



## CONSIDERATIONS REGARDING THE HUMAN RESOURCES IN THE EUROPEAN UNION RESEARCH-DEVELOPMENT AND INNOVATION SECTOR

**Ecaterina STĂNCULESCU**

*Institute for World Economy, Romanian Academy, Bucharest, Romania, E-mail: [estanculescu@yahoo.com](mailto:estanculescu@yahoo.com)*

### **Abstract**

*This article briefly discusses the issue of human resources in the research, development and innovation (R&D) sector in the European Union, in the last four to five years, focusing on presenting the situation in terms of quantity (evolution of the number of personnel involved in this activity) and qualitative (personnel qualification and structure by institutional and industrial sectors). It is also highlighted the EU policy in this regard. As it is known, along with material resources, the human factor is a guarantee for R&D policy success, both of the Union and of each individual Member State. Although the European Commission has made remarkable efforts to develop human resources involved in R&D, until now the situation is quite differentiated by countries, those developed from Western Europe being more advanced than those from the eastern, from this point of view. Finally the author presents some conclusions to the issue.*

### **Keywords**

Research-development and innovation, the European Union, human resources, science and technology sector, knowledge-intensive economies

### **1. Introduction**

Human resources are especially important for science and technology area because investment in human capital is the key to innovation and economic growth. As both producers and users of science and technology, men and women alike, are in the centre of economic expansion driven by technology, they help create jobs and raising living standards in both developed countries and in developing ones.

Educated employees represent one of the key services that the public sector provides to the private sector. However, scientific capital formed in school suffers some depreciation due to the dynamics of technology and to other factors. Because the basic research is becoming increasingly important for technology and innovation, continuous investment in science and technology (ST) capital constitutes a major prerequisite for exploiting the benefits of public research. Long-term sustainability of science and innovation process will depend on an adequate supply of researchers and teachers, especially when it comes for the replacement due to the age of those who are ready to leave the system.

Investing in human capital is vital in a knowledge-based economy. Human capitalism theory regards the education and training as an investment which brings social and individual income through knowledge and skills, for economic development and social progress. European Commission President, Jean-Claude Juncker, highlighted in 2014 that R&D will be one of the

Commission's priority in his presidency, for the EU “Jobs and growth...”, for economy and society development (Juncker 2014).

The economic argument in favour of education and training based on knowledge is linked to the perceived need for the global economy. It is based on the assumption that the economy and its development are managed in close association with knowledge and human capital. In a document from this year of the European Commission we can read: “Innovation and therefore creating jobs in the R&D sector is beneficial for all jobs in the Union economy: the better R&D performance of the EU Member States is, the more high whole employment rate is” (EC 2016).

The transition to a knowledge-based economy is part of a broader plan to achieve the objective of developing the European Union (OECD 2014). With a shift towards knowledge-based economy, a country can achieve sustainable economic and social growth in the long term.

A very important role in the knowledge economy is the training of specialists having informatics knowledge. The link between education and economic growth tightens if there is an increase of the technology transfer rate. The fact that an impact on economic growth is observed only in countries with high affluence of knowledge suggests that technology adoption is strongly linked to workforce education.

*Analysts unanimously agreed that the knowledge and information based economy generates opportunities in*

all sectors, both in developed countries and in developing ones. This creates new jobs, a healthy generation, a fair redistribution of income and a decrease in poverty, for a rapid economic development and prosperity and for increasing the global competitiveness. It is also a commodity itself. Worldwide, industries based on technology and knowledge created 2.5 times more jobs than the rest of the economy (OECD 2014).

In recent years, the EU R&D policy puts an intensified accent on reforms for the European research system becomes more efficient and in accordance with the requirements of the knowledge economy and the European Research Area (ERA) (EC 2014-1). Very important initiatives, part of the Europe 2020 Strategy, of the Framework-programs for research and development (in this case the 7th Framework Program), of Horizon 2020 Initiative (EC 2013), of the Innovative Union (EC 2013), the activity within the European Research Council, the Scientific Advice Mechanism (SAM), the Marie Skłodowska Curie Actions etc., highlight the increased concern for human resources development in the EU R&D.

In May 2008 the European Commission adopted a Communication to launch an initiative entitled "Better careers and mobility: a European partnership for researchers" (CEC 2008). The goal of this initiative is to improve the mobility of researchers and to enhance the diffusion of knowledge throughout Europe, by balancing demand and supply for researchers at the European level, helping create centres of excellence and improving the skills of European researchers. All documents adopted by the European Commission or the European Council on the theme of Innovative Union (EC 2015-1) are considering concrete measures to develop human resources in this sector.

Most states are following the development of legislative packages that give more autonomy to universities, to support actors from public and private research for internationalization, notably by integrating them into European networks of knowledge flows (EC 2014-2). There are pursued the group policy developed in many Member States in the recent years in R&D human resources field, the cross-border staff mobility in this area, the international cooperation with other enterprises and the creation of a favourable business environment for the development of R&D workforce.

## 2. Human resources in science and technology sector in the EU-28

In 2014, almost 74.8 million people, aged between 15 and 74 years, worked in science and technology – S&T (considered human resources in science and

technology occupation - HRSTO). A proportion of 54.9% of these persons was considered "professionals" and 45.1% "technicians". However, the percentage varies between the Member States. Greece, with 70.2%, reported the highest proportion of professionals. Other Member States, with over 65% professionals, were *Romania* (70.0%), Lithuania (69.9%), Luxembourg (69.5%), United Kingdom (67.3%), Ireland (66.1%) and Bulgaria (65.1%) (Eurostat 2015-1).

The "professionals" subgroup includes a special category of interest, "scientists and engineers", covering the staff in science and engineering, health and information and communication technologies (ICT), so, most people involved in R&D. In 2014, scientists and engineers formed 21.8% of all employees in science and technology sector in the EU-28. In absolute figures, the largest number of scientists and engineers was in the UK (approx. 3 million), Germany, France, Spain, Poland and Italy. Together, these countries cumulated 69.7% of all scientists and engineers in the EU. Significant shares of "professionals" subgroup existed also in other countries such as *Romania*, Spain, Portugal, Czech Republic and Sweden, where they accounted for more than 40% of the total workforce from science and technology sector.

In the „technicians" subgroup, six Member States (Slovakia, Germany, Italy, France, Czech Republic and Austria) held between 50 and 60% of the total HRSTO. As the data from Table 1, in 2013, the workforce employed in the European Union, in S&T field, was of approximately 73.5 million people (74.8 million in 2014), with a share of 34.2% (31% in 2010) of the total employment in the whole Union economy. In terms of personnel with higher education, it summed up approx. 46 million people, accounting for 18.9% of all people employed in the EU economy in 2010 and 21.6% in 2013, meaning an average annual growth rate of approx. 1%.

It is estimated that specialised personnel (scientists, researchers, engineers) will increase by 16 million by 2020.

It's important to mention some aspects of science and technology personnel in the EU-28:

- First, the stock of human resources in S&T can be used as an indicator of knowledge economy development. Central group „core human resources" (HRSTC), composed of people who have a higher education and work in S&T sector represents the key to developing knowledge and innovation technology (see Table 1). The population employed in S&T represented 44.4% of the total EU active population in 2014 (Eurostat 2015-2).

Table 1. Human Resources in S & T sector, working full time equivalent (FTE), in the EU-28, 2010-2013

| EU-28 | Human resources in science and technology occupations (HRSTO) |  |  | Human resources in science and technology core (HRSTC) (with higher education) |   |   |
|-------|---|--|--|--|---|---|
|       | 2013<br>- thousand<br>persons -                               | 2010<br>% from the<br>total number of<br>persons<br>employed in<br>economy | 2013<br>% from the<br>total number of<br>persons<br>employed in<br>economy | 2013<br>- thousand<br>persons -  | 2010<br>% from the total<br>number of<br>persons employed<br>in economy | 2013<br>% from the total<br>number of persons<br>employed in<br>economy |
|       | 73,497  | 31.0   | 34.2   | 46,390   | 18.9  | 21.6  |

Source: Eurostat, Statistics Explained, File: Human resources in science and technology, 2010-13 YB15 (Eurostat 2015-1)

- Secondly, in 2014, 13 of the 25 regions with the highest number of HRSTC were regions around State capitals (Eurostat 2015-3). Thus, the region Inner London (Great Britain) tops the list with 40.9% of the local HRSTC workforce. It was followed by Luxembourg (40.8%), and Helsinki - Uusimaa (Finland) with 36.8%. Among the top six HRSTC regions around capital cities were four regions from northern Europe. Also important are the regions with top universities and research centres in Sweden, Belgium, Holland, Germany, France and the UK.

- Thirdly, it is about human resources age in EU S&T sector (Eurostat 2015-4). Thus, in 2014, over 104 million people being aged 25 to 64 were employed in this sector. Of these, 44.5 million were "senior" HRST (aged from 45 to 64), i.e. 42.8% for the whole EU-28. By comparison, people aged between 25 and 34 represented 28%. Among EU Member States, Germany had the largest percentage of "senior" people in S&T field (51.2%), followed by Finland, Denmark, the Netherlands, and Italy with over 45%. In the bottom of the ladder stood *Romania* (32.7%) and Poland (33.0%), with the lowest percentage of seniors.

- Fourth, we mention the women share in all S&T personnel, especially those with higher education (Eurostat 2015-4). For the overall EU-28, the highest share of educated women was in services sector (56.7%), while in manufacturing industry their average weight was only 27.8%.

### 3. Development and structure of human resources in the EU R & D sector

R&D personnel consist of individuals employed directly in this field (researchers, managers, support staff etc.). A researcher can be employed in the public or private sector - including academia - to create new knowledge, products, processes or methods or to be involved in project management.

Between 1995 and 2005 the majority of jobs in the EU-15 have come from the expansion of knowledge-based industries, where they increased by 24%. In the rest of the EU-15 economy the rise was only 6%.

According to the Innovation Union 2015 Scoreboard (EC 2015-2), in 2013, from the European States, the best results in terms of RDI professionals had Finland and Sweden, two of the innovation leaders. Also, Ireland and the UK performed very well in this respect. The workforce in these countries is trained to participate and further develop the knowledge economy (OECD 2014). Other states with status of innovators followers are also efficient in terms of human capital, exceeding the average of the EU-28, except Luxembourg. Among the moderate innovators, the majority had results under the EU average, less Lithuania, Croatia, Slovakia and Cyprus.

The number of researchers in the EU-28 increased in recent years. In 2013 there were 1.73 million researchers in full time equivalent (FTE), which meant an increase of 501,700 (or 41%) compared to 2003 (Eurostat 2015-4). In 2013, of the EU total employment, RDI staff represented 1.1%, on average. It reached a stake of over 2% in Denmark, Finland and Luxembourg and of 1.6% in Sweden. In *Romania* and Cyprus the proportion was of 0.3%.

An analysis of R&D staff in the EU-28, in 2013, shows that there is a high concentration of researchers in the business sector - 48% (compared to 45% in 2010) and in higher education - 39% (41% in 2010), while 12% of the total number of researchers worked in the government sector (13% in 2010). Private non-profit sector have an insignificant 1% of the total number of researchers (see Table 2 and Figure 1).

The relative importance of different sectors varied considerably between Member States. The highest proportion of staff in the business sector were recorded in Sweden (69%), Malta (63%), Ireland (62%), Denmark (62%), France (60%), the Netherlands (60%), Hungary (57%), Finland (57%), Germany (56%), Slovenia (54%), Belgium (50%), Czech Republic (49%) - (Eurostat 2015-4).

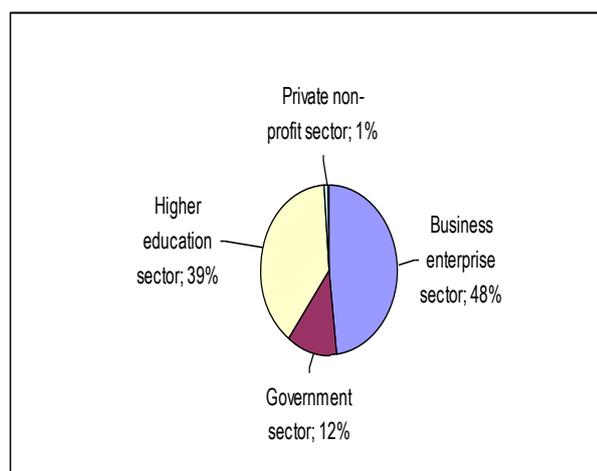
*Romania* had a share of 29% of the total R&D personnel in the business sector.

Table 2. EU R&D staff working full time equivalents (FTE), by sector, 2013

|                  | Total          | Business enterprise sector |                | Government sector |                | Higher education sector |                |
|------------------|----------------|----------------------------|----------------|-------------------|----------------|-------------------------|----------------|
|                  | (thousand FTE) | (thousand FTE)             | % of the total | (thousand FTE)    | % of the total | (thousand FTE)          | % of the total |
| <b>EU-28</b>     | 1,726.1        | 830.1                      | 48             | 209.0             | 12             | 667.8                   | 39             |
| <b>Euro Zone</b> | 1,195.3        | 607.4                      | 51             | 159.2             | 13             | 414.9                   | 35             |

Source: Eurostat, Statistical books, Key Figures on Europe, 2015 edition (Eurostat 2015-4)

Figure 1. Researchers employed by institutional sector (FTE), as a percentage of total number of researchers, in 2013



Source: author, according to data from Eurostat, Statistical books, Key Figures on Europe, 2015 edition (Eurostat 2015-4)

In the higher education, the greatest weight of R&D staff was in Greece (65%), Latvia (65%), Slovakia (65%), Lithuania (63%), Cyprus (62%), UK (59%), Portugal (55%), Estonia (54%) and Poland (52%).

Romania registered a weight close to the EU average - 35%.

The government sector had the largest number of R&D employees in Bulgaria (43%), Romania (35%), Luxembourg (28%), Slovenia (21%) and Latvia (20%).

As we may note, apart from Luxembourg, the other states are former socialist countries.

In Euro Zone the weights were slightly different: 51% in the business enterprise sector, 35% in higher education and 13% in the government sector.

An analysis of researchers' gender shows that men accounted for 67% of the whole R&D sector in EU-28, in 2013, with 3% less than in 2003. Women have accounted for more than half of the total number of researchers in Latvia and Lithuania. In Bulgaria and Croatia they were approximately at parity with men (EC 2015-2).

EU Investment Scoreboard 2014 (EC 2014-3) undertakes an analysis of the increase in the number of employees by industry, according to the intensity of these sectors in R&D activity. In accordance with this

study, industries with high R & D intensity (over 5%) are: pharmaceuticals and biotechnology, equipment and services for health care, electronic equipment, computer services and software, aerospace and defence. The sectors with medium-high intensity (between 2 and 5%) in R&D are electronics and electrical equipment, motor vehicles and parts, engineering products, chemicals, personal goods, household products, general industrial goods and support services. R&D industrial sectors with medium-low intensity (1 to 2%) are the food and drinks industry, travel and leisure, media, oil equipment, electricity and telecommunications. Industrial sectors with low R & D intensity (under 1%) include oil and gas, metallurgical engineering, construction and building materials, food and drinks retail, transport, mining, tobacco and multiple utilities.

Regarding the distribution of R&D employees by industrial sectors, depending on the R&D intensity (R&D investments divided by the volume of sales value) of these sectors (EC 2014-3) we can say that the top 2172 companies investing in R & D, on the worldwide level, totalized 48.6 million people in 2013, slightly more than the number in 2012 (0.1%). Distribution by regions was: 18 million employees in 603 companies in the EU-28, 11.3 million in 765 companies in the US, 8.3 million in 386 companies in Japan and 11 million in 418 companies in other countries.

An important aspect of analysis of the top 1618 companies investing in R & D worldwide, in the period 2005-2013, is that the number of employees increased by 23.7%. In sectors with high R & D intensity the growth was 35.6% and in sectors with average R & D intensity the growth was 26.6%.

For the 476 companies in the EU-28 who answered the questionnaire, the overall growth in staff number during the mentioned period was 18.9% (thus lower than the world average). For the companies from sectors with high R&D intensity the growth rate was 40.1% (higher than the world average) and for companies from sectors with medium R&D intensity - 25.1% (closed to the world average).

Companies with low R & D intensity had smaller staff increases, both globally and at EU level. It is an

argument to support the idea that R&D activity leads to faster growth of jobs, in general.

It is important to note that the data reported by EU companies listed in the Investment Scoreboard do not provide information about the actual geographical distribution of the number of employees. A detailed geographic analysis should take into account the location of companies' subsidiaries listed in Scoreboard and other production activity location involved in value chains. Such an analysis could give more precise indications about the employment increase in the European Union industries.

It should also be noted that innovations made by companies in areas such as software and semiconductors can strengthen production and services (and consequently sales) and increase the number of employees in companies not listed in the Scoreboard, as they are not engaged in an important R&D activity.

#### 4. Conclusions

From the brief analysis undertaken in this article it can be drawn some conclusions:

- In 2014, were almost 74.8 million people aged between 15 and 74 years working in science and technology on the EU economy. These were "professionals" and "technicians". Professional category includes scientists and engineers, so that staff which can be directly involved in scientific research – "researchers".
- In the period 2010-2013, the majority of jobs in the EU - 28 have come from the expansion of knowledge-based industries. In 2013, in EU-28 were 1.73 million full-time researchers (cca.1.1% of the total number of employees in the EU economy), approx. 41% more than in 2003. Of these researchers, in 2013, 46% were in the business sector, 40% in higher education, 13% in the R&D funded by governments and 1% in the private non-profit sector.
- The overall increase in employment in EU companies, during that mentioned period, was at 18.9%, in average (lower than the world average of 23.7%). The highest increases, of 40.1% and, respectively, 25.1%, marked companies in sectors with high R & D intensity (higher than the world average) and medium intensity (close to the world average).
- In 2013, in the EU R&D personnel, by age, 44.5 million people were „seniors” (ages between 45 and 64), i.e. 42.8% for the whole EU-28. By comparison, people aged between 25 and 34 were 28%.
- R&D activity belongs mostly to the men. In 2013, in the EU, men represented 67% of the whole R&D employees, 3% less than in 2003.
- In 2013, the strongest regions in terms of R&D activity and, implicitly, the largest concentration in the number of researchers were those around some capitals as

London (UK), Stockholm (Sweden), Prague (Czech Republic), Luxembourg or Bratislava (Slovakia) or high university centres such as those in Sweden, Belgium, Holland, Germany, France or Spain.

- Romania was situated very low in terms of the number of researchers, in the considered period of time, with a constant share of 0.3% in its total workforce (compared to the EU average of 1.1%). In exchange, a defining remarkable feature is the proportion of professionals (70% of total workforce), and the almost equal division of the R&D personnel among the institutional sectors (35% in higher education, 35% in the public sector - government and 29% in the business enterprise sector). Of course, it must be a greater proportion in the business enterprise sector.

- A statement worthy of being made is that Romania, despite existing claims, have a modest percentage regarding the R&D staff aged between 45 and 64 years (32.7% of total), compared with developed countries, where their percentage is, in average, of 42.8%. The researchers in the age group of 25-34 years old have also a small percentage (approx. 31%).

*The final conclusion could be the evident need for all EU Member States, including Romania, of a more sustained concern for the development of both quantitative and qualitative human resources in R&D sector, which is one of the basic conditions for the development of economy and society.*

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