Statistics in focus

SCIENCE AND TECHNOLOGY

11/2006

Author

Håkan WILÉN

Contents

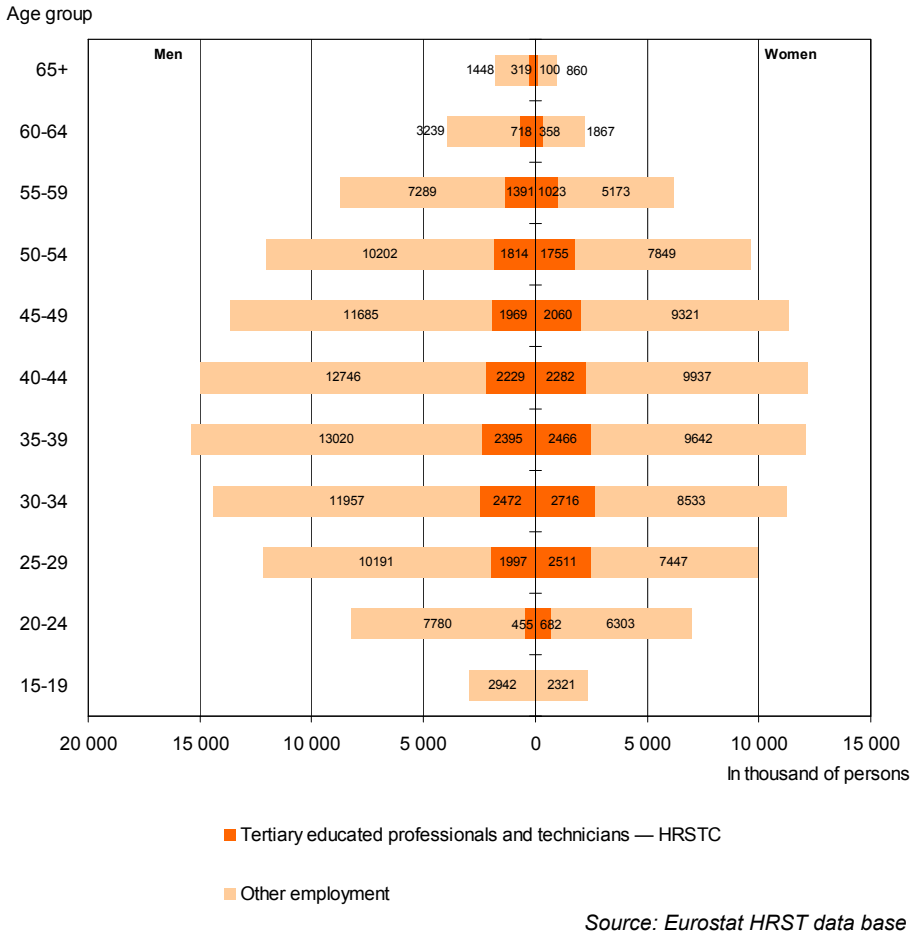
Manuscript completed on: 3.05.2006
Data extracted on: 3.05.2006
ISSN 1609-5995
Catalogue number: KS-NS-06-011-EN-N

Ageing work force – how old are Europe's human resources in science and technology?

MAIN FINDINGS

- The age distribution of tertiary educated professionals and technicians indicates smaller ageing workforce problems than for other employees.
- In Spain more than 38 % of the population with third level education is aged 25-34, in Germany the corresponding figure is 16 %.
- Latvia and Bulgaria have Europe's oldest population of scientists and engineers.
- Unemployment among human resources in science and technology is very low in the Czech Republic and very uneven in Italy.
- Graduation from science and engineering is growing, but at a slower pace than graduation from other fields of education.

Figure 1: Age pyramid of total employment and HRSTC – tertiary educated professionals and technicians, in the EU, 2004



Source: Eurostat HRST data base

Spain has Europe's youngest population of tertiary educated

Of the 193 millions employed in 2004 in the EU, 32 millions or 16 % are classified as core human resources in science and technology – HRSTC – since they all share the characteristics of being employed as professionals or technicians as well as having a third level education. The age and gender distribution of HRSTC together with the total population employed are shown in the age pyramid in Figure 1.

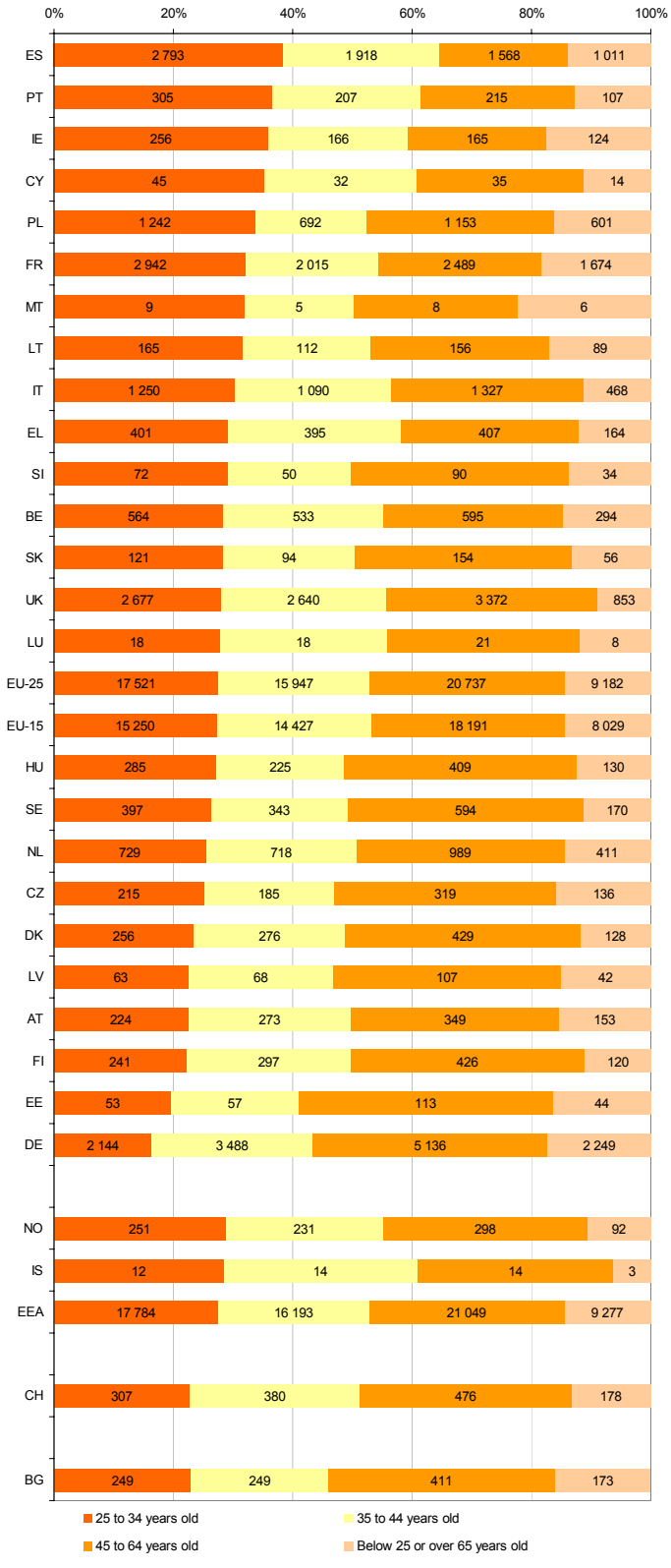
The most striking feature of the age pyramid is that the base is less wide than the middle, indicating a possible future scarcity of workers in the EU. As persons still within the educational system and unemployed persons are not included in the figure, no further conclusions can be drawn. Nevertheless, looking at the HRSTC, possible future shortages of this highly productive labour force could be less severe than for other types of employees. This is illustrated in the figure where the smaller HRSTC part bears much more resemblance to a pyramid. The broadest part of the HRSTC pyramid is found in the age group 30-34, an age at which the majority of the individuals in the workforce have completed their formal education.

Some interesting gender differences also appear. On the female side of the age pyramid, the share of HRSTC in the employed population is highest in the age group 25-29, around 25.2 %, and diminishes for each step upwards reaching a minimum of 10.4 % in the age group 65 or more. For men the share of HRSTC is more equally distributed over the age groups, scoring the highest level, 18.2 %, for 60-64 and the lowest 14.4 % for 45-49.

The further analysis includes all persons, irrespective of occupation or labour market status, which have successfully completed a third level education - HRSTE. The national distribution in somewhat broader age groups for HRSTE is shown in Figure 2. Highest in the ranking is Spain because of its relatively high share of HRSTE in the age group 25-34. More than 38 % or 2.8 million of the Spanish HRSTE are found in this age group. Germany, at the other side of the scale, has around 16 % or 2.2 millions of its tertiary educated human resources in the 25-34 age group.

However, Estonia could be seen as having the oldest tertiary educated population as more than 42 %, (around 113 000) of their HRSTE population, are between 45-64 years old. Many other countries, among them Sweden, Germany, Denmark, Finland, and Hungary have almost as high shares of their HRSTE in the 45-64 age group.

Figure 2: Age distribution of HRSTE – Human resources in science and technology by virtue of education – in % and in thousands, 2004



Source: Eurostat HRST data base

Exception to the reference year: NL 2003.

The majority of Latvian Scientists and Engineers are older than 45 years

Scientists and engineers, S&E, are often seen as a key group in the process of creating scientific knowledge and putting in place innovation. In 2004, more than 9 million, or around 4 % of the economically active population in the EU, were employed in occupations that make them eligible as S&E.

In Table 1 the age distribution of S&E is broken down into the same age groups used in Figure 2. A bit less than one third of the EU's S&E are found in either the age group 25-34 (29.2 %) or in the age group 35-44 (30.5 %). A bit more than one third (35.5 %) is found in the age bracket 45-64. 4.8 % of EU's S&E are either below 25 or above 64, gathered in the table under the heading "Other".

Three countries, Germany, UK and France, account for over 37 % of the total EU population of S&E. Germany, which has by far the largest population of S&E of the three countries (2 million), also has the oldest. 38.7 % of the German scientists and engineers are in the age group 45-64 and only 22.6 % are between 25 and 34. In the two other countries mentioned, UK and France the age distribution is more close to the EU average.

Of all the 25 EU countries, Latvia has the oldest S&E population with nearly 52 % in the 45-64 age group compared to 20 % in the 25-34 age group. Bulgaria, not yet a member of the EU, with around 84 000 S&E has an age distribution similar to Latvia, with more than 47 % of its scientists and engineers between 45 and 64 and only 20 % between 25 and 34. Another example of a country with relatively few young S&E is Lithuania with 21 % in the 25-34 age group. In Lithuania, however, the distribution of S&E between the age groups 35-44 and 45-64 is more even than in Latvia and Bulgaria.

Malta, with a comparably small population of S&E, has the relatively youngest S&E population of all EU countries. The majority, 55 %, of the Maltese scientists and engineers is between 25 and 34 years. Spain has the second youngest S&E population, with 40.3 % in this age group, closely followed by Ireland, 40 %. Cyprus, Portugal, Slovenia and Finland are also countries with a relatively young population of S&E. These four countries have 39 %, 37.5 %, 35.8 % and 35.6 % respectively of their scientists and engineers in the 25-34 age group.

Table 1: Age distribution of scientists and engineers (S&E), 2004

	In thousands					*as % of total S&E population*			
	25 to 34 years old	35 to 44 years old	45 to 64 years old	Other [1]	Total	25 to 34 years old	35 to 44 years old	45 to 64 years old	Other [1]
EU-25	2 681	2 793	3 257	437	9 168	29.2	30.5	35.5	4.8
EU-15	2 359	2 538	2 855	380	8 131	29.0	31.2	35.1	4.7
BE	112	109	90	22	333	33.5	32.7	27.1	6.7
CZ	47	42	61	9	160	29.4	26.5	38.3	5.8
DK	36	47	65	: u	147	24.2	31.8	44.0	: u
DE	466	709	799	89	2 063	22.6	34.4	38.7	4.3
EE	: u	5	7	: u	17	: u	31.2	39.6	: u
EL	51	57	70	4	183	28.1	31.2	38.3	2.4
ES	363	240	255	42	900	40.3	26.6	28.3	4.7
FR	330	392	459	41	1 222	27.0	32.1	37.5	3.3
IE	56	37	37	11	141	40.0	26.1	26.0	7.9
IT	190	263	312	30	795	23.9	33.0	39.2	3.8
CY	6	3	5	1	15	39.0	22.6	33.8	4.5
LV	7	10	18	: u	35	20.5	27.8	51.8	: u
LT	15	24	26	7	72	21.0	33.1	36.6	9.3
LU	3	3	4	0	10	31.3	32.1	36.6	0.0
HU	52	36	72	9	170	30.7	21.4	42.7	5.2
MT	2	: u	: u	: u	3	55.0	: u	: u	: u
NL	145	143	143	20	451	32.2	31.7	31.6	4.5
AT	33	38	33	6	109	29.9	34.3	30.5	5.3
PL	156	107	173	19	455	34.3	23.5	38.0	4.3
PT	58	44	42	12	156	37.5	28.3	26.7	7.5
SI	15	11	15	1	42	35.8	26.0	34.6	3.6
SK	17	15	24	5	61	28.3	24.6	39.7	7.5
FI	61	45	59	7	173	35.6	26.0	34.2	4.2
SE	79	80	105	6	270	29.2	29.6	38.9	2.3
UK	439	393	437	96	1 365	32.1	28.8	32.0	7.0
IS	2	3	3	: u	8	24.4	35.3	40.3	: u
NO	29	37	48	: u	114	25.9	32.3	41.8	: u
EEA	2 713	2 832	3 308	441	9 294	29.2	30.5	35.6	4.7
CH	80	84	96	19	279	28.7	30.1	34.5	6.8
BG	17	27	40	: u	84	20.1	32.6	47.3	: u

Source: Eurostat HRST data base

[1] Age group "Other": Below 25 or over 65 years old.
u Due to reliability constraints, data may not always be published for small populations.
Exception to the reference year: NL 2003.

The EU unemployment rate for HRST was 3.5 % in 2004

In 2004 more than 2.6 million people with a successfully completed education at the third level were unemployed, as displayed in Table 2. In relation to the total HRST labour force, this yields an unemployment rate of 3.5 %. Around 1.1 million of the unemployed HRST are found in the age group 25-34 which corresponds to an unemployment rate of 5.1 %. For the age groups 35-44 and 45-64 both lower absolute numbers and rates for HRST unemployment were recorded.

The highest total HRST unemployment rates are found in Spain (7.1 %), Greece (6.5 %) and Lithuania (5.4 %). In Spain and Greece the majority of the unemployed HRST are between 25-34, resulting in particularly high rates of HRST unemployment in this group, 9.5 % and 10.2 % respectively. In Lithuania, the HRST unemployment is much less concentrated in the 25-34 age bracket, with unemployment rates that lie between 4.2 % and 4.9 % across the different age groups.

HRST unemployment in the 25-34 age group is also high in Italy. This country shows an HRST unemployment rate of 5.8 % for this age group, well above the EU average. At the same time, among countries for which data is available, Italy has the lowest HRST unemployment rate, 0.3 %, for 45-64 years old, and the second lowest, 0.9 %, for 35-44 years old.

The Czech Republic, Austria, Ireland, the Netherlands and the UK often show relatively low unemployment among the tertiary educated part of the labour force. In the Czech Republic only 14 thousand HRST are unemployed with an unemployment rate which varies between 0.7 % and 0.9 % for the different age groups. In Austria, Ireland, the Netherlands and the UK, the HRST unemployment rates did not exceed 2 % in any of the age groups.

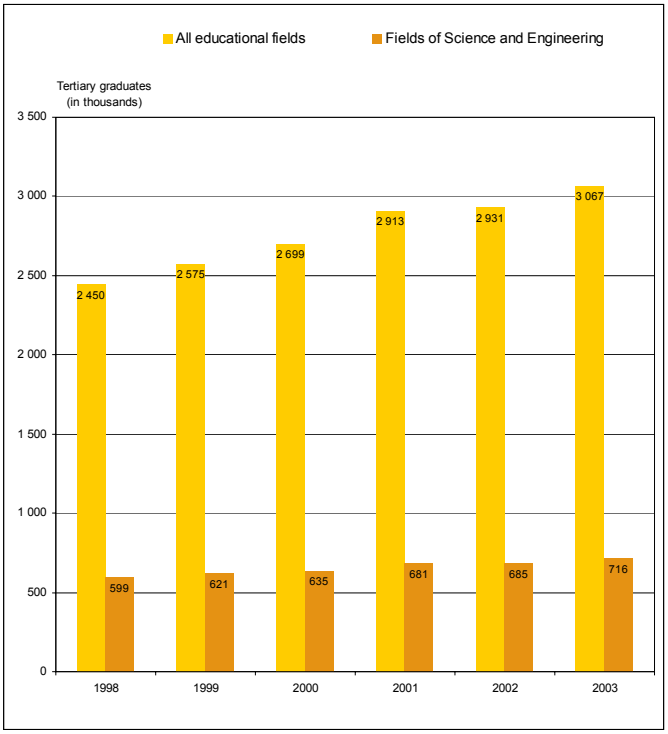
Table 2: Unemployed tertiary graduates, HRSTU, in thousands and as a share of total HRST labour force, by age group, 2004

	Between 25 and 34 years old		Between 35 and 44 years old		Between 45 and 64 years old		Total [1]	
	HRSTU in 1000	as % of total HRST labour force	HRSTU in 1000	as % of total HRST labour force	HRSTU in 1000	as % of total HRST labour force	HRSTU in 1000	as % of total HRST labour force
EU-25	1 091	5.1	564	2.6	622	2.4	2 640	3.5
BE	28	4.5	17	2.7	12	2.1	74	3.8
CZ	4	0.9	3	0.8	4	0.7	14	0.9
DK	15	4.7	7	2.0	12	2.3	36	2.9
DE	94	2.8	152	3.0	266	4.1	524	3.3
EE	: u	: u	: u	: u	: u	: u	12	4.5
EL	45	10.2	20	4.6	9	2.3	87	6.5
ES	257	9.5	96	4.7	52	3.1	497	7.1
FR	233	7.4	92	3.3	77	2.3	494	4.9
IE	5	2.1	4	2.0	: u	: u	14	1.9
IT	124	5.8	20	0.9	8	0.3	168	2.2
CY	1	3.3	1	2.4	: u	: u	3	2.6
LV	: u	: u	: u	: u	6	4.7	8	2.4
LT	8	4.9	6	4.2	8	4.6	30	5.4
LU	1	3.1	: u	: u	: u	: u	2	2.3
HU	8	2.0	: u	: u	5	1.0	18	1.4
MT	: u	: u	: u	: u	: u	: u	0	0.8
NL	20	2.0	17	1.6	20	1.6	65	1.8
AT	8	2.0	7	1.4	7	1.5	22	1.5
PL	115	7.5	16	1.4	33	2.2	208	4.7
PT	19	5.0	: u	: u	: u	: u	32	3.0
SI	3	3.1	: u	: u	1	0.9	5	1.6
SK	8	4.0	3	1.4	5	2.0	20	2.8
FI	12	4.3	14	4.3	14	3.1	43	3.8
SE	19	4.0	13	2.4	14	1.6	50	2.5
UK	57	1.9	60	2.0	57	1.5	200	1.8
IS	: u	: u	: u	: u	: u	: u	0	0.7
NO	9	3.1	7	2.3	: u	: u	24	2.4
EEA	1 099	5.0	571	2.6	627	2.4	2 664	3.5
CH	11	2.5	10	1.8	8	1.2	30	1.6
BG	15	5.6	11	4.0	15	3.7	46	4.7
RO	20	3.1	: u	: u	: u	: u	35	1.9

Source: Eurostat HRST data base

[1] The total is the sum of the 3 age groups detailed the table (”25-34 years old”, “35-44 years old”, “45-64 years old”) and the age group “below 25 or over 65 years old”. Due to reliability constraints data may not always be published for small populations.
Exception to the reference year: NL 2003.

Figure 3: Number of tertiary graduates in all fields and in science and engineering in EU-25, 1998-2003



Source: Eurostat HRST data base

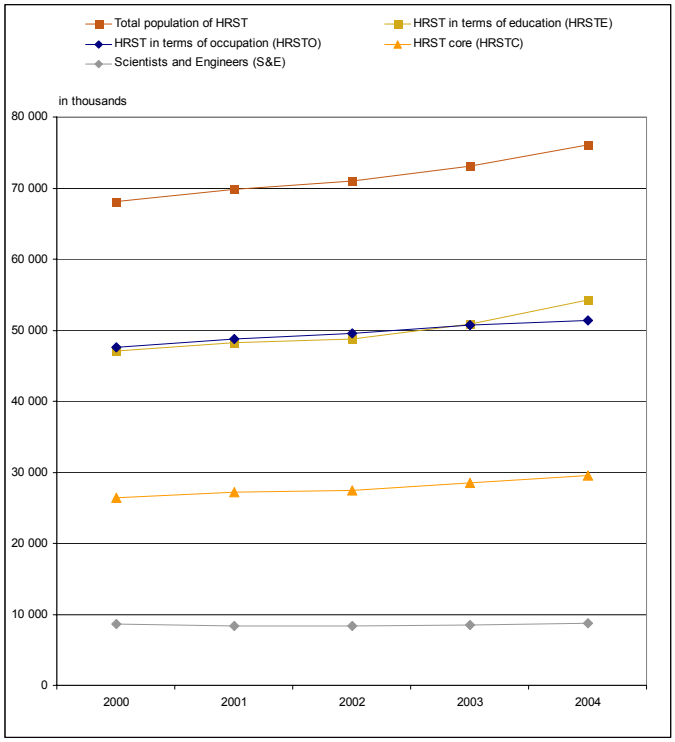
Graduation from third level education is the most important source for the inflow into the stock of human resources in science and technology. In Figure 3 the size of this yearly inflow between 1998 and 2003 is shown for EU-25 level.

Tertiary graduation from all fields of education grew steadily between 1998 and 2003. In 1998 the total number of students who graduated at third level equalled 2.4 million. By 2003, this had grown to 3.1 million, which gives an annual average growth rate (AAGR) of 4.6 %.

The smaller bars in Figure 3 show tertiary graduation from the fields of science, mathematics, computing, engineering, manufacturing and construction, referred to as fields of Science and Engineering. Yearly graduation from Science and Engineering also show an increasing trend, from 599 thousand graduates in 1998 to 716 thousand graduates in 2003.

The AAGR for graduation from Science and Engineering is 3.6 %, thus lower than for total third level graduation. As a result the share of students graduating from Science and Engineering, compared to total tertiary graduation, has diminished over the observation period, from 24.4 % in 1998 to 23.3 % in 2003.

Figure 4: Human Resources in Science and Technology (HRST) and sub-groups, aged 25-64, in EU-25, 2000-2004



Source: Eurostat HRST data base

In 2004 around 76 million HRST in the EU-25 were aged between 25 and 64. In 2000, this population was 68 million, which gives an AAGR of 2.8 % over this period. The number of persons employed as professionals and technicians, and thereby constituting the sub-group HRSTO, has grown during the same period from 48 million to 51 million which gives an AAGR of 1.9 %.

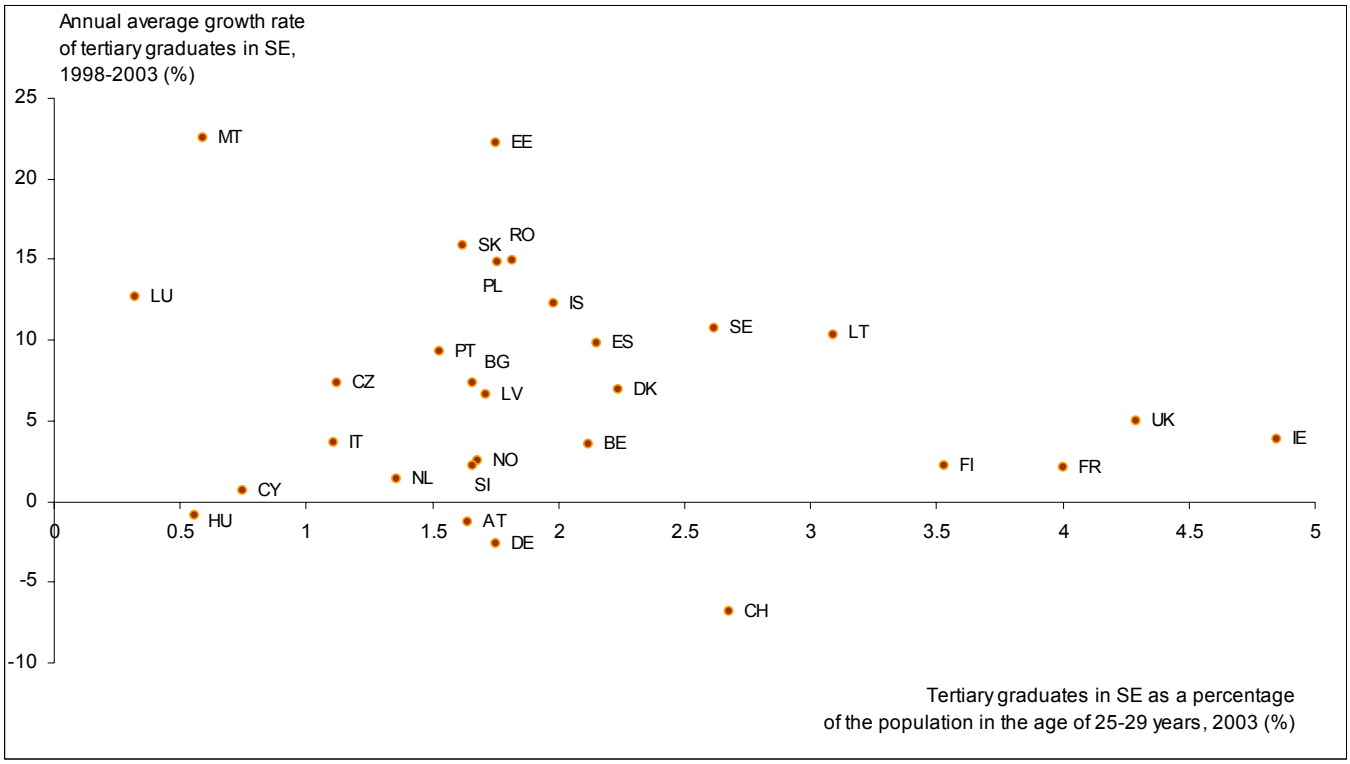
The HRSTE population was around 47 million in 2000. With an annual average growth rate of 3.6 % their number had in 2004 increased to 54 million, overtaking the HRSTO. Thus, the "knowledge workforce" is growing faster than the "knowledge jobs", indicating that the potential of the highly qualified labour force might not be fully utilised by the labour market.

This indication is even stronger considering the size of the intersection between of HRSTO and HRSTE. This group, HRSTC, were in 2004 less than 30 million, only 54 % of total HRSTE. The AAGR for HRSTC, 2.8 %, were also lower than that for HRSTE.

The number of Scientists and Engineers, S&E, increased at a much slower pace than the other sub-groups, with an AAGR of only 0.4 % during the period shown. In 2004, 8.7 millions or 4 % of the EU work force where working in occupations classified as S&E.

Graduation from Science and Engineering are growing fast in Malta and Estonia

Figure 5: Share of tertiary graduates in science and engineering (SE) as a % of the population aged 25-29, 2003, AAGR of tertiary graduates in SE between 1998-2003, in EU-25 and other selected countries



Source: Eurostat HRST data base

Exception to the reference period (AAGR): BE 2000-2003; CH 2002-2003; CY 1999-2003; FI, FR and IT 1998-2001; LU 1998-2000; IS 1998-2002. Exception to the reference year: IS: 2002, FI, FR and IT: 2001, LU: 2000.

Figure 5 combines the annual average growth rate (AAGR) of tertiary graduation in Science and Engineering (SE) 1998-2003, and the proportion of new SE graduates to total population of 25-29 years old in 2003.

Ireland and the United Kingdom have the highest shares of tertiary graduation in SE among the 25-29 years old, 4.9% and 4.3% respectively. The growth in SE graduation is for these countries however relatively modest, with an AAGR of 3.9 % and 4.9 %, respectively. France and Finland have also a relatively large share of SE graduations, compared to the total population of 25-29, but lower growth rates than Ireland and the UK. Lithuania and Sweden on the other hand, have an even lower share of tertiary SE graduates, 3.1 % and 2.6 % respectively, but are at the same time recording an annual average growth rate of over 10 %.

Malta and Estonia have the highest growth rates with an annual average increase of 22.5 % and 22.2 %, respectively. However, the proportion of tertiary graduates in SE as a share of the 25 to 29 years old was in Malta only 0.6 %, which is among the lowest in Europe. At the same time, Estonia reached a proportion of 1.8%. Luxembourg was the country with the lowest share, 0.3 %, of SE graduates to the total population, 25-29 years old.

Cyprus and Hungary did not progress very well in terms of SE graduates. Their AAGR between 1998 and 2003 were close to zero, with 0.7 % and -0.8 % respectively. Furthermore, the shares of SE graduations to the 25 to 29 years old were not more than 0.6 % for Hungary and 0.8 % for Cyprus. Three other countries, Austria, Germany and Switzerland show a decreasing number of yearly SE graduations. Their AAGR for the period were negative: -1.3 %, -2.6 % and -6.8 % respectively.

The remaining countries are all located in the same zone of the figure. This group has a proportion of SE graduates between 1.1 % and 2.2 %. The average annual progression in the number of SE graduates is between 1.4% and 15.8% with Slovakia, Poland and Romania scoring the highest.

➢ ESSENTIAL INFORMATION – METHODOLOGICAL NOTES

1. Human resources in science and technology — HRST

HRST and their sub-groups are measured using characteristics of educational attainment and occupation, mainly following the guidelines of the *Canberra Manual, OECD, Paris, 1994*.

• HRST
Individuals who fulfill at least on of the following conditions:

- having successfully completed education at the third level (ISCED '97 version levels 5a, 5b or 6) in an S&T field of study

or/and

- working in an S&T occupation where the above formal qualification is normally required (ISCO '88 COM codes 2 or 3)

•HRSTC – HRST core:
Individuals who have successfully completed education at he third level (ISCED '97 version levels 5a, 5b or 6) in a S&T field of study and are employed in an S&T occupation (ISCO '88 codes 2 or 3).

•HRSTE – HRST in terms of education:
Individuals who have successfully completed education at the third level in an S&T field of study (ISCED '97 version levels 5a, 5b or 6).

Note that according the Canberra manual, § 71, the seven broad fields of study in S&T are: natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences, humanities and other fields.

•HRSTO – HRST in terms of occupation:
Individuals who are employed in an S&T occupation: professionals (ISCO '88 COM code 2) or technicians and associate professionals (ISCO '88 COM code 3).

• SE – Scientists and Engineers:
Core group of HRSTO: individuals employed as physical, mathematical and engineering professionals (ISCO '88 COM code 21); or life sciences and health professionals (ISCO '88 COM code 22).

• HRSTU – HRST unemployed
Individuals who have successfully completed education at the third level in an S&T field of study (ISCED '97 version levels 5a, 5b or 6) and are unemployed.

The different HRST sub-groups and their interrelation are given in the figure below.

2. Data source

The data presented are, when nothing else is indicated, derived from the **European Union Labour Force Survey (EU LFS)**. The most recent data were extracted in October 2005 and refer to the spring quarter of 2004.

Quality of the data

The guidelines on the sample size reliability of the data established by the EU LFS are applied to the HRST database. Therefore, breakdowns for which quality levels are considered insufficient are either flagged as not available or unreliable.

3. Statistical abbreviations and Symbols

:	not available
b	break in series
s	Eurostat estimate
u	Unreliable value

<table>
<tr><td></td><td colspan="2"></td><td colspan="3">HRSTE
— Education —</td><td></td></tr>
<tr><td></td><td colspan="2"></td><td colspan="3">Tertiary education</td><td>Lower than tertiary education</td></tr>
<tr><td></td><td colspan="2"></td><td>ISCED 6</td><td>ISCED 5a</td><td>ISCED 5b</td><td>ISCED < 5</td></tr>
<tr><td rowspan="2">HRSTO
— Occupation —</td><td>ISCO 2</td><td>Professionals</td><td colspan="3" rowspan="2">HRST core — HRSTC</td><td rowspan="2">HRST without tertiary education</td></tr>
<tr><td>ISCO 3</td><td>Technicians</td></tr>
<tr><td>ISCO 1</td><td>Managers</td><td colspan="3" rowspan="2">HRST non-core</td><td rowspan="2">Non-HRST employed</td></tr>
<tr><td>ISCO 0, 4-9</td><td>All other occupations</td></tr>
<tr><td rowspan="2"></td><td>Unemployed</td><td colspan="3">HRST unemployed — HRSTU</td><td>Non-HRST unemployed — NHRSTU</td></tr>
<tr><td>Inactive</td><td colspan="3">HRST inactive</td><td>Non-HRST inactive</td></tr>
</table>

Further information:

Data: Table: HRST and sub-groups of HRST by gender and age group

- **Science and technology**
  - Research and development
  - Survey on innovation in EU enterprises
  - High tech industry and knowledge based services
  - Patent statistics
  - **Human Resources in Science & Technology**
    - Stocks of HRST at the national and regional levels; unemployment for HRST and non-HRST
    - Flows of HRST at the national level: Education inflows and job-to-job mobility
    - Data on HRST and mobility derived from the 2001 round of Population and Housing Censuses
      - **Human resources in science and technology by gender and age**
        - ***HRST and sub-groups of HRST by gender and age group***

Journalists can contact the media support service:

Bech Building Office A4/125
L - 2920 Luxembourg

Tel. (352) 4301 33408
Fax (352) 4301 35349

E-mail: eurostat-mediasupport@cec.eu.int

European Statistical Data Support:

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.

Their mission is to provide help and guidance to Internet users of European statistical data.

Contact details for this support network can be found on our Internet site: www.europa.eu.int/comm/eurostat/

A list of worldwide sales outlets is available at the:

Office for Official Publications of the European Communities.

2, rue Mercier
L - 2985 Luxembourg

URL: http://publications.eu.int
E-mail: info-info-opoce@cec.eu.int

This document has been produced in collaboration with Lagrost Céline.