

#### • Unemployment rate

The unemployment rate, used in Table 7, expresses the number of unemployed HRST divided by the respective labour force.

### 3. Data sources

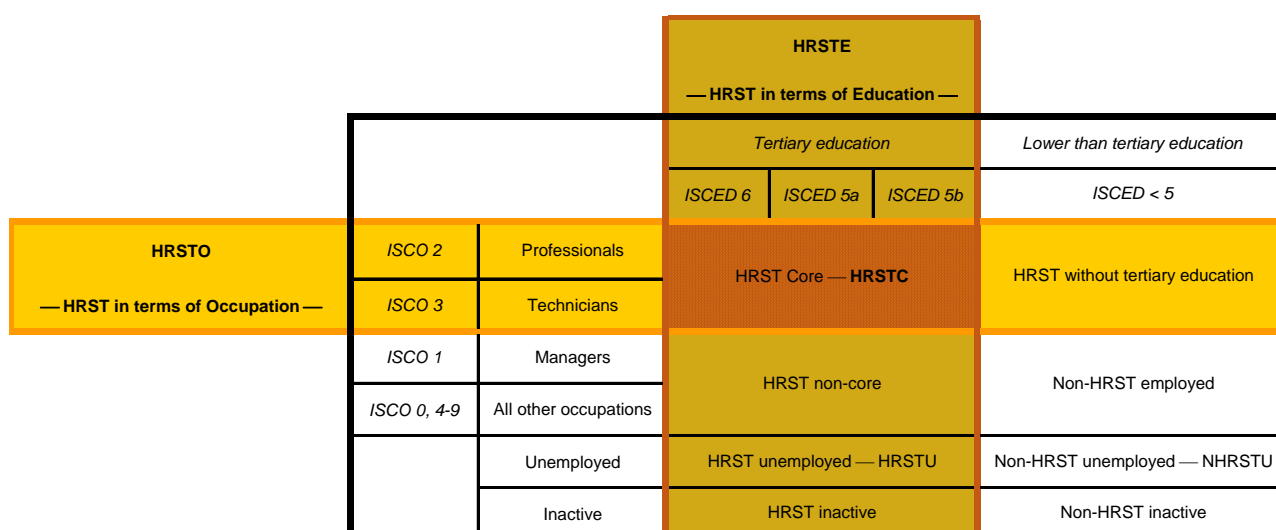
The indicators presented are derived from the **European Union Labour Force Survey (EU LFS)**. The most recent data were compiled in November 2007. A break in series for all the HRST stocks exists for all countries except BE and LU in 2006. This is due to a change in the methodology of the LFS data collection modifying the periodicity of certain variables changed to annual.

#### Quality of the data

The guidelines on the sample size reliability of the data, established by the EU LFS, are applied to the HRST statistics. Therefore, breakdowns for which quality levels are considered insufficient are flagged as data that lack reliability due to reduced sample size.

### 4. Statistical abbreviations and Symbols

- : Not available
- u Lack reliability due to reduced sample size
- s Eurostat estimate



## ***Further information:***

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

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