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– Quality of human resources

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ANALYSIS

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Competitiveness Yearbook Czech Republic 2007 – 2008
Analysis
Part – Quality of human resources

CONTENT

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Introduction

The Quality of Human Resources

The content of this publication, which is the third of its kind, was influenced by the availability of data from new surveys. In particular, these include the PISA study that examines the level of literacy in fifteen-year-old pupils, and the CVTS 3 survey focused on staff training in companies. Moreover, for the first time attention is focused not only on an analysis of data mapping the past, but also on an analysis of forecasted development of demands for the skills of human resources. The publication is traditionally divided into three chapters. The first chapter assesses and compares, in international terms, the level of literacy in fifteen-year-old pupils and the educational attainment of the population. The second chapter concerns employment with a particular focus on technology-intensive industries. Furthermore, it deals with the future requirements for skilled labour in the CR and the preparation of human resources for skills-intensive occupations. The third chapter provides an analysis of various aspects related to the training of employees in enterprises, and changes in the requirements for their knowledge and skills in several selected industries.

Knowledge and Skills of Human Resources (Olga Kofroňová, Zdeňka Šímová, Hana Žáčková): The chapter is divided into two subchapters. The first subchapter uses the data from the PISA survey concerning the average levels of scientific, reading and mathematical literacy, and data about the proportions of pupils with the highest and lowest levels of literacy. The results in scientific literacy are analysed in more detail, since it was the main focus of the 2006 PISA study. The survey was carried out in regular intervals, which made it possible to assess a shift in pupils' literacy levels in the periods between 2000, 2003 and 2006. The second part of this chapter deals with the educational attainment of the population and the educational mobility. The shift in the educational attainment of the population aged 25-64 in the 2000-2007 period is analysed. Moreover, the educational attainment is assessed according to industries – its levels indicate how advanced an industry is, but also point to limitations resulting from the overall educational structure. Educational mobility in the CR is assessed in relation to the situation in the EU and in view of the process of the CR's catching up with the EU and developed countries in terms of the proportion of people with tertiary qualifications. Moreover, the future development of educational mobility is analysed based on a projection of the number of graduates at various levels of education.

Human Resources for the Knowledge Economy (Věra Czesaná, Michal Lapáček, Jiří Braňka, Zdeňka Matoušková): In the first part the chapter presents an analysis of the development of employment in terms of industry structure and identifies industries where the steepest growth in employment occurred in the period from 2003 until 2007. The core of the chapter consists in an analysis of employment in the technology-intensive segment of the economy – i.e. high-tech manufacturing industries and high-tech services. Attention is paid both to the total employment in this sector and to the proportion of employees with tertiary qualifications. The analysis concerns both the past and expected development of employment in various industries and technology-intensive sectors of the economy. The second part of the chapter provides a more detailed analysis of future requirements for skilled labour in selected sectors. At first, the starting points for forecasting skills needs are explained and decisive general trends are defined that will have a major impact on the overall situation in the labour market. Focus is not only on an analysis of the past development but also on the expected development in terms of requirements for human resources in energy; in the manufacture of ICT, optical and medical instruments; and in the manufacture of electrical machinery and apparatus. The third part deals with the preparation of human resources for skills-intensive occupations via tertiary education. It provides an analysis of changes in accessibility of tertiary education in the CR in 2000-2005 on the basis of a net entry rate into tertiary education at various levels. There is also an international comparison of the proportion of graduates in the relevant age cohort and the position of the CR within the EU is assessed. Since it is primarily graduates of technology and science programmes who are expected to contribute to the technological advancement of the economy, this issue is also discussed. Last but not least, it is not possible to ignore globalisation trends. These are characterised by student mobility.

Training in Enterprises (Zdeňka Matoušková, Jiří Braňka, Věra Czesaná): The initial two parts of the third chapter concern training implemented in enterprises. The analysis draws on the results of the CVTS survey that relate to years 1999 and 2005. In the first part the situation in the CR is compared with the EU-27 average and also with countries that achieve the best results in staff development. Changes in the proportion of companies providing continuing vocational training to their employees were assessed, and major factors that affect this proportion were identified. The survey also made it possible to explore issues related to a systemic approach of enterprises to training and to the level of expenditure on staff development. The second part provides a more detailed analysis of one type of training provided by companies – i.e. continuing training courses that represent the most frequent mode of training in enterprises. Various aspects were examined such as the proportion of employees who took part in a certain type of course, the average course length, and also the course content and gender-based differences. The third part of the chapter makes use of information ascertained as part of eleven case studies undertaken in selected innovative companies. The comparative analysis presented uses Puttick's matrix that identifies the position of companies based on product complexity and the level of uncertainty in sales. Based on the findings acquired through the case studies and from other sources of information companies' approaches to human resources development are assessed according to the scope and predominating type of innovation implemented.

1. Knowledge and skills of human resources

The level of the population's knowledge and skills is analysed in relation to the age of the population. The first part of the chapter looks at the competencies of fifteen-year-olds based on the findings of the international PISA survey, compares the Czech Republic's position against the other OECD countries, and looks at changes in this position and in the level of competencies over time. The second part of the chapter focuses on the educational structure of the adult population and on educational mobility, which is also analysed with a view towards the future five years. Moreover, the chapter analyses dropouts from the educational system and participation in continuing education.

1.1 Basic competencies of the young population

For an economy to be competitive, it is important for the entire population, if possible, to be equipped with competencies which will enable them to actively engage in social and working life – competencies which form the basis for lifelong learning. The assessment of the competencies of the young population is based on the findings of the international PISA surveys performed among fifteen-year-olds in the years 2000, 2003 and 2006.[1] We here look primarily at the figures for Czech students within an international comparison, and provide a detailed description of the findings from the 2006 survey, which focused on scientific literacy – the foundation for technical and science education. We also compare the survey findings from the years 2000, 2003 and 2006, which show whether and how students' results have changed in comparison to other countries.

The PISA surveys are held every three years, each time with a focus on one of three domains. Since 2003, the surveys have included all OECD member states, and some non-members as well. Students' competencies are determined on the basis of written 120-minute tests which include both multiple-choice questions and questions with an open answer. The survey also includes a student questionnaire which looks at factors influencing students' results (for example, the family's socio-economic background, student attitudes) and a school questionnaire which looks at students' educational environment at the various schools.

The survey determines the level of literacy of fifteen-year-old students, i.e. it provides information primarily on the quality of primary-level education. Students' literacy is influenced by many other factors, and the PISA surveys study the influence of the family and social environment.

In 2006, the main tested domain was **scientific literacy.** From the viewpoint of an economy's competitiveness, scientific literacy is of key importance, since it represents the foundation for the future study of technology and the sciences. Graduates of these fields of study represent a country's greatest potential for the discovery and application of new scientific and technological findings. It is thus important to encourage young people to have a positive relationship to science and technology while still attending mandatory education. The 2006 PISA survey focused not only on determining students' knowledge and skills, but also on assessing their relationship to the sciences, their attitude towards the possibility of finding employment in science, and what their schools offer in this area, what methods of instruction are used.

Average level of literacy for fifteen-year-olds in 2006

The average[2] level of fifteen-year-olds' performance in science, reading and mathematics is shown in Table 1. The colours differentiate among three positions for the individual countries in comparison to the OECD average: a) countries above the average; b) no statistically significant deviation from the average; c) countries below the OECD average. Except for reading literacy, on average Czech students fared above the OECD average.

Table 1: Mean values of literacy level

Science		Reading		Matemathics	
country	score	country	score	country	score
FI	563	FI	547	FI	548
EE	531	IE	517	NL	531
JP	531	PL	508	JP	523
NL	525	SE	507	BE	520
SI	519	NL	507	EE	515
DE	516	BE	501	DK	513
UK	515	EE	501	CZ	510
CZ	513	JP	498	AT	505
AT	511	UK	495	SI	504
BE	510	DE	495	DE	504
IE	508	DK	494	SE	502
HU	504	SI	494	IE	501
SE	503	AT	490	FR	496
PL	498	FR	488	UK	495
DK	496	CZ	483	PL	495
FR	495	HU	482	SK	492
LV	490	LV	479	HU	491
USA	489	LU	479	LU	490
SK	488	PT	472	LT	486
ES	488	LT	470	LV	486
LT	488	IT	469	ES	480
LU	486	SK	466	USA	474
IT	475	ES	461	PT	466
PT	474	GR	460	IT	462
GR	473	BG	402	GR	459
BG	434	RO	396	RO	415
RO	418			BG	413

	Above the OECD average
	Not statistically significantly different from the OECD average
	Below the OECD average

Source: OECD (2007c).

When it comes to **scientific literacy**, Czech students took seventh place among all EU countries which participated in the survey, and sixth place in **mathematical literacy**. As usual, Finland had the best results, with a large lead ahead of the other countries. Estonia fared best among the new member states, and students from the Czech Republic and Slovenia also ranked above-average. Other students with excellent results in these domains were from the Netherlands and Japan. Students from the United States, on the other hand, placed below average. Above-average results were found among other European countries with differing educational systems – for instance Germany and Great Britain in the sciences, or Denmark and Austria in mathematics. This

[1] OECD 2007c; OECD 2001a; OECD 2004a.

[2] Median value.

shows that many different paths can lead to good results, and factors other than the outward appearance of the educational system come into play.

The various countries' results in **reading literacy** differ markedly from the other two types of literacy. Although here, too, the above-average countries include some of the same countries as for the other two forms of literacy (with Finland the best), second place went to Ireland and third place to Poland. These different results may indicate that certain educational systems traditionally emphasise other areas of education. An important finding for the Czech Republic is the fact that our educational system neglects reading literacy as it is defined by the survey – i.e., active work with a written text.

If we are to find inspiration for improving our overall results, we should study primarily the educational systems in Finland, the Netherlands, and – among the new EU member states – Estonia. As for reading literacy, we should look towards Poland, where – as in the Czech Republic – the educational system underwent significant reforms starting in the early 1990s.

Fifteen-year-olds' highest level of literacy

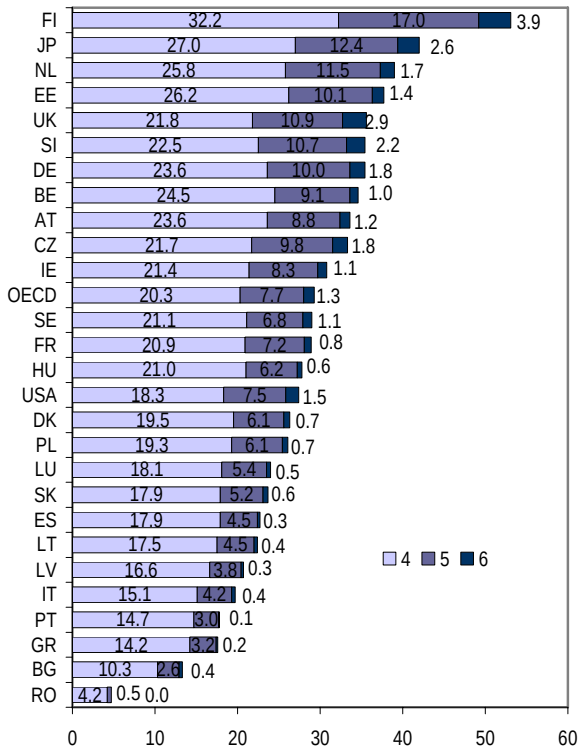
The competitiveness of a country's economy depends to a significant degree on the role it takes in developing high-tech and knowledge-intensive fields. We may assume that students with above-average scientific and mathematical literacy will be interested in going on to study the sciences and technology, and that they thus represent an important potential for these fields' further development. Figure 1 shows the percentage of fifteen-year-old students who reached the three highest levels of **scientific literacy**.

The best students were from Finland, where more than half of all students have the knowledge and competencies characteristic for these three highest levels. In the Czech Republic, a third of students achieved this level – significantly less than in the best countries such as Finland, Japan and the Netherlands, but still above the OECD average of 29 % of fifteen-year-old students. The worst results were by students from Romania, where only an insignificant number of students has this level of literacy.

The greatest benefit for high-tech and knowledge-intensive fields may be expected from those students with the highest level of scientific literacy – of which there are only a few percent in each country. The highest percentage, almost 4 %, was again in Finland, followed by Great Britain with nearly 3 %. The Czech Republic has the same percentage of students in this category as Germany (1.8 %), although its overall results are somewhat poorer. The Czech Republic has a higher percentage of such students than Austria (1.8 % vs. 1.2 %), which has roughly the same overall result (33 %). This means that our educational system produces more students with the highest proficiency level than neighbouring countries with similar educational systems and a comparable proportion of students at the three highest levels of literacy.

The proportion of fifteen-year-old students at the three highest levels of **mathematical literacy** can be seen in Figure 5. Again, students from Finland fared best, with more than half of all students having the knowledge and competencies characteristic for the top three levels. Still, the distance between Finnish students and the second- and third-place countries is not as significant as it is for scientific literacy. In the Czech Republic, more than one third of students made it to these levels, giving the country an excellent fourth-place ranking within Europe. Again, the worst results were in Romania.

Figure 1: Proportion of fifteen-year-old students at the highest levels of scientific literacy (in %)



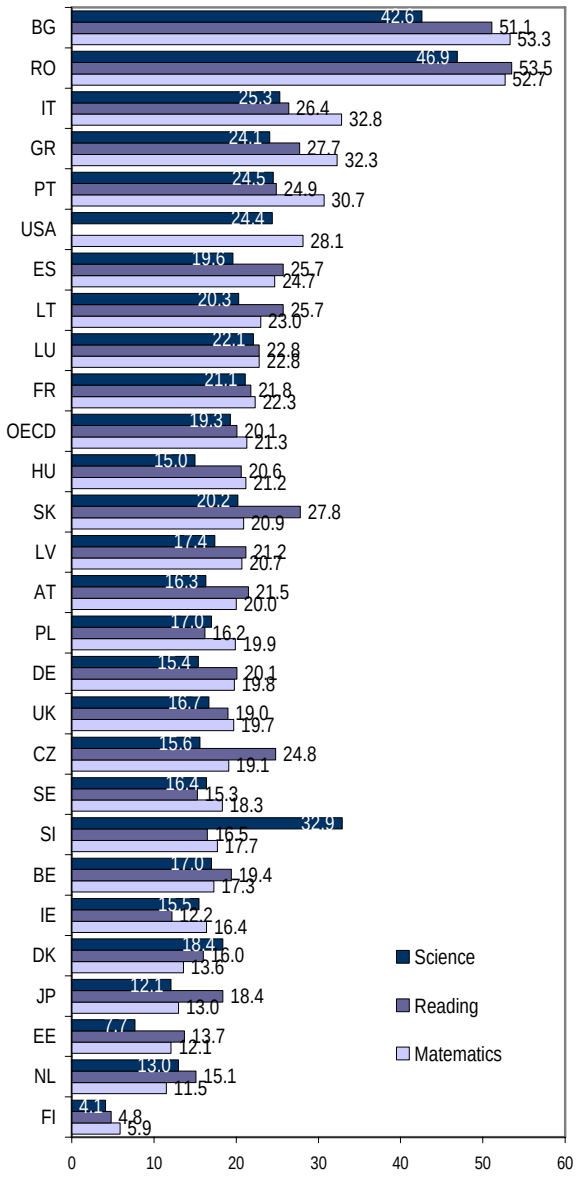
Note: level 4: 560-633 points, level 5: 643-708, level 6: more than 708 points. Source: OECD (2007c).

As for the highest level of mathematical literacy, the highest percentage of students in this category is in Belgium (6.4 %), which placed third for the top three levels. The share of such students in the Czech Republic (6 %) does not differ significantly from the best countries, and is significantly higher than in Austria (3.5 %), which has roughly the same overall figure (37 %) for the top three levels of mathematical literacy. Here too, it is clear that our educational system produces more students with the highest proficiency level than countries with similar educational systems and a comparable proportion of students among the top three levels of literacy.

A quite different picture emerges when we look at the proportion of students at the highest levels of **reading literacy.** Reading literacy is evaluated using a five-point scale, so here we refer to the percentage of students in the two highest levels (see Figure 8).

Again, Finland takes a wide lead, with almost one half of students possessing the skills and competencies characteristic for the two highest levels of reading literacy and almost 17 % of students achieving the highest level. Other leading countries include Ireland and Belgium. The only new EU member to make it among the top countries is Poland. With its 28.5 % of students at these levels of literacy, the Czech Republic finds itself below the OECD average. Still, the share of students in the highest level (9.2 %) is slightly higher than it is for some above-average countries (for instance, Great Britain or Austria with their 9 %). Again, Romania fared the poorest, with only an insignificant share of students reaching these levels of literacy.

Figure 2: Proportion of fifteen-year-old students at the lowest levels of literacy (in %)



Source: OECD (2007c).

Lowest levels of literacy among fifteen-year-olds

While students with a high level of literacy represent a society's potential for development, students at the two lowest levels of literacy will be limited in their integration into social and working life. The OECD average for such students is around 20 %, with the worst situation found in Bulgaria and Romania, where around one half of all students fall into this category. Other southern European countries and the United States also have significant problems when it comes to mathematical literacy; almost one third of students fail to do better than the first proficiency level.

The Czech Republic has significant issues related to **reading literacy**. Together with Slovakia, the country is well below the OECD average. Around one fourth of students from these two countries fail to do better than the lowest level. In Finland, on the other hand, only a very small part of students (around 5 %) have such limited competencies. This finding is very alarming, since employers are increasing their requirements for these key competencies. If we assume that population characteristics do not differ significantly from one European country to another, the differences between the countries show primarily that some educational systems do not apply sufficiently effective methods for developing these competencies.

Scientific literacy

The PISA survey looked not only at overall scientific literacy, but also at the results in various subdomains, for which so-called subscales were created. Tables 2 and 3 compare the students' results on the subscales with their overall results in the science test. The scores of Czech students are compared with those from Finland (who had the best overall results) and those from Romania (who had the worst overall results). The results from three European countries with a traditionally different approach to education are also shown. The scores of Japan and the United States are given in order to provide a comparison with non-European approaches to teaching science.

As can be seen from Table 2 (competency scales), Czech students are significantly more successful in explaining phenomena scientifically, i.e., in applied knowledge. On the other hand, they are significantly less successful when it comes to identifying scientific issues – i.e. identifying issues which can be answered scientifically, and in using scientific evidence. These results reflect the current approach to instruction at Czech schools, which emphasizes knowledge and the application of knowledge, but not scientific thinking. Romania shows a similar distribution of results as the Czech Republic. The best country, Finland, on the other hand has more balanced results, although it also lags behind in identifying scientific issues; Germany shows similar results. Great Britain and the United States showed the most balanced results. The United States lags behind only slightly in applied knowledge, an area on which its educational system traditionally places less emphasis. A very interesting picture is offered by the results from France and Japan, which show that these countries focus the most on scientific thinking – interpretation and using scientific evidence.

Table 2: Competency scales of scientific literacy

	Science literacy mean score	Competency scales		
		Identifying	Explaining	Using evidence
Czech Republic	513	-12	15	-12
Finland	563	-8	3	4
Romaina	418	-9	7	-11
USA	489	3	-3	0
Japan	531	-9	-4	13
Great Britain	515	-1	2	-1
Germany	516	-6	3	0
France	495	4	-14	16
OECD average	500	-1	0	-1

Source: OECD (2007c).

Table 3 (knowledge scales) shows that Czech students are more successful in knowledge of science than knowledge about science, i.e., methodology. The gap between these two knowledge domains is the greatest of all the OECD countries. Also lagging slightly behind in knowledge about science are Finland, Romania and Germany, while the non-European countries studied (the United States and Japan) have more balanced results. France is an exception in that French students did significantly better in knowledge about

science. France thus clearly emphasises scientific thinking, even more than Japan.

Results in the knowledge domains were studied at the level of three content areas. The Czech Republic ranked second-best among OECD countries (after Hungary) in the area of "Physical systems", i.e. physics and chemistry. Romania also did better in this area than in overall scientific literacy. Finland, on the other hand, did significantly better in the area of "Living systems", i.e. biology, as did Great Britain and Germany. France lags the least behind in biology and showed the greatest deficits in the content area of "Earth and space systems".

Table 3: Knowledge scales of scientific literacy

	Science literacy mean score	Knowledge about science	Knowledge of science		
			Physical systems	Earth and space	Living systems
Czech Republic	513	-14	21	13	12
Finland	563	-6	-4	-9	11
Romania	418	-6	10	-12	8
USA	489	3	-4	15	-2
Japan	531	0	-1	-1	-5
Great Britain	515	2	-6	-10	11
Germany	516	-4	0	-5	8
France	495	12	-13	-33	-5
OECD average	500	0	0	0	2

Source: OECD (2007c).

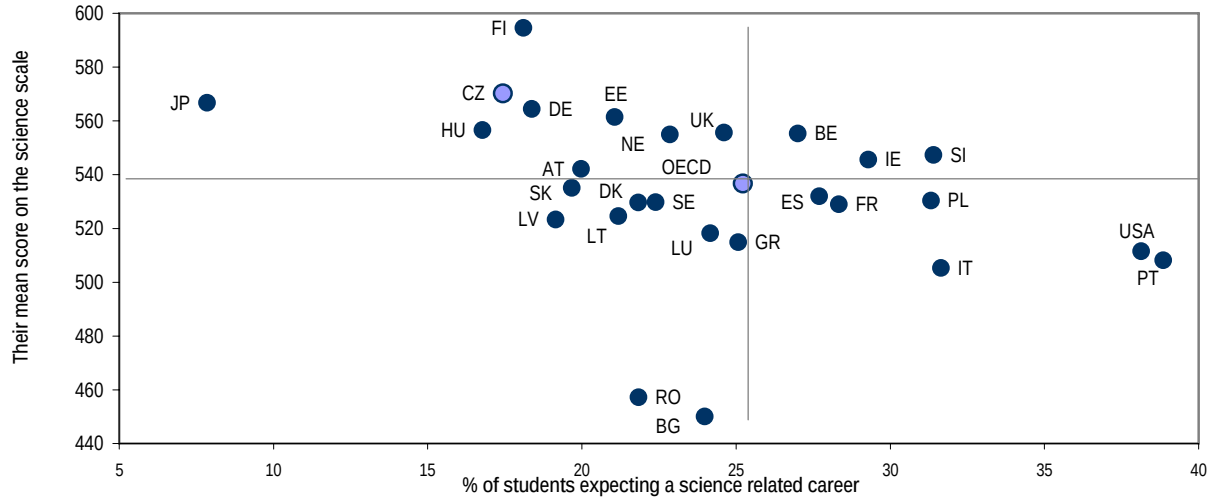
Among non-European countries, the United States did significantly better in "Earth and space systems", while Japan's results on the knowledge scales are quite well balanced, lagging behind slightly only in biology. While any deficits in the knowledge of scientific methodology may significantly limit the ability to apply scientific findings, the different results from the various content areas are more of a reflection of different traditional approaches to instruction in the various countries, which tend to emphasise certain areas of knowledge at the expense of others.

Interest in working in the sciences

The PISA survey considers students' attitudes towards science to be an important component of scientific literacy, because these attitudes are closely tied to students' motivation to continue to study the sciences and to go on to work in the field of science and technology – not only as scientists, but also as engineers, meteorologists, doctors, ecologists etc. Figure 3 shows the percentage of students who expect to be working in the sciences in 30 years in relation to their overall scientific literacy.

The top right quadrant contains Slovenia, Ireland and Belgium, whose students have above-average interest in a scientific career, coupled with above-average competencies. In these countries, the quality of science instruction creates a positive attitude to the sciences and an interest in working in these fields. The top left quadrant contains countries whose students have a below-average interest in a scientific career but those who are interested in one have above-average results. This quadrant also contains the Czech Republic, which has one of the lowest levels of interest in a scientific career despite students' excellent results. In Finland, too, where students did the best in the sciences, interest in a scientific career is one of the lowest. An extreme example of this kind of country is Japan, where despite students' excellent results only slightly less than 8 % of students expect to be working in the field of science and technology. Average interest and above-average results are characteristic for Great Britain and the Netherlands. The bottom left quadrant contains countries with below-average results and an above-average interest in a career in the sciences. The two countries with the absolute lowest student scores – Bulgaria and Romania – nevertheless show student interest approaching the OECD average. The bottom right quadrant contains countries whose students show a high interest in working in the sciences but who have below-average scores. This includes the United States, Portugal and Italy. This picture clearly shows that there is no direct relation between interest in the sciences and good results. In some cases it is apparent that good results are achieved at the expense of a positive relationship to the field, while in other cases demands are reduced and studying and working in the field are promoted. Interest in studying and working in a field is also influenced by the field's level of prestige, which may differ from country to country.

Figure 3: Share of fifteen-year-old students who want to work in the sciences (in %) and their average point score in scientific literacy



Source: OECD (2007c).

Trends in the development of competencies, 2000-2006

As has already been stated, the PISA surveys have been performed in three-year intervals since the year 2000. It has only gradually become possible to compare the survey findings, meaning that the only way to assess the development of results for all three types of literacy is by country ranking. Table 4 depicts the Czech Republic's position relative to the other countries which participated in all three PISA surveys. It is important to remember that the change in ranking is the result not only of the score achieved by the Czech Republic, but also results from an increase or decline in other countries' performance.

The table clearly shows that in 2006 the Czech Republic improved in relation to 2000 in both scientific and mathematical literacy. There was a slight decline from 2003 to 2006, but this decline was statistically insignificant, in particular in scientific literacy.

Reading literacy showed a different development, with no statistically significant change since the year 2000. Although the Czech Republic moved down in absolute ranking in 2003, a smaller number of countries showed a statistically significantly better results compared to Czech Republic in 2003 than in 2000 and 2006.

Table 4: Ranking of countries in 2000-2006

Science			Mathematics			Reading		
2000	2003	2006	2000	2003	2006	2000	2003	2006
KR	FI	FI	JP	FI	FI	FI	FI	KR
JP	JP	JP	KR	KR	KR	IE	KR	FI
FI	KR	KO	FI	JP	JP	KR	IE	IE
AT	CZ	DE	BE	BE	BE	JP	SE	PL
IE	FR	CZ	FR	CZ	DK	SE	BE	SE
SE	BE	AT	AT	DK	CZ	AT	JP	BE
CZ	SE	BE	DK	FR	AT	BE	PL	JP
FR	IE	IE	SE	SE	DE	FR	FR	DE
US	HU	HU	IE	AT	SE	US	US	DK
HU	DE	SE	CZ	DE	IE	DK	DK	AT
BE	PL	PL	US	IE	FR	ES	DE	FR
ES	US	DK	DE	LU	PL	CZ	AT	CZ
DE	AT	FR	HU	PL	HU	IT	LV	¨HU
PL	LV	LV	ES	HU	LU	DE	CZ	LV
DK	ES	US	PL	ES	LV	HU	HU	LU
IT	IT	ES	LV	LV	ES	PL	ES	PT
GR	LU	LU	IT	US	US	GR	LU	IT
LV	GR	IT	PT	PT	PT	PT	PT	ES
PT	DK	PT	GR	IT	IT	LV	IT	GR
LU	PT	GR	LU	GR	GR	LU	GR	*

Statistically significantly better than the Czech Republic
No statistically significant difference
Statistically significantly worse than the Czech Republic

Note: * the United States is not included – data for reading literacy from 2006 are not available. Source: OECD (2001a);. OECD (2004a); OECD (2007c).

This data indicate that the Czech Republic's performance is relatively stable – a positive sign when it comes to mathematical and scientific literacy, but with reading literacy it will be important to pay attention to the reasons for the unsatisfactory results. The traditional Czech language curriculum does not place enough emphasis on working with texts in the sense of reading literacy. Nevertheless, curricular reforms have brought some changes, with the reforms placing greater emphasis on working with information. However, it will be some time before we can expect Czech students to show better results.

Development of mathematical literacy

The development of mathematical literacy between 2000 and 2003 can only be partially estimated. The overall score cannot be compared, since the two testing scales used in 2000 (Space and shape and Change and relationships) were augmented by two more in 2003 (Quantity and Uncertainty). The results for the two scales from 2000 were recalculated in 2003 in order to make it possible to compare the 2003 results for the same scales. Between 2000 and 2003, we can thus only compare these two content areas. The third survey in 2006 was based on the methodology for assessing mathematical literacy used in 2003, thus ensuring that the results for 2003 and for 2006 can be easily compared.

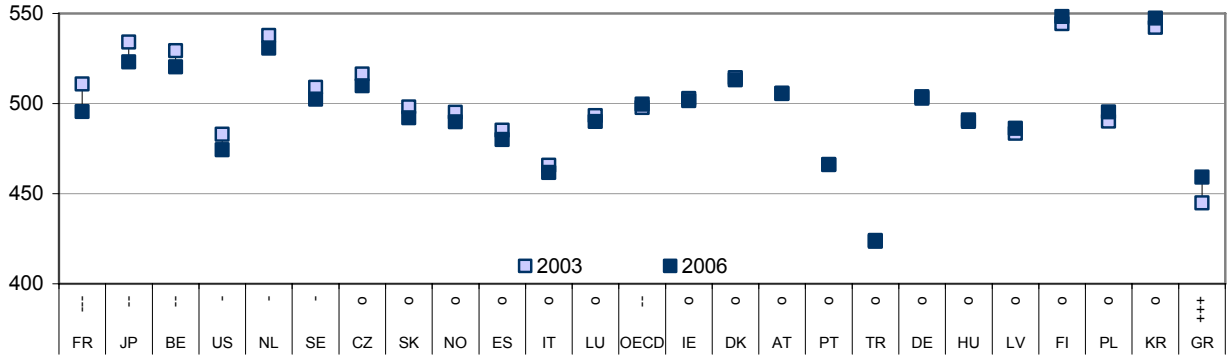
Between 2000 and 2003, the average performance for all 25 OECD countries remained almost unchanged in the area of **Space and shape** (494 points in 2000, 496 points 2003). The Czech Republic's results improved over the year 2000 from 510 to 527 points. Other countries with increased performance are[3] Latvia, Belgium, Poland, Italy, Korea and Germany. Changes in other countries' performance were statistically insignificant. In the area of **Change and relations**, the OECD average improved from 488 to 499 points between 2000 and 2003. The Czech Republic, Latvia, Belgium, Poland, Korea and Germany recorded improvement on this scale, as did Portugal, Spain, Hungary, and Finland. The Czech Republic increased its performance from 484 to 515 points – the second best improvement among the countries surveyed (Poland showed the best improvement). The other countries did not show any statistically significant change. The significant improvement shown by Czech students placed them among those students whose results were above the OECD average.

Thanks to the introduction of two new scales in 2003 – **Quantity** and **Uncertainty** – the 2003 results showed one of the weaknesses of Czech mathematics education. While Czech students scored above-average results on three scales (Space and shape, Change and relationships, and Quantity), in Uncertainty they only managed average results. This is understandable considering the fact that, unlike arithmetic for instance, the Czech mathematics curriculum for primary-level education does not spend much time on statistics and probability.

The development of the overall score for mathematical literacy between 2003 and 2006 shows that no further improvement occurred. In fact, the Czech Republic's performance declined by 7 points from 2003 – a statistically insignificant difference. The Czech Republic thus definitely did not show any improvement in the level of mathematical literacy between 2003 and 2006. A statistically significant decline in performance was recorded primarily in economically advanced countries such as France, Japan, Belgium, the United States, the Netherlands and Sweden. The only country to improve its performance was Greece (see Figure 4).

[3] Of the countries which participate in the PISA surveys, we have chosen only EU countries. For a comparison with advanced countries from other continents, we include the United States, Japan and Korea.

Figure 4: Mathematical literacy (overall score) – difference between 2003 and 2006



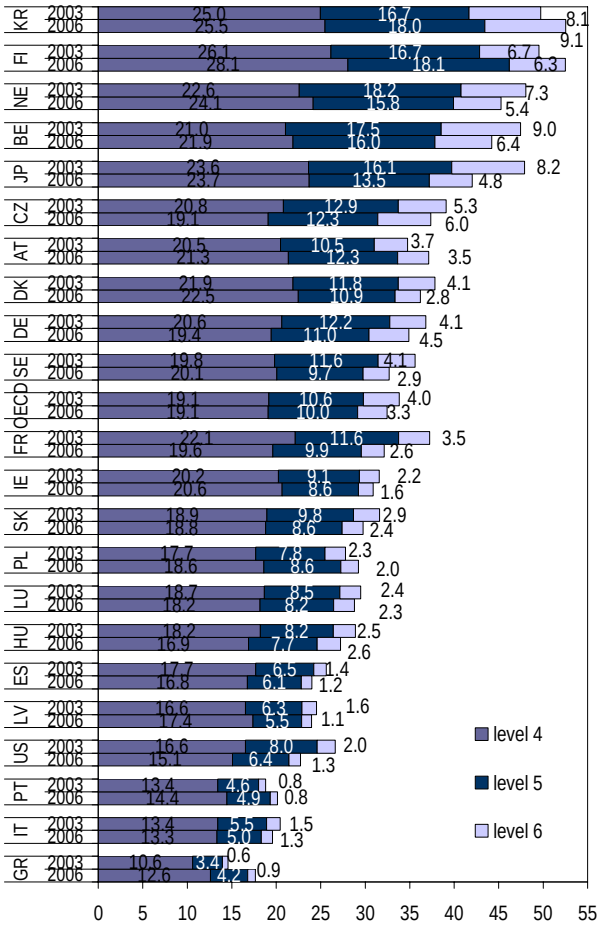
Note: Countries are ordered by the size difference in the average result for mathematical literacy in 2003 and 2006. +++ - statistically significant increase at a level of 99 %, --- - statistically significant decline at a level of 99 %, -- - statistically significant decline at a level of 95 %, - - statistically significant decline at a level of 90 %, o – no statistically significant difference. Source: OECD (2007b).

Figure 5 shows the share of students in each country to achieve the **three highest levels** of mathematical literacy in 2003 and 2006, with the countries ranked by the results for 2006. The Czech Republic ranked relatively well, taking sixth place behind Korea, Finland, the Netherlands, Belgium and Japan. Since 2003 there has been a slight increase in the share of children to reach the highest level, level six (from ca. 5 % in 2003 to ca. 6 % in 2006). A more visible and significant phenomenon, however, is the decline in the share of students in the second and third best levels, with level 5 seeing a decline from ca. 13 % to 12 % and level 4 seeing a decline from ca. 21 % to 19 %. The overall percentage of children in the three best levels thus decreased from ca. 39 % to 37 %. For now, this is not a significant decline, but it is important that this decline not become a permanent trend. Should this occur, it would become necessary to focus attention on developing the potential of children with above-average (though not the best) results. In some advanced or rapidly growing economies – Finland, Korea, Greece – the proportion of children to reach the best levels increased between 2003 and 2006 (in all cases by ca. 3 percentage points). Most advanced countries, however, showed a decline in the share of students in these categories, in some cases a much more significant decline than in the Czech Republic (Belgium, the United States, France, Japan by 3-6 p.p. – see Figure 5).

In order to understand the overall situation, it is important to have an overview of the other end of the performance spectrum, i.e. the **lowest levels of mathematical literacy.** Here, the figures do not speak in the Czech Republic's favour. Since 2003, the Czech Republic has seen an increase in the share of children who failed to reach a level higher than level 2 – a growth by 3 p.p. (from 37 % in 2003 to 40 % in 2006), with the greatest increase among those children who failed to do better than level 1 (by ca. 2 p.p.). Among the countries surveyed, this is the second highest increase in the share of pupils with extremely poor results.

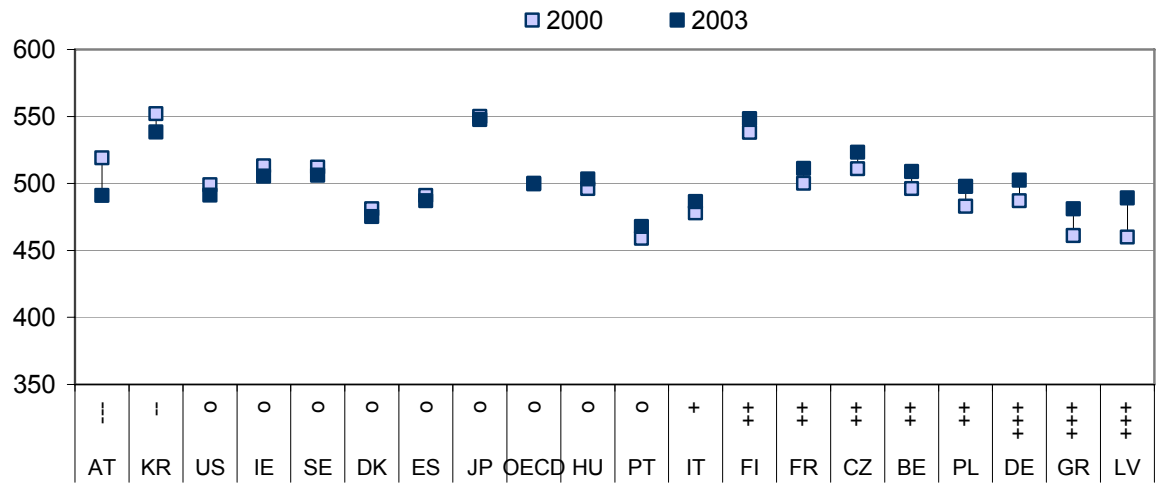
The decline in the Czech Republic's overall mathematical literacy in 2006 is caused primarily by the fact that there has been an increase in the number of children to achieve extremely poor results and a slight decrease in the number of above-average children. From two tests performed at different times, it is not possible to clearly state whether this is a stable trend or merely a temporary fluctuation. It does, however, represent a clear signal to the educational system that more attention needs to be paid to encouraging interest in mathematics not only among truly mathematically talented students, but also among students who, if properly guided and motivated, can achieve above-average results. On the other hand, we should not forget about the students with poorer results, who – without a motivating environment – may end up lacking even basic competencies, with all the negative impacts for success at work and in social life.

Figure 5: Development in the proportion of pupils to reach the three best levels of mathematical literacy (in %)



Note: Countries are ordered by the percentage of students in the three best levels for 2006. Source: OECD (2007b); OECD (2004b)

Figure 6: Scientific literacy – difference between 2000 – 2003



Note: Countries are ordered by the size difference in the average result for scientific literacy in 2000 and 2003. +++ - statistically significant increase at a level of 99 %, ++ - statistically significant increase at a level of 95 %, + - statistically significant increase at a level of 90 %, - - statistically significant decline at a level of 90 %, -- - statistically significant decline at a level of 95 %, --- - statistically significant decline at a level of 99 %, o – no statistically significant difference. Source: OECD (2004a).

Development of scientific literacy

Most of the test items used for testing scientific literacy were the same in 2003 as in 2000, but for methodological reasons the data from the most recent testing in 2006 cannot be added. Between 2000 and 2003, the average result for the 25 OECD countries for which comparable data is available remained unchanged (500 points). Figure 6 shows the change in performance for the individual countries. The Czech Republic is one of nine countries examined with a statistically significant increase in performance (the others are Belgium, Finland, France, Germany, Greece, Italy, Poland and Latvia). The Czech Republic's overall score increased from 511 to 523 points – the sixth best improvement. Only Austria and Korea recorded a significant decline in performance; in the other countries, the change was not statistically significant.

The 2006 ranking shows that in the Czech Republic the positive trend in the level of scientific literacy did not continue (see Table 4). When implementing changes to the educational system, it will thus be important to make sure that any increased focus on the weaker areas does not reduce the quality of instruction in traditionally strong areas.

The first two surveys (2000 and 2003) did not divide the scale of scientific literacy into proficiency levels, meaning that there are limited possibilities for assessing the changes in the distribution of students' score. For a basic orientation, we may use changes in percentile values. Table 5 contains the statistical significance of positive or negative changes.

In the Czech Republic, as well as in Belgium, Finland, France, Germany, Italy and Poland, the increase in overall average score is primarily a result of increased performance by students in the top half of results (75th, 90th and 95th percentile), i.e. improvement on the part of the good students. There is no statistically significant difference among Czech students with lower scientific literacy. At the same time, this result means that there was an increase in the difference between good and poor students. For the future, it is important that the level of the poorer students not begin to decline further in this area.

Table 5: Scientific literacy – a comparison between 2000 and 2003 – differences in percentile values

	Percentile						
	5.	10.	25.	50.	75.	90.	95.
LV	+++	+++	+++	+++	+++	+++	++
GR	o	o	++	+++	+++	+++	+++
DE	o	o	o	+++	+++	+++	+++
PL	o	o	o	++	++	++	+++
BE	+	o	o	++	++	++	++
CZ	o	o	o	++	+++	+++	+++
FR	o	o	o	++	+++	+++	+++
FI	o	o	o	++	+++	+++	+++
IT	o	o	o	+	+++	+++	+++
PT	o	o	o	o	+	+	+
HU	o	++	+	o	o	o	o
OEC	--	--	o	o	o	++	+++
JP	--	--	--	o	+	+++	+++
ES	-	-	o	o	o	o	o
DK	o	o	o	o	o	o	o
SE	---	---	-	o	o	++	+
IE	o	o	o	o	o	o	o
US	o	o	o	o	o	o	o
KR	---	---	---	--	o	o	++
AT	---	---	---	---	---	---	--

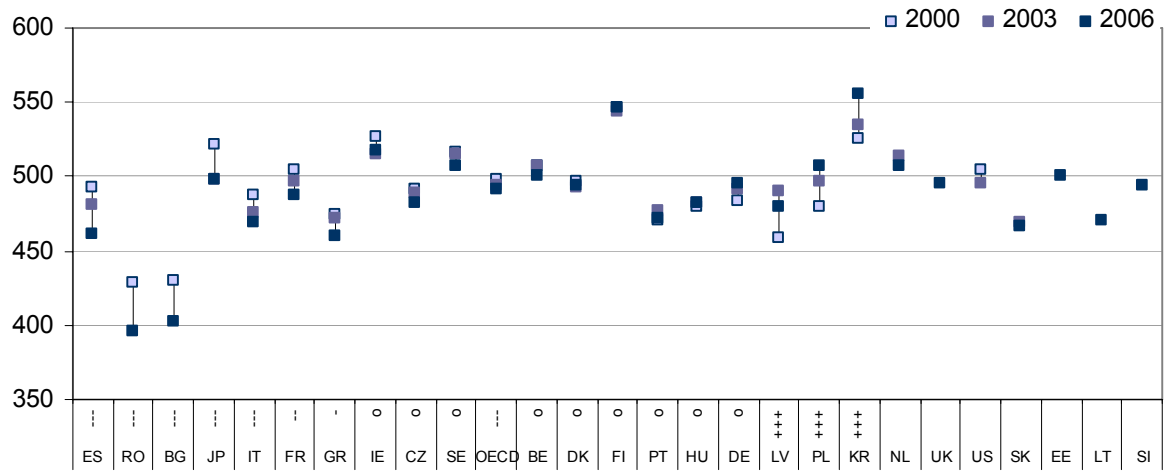
Source: OECD (2004b); OECD (2001b).

Development of reading literacy

Reading literacy was tested extensively in 2000, and in subsequent years test tasks were selected in such a manner so that the results could be compared. The average result for 2000 was assigned the value 500 and serves as a baseline for measuring subsequent years.

Figure 7 shows the overall score for reading literacy. The OECD average has decreased as a result of new countries with poorer results joining the PISA survey. The average of countries whose data from both the surveys (2000 and 2006) can be compared has remained almost unchanged.

Figure 7: Reading literacy – development from 2000 to 2006



Note: the graph does not contain data for Austria – it was not possible to determine the statistical significance of difference. +++ - statistically significant increase at a level of 99 %, - - statistically significant decline at a level of 90 %, -- - statistically significant decline at a level of 95 %, --- - statistically significant decline at a level of 99 %, o – no statistically significant difference. Source: OECD (2007b); OECD (2004b); OECD (2001b).

The Czech Republic's performance declined by 9 points, which is not a statistically significant decline. In this context, a highly interesting development is the marked improvement in reading literacy in two other post-communist countries, Latvia (21 points) and Poland (an impressive 29 points). After Korea, Poland had the second best improvement among the surveyed countries.

Since the start of measurement in 2000, reading literacy has been divided into five proficiency levels. The Czech Republic shows a clear trend in increased differences between high and lower levels of performance: while the share of students of reading literacy increased from 6 % to 10 %, and the percentage of students at level one increased from 11 % to 15 %. This is highly inauspicious news for the Czech educational system. Students who are incapable of meeting basic school assignments involving reading literacy will have limited opportunities for succeeding at higher levels of education and may have difficulties on the employment market in the future.

Developments in other countries frequently take a very different turn. Korea or Poland, for instance, have in recent years been highly successful in systematically increasing the level of reading literacy across all levels of performance, i.e. both good and poor students are showing improvement. Considering its similar recent history and geographical and cultural proximity, Poland in particular may serve as an interesting inspiration for the Czech Republic. On the other end of the spectrum, other advanced countries such as Japan or Spain are facing a decline in the share of students at the best levels and an increase in the share of students at the lowest levels. Neighbouring Austria shows a somewhat similar trend as the Czech Republic – an increase in the differences between good and poor students.

The size of the gap between the best and poorest students can serve as one important indicator for classifying educational systems. If reforms are targeted at excellent and average students, any increase in average results may be considered as leaving behind the poorest students, thus increasing the gap between the best and the poorest students. On the other hand, reforms which focus on those students who are lagging behind may result in an improvement in average results and a decrease in the difference among students. An ideal approach would combine good overall average results and small differences among students. This should be the aim of the reform of the Czech educational system.

to reach the best level (level 5) increased from 7 % to 9 % (see Figure 8), the share of students to reach the second highest level (level 4) declined from 20 % to 19 %, and the share of students to reach level 3 declined from 31 % to 25 %. We thus see a similar trend as for mathematical literacy, and here too we may state that increased attention should be paid to students with average to above-average results in order to prevent their tumbling into below-average categories.

There was significant growth in the **lower levels of literacy**. The proportion of students who failed to reach the basic level

Reading literacy as a general precondition for study

From an analysis of the correlation between the various types of literacy and the number of tertiary education students and graduates in the individual countries, it would seem that reading literacy as measured by the PISA surveys expresses a set of capabilities that is important for successfully managing tertiary studies – including technical fields for which we would be more likely to presuppose a higher correlation with mathematical and scientific literacy (see Table 6).

The analysis looked at data on the number of tertiary education students and graduates in 2006[4] and at data from the PISA 2000 survey, since the age group of students tested in that year reached tertiary education age age in 2006. Data on graduates applies to an age group which was older than 15 in 2000 and was thus not tested by the PISA survey, but in view of the fact that we are talking about only a few years'

[4] Source: Eurostat: Population and Social Conditions, Education and Training 2006 (July 2008).

Table 6 : Correlation of PISA 2000 results with number of tertiary education graduates

	Correlation with country's PISA 2000 mean performance		
Students/graduates ISCED 5-6 (2006)	mathematics	science	reading
Students of technical and scientific disciplines as a % of all students	0.05	0.21	0.29
Gaduates in technical and scientific disciplines as a % of all disciplines	0.29	0.28	0.33
The share of graduates in technical and scientific disciplines in 1000 citizens aged 20-29	0.47	0.44	0.61
The share of graduates aged 20-29 in 1000 citizens aged 20-29 *	0.28	0.33	0.49

Note: * no data for US, JP, FR, IE. Source: Eurostat (2006d), červenec 2008; OECD (2001a).

difference, we may assume that differences in students' average performance did not change in any dramatic manner. Also analysed was the relation between students' results on the various scales and the share of tertiary education graduates in the relevant age group, as well as the share of students studying technical fields in the group of all students.

The results show that the better a country did on the reading literacy scale, the higher the share of tertiary education graduates, regardless of area of study, in the relevant age cohort (correlation coefficient 0.49). The science and mathematical scales show the same, though weaker, positive dependency (correlation coefficient 0.33 and 0.28).

It was also found that all types of literacy correlate with the percentage of students/graduates of technical and scientific disciplines, while reading literacy shows a stronger correlation than the other scales. Countries in which students achieve good results have a high number of students/graduates of technical and scientific disciplines at the level of tertiary education. This result was confirmed even when the number of students/graduates of technical and scientific disciplines was correlated not to the relevant age cohort, but to the total number of tertiary education students/graduates. It thus results that success in the PISA tests correlates to a higher preference for technical and scientific disciplines or their higher relative representation in the country's tertiary education system.

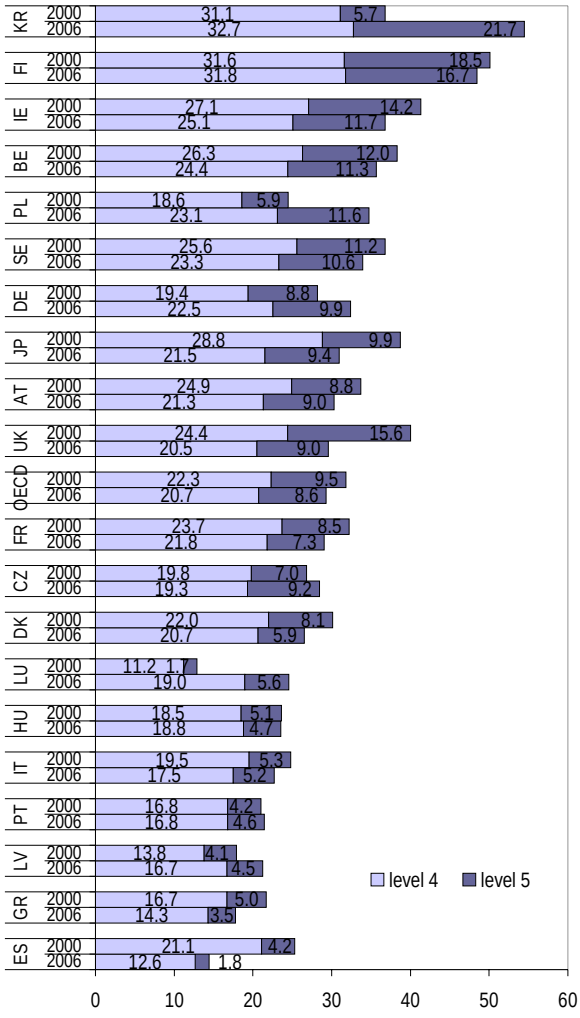
Influence of parents' education on students' scores

The extent to which students' results depend on their parents' level of education is expressed as the percentage of the variance in students' performance that can be explained by their parents' education. According to the results of the PISA survey, in the Czech Republic this dependency showed a marked decline in all three surveyed domains. In 2000, 13 % of the variance in mathematical literacy could be explained by parents' education, while in 2006 this figure was a mere 6 %. Scientific literacy saw a decline from 11 % to 5 % and reading literacy went as far as from 14 % to 3 %. In all three cases, this is the greatest decline among all surveyed countries. The decline was not steady over time, with the greatest change occurring between 2003 and 2006.

A more detailed analysis of data from the PISA survey has shown that, although direct influence of parents' educational attainment is on the decline in the Czech Republic, other factors related to a family's socio-economic status are strengthening. Specifically, parents' jobs and the family's cultural capital (the presence of cultural goods in the household) are increasingly influential.

A more detailed analysis has shown that the dependency between performance and parents' education is loosening across the entire field of performance. Children whose parents have a lower level of education are improving, while children whose parents have a higher level of education are showing worse results. In addition, tertiary education is becoming more accessible than in the past, which may result in a greater variability in results among children of tertiary educated parents.

Figure 8: Development of proportion of students in the two highest levels of reading literacy from 2000 to 2006 (in %)



Note: countries are ordered by percentage for 2006. Source: OECD (2001a); OECD (2004b); OECD (2007b).

We should also point out that we are "only" dealing with the level of performance among fifteen-year-old students. Their future educational career may be influenced by their ambitions, their parents' views, by role models in the family or many other factors. We thus cannot state unambiguously that a decline in influence of parents' education on their

children's performance will result in a higher level of inter-generational educational mobility in the sense that a child's level of education will be independent of the parents' level of education. The facts identified do, however, offer a platform from which we may consider identifying and promoting talented students who show good performance at age fifteen but whose family and social environment do not predispose them to a corresponding educational career.

Other countries with a relatively significant decline in the influence of parents' education include Denmark, Germany and Austria. Of the post-communist countries for which data is available, a similar decline in this dependency exists in Hungary. Poland and Latvia do not show a clear trend, with only a slight change in figures.

1.2 Educational attainment and education mobility

The level of educational attainment of the population plays an ever increasing role due to the growing demands placed on individuals in connection with their chances in the labour market as well as their active participation in community life. Better educated people can acquire new skills more easily and apply them in practice. In addition to this, they are usually more demanding as consumers and therefore stimulate technology development and innovation.

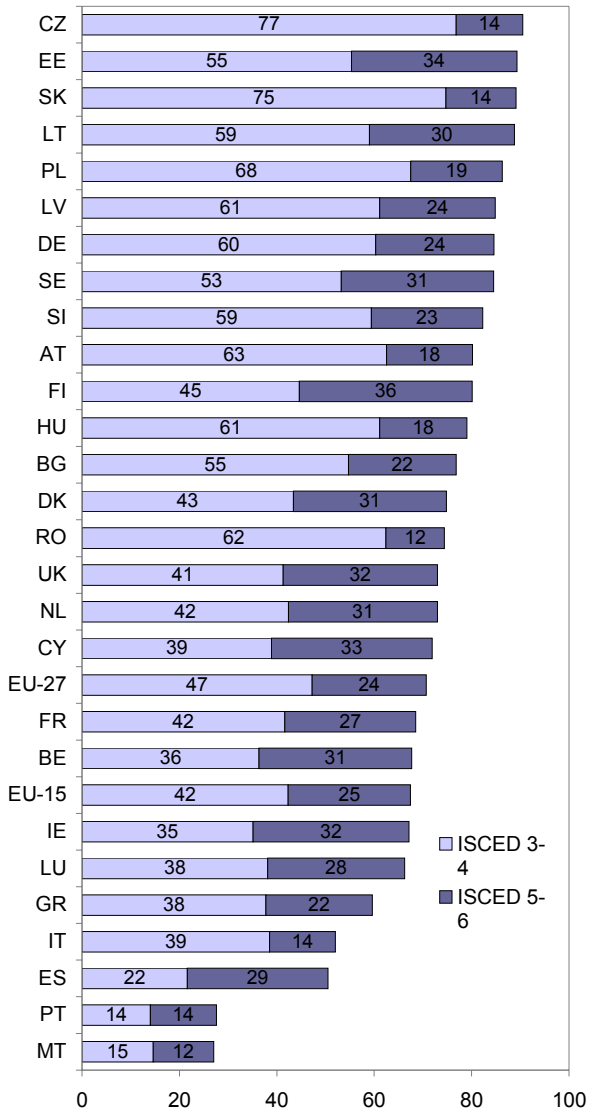
The following subchapter deals with the quality of human resources expressed by the educational attainment of adult population and the labour force in various industries. Following a comparison between junior and senior age groups, education mobility is discussed and its future development forecasted based on the projection of the number of graduates for the upcoming five-year period. Participation of adults in continuing education, which plays an indispensable role in enhancing the educational attainment of the population, is analysed. The section concludes with a brief discussion on the rate of drop-out in the education system.

The educational attainment of adult population

In terms of comparison with other European countries, the Czech Republic has a very high **proportion of population with at least upper secondary education** (ISCED 3 and higher). In 2007, almost 91% of population aged 25-64 acquired at least upper secondary education. This places the Czech Republic at the forefront of Europe and above the reference line of 80% of the population aged 25-64 with at least upper secondary education, along with another ten countries. This line represents the target for the whole EU to be fulfilled as part of the Lisbon Strategy by 2010. In 2007, the proportion of population with at least upper secondary education was 71% in the EU-27 and only 67% in the EU-15. A higher proportion of population with at least upper secondary education in Europe is achieved by new Member States, particularly the post-Communist countries, as well as some countries of the Northern and Central Europe. The results in Malta and Portugal are the least favourable (see Figure 9).

The high proportion of people with completed upper secondary education in the Czech Republic is accompanied with the low **proportion of people with tertiary education**. In the EU-27, the proportion of people with tertiary education in the 25-64 age group was 24% in 2007, while in the Czech Republic it was only 14%. The Czech Republic thus came last but five among the EU countries. However, when comparing the educational attainment of the population in different countries, one needs to take into account the differences between education systems. It is peculiar to the education system in the Czech Republic that specialized education, attained only at tertiary level in other countries, can be completed as early as upper secondary level. Czech education standards have recently been converging to the European ones[5] but there is a multitude of middle-aged and older employees with secondary education whose qualifications correspond to tertiary education degrees in other European countries.

Figure 9: Proportion of population aged 25-64 with completed upper secondary and tertiary education (2007, %)



Source EUROSTAT (2007c), table code lfsq_pgaed, 27. 2. 2008, own calculation.

The **development of educational attainment in the Czech Republic** (see Table 7) shows some significant trends. The proportion of people who attained at most lower secondary education is steadily decreasing. In 2000, 14% of population aged 25-64 completed only basic school; in 2007, it was only 9%. At that time, the age groups born during WWII began to leave the labour market. These groups are rather strong and

[5] Nurse education would be a typical example. Nurses get their qualifications at the tertiary level starting from 2004/5; until then, they received their qualifications already when they completed the secondary school (Act No. 96/2004 Coll.).

have a high proportion of people with at most lower secondary education (over 20%). The rapid decrease in the proportion of people with at most lower secondary education in the population aged 25-64 can be expected to continue also in the coming years as post-war generations will be leaving the productive age.

Complementary to this phenomenon is an increase in the proportion of people with upper secondary education and the even more dynamically growing number of people with tertiary education. The proportion of people with tertiary education in the population aged 25-64 recently increased from 11% in 2000 to 14% in 2007. Among people with upper secondary education the share of ISCED 3C is decreasing and the proportion of ISCED 3A is growing.

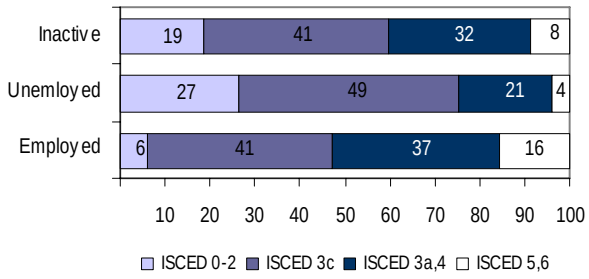
Table 7: Educational attainment of the population aged 25-64 in the Czech Republic (%)

	2000	2003	2007
ISCED 0-2	14.0	11.6	9.5
ISCED 3C	42.9	43.4	41.4
ISCED 3A	32.1	33.0	35.4
ISCED 5-6	11.0	11.9	13.7
Total	100.0	100.0	100.0

Source: ČSÚ (2000); ČSÚ (2003b), ČSÚ (2007b), own calculation.

The educational attainment of employed people is higher than that of the adult population as a whole. All groups, regardless of their economic activity, have a similar proportion of people with upper secondary education, while differences are seen particularly at both ends of the educational attainment scale (see Figure 10). In 2007, there were 16% of people with tertiary education among employed people and only 4% and 8%, respectively, among those unemployed and inactive. Only 6% of employed people have at most lower secondary education, while 19% among those inactive and 27% among those unemployed. More educated people are obviously better motivated to economic activity; at the same time, they find it easier to get a job and they are less frequently unemployed.

Figure 10: Educational attainment of the population aged 25-64 in the Czech Republic by economic activity (2007, %)

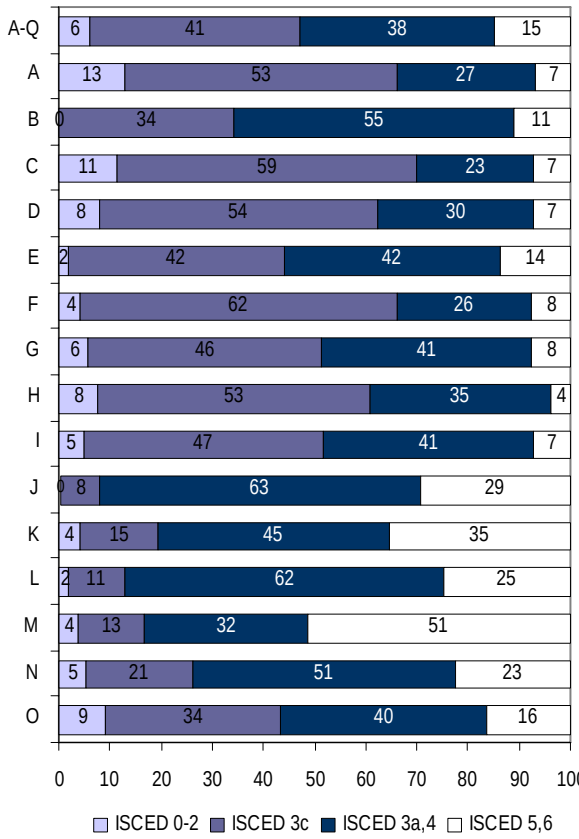


Source: ČSÚ (2007b), own calculation.

Educational attainment by industry

Although in total, people in employment are clearly more educated than the population as a whole, situation in various industries considerably differs (see Figure 11). **The industries with the highest proportions of people who attained upper secondary education with "maturita" exam (ISCED 3A) or tertiary education** in the Czech Republic are: financial intermediation (J; 92%), public administration and defence (L; 87%), education (M; 84%) and real estate, renting and business activities (K; 81 %). These four industries also have the highest proportions of people with tertiary education, although their ranking differs in this respect.

Figure 11: Educational attainment in the Czech Republic by industry (2007, %)



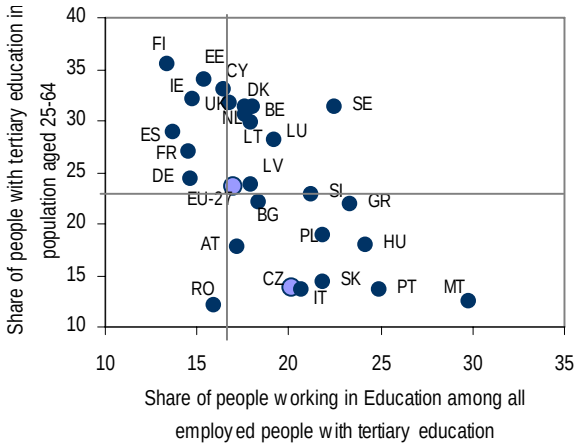
Note: The industries P and Q are not shown separately due to low representation, and therefore low reliability of data. Source: ČSÚ (2007b), own calculation.

In terms of industries, the highest proportion of people with tertiary education in total employment can be seen in education (51%), and this industry is also the strongest as regards the allocation of the labour force with tertiary education. 20% of all working people with tertiary education worked in education in 2007. The high proportion of people with tertiary qualifications in this industry is certainly positive as an investment for the future. Only highly qualified teachers can provide good quality education, thereby making a positive impact on the future development of educational attainment of the whole population. At the same time, however, high allocation of people with tertiary education in the education sector may result in a lack of qualified labour force in other industries.

In other European countries, the proportion of people with tertiary education working in the education sector in the total number of people with tertiary qualifications ranges from 13% in Finland to 30% in Malta. The proportion of people with tertiary education in the adult population of a country negatively correlates with the proportion of its allocation in the education industry (correlation coefficient 0.607). This means that the higher the proportion of people with tertiary education in a country, the lower the percentage of those who work in the education industry and the higher the number of people who work in other industries. The Czech Republic shows the opposite trend, with a relatively low proportion of people with

tertiary education who are largely employed in the education industry (see Figure 12).

Figure 12: Correlation between the proportion of people with tertiary education and the proportion of people with tertiary education working in education (2007, %)



Source: EUROSTAT (2007b), own calculation.

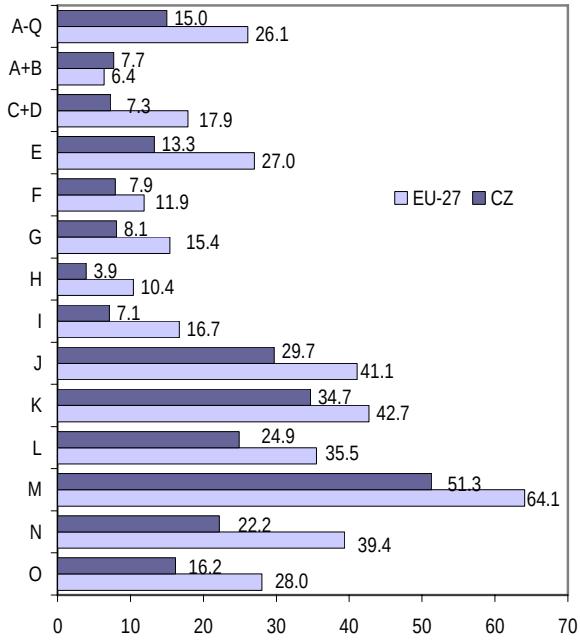
The low **proportion of highly qualified labour force in production** is connected to the low level of skills intensity of these industries, a limited share of research activities in companies, limited innovation dynamics as well as a lack of people with tertiary technical education. The proportion of younger people (up to 39 years of age) with tertiary education working in manufacturing does not grow sufficiently either. The proportions of people with tertiary education working in the service sector, particularly real estate, rental and business, are growing faster. In 2007, 28% of all employed people worked in manufacturing in the Czech Republic but only 14% of the total number of people with tertiary education. By comparison, manufacturing in the EU-27 employs 18% of total employment and 13% of all employed people with tertiary education. Given that manufacturing plays a major role in the Czech economy, its low skills intensity may become a hindrance for future development of competitiveness of the economy as a whole.

Overall, the Czech Republic is among the countries with the lowest proportion of people with tertiary education in the whole EU-27. There is 15% of people with tertiary education in Czech economy, while it is 26% in the EU-27. Some industries lag behind the EU average considerably less than other industries as regards the proportion of people with tertiary qualifications (see Figure 13).

In the Czech Republic, 35% of people with tertiary education work in real estate, rental and business industries (K), which is more than 80% of the EU average. Moreover, as regards the proportion of people with tertiary education, the industries nearest to the EU-27 average include education, financial intermediation, public administration and defence as well as construction. All these industries lag behind the EU average by not more than a third in the share of people with tertiary education. Given that upper secondary education is a commonplace in the Czech Republic, there is a significantly lower proportion of people with only lower secondary education in all these industries. Their competitiveness in Europe in terms of educational attainment could thus be more promising than that of other industries.

However, the persistent problem is that the **growth rate of the proportion of people with tertiary education** in these industries (except for education) in the Czech Republic is still lower than in the EU-27. The average year-on-year growth rate of the number of people with tertiary education in financial intermediation was 1.1% in the Czech Republic in the period of 2003-2007, while it was 4.8% in the EU-27. Unless the proportions of people with tertiary education in these industries grow faster, even those industries that are currently closest to the EU average will be increasingly lagging behind.

Figure 13: Proportion of people with tertiary education in the Czech Republic and the EU-27 by industry (2007, %)



Note: Industries P and Q are not shown separately due to low representation, and therefore low reliability of data. Source: EUROSTAT (2007b), own calculation.

The fastest growth in the proportion of people with tertiary qualifications occurred in hotels and resturants, electricity, gas and water supply, manufacturing, mining, transport and telecommunications. In all these industries, the proportion of people with tertiary education grew faster than the EU-27 average, but even this growth rate will probably not be sufficient for the Czech Republic to catch up with the EU average numbers in these industries in the near future.

Agriculture is an exceptional industry in the Czech Republic, with the proportion of people with tertiary education being above the EU average. However, it needs to be taken into account that agriculture in the Czech Republic is not very significant in terms of employment. The proportion of people with tertiary education in all the other industries is roughly half the EU average. The worst situation is in the hotels and restaurants industry, where the proportion of people with tertiary education is only 38% of the EU average.

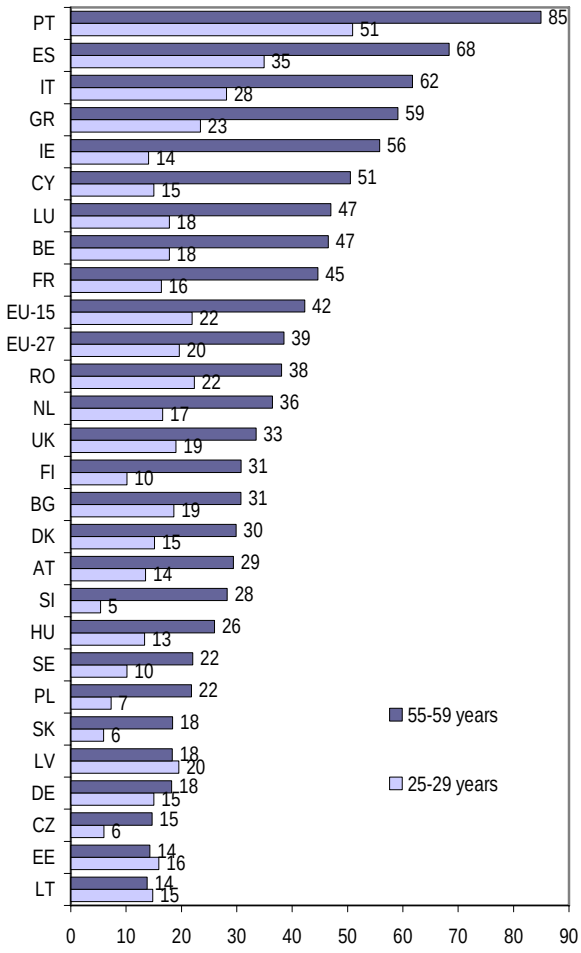
Education mobility

The growing education mobility of people is a precondition for increasing the educational attainment levels of the population. A rising education mobility is considered to occur when children have a higher level of educational attainment than their parents and, at a macro-level, when the educational

attainment level of younger age groups is higher than that of older age groups.

In the EU context, the Czech Republic is among the countries with the lowest proportion of people with the highest education attained at the ISCED 0-2 level (at most lower secondary education), both in the group aged 55-59 and in the young population aged 25-29 (see Figure 14). Furthermore, the Czech Republic, similarly to e.g. Poland and Slovakia, still demonstrates a growing education mobility, when the proportion of people with at most lower secondary education in the group aged 25-29 being still significantly lower than in the group aged 55-59 (6% vs. 15%). On the contrary, the trend of growing education mobility to the level of at least upper secondary education is not achieved, for instance, by the Baltic states and Germany. These countries have a very low proportion of people with at most lower secondary education in the group aged 55-59 but the same proportion is constantly maintained in the group aged 25-29. In some Member States, particularly those more developed, the lower education mobility is caused by an inflow of immigrants from less developed countries, who often have low qualifications. In addition, the families of the immigrants usually do not provide their children with a background that would stimulate them to higher educational attainment levels, and therefore lower educational attainment levels persist also in the second generation of immigrants.

Figure 14: Proportion of people with the highest education attained at the ISCED 0-2 level in the groups aged 25-29 and 55-59 (2007, %)



Source EUROSTAT (2007b), own calculation.

Contrary to that, Slovenia and also Cyprus and Ireland show a steeply rising education mobility. They are among the countries with the highest proportion of people with at most lower secondary education level in the group aged 55-59. In the group aged 25-29, these countries only have 14% and 15% of the population with at most lower secondary education, which puts them above the EU average – i.e. at the same level as Germany, Austria or Denmark. The countries of Southern Europe (Portugal, Spain, Italy and Greece) also show a significantly growing education mobility, but their proportion of people with lower secondary education in the group aged 25-29 is still over 20%, in Portugal even 51%.

Monitoring **education mobility at the level of tertiary education** is more complicated in terms of methodology. The usual age of first university degree varies between countries and also develops over time. Another significant factor is whether the country has a predominantly two-cycle tertiary education system, where Bachelor graduates achieve their first university degree usually after three years of studies and can subsequently continue to achieve their Master degree, or a single-cycle system, where one needs to study 5-6 years to achieve his/her first (Master) degree. As part of the Bologna process, a number of countries including the Czech Republic are currently transforming their education systems from single-cycle ones to two-cycle ones (or three cycle ones, where Doctoral studies constitute the third cycle), which makes it difficult to analyse the development of the proportions of people with tertiary education in the younger age groups over time.

The following analysis compares the educational attainment of the population aged 55-59 with that of the population aged 25-29 and 30-34. However, when monitoring education mobility it is very difficult, for reasons stated above, to clear the real education mobility of the influence of a shift in the age characteristic for acquisition of a first higher education degree.

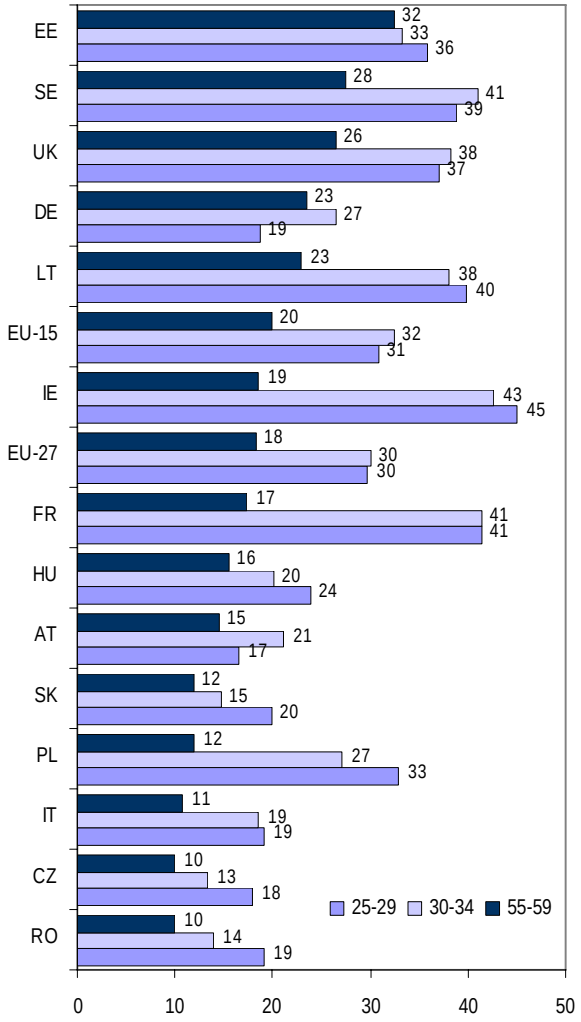
There has been a significant increase in education mobility at tertiary level in the Czech Republic since 2006. In 2007, 17% of people achieved tertiary education in the group aged 25-29 compared to less than 10% in the group aged 55-59. At the same time, the educational attainment of the population aged 25-29 is higher than in the group aged 30-34. This relatively fast growth can be attributed, to a large extent, to the tertiary education reform, in which most of the five- to six-year Master programmes were divided into a two-cycle system of Bachelor programmes and follow-up Master programmes. The majority of students achieve their university degree before they are 25 in Bachelor programmes and, as a result, the proportion of people with tertiary education in the group aged 25-29 is naturally growing. Along with an expanding provision of Bachelor programmes the range of tertiary programmes on offer and the capacity of tertiary education increases in general. As a result, the number of tertiary education graduates is growing in absolute terms (see Chapter 2.3). Given the fast-growing rate of participation in tertiary education, one can expect the education mobility to grow significantly and the educational attainment of the whole population to increase in the future.

The proportion of people with tertiary education in the Czech Republic is still among the lowest in Europe, and this is also true of the younger age groups. The proportion of people with tertiary education in the group aged 25-29 in the Czech Republic represents 178% of the proportion of people with tertiary education in the group aged 55-59, while in the EU-27 it is 162%. This means that education mobility in the

Czech Republic is slightly above the EU average. However, considering the initial values from which the countries start to develop, an even more dynamic growth rate would be necessary to achieve a proportion of people with tertiary education that would be comparable to Europe.

Figure 15 shows the proportions of people with tertiary education in the various age groups in selected countries. France, Ireland and Poland achieve the highest levels of education mobility. Contrary to that, for instance, Estonia has a similar proportion of people with tertiary education across all age groups. Education mobility is low here, but the proportion of people with tertiary education in all the age groups monitored is above the 30% threshold.

Figure 15: Proportion of people with the highest education attained at the ISCED 5-6 level in groups aged 25-29, 30-34 and 55-59 in selected countries (2007, %)



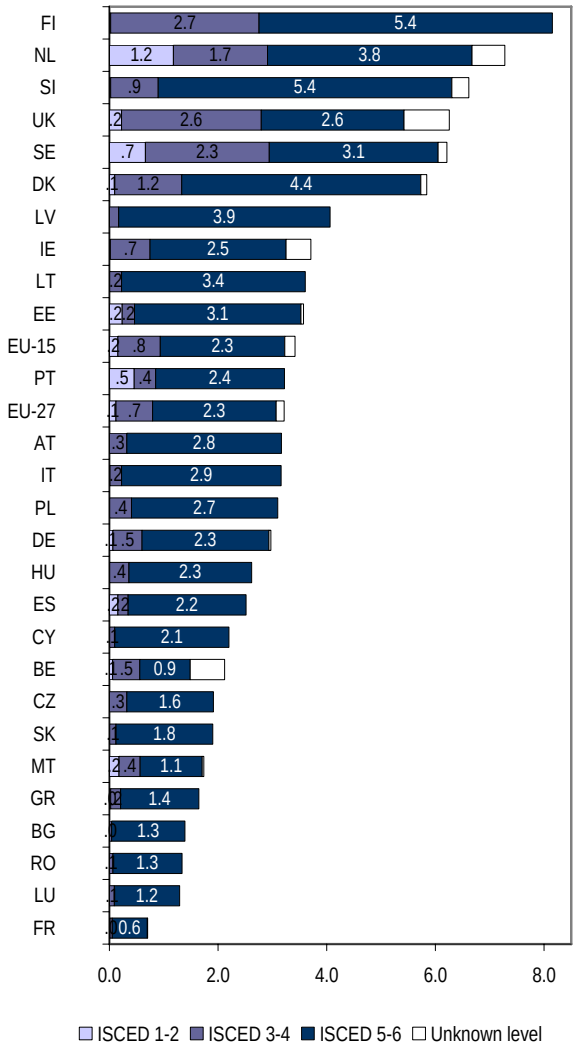
Source: EUROSTAT (2007b), own calculation.

Education mobility between the secondary and tertiary education has its natural limits when a certain level is achieved. If one assumes normal distribution of intelligence in the population, it is obvious that the proportion of people with tertiary qualifications cannot grow forever without tertiary education being devalued. Therefore, lower levels of mobility in countries that have a higher number of people with tertiary education also in the older age cohorts are natural. Also, some European countries are beginning to discuss the issue of over-qualification and it is yet to be determined whether the Czech Republic really needs to catch up quickly with the EU-15 in the proportion of people with tertiary education. In addition to increasing the proportion of people with tertiary education, it is equally important to address the issue of quality in tertiary education and field structure of graduates as there is a lack of graduates particularly in science and technology (see Chapter 2.3).

Participation in continuing education

A higher level educational attainment in younger age cohorts, that are gradually replacing the older and less educated cohorts in the labour market and in the whole population, is the main driving force behind growing education mobility. However, the level of educational attainment of the population can also be increased by enhancing the qualifications of people in the middle and older age groups by means of continuing education. Particularly at a time when the younger cohorts are beginning to be less populated than the cohorts of those leaving the labour market, and when the retirement age is being shifted upwards, continuing education is beginning to play an indispensable role in increasing the qualification levels of the labour force.

Figure 16: Proportion of people participating in various levels of formal education in the population aged 25-64 (2007, %)



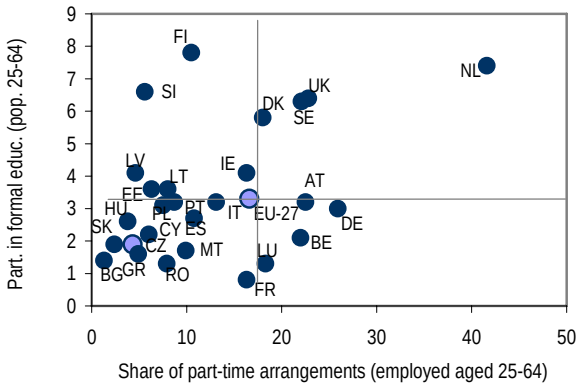
Source: EUROSTAT (2007b), own calculation.

Based on EUROSTAT methodology, the proportion of people who participated in education in the past 4 weeks in the group aged 25-64, is used as an indicator to measure the extent of continuing education in the population. The data from Labour Force Survey used to calculate this indicator unfortunately do not allow any distinction to be made between initial and continuing education. Thus, in younger age cohorts and in countries where people largely remain in initial education also after the age of 25, the indicator may distort and overvalue the scope of continuing education.

The educational attainment of an individual is directly enhanced by **formal education**, in which one's qualification increases at a nationally (or internationally) recognised levels. The highest proportion of participants of formal education in the population aged 25-64 (over 5%) can be found in the Scandinavian countries, the Netherlands, Slovenia and Great Britain (see Figure 16). In all these countries, there is a great proportion of adult participants not only in tertiary education, but also in higher secondary education. This indicates that high numbers cannot be explained exclusively by the fact that people complete tertiary education at a higher age, and it means that these are really countries with a high proportion of people participating in continuing education.

The Czech Republic is among the countries with the lowest rate of participation in continuing education. The proportion of participants in formal education in the population aged 25-64 is 1.9% in the Czech Republic and 3.2% in the EU-27. In terms of earnings differentiation, people in the Czech Republic should be highly motivated to increase the level of the qualification, particularly at tertiary level. The average earning of a person with tertiary education in the Czech Republic in 2002 represented 174% of the average wage of a person with upper secondary education. In Great Britain it was only 151% and in the Netherlands 149%. (See EUROSTAT: Structure of Earnings Survey 2002, own calculation.)

Figure 17: Correlation between the proportion of participants in formal education and the proportion of part-time work in the population aged 25-64 (2007, %)

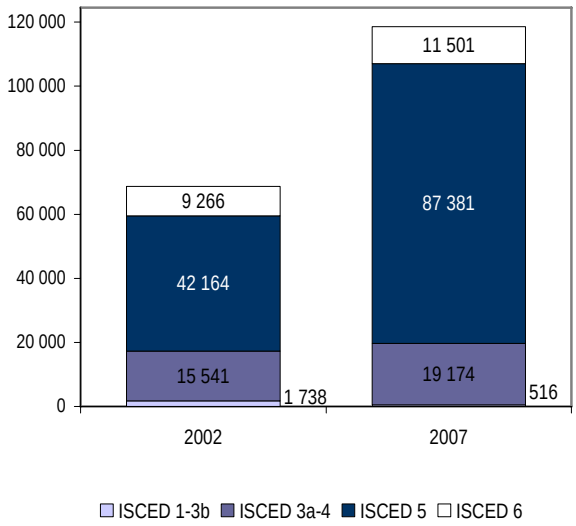


Source: EUROSTAT (2007b), own calculation.

Earnings differentiation by education is high in the Czech Republic and should motivate people to achieve higher levels of qualification. The fact that people do not largely increase their levels of qualification indicates the difficulties that people interested in continuing formal education are facing. One problem consists in reconciling work and study. Part-time work, which makes it possible to manage both work and study, is very unusual in the Czech Republic compared to other European countries, and participation in continuing education is thus hindered by a lack of labour market flexibility. The proportion of part-time work correlates with participation of adults in formal education in the various countries (correlation coefficient 0.418), although Finland and Slovenia, for instance, show that a high proportion of part-time work is not the only way to achieve a higher rate of participation of adults in continuing education (see Figure 17). Other options include e.g. support for employees in study programmes through the provision of paid leave by their employers etc.

The predominant portion of the population aged 25-64 involved in continuing education participates in tertiary education (ISCED 5), followed by upper secondary education at ISCED 3A level. The number of tertiary education students aged 25-64 according to Labour Force Survey grew twofold between 2002 and 2007 (see Figure 18). This growth cannot be attributed only to the increasing number of students who finish their initial education when they are over 25, since it also occurs in older age groups where a negligible proportion of students in initial education can be assumed. The significance of continuing education for education mobility between secondary and tertiary education is thus constantly growing. The number of students in upper secondary education in the population aged 25-64 compared to the number of tertiary education students increased only slightly (by less than 4 thousand) between 2002 and 2007. However, with the growing proportion of people who complete upper secondary schooling with "maturita" exam already as part of their initial education, even a slight increase in the number of participants in continuing upper secondary education represents an important contribution to education mobility.

Figure 18: Number of participants aged 25-64 at the different levels of formal education



Source: ČSÚ (2002); ČSÚ (2007b), own calculation.

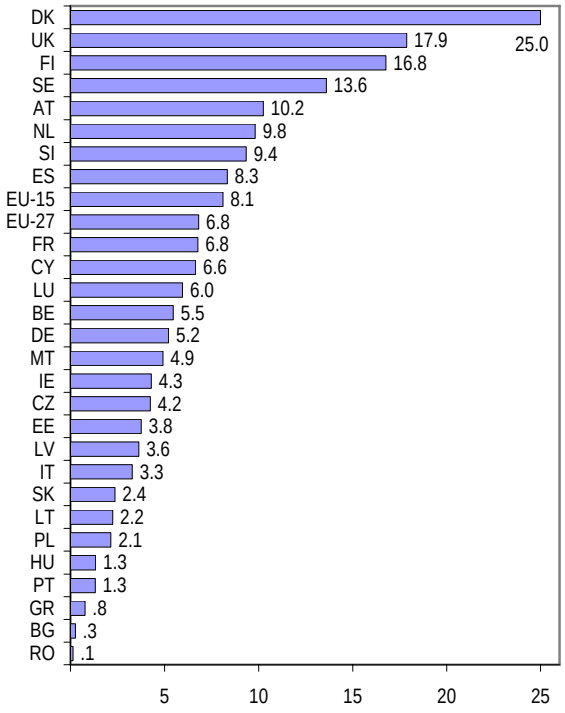
Non-formal education does not directly lead to a higher formal educational attainment of an individual and thus it is not immediately reflected by educational attainment indicators. However, its participants acquire new knowledge and skills that often go beyond the highest level of formal education they achieved.

Participation in non-formal education may become a basis for a future formal recognition of a qualification, and therefore it can become a means of increasing the education mobility of the population. Recognition of prior learning is only beginning to emerge in the Czech Republic and for that reason education mobility stemming from non-formal education and informal learning cannot be quantified. In most cases non-formal

education does not increase one's formal qualifications but, in fact, the participants' knowledge and skills are being updated and enhanced, which increases the qualification of the whole population, although this is not directly measurable. As a result, participation in non-formal education is a suitable ancillary indicator in the study of education mobility.

The Labour Force Survey measures participation in non-formal education in the last four weeks and the indicator is again related to the population aged 25-64. As Figure 19 shows, the Czech Republic ranks below the EU average in terms of participation in non-formal education. 4.2% of population aged 25-64 participated in non-formal education in the last four weeks in the Czech Republic and 6.8% in the EU-27. The countries of Northern Europe and Great Britain have the highest number of participants in non-formal education.

Figure 19: Proportion of participants in non-formal education in the population aged 25-64 (2007, %)

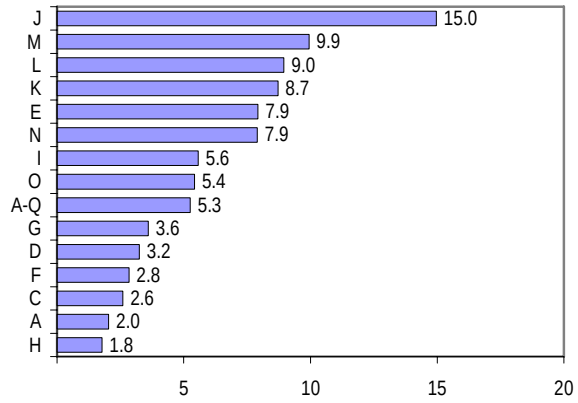


Source: EUROSTAT (2007b), own calculation.

There are significant differences between the various industries of the Czech economy in terms of participation in non-formal education (see Figure 20). The highest proportion of participants is in financial intermediation (15%), the lowest participation in hotels and restaurants (1.8%). However, the average number of hours that participants spent in non-formal education in the last four weeks was very similar across all the industries – between 10 and 13 hours.

Participation in non-formal education varies between industries even after the indicator is cleared of the impact of the most significant variables affecting one's participation in education. A number of surveys indicates that an individual's level of educational attainment and his/her profession, which is largely based on the level of educational attainment, are among the major characteristics that have an impact on participation in continuing non-formal education. The highest rate of participation in continuing education is among people with tertiary education, followed by people with upper secondary education with "maturita" and, in terms of occupation, people in demanding professions (KZAM 1-3). However, there are marked differences also within these groups with high participation depending on the industry (see Figure 21).

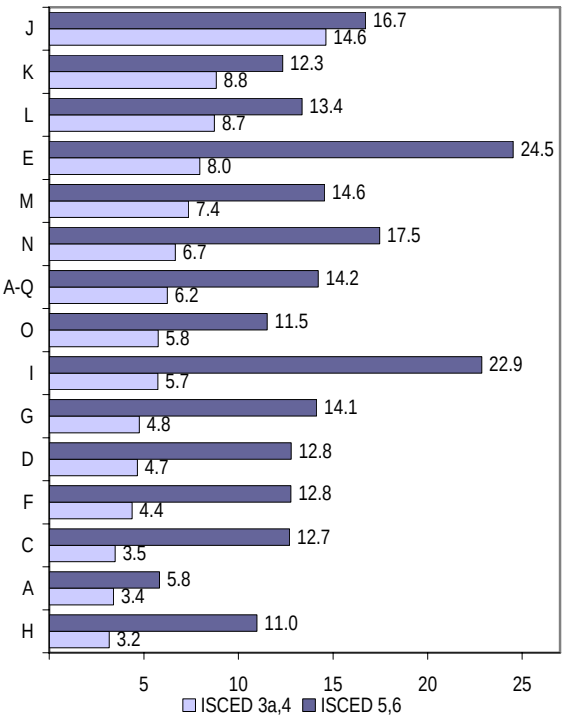
Figure 20: Proportion of participants in non-formal education in the population aged 25-64 by industry in the Czech Republic (2007, %)



Source: ČSÚ (2007b), own calculation.

Among people with tertiary education, the highest proportion of participants in non-formal education was in electricity, gas and water supply (E; 25 %), transport (I; 23 %) and financial intermediation (J; 17 %). Among people with upper secondary education with "maturita" (ISCED 3A), the markedly highest proportion of participants in non-formal education was in financial intermediation (J; 15 %), followed at a distance by real estate, renting and business activities (K), public administration and defence (L) and electricity, gas and water supply (E).

Figure 21: Proportion of participants in non-formal education in the population of people with tertiary education and ISCED 3A education aged 25-64 by industry in the Czech Republic (2007, %)



Source: ČSÚ (2007b), own calculation.

Future development of education mobility

Future development of education mobility may be estimated based on the projection of the number of graduates at various levels of education. Figure 22 shows the development of the number of graduates used in the ROA-CERGE model to project educational needs, a model developed in a project entitled Knowledge Society - Requirements on Human Resources Skills and Continuing Training (see Chapter 2.1). The figure shows the numbers of graduates from 2001 and a projection of their development between 2008 and 2012. It provides information about the number of graduates who do not continue their education at the next level, and therefore enter the labour market.
The development of the number of graduates entering the labour market depends on two main factors – demographic changes and changes in the participation rate at the various education levels.

In the Czech Republic, the total **number of graduates entering the labour market** during 2001-2007 was slightly growing (the average year-on-year growth rate was 0.8 %). Despite demographic projections that predict a decreasing number of people in the relevant groups, one can anticipate a further growth in the total number of graduates in the next five years, at a year-on-year rate of 2.5%. Thanks to the growing participation in tertiary education a greater number of people are retained in the education system. Once they have completed their university studies, these people enter the labour market with a delay, thus increasing the total numbers of graduates despite the decreasing population in their specific age group. However, considering the demographic development, it is obvious that the overall number of graduates can only grow temporarily. Another reason for the growing number of graduates, despite the decreasing population in the specific age group, may be the growing participation of older age cohorts in education.

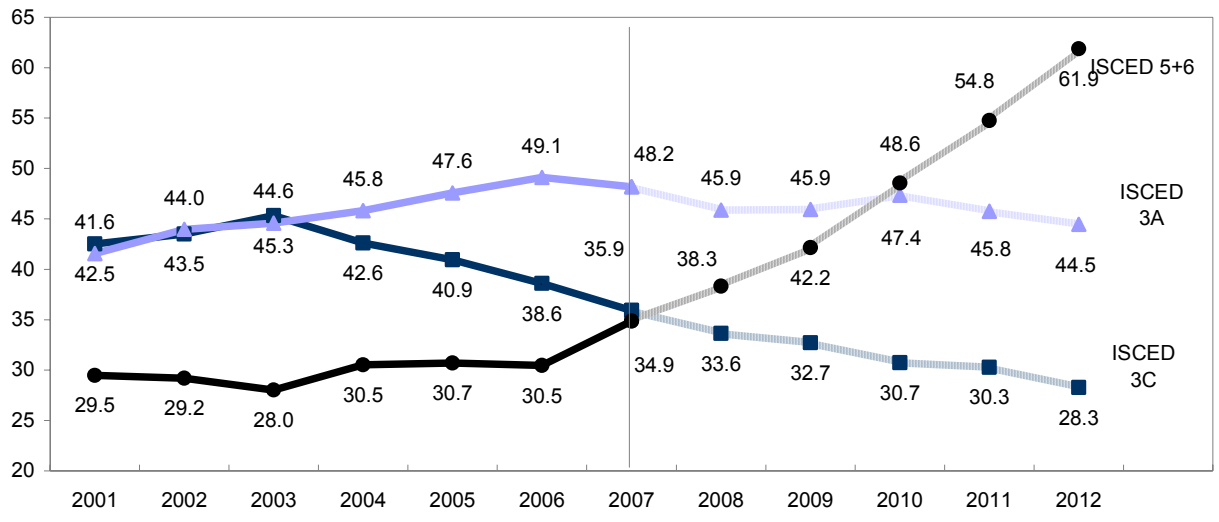
From 2003 on, there has been a sharp decrease in the **number of secondary vocational school (ISCED 3C) graduates** entering the labour market. A further decrease may be expected in 2008-2012. While over 45 thousand ISCED 3C graduates entered the labour market in 2003, only 36 thousand did so in 2007 and it is possible to assume that only 28 thousand ISCED 3C graduates will enter the labour market in 2012.

This decrease, however, is compensated by an increase in the number of graduates at higher education levels. From the beginning of the period in question, the **number of graduates of upper secondary education with "maturita" (ISCED 3A)** grew until 2006, when 49 thousand of them entered the labour market. This increase is caused primarily by a growing preference for technical programmes completed by a "maturita" examination (ISCED 3A) as opposed to programmes providing only a vocational certificate (ISCED 3C). In the next five years, however, it is expected that the number of graduates of ISCED 3A education who will enter the labour market will decrease slightly due to a growing participation in tertiary education as well as demographic development.

The number of tertiary education graduates began to grow in 2004; 2007 saw a very dramatic growth rate, which is expected to continue in the future. In 2007, almost 35 thousand tertiary education graduates entered the labour market and almost 62 thousand are expected to do so in 2012. However, any projection of the number of tertiary education graduates entering the labour market is limited by the fact that it is difficult to estimate the proportion of students who will continue their follow-up Master programmes once they complete their Bachelor programmes. The main reason is that tertiary education reform, which enlarged the provision of Bachelor programmes, took place only recently.

In summary, the **development of the number of graduates between 2001 and 2012** can be described as a gradual shift from lower to higher education categories. The process started in 2004, first by a shift from ISCED 3C to ISCED 3A, and continued from 2007 by a faster shift from upper secondary to tertiary education. Therefore, the development of the number of graduates entering the labour market is relatively favourable as regards the growing educational attainment of labour force. Along with the slightly growing total number of graduates, the proportions of graduates at higher levels of education who enter the labour market are also increasing.

Figure 23: Development projection for the number of graduates until 2012 (in thousands)



Source: : NVF-NOZV, VÚPSV (2008).

While only 24% of graduates entering the labour market in 2003 were tertiary education graduates, 46% are expected in 2012. Contrary to that, the number of ISCED 3C graduates will drop from 38% to 21% (see Table 8). As the number of tertiary education graduates increases and the number of secondary vocational school (ISCED 3C) graduates decreases, the overall situation of school leavers in the labour market should improve – there are still problems related to the unemployment of school leavers – particularly those of secondary education without "maturita" (ISCED 3C).

Table 8: Projection of the number of graduates by education level

	2003		2007		2012	
	th.	%	th.	%	th.	%
ISCED 3C	45.3	38	35.9	30	28.3	21
ISCED 3A	44.6	38	48.2	40	44.5	33
ISCED 5+6	28.0	24	34.9	29	61.9	46
Total	117.9	100	119.0	100	134.6	100

Source: NVF-NOZV, VÚPSV (2008).

There will also be changes in the structure of graduates in terms of their **fields of study**. The total number of ISCED 3C graduates (see Table 9) entering the labour market will be decreasing at a rate of 4.6% year-on-year. The rate of decrease will be slightly lower in vehical maintenance, mechanics and metal work (1%), and conversely faster in the textile and clothes (17%) and also in electricity, transport and communications (8%). The proportion of graduates in the textile and clothing will continue to decrease from the current 2.2% to 1%. A slower decrease in vehical maintenance, mechanics and metal work in the upcoming five years will compensate the decrease in their proportion between 2001 and 2007 and the proportion of graduates of mechanics will get to 21.6% of all ISCED 3C graduates by 2012.

Table 9: Projection of the structure of ISCED 3C graduates entering the labour market by field of education and the average year-on-year change in their number (%)

	2007	2012	Change 08-12
Vehicle maintenance, mechanics and metal work	18.0	21.6	-1.0
Electricity, transport and communication	9.2	7.6	-8.0
Chemical and process, food processing and other.	7.4	6.9	-6.0
Textile, clothes	2.2	1.0	-17.2
Wood, footwear	8.0	7.1	-6.7
Bulding	8.9	8.8	-4.8
Agriculture and forestry	7.2	7.9	-2.9
Business, services	39.1	39.0	-4.7
Total ISCED 3C	100.0	100.0	-4.6

Note: The average year-on-year change is based on absolute figures, not on a percentage structure. Source: NVF-NOZV, VÚPSV (2008).

The structure of ISCED 3A graduates entering the labour market will also remain essentially the same. In total, the number of ISCED 3A graduates will be decreasing at an average rate of 1.6% in the next five years. The numbers of graduates in health fields will be decreasing at the highest rate (8.2%), particularly because new legislation stipulates the requirement of tertiary education for the majority of health specialisations. Therefore, less and less graduates of secondary health schools will go directly to the labour market. For those who want to study health sciences at tertiary level it is also more convenient to choose a general upper secondary education, which provides them with a better chance of admission to a higher education institution. The absolute number of graduates of *gymnázia* (secondary general education) will remain at the same level, as will their proportion in the total number of graduates (around 12%). Only one category of graduates with upper secondary education is expected to grow in number by 2012 – the category labelled "other", which contains a variety of fields (e.g. transport and communications, textile, materials and food processing).

The decreasing number of ISCED 3A graduates entering the labour market reflects the decreasing population at an age typical of upper secondary education and also an increasing rate of participation in tertiary education. Table 10 provides a comparison between the projected year-on-year change in the total number of graduates and the graduates entering the labour market. The numbers of graduates entering the labour market are decreasing at the fastest rates in electricity, mechanics and teacher training. This may indicate that the number of people who will continue to study at tertiary level once they have completed secondary school will be growing in these industries.

Table 10: Projection of the ISCED 3A graduates by field of education entering the labour market and the average year-on-year change in their number (%)

	Structure 2007	08-12 Entering labour market	08-12 All graduates
Gymnázia	11.0	0.1	0.2
Bulding, science	4.6	-4.5	-4.0
Mechanics	7.0	-3.3	-2.0
Electricity	10.4	-3.9	-2.4
Agriculture	3.6	-2.8	-4.6
Health	6.7	-8.2	-8.1
Economics, business, law	42.2	-2.3	-2.8
Teacher training	3.4	-1.5	0.0
Other	11.0	6.7	3.4
Total ISCED 3A	100.0	**-1.6**	**-1.4**

Note: The average year-on-year change is based on absolute figures, not on a percentage structure. Source: NVF-NOZV, VÚPSV (2008); Kleňhová (2008).

The number of tertiary education graduates entering the labour market in the next five years will be growing in all fields with the exception of mechanics (see Table 11). The numbers of graduates in economics, law and other social sciences will be growing at the fastest rate.

Table 11: Projection of the specialisation structure of tertiary education graduates and graduates of higher secondary schools entering the labour market and the average year-on-year change in their number (%)

	2007	2012	08-12
Building and science	11.7	8.0	4.5
Mechanics	4.3	1.9	-4.8
Electricity	6.2	4.7	6.4
Agriculture and other technical fields	11.7	9.8	8.6
Health	9.3	7.7	8.2
Economics, business and other	26.2	36.5	19.8
Law and other social sciences	17.9	20.4	15.3
Education and teacher training	12.7	11.1	9.7
Total ISCED 5+6	100.0	100.0	12.2

Note: The average year-on-year change is based on absolute figures, not on a percentage structure. Source: NVF-NOZV, VÚPSV (2008).

Drop-outs of the education system among young people

Educational attainment and education mobility are negatively influenced by the failure to complete one's educational path. The proportion of people aged 18-24 who completed at most lower secondary education and do not participate in any form of education in the total population in this age category is used as an indicator to **assess the rate of drop-out of the education systems for the purpose of international comparison**. According to this assessment the Czech Republic is among the European countries with the lowest proportion of drop-outs of the education system (5.5% in 2006, 15.2% in the EU-27).

The problem of drop-outs of upper secondary education in the Czech Republic concerns particularly secondary vocational schools. The drop-out rate of secondary technical schools and *gymnázia* is significantly lower. Some students successfully transfer from one school to another at the same or a lower level. Table 12 shows the proportion of drop-outs at various types of school in the school year 2004/2005 according to the results of a country-wide survey conducted by the National Institute for Technical and Vocational Education at upper secondary schools. These proportions can be overvalued because the survey does not capture the number of those who transferred to another school and also those who resumed study after one or more years of interruption.

Table 12: Proportion of drop-outs after deduction of reported transfers (school year 2004/5, %)

	Grade				
	1.	2.	3.	4.	Total
Gymnázium	0.3	0.0	0.3	0.2	0.2
Secondary technical school	3.5	2.4	1.8	1.7	2.4
Secondary vocational school – programs with maturita exam	13.2	2.7	1.1	3.8	5.6
Secondary vocational school – programs with vocational certificate	13.2	6.8	3.4	-	8.0
Secondary vocational school without vocational certificate	21.6	12.6	10.5	-	15.9
Total	7.7	3.9	2.3	1.4	4.2

Source: Úlovcová a kol. (2006).

Drop-outs are a major issue where there is no transfer to another education programme. Transfers between schools help reduce significantly the numbers of students who drop out of the education system. This applies particularly to drop-outs of *gymnázia* and secondary technical schools. The transferability (both horizontal and vertical) of the education system appears to be important and should be further enhanced also at the level of secondary vocational schools (ISCED 3C).

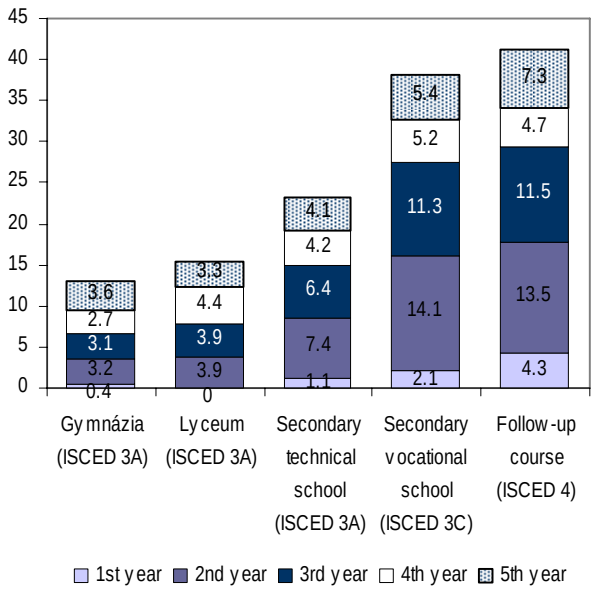
Higher numbers of both drop-outs and transfers in the first and second year of study often point to the wrong choice of a study programme. Students often select programmes that are beyond their skills, or they find it difficult to choose a field in which they would be interested. Until recently, students could only submit one application to a secondary school in the first round of the admission proceedings. As a result, the choice was frequently made on the basis of probability of admission, rather than real interest in the field of study. Low motivation to study a poorly chosen field can result in a lack of commitment and subsequent problems in coping with the study requirements. This should be prevented by a guidance system, where there is still lot of space for improvement. Improvement can also be anticipated with the introduction of a new rule allowing students to submit up to three applications, starting from the school year 2008/9.

Those who drop out of tertiary education do not immediately fall into the category of the poorly educated because unsuccessful tertiary education students have at least ISCED 3A level of education. However, drop-outs of tertiary education represent a waste of both public and private resources. Moreover, the statistics provided in the previous sections of this chapter show that although the level of young people's participation in education in the Czech Republic is almost comparable to that in the EU-27, the proportion of people with tertiary education in younger age groups is considerably lower. This may indicate a higher drop-out rate. However, as Bachelor programmes are becoming more available, this unfavourable situation is changing.

Of the total number of students who completed upper secondary education in 2002 and enrolled at a higher education institution, 19% dropped out.[6] These are students who dropped out of higher education institutions during 2002-2007 and did not start another study programme. An increase in the success rate is expected in the future due to the shift to a two-cycle system of tertiary education. A higher success rate can be expected in shorter Bachelor programmes than in long Master programmes.

The success rate by the type of secondary school from which the students are coming is in direct proportion to the level of success scored during the entrance examination. The highest proportion of admitted applicants and also those who complete the study is among *gymnázia* graduates. Graduates of secondary vocational schools and follow-up courses are at the other end of the scale (see Figure 24).

Figure 24: Proportion of drop-outs to the number of 2002 secondary school graduates who started studies at a higher education institution (%)



Note: This includes students who dropped out of higher education studies during 2002-2007 and did not start another study programme. Source: Úlovcová a kol. (2006).

[6]Note: Chamoutová, D., Burdová, J. (2007).

Gymnázia graduates are provided with a fairly good basis in a variety of subjects. If they are not successful in a particular field of tertiary studies, they find it relatively easy to switch over to another field. As distinct from this, vocational education only allows students to focus on those subjects that are related to the particular specialisation provided by the relevant school. An additional problem associated with secondary vocational school graduates is that their study is primarily aimed at gaining practical skills readily applicable in the labour market; as a result, they often lack theoretical knowledge as well as study habits. However, apart from the focus of studies, success in admission to tertiary education institutions is somewhat influenced by selection taking place as early as at the point of entry into secondary education. *Gymnázia* (followed by secondary technical schools) select those students who are best-suited to study, and therefore are better predisposed to succeed in higher education institution at a later stage.

Naturally, the success rate also varies between higher education institutions and the fields of study. The highest proportion of drop-out is in technical fields - a sign of milder selection during entrance examinations due to insufficient numbers of applicants, but also a sign of how demanding the study is.

2. Human Resources for the Knowledge Economy

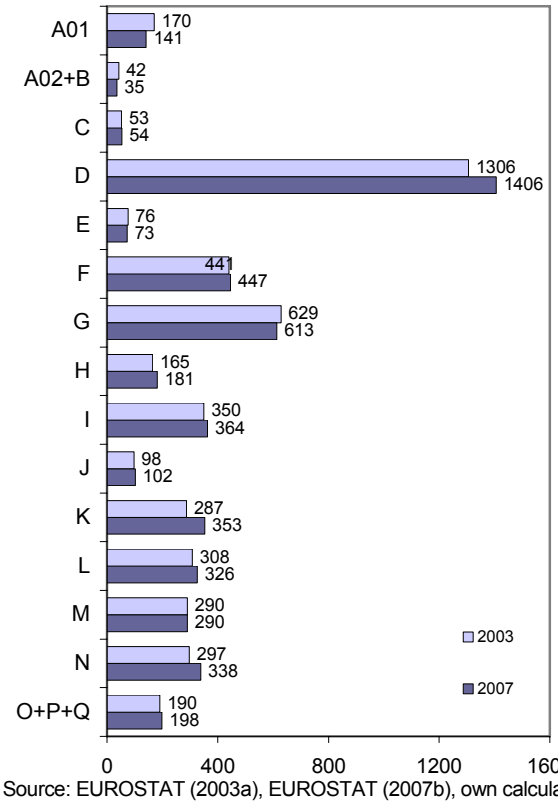
The chapter is divided into three parts. The first part concerns the industry structure of the economy, technology-intensive sectors and a forecast of employment in the Czech Republic until 2012. The second part deals with future requirements for skilled workforce and the basic evidence for forecasting skills needs, and it analyses these in selected sectors of the economy. The third part focuses on the preparation of human resources for demanding occupations. Emphasis is placed particularly on tertiary education, students and graduates of science and technology disciplines and the international mobility of students.

2.1 Employment in the industries of the national economy

The structure of employment according to industries reflects the level of economic development of a given country. The more employment concentrated in industries with a high value added, the higher GDP the country produces, which has a positive impact on the living standards of its population and the development of the entire society. An overview of the industry classification of economic activities is presented in Box 1

The development of employment in the CR from 2003 until 2007 is illustrated in Figure 1. While employment in agriculture (decrease by 29 thousand individuals in the 2003-2007 period), forestry and fishing is clearly declining, there were increases in employment in manufacturing, real estate and renting (particularly other business activities), health and social work, hotels and restaurants and public administration and defence.

Figure 1: The development of employment in industries of the CR's economy (in thousand, not expressed as a full-time equivalent)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

Box 1 – Economic industries according to NACE classification

A01 – Agriculture, hunting and related service activities
A02 – Forestry, logging and related service activities
B – Fishing, fish farming and related service activities
C – Mining and quarrying
D – Manufacturing
E – Electricity, gas and water supply
F – Construction
G – Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
H – Hotels and restaurants
I – Transport, storage and communication
J –Financial intermediation
K – Real estate, renting and business activities
L – Public administration and defence; compulsory social security
M – Education
N – Health and social work; veterinary activities
O – Other community, social and personal service activities
P – Activities of households
Q – Extra-territorial organizations and bodies

In manufacturing, the increases can be mainly attributed to the manufacture of motor vehicles (increase by 60 thousand persons from 2003 until 2007), manufacture of metal structures and fabricated metal products (increase by 24 thousand persons) and manufacture of electrical machinery and apparatus n.e.c. (increase by 23 thousand persons). The increase in employment in the automotive industry is the result of large investments in this area, particularly the investment of the TPCA car maker in the Central Bohemian region. The other two industries mentioned are major suppliers to the automotive industry and other growth segments such as construction.

As there was an overall expansion of manufacturing, employment only decreased in a few industries. It was, above all, in the manufacture of textiles and textile products (decrease by 28 thousand persons), manufacture of food products and beverages, and manufacture of paper. This was the consequence of the import of cheap textiles from East Asia and the continuing automation of food processing and a growing imports of foodstuffs.

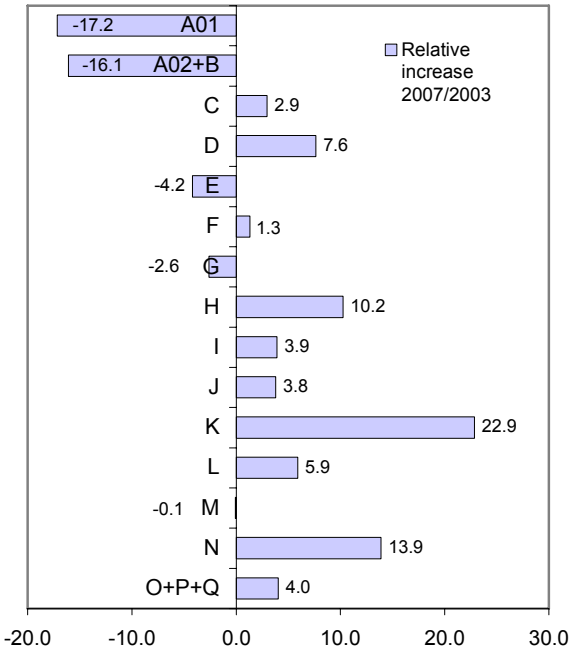
The largest relative growth in employment in the period under review occurred in real estate and renting; business activities (increase by 22.9%), health and social work; veterinary activities (13.9 %) and hotels and restaurants (10.2 %). Conversely, the largest decrease in employment in relative terms occurred again in agriculture and hunting (decrease by 17.2 %) followed by forestry and related service activities (16.1 %). A slight relative decrease can also be observed in electricity, trade and repair of motor vehicles (see Figure 2).

The results mentioned above reflect the continuing shift of the economy of the Czech Republic from the primary sector to the tertiary sector, and the increasing focus on activities and manufacturing that involve higher value added and require large investments in technology and higher skilled workforce.

In average European terms the trend is similar. **The sectors experiencing the steepest growth in EU-27** include real estate, renting and business activities (NACE K), health and social work; veterinary activities (NACE N), trade and repair of motor vehicles (NACE G), construction (NACE F) and other activities falling within NACE O, P and Q. Europe-wide, there is also a decrease in employment in agriculture and in manufacturing. The transforming economies of the new member states of the EU, particularly Romania, Latvia and

Lithuania, but also France and Greece, largely contribute to this development.

Figure 2: A relative increase/decrease in employment in industries of the Czech economy in 2003-2007 (in %)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

Employment in technology-intensive sectors

Technology-intensive sectors are defined by the OECD classification. It distinguishes (a) high-tech manufacturing, (b) medium high-tech manufacturing and (c) high-tech services. A detailed structure of these sectors is presented in Boxes 2,3 and 4.

Employment in the high-tech services

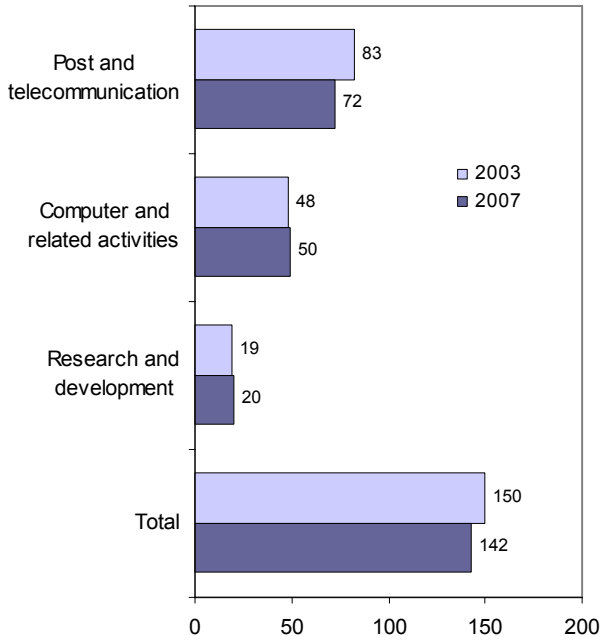
The sector of high-tech services (see Box 2) is closely linked to the development of modern technologies, particularly in ICT and telecommunications. The increasing number of mobile operators and ICT modernisation of operations have positive effects on demand for the workforce with relevant skills.

Box 2 – High-tech services

NACE 64 – Post and telecommunications
NACE 72 – Computer and related activities
NACE 73 – Research and development

In the 2003-2007 period total employment in this sector decreased from 150 to 142 thousand persons (see Figure 3). This decrease was caused, above all, by restructuring and a growing number of outsourced operations in large companies such as Česká pošta and Český telecom (NACE 64 – post and telecommunications). Other industries in the sector are growing in terms of employment, but this growth did not offset the decrease in employment in post and telecommunications. The growing number of individuals employed in NACE 72, computer and related activities, denoted also as IT services, is closely connected, among from other things, with the development of industries in the sector of high-tech manufacturing – manufacture of office machinery and computers (NACE 30).

Figure 3: Development of employment in the sector of high-tech services in the CR in 2003-2007 (in thousand)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

As compared with the European Union the CR has, on the whole, a lower proportion of employment in high-tech services than the EU average. This is particularly due to the insufficient level of R&D development and a decrease in employment in post and telecommunications. In 2007 this sector accounted for 3% of total employment in the CR, while the EU-27 average was 3.3%. The EU-15 average was even higher - i.e. 3.5% (see Figure 6). However, this difference is expected to diminish in the following years.

Employment in the of medium high-tech manufacturing

The sector of medium high-tech manufacturing in the CR include, above all, manufacture of motor vehicles and manufacture of machinery and equipment n.e.c.

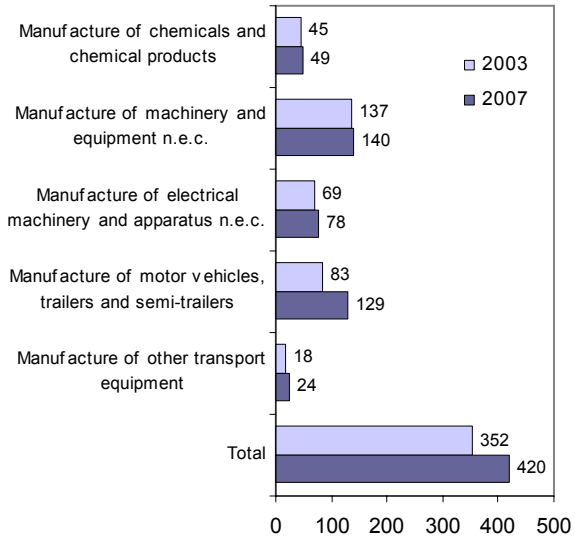
Box 3 – Medium high-tech manufacturing

NACE 24 –Manufacture of chemicals and chemical products
NACE 29 – Manufacture of machinery and equipment n.e.c.
NACE 31 – Manufacture of electrical machinery and apparatus n.e.c.
NACE 34 – Manufacture of motor vehicles, trailers and semi-trailers
NACE 35 – Manufacture of other transport equipment

In all five industries that fall within this sector employment grew from 352 to 420 thousand persons in the 2003-2007 period (see Figure 4). The largest growth occurred in manufacture of motor vehicles (increase by 46 thousand) and manufacture of electrical machinery and apparatus n.e.c. (increase by 9 thousand).

In 2007 this sector accounted for some 9% of total employment in the CR, which is the highest figure in the European Union (Figure 6). The Czech Republic exceeds the EU-27 average by 3.4 p.p. The CR has a long tradition in most of these industries, and it successfully builds on it and these industries expand thanks to foreign investment (Škoda auto, ABB s.r.o., Brano a.s.). It is the automotive industry that is behind the leading position of the CR in the EU in this respect. However, employment in this sector is expected to decline slightly in the future.

Figure 4: Development of employment in the medium high-tech manufacturing in the CR in 2003-2007 (in thousand)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

Employment in the high-tech manufacturing

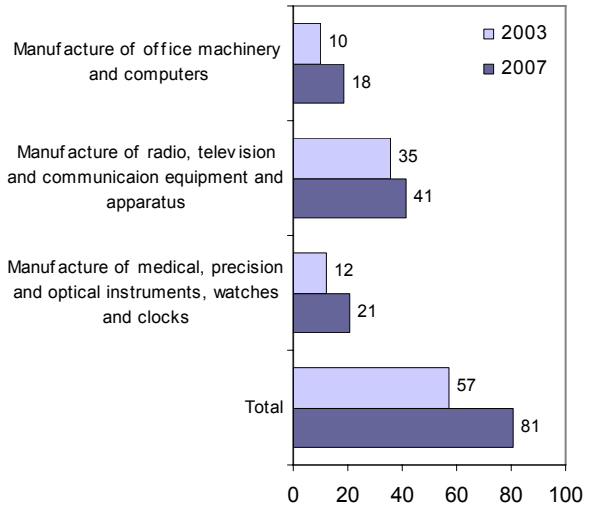
The sector of high-tech manufacturing includes three industries that are stated in Box 4.

Box 4 – High-tech manufacturing sector

NACE 30 - Manufacture of office machinery and computers
NACE 32 - Manufacture of radio, television and communication equipment and apparatus
NACE 33 - Manufacture of medical, precision and optical instruments, watches and clocks

Overall, employment in the sector rose from 57 thousand in 2003 to 81 thousand in 2007 (see Figure 5). Good future prospects are the result of a relatively large inflow of foreign investment and a high level of Czech and foreign demand for products. All industries within the sector contributed to the growth in employment, the largest contribution was made by manufacture of medical, precision and optical instruments, watches and clocks (increase by 9 thousand persons).

Figure 5: Development of employment in the high-tech manufacturing in the Czech Republic in 2003-2007

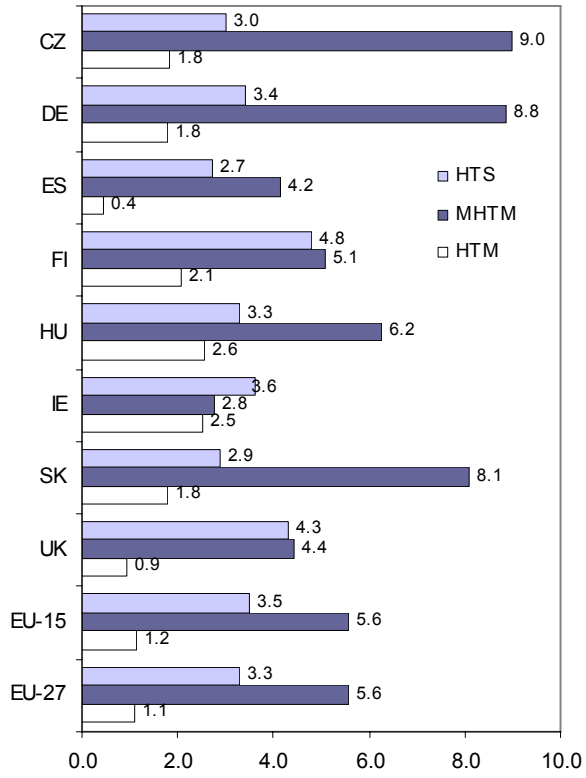


Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

This sector accounts for 1.8 % of total employment in the Czech Republic. For this figure the CR exceeds the EU-27 average by 0.7 p.p. (see Figure 6).

Figure 6 shows that the Czech Republic is a country with an above-average level of employment in technology-intensive sectors. The roots of the far higher proportion of employment in the medium high-tech manufacturing lie the structure of industry before its transformation and in the system of investment incentives that focused on this area. However, in the future we can expect that the workforce will move into the sector of high-tech manufacturing. At present, Hungary ranks first for the level of employment in the high-tech manufacturing as a proportion of total employment (2.6 %).

Figure 6: The proportion of employment in technology-intensive sectors in total employment in selected EU countries in 2007 (in %)



Note: HTS = high-tech services, MHTM = medium high-tech manufacturing, HTM = high-tech manufacturing
Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

Occupational structure of employment in the CR

The occupational structure of employment is analysed in terms of the proportion of occupations with a varying level of skills intensity. The following subchapter provides a comparison of the situation in the Czech Republic and that in the EU not only from this perspective, but also in terms of employment in the high-tech manufacturing and high-tech services. We can see the development of various indicators in the 2003-2007 period in the CR and in EU-27. In some cases only some EU member countries were selected for comparison purposes. The reason is that the relevant data are not available or they lack validity.

Evaluation of the occupational structure of employment is based on the classification of occupations of the Czech Statistical Office (KZAM) that is derived from the ISCO-88 international classification. An occupation is understood to

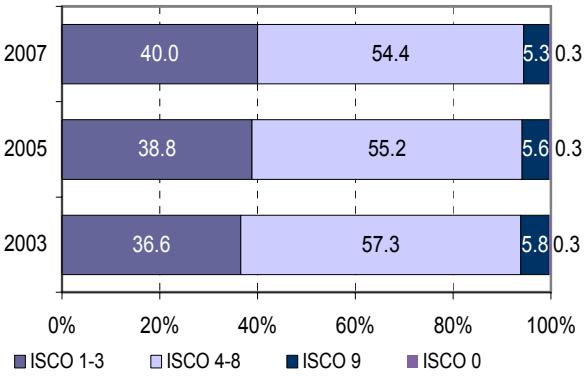
be a specific activity or a set of tasks and obligations performed by a worker. The system identifies 10 major groups (0-9) which are further subdivided. Professions may be identified in exact detail up to a five-digit numerical key (the so-called KZAM-R) that is a frequently used Czech version of the four-digit international classification. The major ISCO groups can be organised by their level of skills intensity into three categories: (i) – demanding occupations (ISCO 1-3) (ii) – less demanding occupations (ISCO 4-8) and (iii) – low-skilled occupations (ISCO 9). Members of the armed forces (ISCO 0) are not categorised because their skills intensity can not be specified by the classification system (see Box 5).

Box 5 – Classification of main occupational categories (ISCO)

ISCO 1 Legislators, senior officials and managers
ISCO 2 Professionals
ISCO 3 Technicians and associate professionals
ISCO 4 Clerks
ISCO 5 Service workers and shop and market sales workers
ISCO 6 Skilled agricultural and fishery workers
ISCO 7 Craft and related trades workers
ISCO 8 Plant and machine operators and assemblers
ISCO 9 Elementary occupations
ISCO 0 Armed forces

Figure 7 clearly shows that the proportion of employment in demanding occupations increased in the CR by 3.4 p.p. in 2003-2007. This development was primarily at the expense of less demanding occupations. The proportion of employment in low-skilled occupations showed a negligible decrease by 0.5 p.p. The number of members of armed forces remains unchanged at 0.3% of total employment.

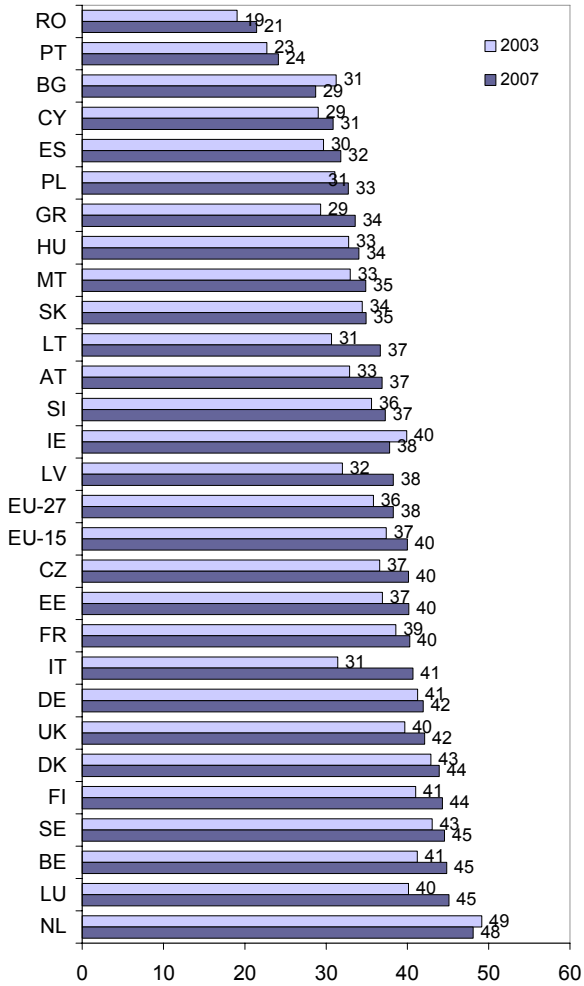
Figure 7: Development of employment in the CR according to main ISCO categories in 2003-2007 (in %)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

The proportion of people working in demanding occupations points to the level of advancement of the economy. In the CR employment in demanding occupations accounts for 40% of total employment. For this figure the CR, together with Estonia and France, ranks slightly above average in EU-27 terms and average in EU-15 terms. The dynamics of the development in the proportion of employment in ISCO 1-3 categories are also at an above-average level. In 2003-2007 this proportion grew by over 3 p.p., while EU-27 only scored a 2 p.p. increase. The largest growth occurred in Italy (10 p.p.), Lithuania (6 p.p.) and Latvia (6 p.p.). A decrease in employment in demanding ISCO categories occurred only in Ireland (-2 p.p.), the Netherlands (-1 p.p.) and Bulgaria (-2 p.p.) (see Figure 8).

Figure 8: The proportion of ISCO 1-3 categories in total employment in EU countries in 2003 - 2007 (in %)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

As regards demanding occupations (see Box 6) the Czech Republic shows a very high proportion of employment in physical and engineering science associate professionals (ISCO 31) – 7.1%. This is nearly double the European average (see Figure 9). On the contrary, the proportion of employment in ISCO 12 is twice as low. The CR also shows an above-average proportion of employment in ISCO 32, ISCO 34 and ISCO 11.

Box 6 – Two-digit categorisation of occupations in the ISCO 1, 2 and 3 groups

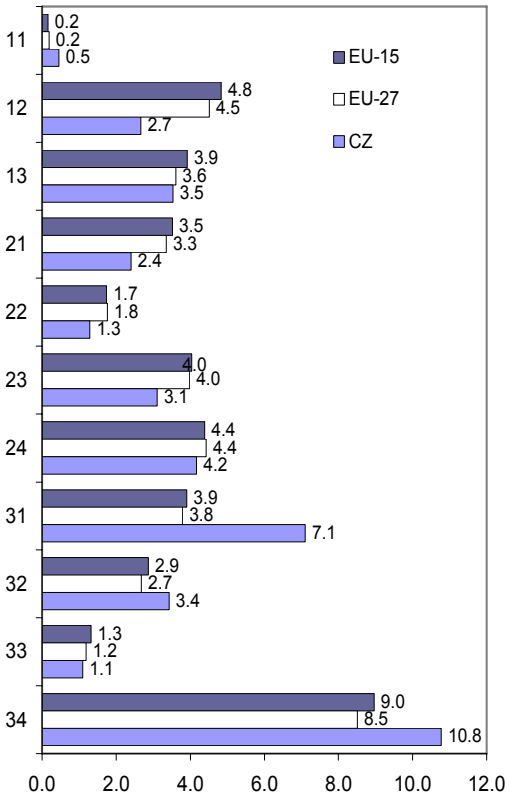
According the classification of occupations used by ČSÚ are the main occupational categories divided into these two-digit groups:

ISCO -11 Legislators and senior officials
ISCO -12 Corporate managers
ISCO -13 Managers of small enterprises
ISCO -21 Physical, mathematical and engineering science professionals
ISCO -22 Life science and health professionals
ISCO -23 Teaching professionals
ISCO -24 Other professionals
ISCO -31 Physical and engineering science associate professionals
ISCO -32 Life science and health associate professionals
ISCO -33 Teaching associate professionals

The proportion of employment in ISCO 1 category is below the average, the only exception is the legislators and senior officials group (ISCO 11) where the CR shows a higher

proportion of employment over the long term as compared to the rest of the EU. Even the pressure to reduce employment in state administration has not changed this reality.

Figure 9: The proportion of ISCO 1-3 subgroups in total employment (2007, in %)



Source: EUROSTAT (2007b), own calculation.

The Czech Republic has, over the long term, shown a below-average proportion of representatives of category of professionals as compared with other European Union countries. Compared to 2006 there was a slight increase in the number of persons employed in ISCO 23 and ISCO 24, but ISCO 21 and ISCO 22 remained virtually unchanged. Although the proportion of employment in the teaching professionals subgroup (ISCO 23) increased, there is a strong negative impact of poor remuneration of teachers that is below the average over the long term and its level is among the lowest in the European Union.

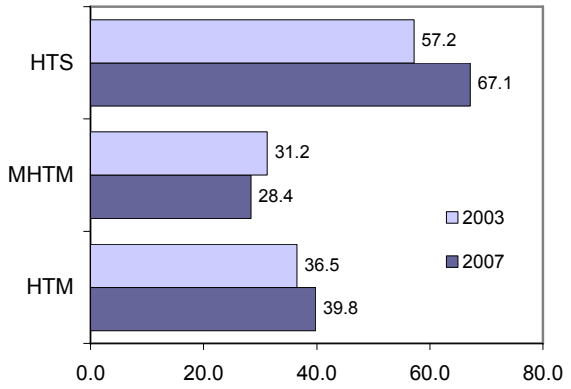
According to the OECD publication Education at a Glance 2007[7] that concerns various aspects of education including the financial remuneration of teachers, the average annual pay of a beginning teacher in the CR was some 18,700 USD in PPP, while the EU-19 average was roughly 28,300 USD in PPP. Only teachers in Hungary received a lower pay (11,800 USD in PPP per year). Conversely, Luxembourg showed the highest level of remuneration for teachers in 2005 (49,200 USD in PPP per year on average). In terms of the average pay teachers in the Czech Republic get 120% of the average pay, in Hungary it is 140 %[8].

The large proportion of employment in the physical and engineering science associate professionals category (ISCO 31) reflects, above all, a very high proportion of employment in industry, particularly in the medium high-tech manufacturing. This is also associated with the high proportion of employment in the other associate professionals category (ISCO 34). The 7.1% proportion of this group in total employment is 3.2 p.p. higher than in EU-15 and 3.3 p.p. higher than in EU-27. The significantly higher proportion of employment in ISCO 3 in overall terms is only decreased by the teaching associate professionals subcategory (ISCO 33) where the CR shows figures, over the long term, that are slightly below the average. This is the result, as with teaching professionals, of a low level of pay for special education teachers and educators.

Occupational structure in technology-intensive sectors

The proportion of demanding occupations in total employment in technology-intensive sectors in the Czech Republic is growing (see Figure 10).

Figure 10: The proportion of demanding occupations in total employment in technology-intensive sectors in the CR (in %)



Note: HTS = high-tech services, MHTM = medium high-tech manufacturing, HTM = high-tech manufacturing
Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

A slight decrease in the 2003-2007 period only occurred in the **medium high-tech manufacturing**. It was caused, above all, by an increase in employment in ISCO 7 and 8 categories. The number of craft and related trades workers increased and so did the number of plant and machine operators and assemblers. On the contrary, the number of professionals decreased in this sector.

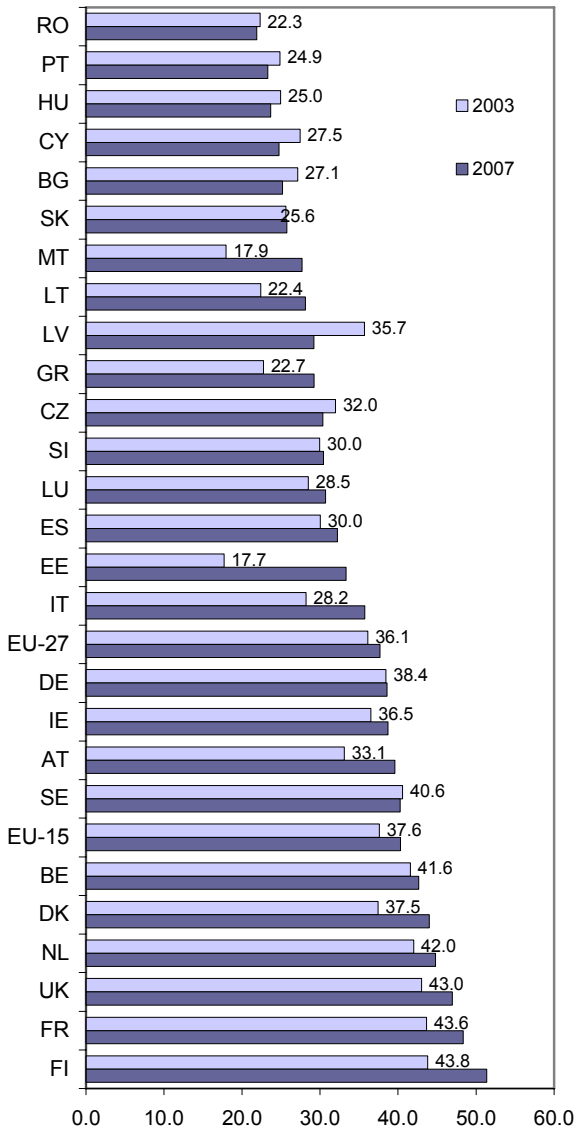
The high increase in the proportion of demanding occupations in **high-tech services** was caused both by a rise in the number of professionals and also by a significant decrease in the number of clerks due to a widespread practice of outsourcing of accounting services.

As regards the **high-tech manufacturing** there was an increase in employment in nearly all ISCO categories except for ISCO 5. The largest increases occurred in ISCO 3,7 and 8 categories.

If we compare the proportion of employment in demanding occupations in total employment for all industries of the Czech Republic (40%) it is clear that this proportion in the high-tech manufacturing is below the average (30.3%), whereas it is far above the average for high-tech services (67.1%). The pace of this increase for high-tech services is several times higher than the dynamics of the economy as a whole. The medium high-tech manufacturing constitutes an exception – there was a decrease in this proportion in 2003-2007.

[7] Source: OECD (2007a), p. 396.
[8] Source:ILO (2003), Table 5A.

Figure 11: The proportion of demanding occupations in total employment in the medium high-tech and high-tech manufacturing in the EU in 2003-2007 (in %)

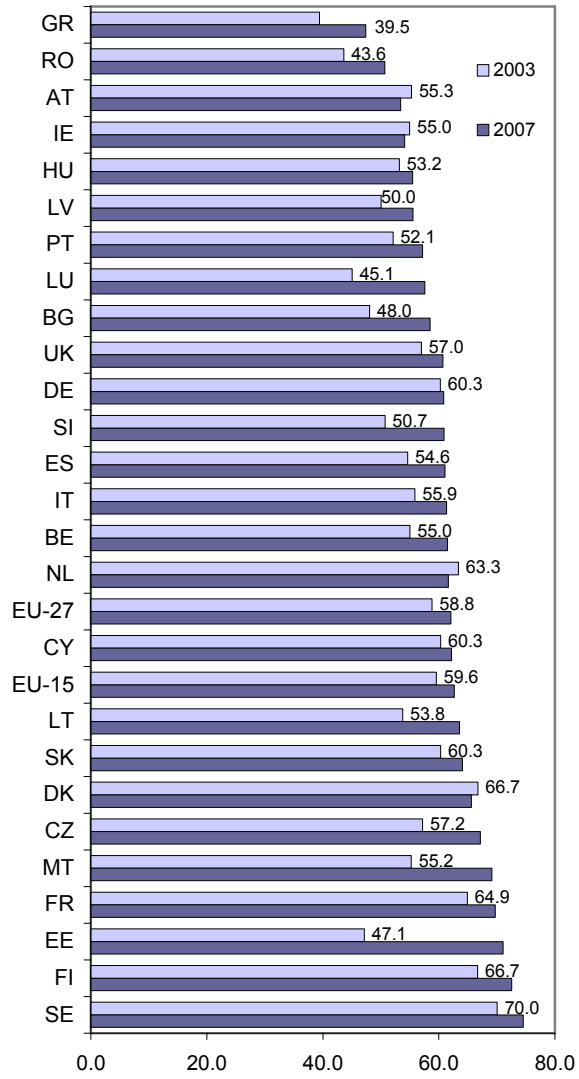


Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

The proportion of demanding occupations in total employment in the medium high-tech and high-tech manufacturing increased in most European Union countries in 2003-2007. The largest growth in relative terms occurred in new member states – in Malta, Lithuania and Estonia. As distinct from this, there the Czech Republic scored a decrease (see Figure 11) that was caused by a major decline in the proportion of employment in demanding occupations in the medium high-tech manufacturing. Employment in the high-tech manufacturing is many times lower as compared with the medium high-tech manufacturing, and even the increase in the proportion of people employed in demanding occupations in this sector could not offset this decline.

As regards high-tech services (see Figure 12), there was a decrease in the proportion of persons performing demanding occupations in 2003-2007 in Austria, Denmark, Ireland and the Netherlands, and an increase in all other EU countries. The largest increase in relative terms was reported by Estonia, Malta and Slovenia. In this period the Czech Republic exceeded the EU average and it ranks sixth among European countries for this proportion (67.1%). The high pace of growth by nearly 10 p.p. in the 2003-2007 period means that the CR will retain its position among the leading countries still in the future.

Figure 12: The proportion of demanding occupations in total employment in high-tech services in the EU in 2003-2007 (in %)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

The educational structure of employment in the CR

The educational structure of employment is examined in terms of the proportion of people with tertiary qualifications in total employment. The definition of tertiary education is presented in Box 7.

Box 7 – Tertiary education according to the ISCED classification

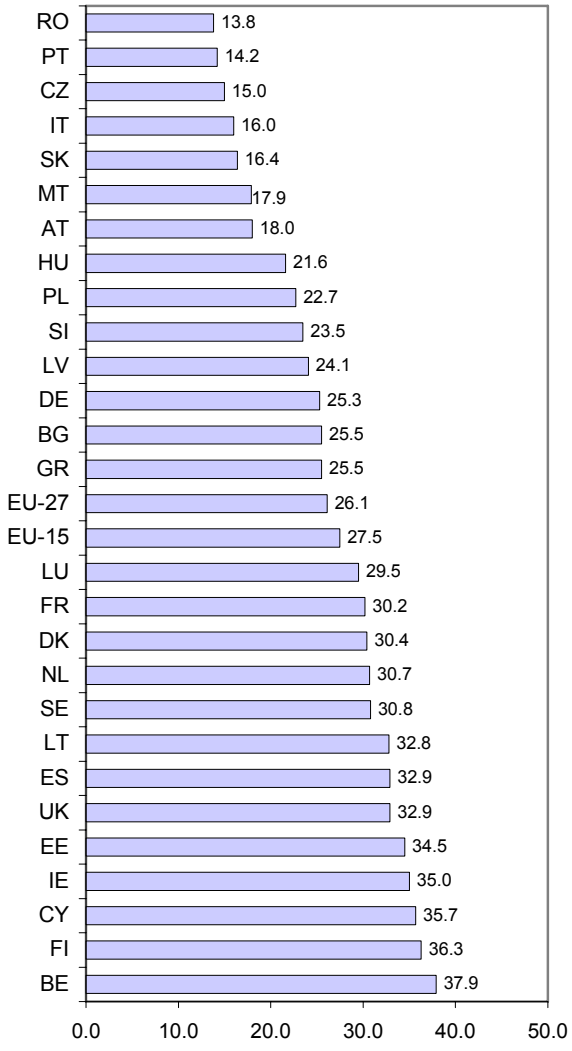
Level 5 - First stage of tertiary education

- 5A - programmes intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements (in the CR it is bachelor and master university study and state rigorous exam)
- 5B - programmes that are practical/technical/occupationally specific (higher technical schools, conservatoires)

Level 6 - Second stage of tertiary education (doctoral university study)

It is clear from Figure 13 that the Czech Republic ranks third from the bottom in the European Union for its proportion of people with tertiary education in overall employment. The 15 % proportion places it 9.1 p.p. below the European average. Only Portugal and Romania get lower scores. Conversely, Belgium has a high proportion of people with tertiary degrees (37.9 %) followed by Finland (36.3 %), Cyprus (35.7 %), and Ireland (35 %). Among the new members states Estonia scores high in this respect (34.5 %).

Figure 13: The proportion of individuals with tertiary education in total employment in EU countries in 2007 (v %)



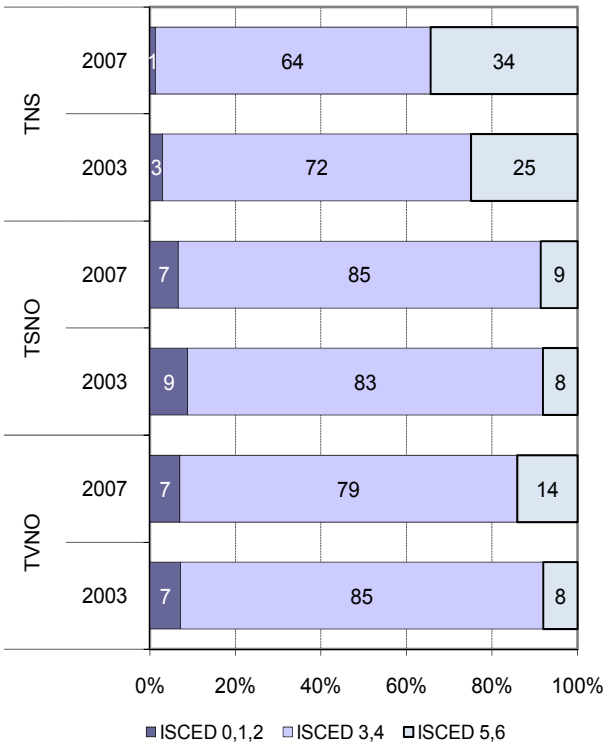
Source: EUROSTAT (2007b), own calculation.

Although the number of tertiary education graduates in the CR has been constantly growing since 2003 at an increasing pace (see Chapter 1.2), it will take a long time for this development to appear in statistical data. Therefore no major change in the current state of affairs can be expected in the near future.

The educational structure of employment in high-tech sectors of the Czech economy

The demands placed on the workforce in high-tech sectors are constantly growing. This along with the expanding supply of the workforce with tertiary education results in an increasing proportion of people with tertiary qualifications in total employment in this sector (see Figure 14).

Figure 14: The proportion of the workforce with tertiary education in technology-intensive sectors in 2003 - 2007 in the CR (in %)



Note: HTS = high-tech services, MHTM = medium high-tech manufacturing, HTM = high-tech manufacturing
Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

In all three technology-intensive sectors the proportion of people with tertiary education in employment increased in 2003-2007. The largest growth occurred in high-tech services (by 9 p.p.), in the high-tech manufacturing the increase was 6 p.p. In both cases this occurred predominantly at the expense of the workforce with secondary qualifications (ISCED 3 and 4).

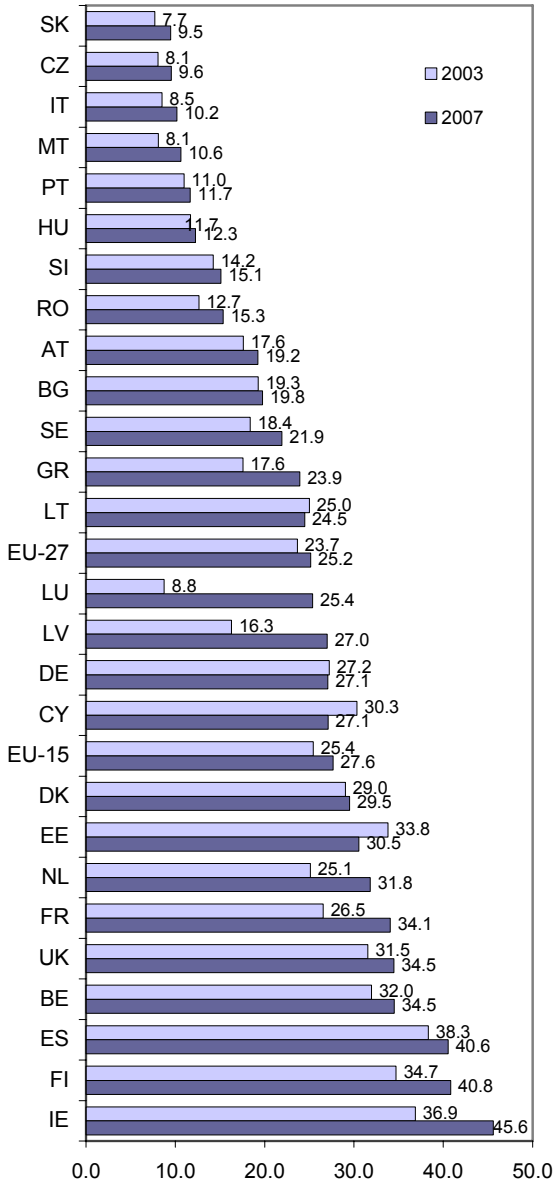
The proportion of the workforce with tertiary education grew slightly in the medium high-tech manufacturing, but there is a declining proportion of people performing demanding occupations. This is the result of the fact that people with tertiary education are recruited for jobs designated for people with lower education that are in short supply in the labour market. The growing proportion of the workforce with tertiary education in total employment is a trend that can be expected to continue.

In both sectors of high-tech manufacturing there is a below-average proportion of the workforce with tertiary education in terms of comparison with the economy as a whole. Conversely, this proportion is far above the average in high-tech services – it is more than twice as high as compared to the economy as a whole.

In EU terms the Czech Republic lags behind as regards the proportion of people with tertiary education working in technology-intensive sectors (see Figure 15). For its 9.6 % proportion the CR ranks among the lowest among EU countries (together with Slovakia and Italy). This is caused, to a large extent, by a low level of demand for workers with tertiary

education in these sectors, as the majority of employees in manufacturing have upper secondary education (ISCED 3,4). Conversely, the highest proportions are reported by Ireland, Finland and Spain.

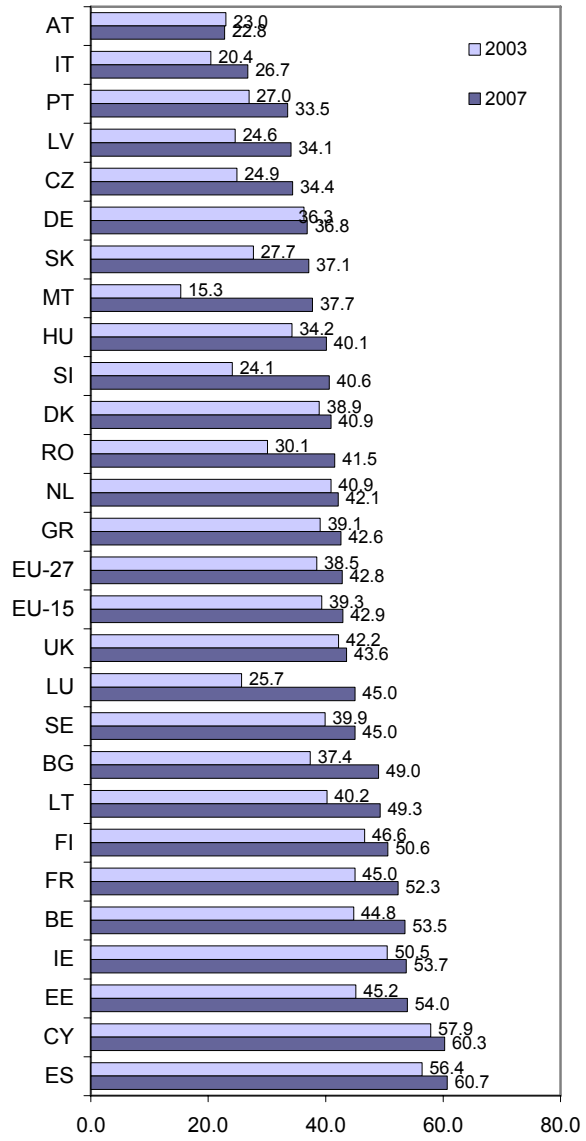
Figure 15: The proportion of people with tertiary education in the medium high-tech and high-tech manufacturing in 2003-2007 in the EU (in %)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

In the Czech Republic a higher proportion of the workforce with tertiary education can be seen in high-tech services (see Figure 16). Although the 34.4% is still below the EU average, we can observe favourable dynamics that will continue in the future. The proportion grew by nearly 10 p.p. in 2003-2007. Due to the high level of skills intensity of this sector, which has the largest proportion of demanding occupations (67.1 % in 2007), a higher proportion of people with tertiary education can be expected. Countries that show the highest proportion of people with tertiary education in high-tech services include Estonia (60.5 %) and Cyprus (60.3 %). Conversely, Austria and Italy scored the lowest in this respect – less than 30%.

Figure 16: The proportion of the workforce with tertiary education in high-tech services in 2003-2007 in the EU (in %)



Source: EUROSTAT (2003a), EUROSTAT (2007b), own calculation.

Future development of employment in industries, and of the qualification and educational structure in the CR

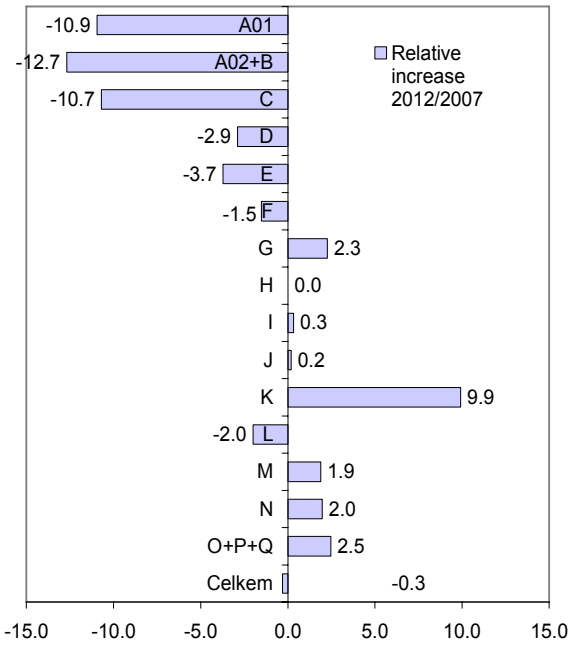
As the economic performance and the gross domestic product of the Czech Republic are growing in real terms and over the long term, there are differences from segment to segment. Some segments of the economy are experiencing a steep growth, other segments are being phased out. It is useful to predict which industries will see a downturn, which industries will undergo major technology changes affecting employment and the knowledge and skills requirements for the workforce, and which sectors will become the key drivers of the economy.

In 2007-2008 an **employment forecast** was developed for 42 aggregated industries of the CR. The work on the forecast was managed by the National Observatory of Employment and Training. The projection drew on the results of the E3ME statistical-econometric model supplied by the British company Cambridge Econometrics. This basic forecast was based on specific assumptions and data for the Czech Re-

public, and it was further adjusted to take account of views of Czech decision-makers and private sector experts[9].

At the same time a forecast of future skills and training needs of the Czech labour market was developed based on the ROA-CERGE projection model. The ROA-CERGE mathematical model was developed by CERGE-EI in cooperation with the Dutch Research Centre for Education and the Labour Market (ROA) and the Irish Economic and Social Research Institute (ESRI). It is owned by he National Observatory of Employment and Training. Five-year projections are generated by means of the model for 32 groups of occupations and 27 educational attainment groups. It draws on the Labour Force Survey data of the Czech Statistical Office and on the data on graduates provided by the Institute for Information on Education. One of the inputs in the model is the aforementioned projection of employment in industries. This subchapter presents the outcomes of these forecasts.

Figure 17: The projected increase/decrease in employment in industries in 2007-2012 in the CR (in %)



Source: NVF-NOZV, VÚPSV (2008).

It is projected that, in the next five years, the largest **increase in employment** (see Figure 17) will occur in real estate and renting; business activities (NACE K) – by 9.9%. This industry will retain its growth dynamics to date. Computer and related activities (NACE 72) will make the biggest contribution to this growth with an over 23% increase in the number of the workforce in this period. The overall importance of IT in the economy will undoubtedly grow along with expanded opportunities for their use. There are good prospects for this industry due to high pay levels, and the number of individuals interested in studying IT fields is constantly rising, although this increase is not sufficient. Moreover, foreign investors prefer this area – particularly as regards the development of software and service centres. The only barrier is the already low number of the available workforce. In the upcoming years the workforce will move from user sectors (industry, state administration, banking, etc.) to supplier companies – i.e. to NACE 72.

The following sectors will also experience growth: wholesale and retail trade, repair of motor vehicles and other goods (NACE G), education (NACE M), health and social work (NACE N) and activities that fall within NACE O, P and Q. Employment in NACE G will only grow thanks to an increase in employment in retail trade (NACE 52), other industries within NACE G will tend to stagnate. The increasing employment in retail trade should be mainly the result of continuing investment in expansion of the network of retail outlets, while investors are predominantly interested in smaller towns and underdeveloped regions of the Czech Republic where the potential is still considerable. According to the research report Shopping Center & Hypermarket 2008 carried out by the Incoma Research agency there are plans to build up to 70 new shopping centres in the CR in the following years. The consumer demand is expected to grow further, which will have a favourable impact on GDP.

In the education sector (NACE M) employment will grow mainly as a result of increasing interest in lifelong learning, particular adult education, and in tertiary education in general. The growth in employment in the health and social work sector (NACE N) will be affected by population ageing and the related growing demands for both types of care.

On the contrary, a considerable **decrease in employment** will continue in agriculture, hunting and forestry (NACE A), and in fishing (NACE B). Both sectors will see a decrease in employment by more than 10%. Employment will also decline in mining and quarrying (NACE C), in manufacturing (NACE D), electricity, gas and water supply (NACE E), construction (NACE F) and in public administration and defence (NACE L). In NACE C the decline in employment will mainly concern the mining of coal (NACE 10). However, despite the predicted decrease, employment in this sector will remain high above the average of West European countries (the proportion in neighbouring Germany will only be 0.1%, while the CR will have 0.7% in 2020).[10] In the energy sector (NACE E) the largest decrease in employment in predicted for gas distribution (NACE 40.2). The construction sector should not face any risk in terms of production increases, particularly due to good prospects for transport construction. However, in terms of the labour market potential the situation is different. Due to low pay levels and low interest in construction jobs on the part of young people this sector will face a robust outflow of the workforce in the following years. This could be offset, to an extent, by migration of foreign labour into the Czech Republic.

2.2. Future requirements for skilled workforce in selected sectors of the economy

The labour market in each sector of the economy faces specific problems. Technology and skills intensive sectors now tackle the problem of a shortage of skilled workers with secondary technical and tertiary education. In view of the projected demographic changes in the Czech Republic it is likely that this situation will get worse in upcoming years, and it will be increasingly difficult to replace elderly and retiring workers. Problems arise that concern the quality of graduates and mismatch between the content of study programmes and the actual occupational needs as employers see them. Demand for occupations and qualifications is gradually changing due to the influence of various trends, and it is very difficult for the education system to respond to these changes promptly and flexibly. For this reason it is desirable to fore-

[9] For details see Lapáček, M., Havlíčková, V. (2008).

[10] Source: CEDEFOP (2008).

cast possible twists and turns in the economy so that it would be possible to prepare for changes in quantitative and qualitative requirements for the workforce.

This subchapter forecasts expected changes in two sectors - energy (NACE 40 – electricity, gas and steam supply) and in electrical engineering (NACE 30-33). The latter sector was divided into two parts – high-tech manufacture of ICT and optical and medical instruments (NACE 30, 32 and 33[11]) and medium high-tech manufacture of electrical machinery and instruments (NACE 31). The main source of information were sectoral studies evaluated in 2007 and 2008. Each study was based on interviews with major experts and employers.

Starting points for forecasting skills needs

The economy of the CR has experienced a period of robust and stable economic growth. Year-to-year increases in GDP in 2005-2007 exceeded 6%. Job creation was very dynamic as well, both in services and, most importantly, in industry. The most important factors that facilitated a significant growth in employment included the following:

- **a system of investment incentives** introduced in 2000. It considerably increased the level of the CR's attractiveness for investments in production and assembly within the manufacturing industry, and gradually also for investments in strategic and technology service centres;
- **the quality of technical education** in the CR and availability of the workforce with these qualifications. This was the consequence of the transformation of the Czech economy and the loss of tens of thousands jobs in industry during the 1990s; and
- **cost advantage of the Czech Republic** (e.g. wages, property and energy prices) in comparison with developed countries in Western Europe.

Except for the quality of technical education these success factors may be seen as of a short-term nature. However, thanks to them the economic growth in the CR was virtually unaffected by oscillations in the global economy. This advantage will no longer exist in years to come, and the increasingly open Czech economy will be fully exposed to the workings of global trends and changes.

The following trends will affect the labour market in the future:

- **shortage of skilled workforce in the labour market** will force enterprises and the state to "manage" human resources more efficiently, making use of what is available;
- **demographic development** – thanks to the weaker cohorts entering the labour market and due to changes in students' preferences the supply of the workforce in certain fields will continue to decline;
- **a slowdown in economic growth** will limit the creation of new jobs – there may be a gradual increase in unemployment in future years;
- **"Y generations"** – new generations that are entering the labour market have different values, preferences and expectations from work. This threatens particularly the traditional occupations in industry and, also, technical education in general that is often seen as too difficult and "socially less attractive";
- **Development in global markets** – the Czech economy will be increasingly sensitive to global changes – the labour market may be affected by unexpected twists and turns that will originate outside the Czech Republic;
- **Changes in investment policies of trans-national companies** – due to the loss of cost advantage the CR may be afflicted by a loss of thousands of jobs in assembly plants of foreign investors;
- **Sectoral threats** – a global crisis, e.g. in some sectors of industry, could have tough implications for the CR. The question is whether such a situation can occur and when;
- **Cost factors** – due to growing wages and energy prices, and also due to exchange rate changes, the CR will gradually lose one of the advantages that fuelled economic development in the previous years. It will be necessary to boost competitiveness by means of human resources development. Skilled workforce is one of the most important factors for retaining foreign investors and developing the knowledge economy.

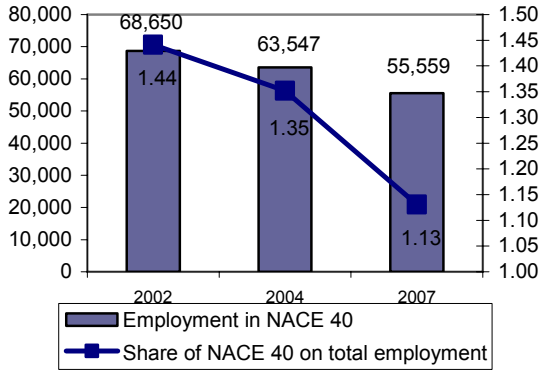
The economic sectors that are analysed in this subchapter should undergo major changes in upcoming years that will affect demand for occupations and qualifications.

Energy supply

In relative terms **energy supply** (NACE 40 – electricity, gas, steam and hot water supply) is not a very important employer. The share of this sector on total employment was some 1.1% in 2007, i.e. roughly 56 thousand workers. In recent years the overall number of employees decreased by some 13 thousand people (see Figure 18).

The changes in the rate of employment were caused, above all, by structural adjustment, but also by technological advancement and the related growth in labour productivity and the outsourcing of some activities (particularly services). Employment should not decrease significantly in the future, because increasing competition in the energy market will force enterprises to pay more attention to obtaining and looking after customers. The demand for jobs in customer care and also in ICT will rise.

Figure 18: Employment in energy supply (number of persons)



Source: ČSÚ (2002); ČSÚ (2004); ČSÚ (2007b), own calculation.

Energy supply is one of the skills-intensive sectors. The proportion of jobs requiring tertiary qualifications is quickly growing, particularly in electricity and steam supply, while jobs where basic skills suffice are gradually being phased out. Occupations requiring full secondary education (with

[11] NACE 33 also includes the manufacture of watches and clocks. However, this part of the sector is underrepresented in the CR and does not play a major role in the employment structure.

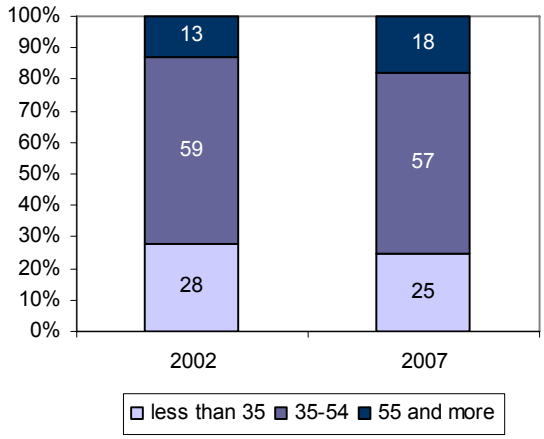
"maturita") have become the most important group in the sector, while the importance of jobs designated for vocational qualifications holders decreased (see Table 1).

What is very unfavourable is the age structure of the workforce in the energy sector – they rank among the oldest in the CR. The average age is 44, while the average age in the economy as a whole is 40. The proportion of young workers is constantly decreasing along with an increasing share of workers approaching retirement. This is one of the major future threats for the sector (see Figure 19).

The proportion of employees aged 55 and more increased from less than 13% in 2002 to 18% in 2007. On the other hand, the number of workers aged up to 34 dropped from 19 thousand to less than 14 thousand and their proportion in total employment in this sector went down from 28% to 25%. Although there is no optimal age structure of the workforce, it is clear that sectors where young people are underrepresented face certain disadvantages.

Practical experience and more prudence in decision-making that are typical of older workers are not sufficiently complemented by new knowledge and drive – i.e. qualities that young people can offer. There is a number of experts in the energy sector who stay at work, particularly in specialised occupations, although they are around 70 years old. The reason is that their experience and knowledge are priceless and the substitute that schools and the labour market can offer is insufficient both in qualitative and quantitative terms.

Figure 19: Age structure of the workforce in energy (NACE 40, in %)



Source: ČSÚ (2002), ČSÚ (2007b), own calculation.

The skills intensity of occupations expressed as a proportion of various jobs increases in the energy sector as a whole. In particular, there is an increasing proportion of technicians (from 29% in 2002 to 37% in 2007).

What is also favourable is the increase in the proportion of experts who bring in innovation and technological changes. The proportion of skilled workers remains the same (28 %).

Two major trends **will influence the energy sector in the following years**:

- **Change in the energy mix:** the energy sector is at present based on the predominating combination of coal and nuclear energy with the corresponding occupational and qualification requirements. The CR can decide to proceed further in this direction and not to change the energy mix in a major way. However, this scenario is rather risky from the perspective of human resources. Institutions offering study programmes in the field of energy (particularly heavy-current electrical engineering) face a severe decline in the number of applicants.

  Young graduates do not join the workforce because their occupational preferences change. If the CR sets on the path of major changes in the energy mix (a robust increase in the proportion of renewable resources, a higher proportion of electricity generated from gas, or transformation from the position of a net importer to a net exporter), the changes in requirements for human resources will also be significant.

- **The increasing average age of the workforce boosts the importance of generational replacement** and of continuing professional education. However, the low prestige of the energy sector, unclear policies for its development and the resulting fuzzy prospects for employment in this sector – all this slashes the interest in studying "energy disciplines".

Figure 20 illustrates a potential development in the supply of and demand for occupations in energy in 2008-2016. It compares expected retirements (workers who were older than 50 in 2007) with an expected appearance of recent graduates of study programmes that are the largest base for the training of new experts in this sector.

If the current trends in the labour market remain unchanged for the sector, by 2016 there will be a shortage of up to 14 thousand workers in electricity, heating and gas distribution.

Even if we assume that not all vacated positions will have to be filled (as a result of growing labour productivity), it is clear that the shortage will be considerable. The most severe problem faced by enterprises will concern lack of workers with secondary vocational qualifications, where the expected inflow of new graduates will be nearly four times lower than the number of workers who are expected to retire in the same period of time.

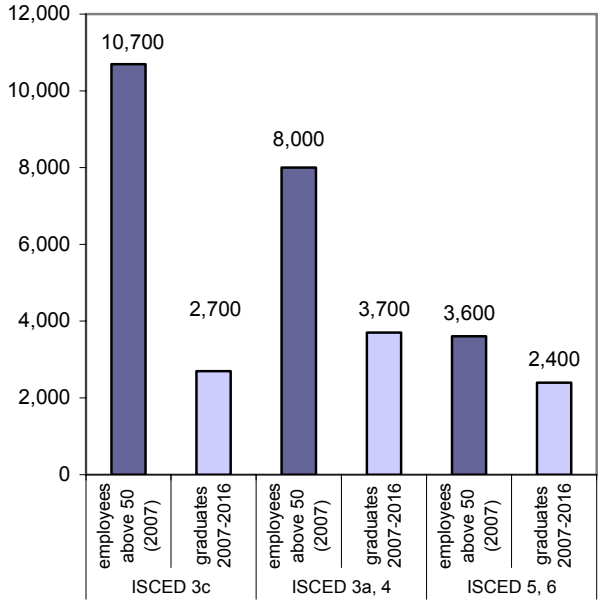
As regards occupations requiring full secondary education, the number of new graduates will be twice as low as the demand, and the same will apply to tertiary education graduates – i.e. their number will be 50% lower than what enterprises are expected to require as a result of the natural outflow of the workforce.

Table 1: The workforce in energy according to educational attainment (2002-2007, in %)

Branch	ISCED 0-2		ISCED 3c		ISCED 3a, 4		ISCED 5,6	
	2002	2007	2002	2007	2002	2007	2002	2007
Electricity supply	2.9	0.5	39.9	39.4	45.6	41.4	11.6	18.7
Gas supply	1.1	2.5	54.3	39.4	34.4	51.2	10.2	7.0
Steam and hot water supply	4.1	1.2	59.4	38.8	29.9	45.1	6.6	14.9

Source: ČSÚ (2002); ČSÚ (2007b), own calculation.

Figure 20: Anticipated generational replacement of the workforce in energy (NACE 40) by 2016



Source: ČSÚ (2007b); NVF-NOZV, VÚPSV (2008), own calculation.

It will be necessary to make robust **investments in the transmission and distribution networks.** In particular, it will be of primary importance to ensure a higher level of system reliability and security, to provide for management of distribution of electricity from renewable resources, to involve smaller sources, to satisfy the increasing number of consumers, to expand connection to Europe-wide energy networks and, in the case of gas, also to increase the storage capacity. This will result in increased requirements for the number and quality of the workforce, their technical skills, decision-making capacities and the ability to handle stressful situations.

Requirements will also toughen as regards the capacity to operate ever **more complex technologies** (ICT, automation) and the level of interdisciplinary knowledge. Workers should not only master their work, but they should be able to understand the preceding and following stages of production and distribution. Enterprises already complain about the inappropriate quality of graduates and the workforce available in the labour market.

The energy sector currently does not have its own institution dealing with **research and development**. This decreases its chances of major involvement in the development of new technologies that make use of new sources of energy. Talented students therefore do not show much interest in becoming top experts and researchers in energy. This, in the long term, may lead to the Czech Republic's dependence on transfer of foreign technologies.

There is a low level of interest in **study programmes focused on design and construction in energy engineering.** This field does not fall directly into the energy supply sector, but it is closely linked to its development. The Czech Republic will have to make big investments both in modernisation of outdated power plants and in the construction of new facilities. Moreover, a new opportunity is emerging for Czech suppliers consisting in supplies for power plants in developing markets in Asia and Eastern Europe. The CR has a long tradition in this area but the current shortage of skilled designers and engineers limits its potential in this respect.

The shortage of energy specialists is a **Europe-wide problem.** Companies in Western Europe seek key professionals all over the world including, of course, the CR. This may result in an outflow of skilled workers who will go after high wages in Western Europe. There will be a strong demand across Europe particularly for specialists in nuclear energy. Many Western countries run special schemes focusing on imports of workers in short supply. In the Czech Republic the "green cards scheme" is currently based on information about the actual shortage of occupations, and not on information about the future labour market developments.

The shortage of skilled workers in nuclear energy may threaten development plans that are being prepared in this sector. If the current level of interest in the relevant study programmes remains unchanged there will not be enough technical experts to complete the construction of the Temelín nuclear power plant or to further reconstruct the Dukovany nuclear power plant. Moreover, the Czech market of nuclear energy experts will be increasingly weakened by demand on the part of Germany (where it will be necessary to decommission some nuclear plants) and Slovakia (where the Mochovce nuclear plant is planned to be completed). The Czech Republic currently has an advantage in that domestic workers were involved in the building of the newest nuclear power plant in Europe and therefore have extensive experience with the complex process of putting it into operation. However, this advantage will diminish in years to come.

A major problem in the area of human resources may occur in the **gas industry** – particularly if the use of gas will further expand. Most systems were built and put into operation by experts in the past 20 years. This generation is approaching retirement age and a problem arises as to who will replace them. Some professions have disappeared, e.g. those concerned with gasification of coal. In some time there will be a similar lack of experts in compression stations, etc. There is a very limited supply of study programmes in this field. The largest part of the qualification must therefore be acquired in practice or via in-service training provided by companies or through courses held under the patronage of professional associations in the gas industry.

There will be growing requirements in the energy sector for **savings, energy audit and management** – energy management in the CR is still not very efficient. The knowledge and capacities related to achieving savings are inappropriate and they will have to be strengthened in the long term. Another major trend is the growing proportion of **renewable sources** of energy which, again, is not backed up by the development of new competencies and study programmes. The energy sector will undergo major changes in upcoming years that will change it entirely. However, these changes will also constitute new and robust challenges for the labour market, education and human resources.

Manufacture of ICT, optical and medical instruments

Manufacture of ICT, optical and medical instruments accounts for an overwhelming majority of employment in high-tech manufacturing industries in the Czech Republic. This sector includes companies whose main business activities are primarily related to the manufacture of apparatus and equipment that is necessary for work with electronic data and information (ICT products). Moreover, the Czech Republic has a well developed manufacture of medical equipment (NACE 33.1) and manufacture of optical instruments and photographic equipment (NACE 33.4). On the contrary, there is a very low occurrence of manufacture of watches

and clocks (NACE 33.5). Definition of ICT manufacture is presented in Box 8.

Box 8: Definition of ICT manufacture according to the OECD and CSO, 2007

NACE 30 – Manufacture of office machinery and computers

NACE 32 – Manufacture of radio, television and communication equipment and apparatus

NACE 33.2 – Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment

NACE 33.3 – Manufacture of industrial process control equipment

The manufacture of ICT, optical and medical instruments in the CR has experienced an extremely dynamic development which has a potential to continue still for several years. This was mainly due to foreign investors. Of these investors six major ones created over 17 thousand new jobs in the past years. The development of the sector has not even been slowed down by the economic problems of the L.G.Philips company that have lead to restricted production in its plant in Hranice na Moravě (see Table 2).

Table 2: Major investors in manufacture of ICT, optical and medical instruments

Investor	Jobs created
Hon Hai Precision Industry	4,500
Matsushita Electric Industrial Co.	4,230
L.G. Philips Displays Holding	3,250
IPS Alpha Technology	2,100
Hitachi	2,000
FIC	1,300

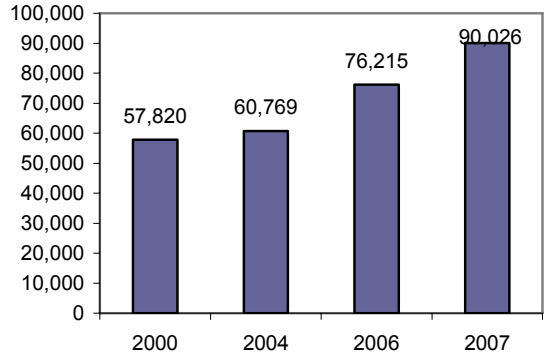
Source: CzechInvest (2008); NVF-NOZV, ČOK (2008).

Employment in this sector is likely to exceed 100 thousand people by 2010 as a result of investments projects either planned or already launched by the aforementioned companies. Thanks to foreign investors overall employment in the manufacture of ICT, optical and medical instruments gradually catches up with employment in the manufacture of electrical machinery and equipment, and this sector is becoming one of the most significant employers in the entire manufacturing sector (see Figure 21 and 25). Employment in the manufacture of ICT, optical and medical instruments increased by 55% in the 2000-2007 period.

The growth in this sector largely contributed to the decrease in unemployment in some regions, since a number of plants dealing predominantly with assembling parts could easily provide on-the-job training to workers from other industries that had experienced crises (textiles, wearing apparel, food industry). This concerns mainly the manufacture of computers and their components (NACE 30) and also the manufacture of audio-visual technology (NACE 32.2). Moreover, the manufacture of semiconductors (NACE 32.1) and the manufacture of optical instruments (NACE 33.4) based in Brno provide for qualitative growth.

Trends in investment have caused a major increase in employment in the manufacture and assembly of consumer electronics (see Table 3). Growth occurred in all other types of manufacture, except for semiconductors and the manufacture of small electronic components where Asian countries are increasingly taking the lead at the expense of European and North American countries.

Figure 21: Employment in manufacture of ICT, optical and medical instruments (number of persons)



Source: ČSÚ (2000); ČSÚ (2004), ČSÚ (2006c), ČSÚ (2007b), own calculation.

In comparison with Asian competitors Europe has inappropriate capacity of human resources and, increasingly, also the quality of technical qualifications and knowledge. This in combination with insufficient knowledge of the market and customers constitutes a major weakness. Research and development centres operated by electronics manufacturers are more and more frequently placed in China, India, Vietnam, Taiwan and other countries in South and East Asia. The Czech Republic has not yet managed to grasp the trend of outsourcing these activities to countries offering better cost advantage. In view of the fact that the Czech Republic already faces a shortage of engineers and technicians specialised in electronics/electrical engineering, and the number of graduates of these disciplines will only slowly grow in years to come, its position in the global competition for knowledge-intensive investments is not very likely to change.

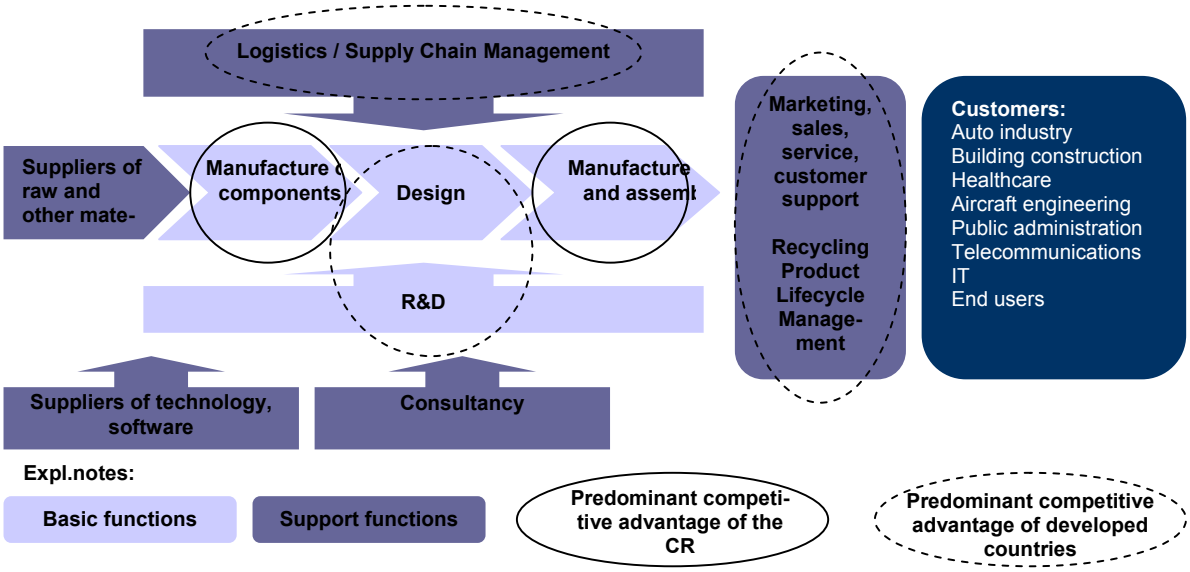
Table 3: Employees in sectors according to disciplines (2002-2006)

Branch	Number of employees		Change
	2000	2006	%
Consumer electronics	11,467	19,453	70%
Semiconductors	19,136	16,995	-11%
Television and radio transmitters	5,246	7,698	47%
Medical equipment	9,987	13,548	36%
Watches, clocks, measuring, checking and testing equipment	15,175	17,441	15%
Optical equipment	5,525	6,716	22%

Source: MPO (2007).

The manufacture of ICT, optical and medical instruments is described as the most demanding part of the manufacturing industry. Over the last seven years, however, the growth in this sector in the CR was based on those parts of the value chain (see Figure 22) that meet this description to a little degree (manufacture of components and assembly of final products).

Figure 22: Value chain in the manufacture of ICT, optical and medical instruments and the CR's competitive advantage

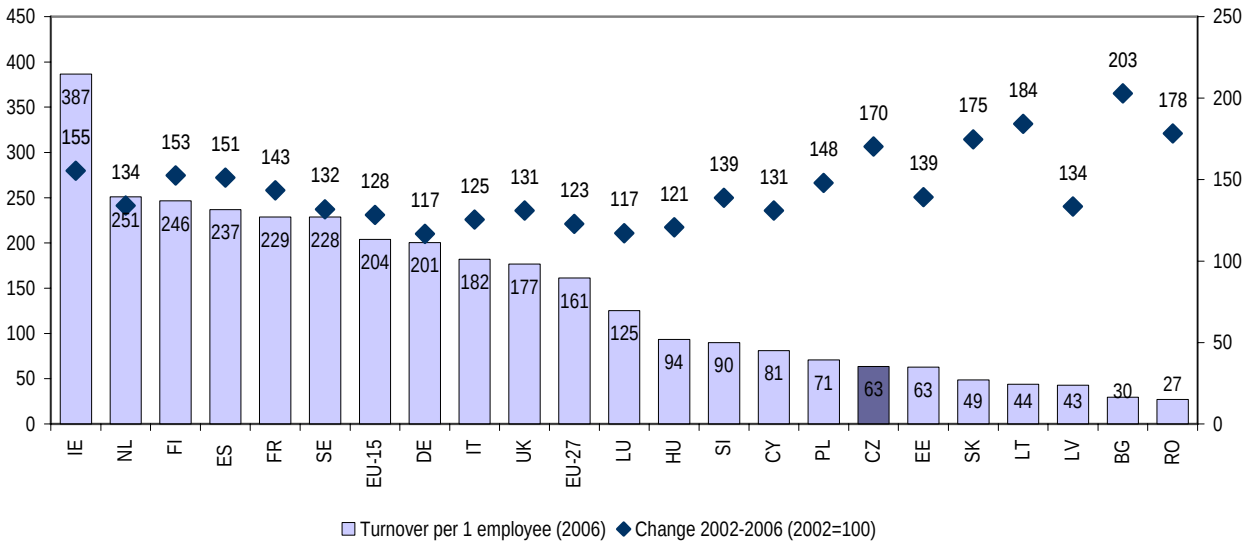


Source: NVF-NOZV, ČOK (2008)

It is clear that the current nature of this sector in the CR represents one of the stages of its gradual transformation. At the turn of the millennium the industry in the CR tackled, above all, the problem of lack of competitiveness in production, lack of capital and, consequently, hindered access to new technologies. These problems were relatively well resolved by the inflow of foreign capital. However, it would not be realistic to expect that the CR will manage, in a short period of time, to establish conditions for ensuring competitive production over the long term that would be based more on research and on advanced services. It is necessary to respect the limitations resulting from the way in which the country and its human resources potential are viewed by investors, from the prestige of brands and the quality of the business environment and related services.

In order to set a further direction for this sector it is possible to consult data on international comparison of labour productivity and its growth in the past years (see Figure 23). The Czech Republic fares better than Slovakia, Bulgaria and Romania on the scale, but it lags behind Hungary, Poland and Slovenia. Annual turnover per 1 employee is three times lower than in Germany and more than six times lower than in Ireland. While in Germany this sector has a high proportion of employees in research, development and design, the Irish success is based on high-quality customer services, handling the product life-cycle and a remarkably flexible and well-developed logistics chain. On the other hand, the CR managed to score a major increase in labour productivity during four years (by 70%). However, this is partly thanks to the low starting level that distorts comparison with developed countries to a large degree.

Figure 23: Annual turnover per 1 employee (2006, in thousand EUR) and its growth in % in the manufacture of ICT, optical and medical instruments (2002-2006)



Source: EUROSTAT (2002b); EUROSTAT (2006e), table code: sbs_na_preli, sbs_na_2a_dfdn, 6.8.2008

In the following years the manufacture of ICT, optical and medical instruments in the CR will be influenced, above all, by the **commodisation process.** Traditional producers gradually lose their predominance in terms of technology know-how. Due to technological innovations sophisticated products may be manufactured by a far higher number of producers who do not need to buy the know-how of market leaders, nor do they need to invest in in-house development. Moreover, the quality of products by these producers begins to approach the quality achieved by so-called traditional producers. Thanks to the expanding supply of good quality products from various companies the market gradually ceases to distinguish between brand and non-brand products, and the price is becoming the main criterion in for purchase. Moreover, market pressures accelerate the product life-cycle which makes it possible for non-brand producers to easily supply mass produced and mature products. The so-called OEM (see Box 9) thus lose their main competitive advantage – intellectual property. Non-brand producers benefit from this position and may expand and demand more skills-intensive occupations and workers with tertiary qualifications specialised in electronics/electrical engineering, as well as trade-related occupations and specialists in supply chain management. Typical representatives of this trend in the CR are ASUS, Celestica and Foxconn.

Box 9: Company types in the sector

OEM - Original Equipment Manufacturers. These companies (e.g. HP, Sony, Nokia, Siemens, Panasonic, Hitachi) own brands, they are customers for other components of the supply chain and they are in direct contact with end users. At present they purchase most of the products and services from external suppliers and fully manage marketing and sales activities and a major part of research, development and design. They face the threat of commodisation of production that, on the contrary, represents an opportunity for EMS and ODM (see below).

EMS – Electronics Manufacturing Services. They produce for OEM on a contractual basis, but do not have access to the results of their research and development. Thanks to the growing ICT market they have good future prospects. EMS are relatively well represented in the CR (Foxconn, Celestica. ..) and there is a trend of growing demand for occupations. The downside of this growth in demand is that it is often satisfied by a large-scale import of foreign workers from East Europe and Asia, and the skills intensity of these investments is not yet very high.

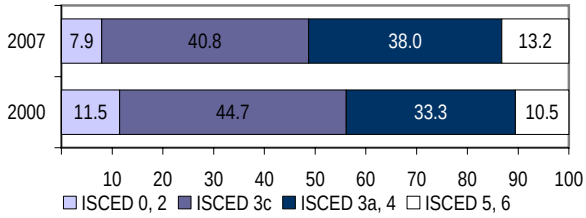
ODM – Original Design Manufacturers. They supply finished products to OEM – so-called white boxes on which OEM put their tag and sell. ODM are competitive on a mature market where protection of intellectual property is not relevant and products are standardised. The price of such a product is relatively low and tends to decrease further. ODM focus on mass production where unit profit margins are low. The group of ODM companies has a large potential for further growth and can push OEM companies out of the market. ODM is represented in the CR, for example, by Asus, which is increasingly perceived in the CR as an independent brand – an OEM producer.

Source: UK - Department of Trade and Industry (2004).

On the other hand the prospects of OEM producers in the Czech Republic are jeopardized by this trend. Moreover, the strengthening of the crown against the Eurozone currency (where most of the products are headed) and the growing energy and labour costs have negative effects as well. There is therefore the threat of a gradual decrease in employment in these companies. The pace of growth of Western economies is also important – the optimism related to investments and consumption west of the Czech border will tend to diminish in the following years, and this may have a negative impact on employment in this sector.

Ireland experienced a similar cost-based shock when the five-year dynamic growth in employment (1996-2000), which was based mainly on comparatively low prices, was replaced by a dramatic downfall during one year (by up to 40%). It was as many as four years that the Irish ICT, optical and medical instruments sector needed to recover fully from this development (2001-2005). The lower-skilled occupations in manufacturing and accompanying activities were most affected (there is a majority of these still in this sector in the CR). The evidence is derived from an analysis of the development of the education structure in the sector. The proportion of the workforce with basic qualifications dropped by 3.6 p.p. in 2000-2007, while the proportion of workers with secondary qualifications in total employment remained at over 78% (see Figure 24).

Figure 24: Employment structure in the manufacture of ICT, optical and medical instruments (2000-2007, in %)



Source: ČSÚ (2000); ČSÚ (2007b), own calculation.

Employment in this sector in the CR may take several directions in the future. The effect of new investors is beginning to be offset by negative implications of the exchange rate, and large new investments of Foxconn, Hitachi and IPS Alpha fill the announced jobs far more slowly than expected. This suggests that employment in ICT manufacture is currently approaching a peak level. This means that, from 2009, there may either be stagnation or decline in terms of the labour market development. As the consequences of the global financial crisis reach out to a growing number of economic sectors, decline is increasingly likely.

These trends will be reflected in a **change in the qualification structure**. The manufacture of ICT, optical and medical instruments differs from other manufacturing industries in that workers in production represent a far smaller proportion in total employment in the sector. In developed European countries the proportion of production workers in industry hovers at around 25-30%, while in this sector it is between 15-20%.[12] In the CR over 40% of the workforce are in production (and there has been a growing trend in recent years, which is not sustainable in the long term).

Another major factor affecting the manufacture of ICT, optical and medical instruments in the CR consists in **changing investment priorities.** Changes in the investment incentives scheme, changing priorities of the government (and, consequently, of CzechInvest) as regard the desired structure of industry and a growing number of higher education graduates with technical specialisations – all this will attract new investors in the area of development, design or service activities. This will further enhance the structure of employment. However, new jobs will only appear in the order of tens or hundreds at most – the labour market will not be able to absorb a larger investment in his area. If there is an outflow of some investors, it will be necessary to find new jobs for lower-skilled people. Some of them are likely to be absorbed

[12] U.S. Department of Labor (2005).

by other industrial sectors, the growing sector of services showing the largest potential in this respect. However, it will be necessary to expand the provision of continuing training and retraining to ensure that these employees can perform their jobs effectively.

A shortage of lower-skilled workers can still cause difficulties in the sector in the following couple of years. It is likely that companies will seek these occupations at labour offices and through recruitment agencies. Moreover, they will seek to import foreign workforce from increasing number of countries. There will be fewer Slovaks, Poles and Ukrainians, while the number of workers particularly from the Balkans and Asia will rise. As a result companies will face specific complications due to cultural and language differences.

The growing number of higher education graduates with technical degrees will only have a limited positive effect. Enterprises in the sector will face difficulties in attracting these graduates due to their changing preferences (decreasing attractiveness of the sector, lower pay levels, lower willingness on the part of the graduates to move to accept a job in more remote regions). An increasing number of graduates of technical universities will end up in the services sector where the demand for them will soar in the future.

In a short period of time there will also be a shortage of skilled technicians with secondary qualifications ("maturita"). The demand on the part of enterprises will not be satisfied due to an overall decrease in the number of students, a higher proportion of those who continue studying at tertiary education institutions, and preferences for general education that does not provide such good foundations for work in technical occupations.

As regards occupations requiring tertiary education, there will be the highest level of demand for programmers who are drawn into ICT companies in large numbers. The proportion of software development in total development in ICT will increase. There is a shortage of designers and developers. However, in view of scope of development in the CR that is still tiny (as compared with Western countries) this problem will not yet be as perceptible. Technologists and production designers represent other professions that require tertiary education and that might be in short supply.

In terms of professional competencies in skilled workers there is a problem in that employment is concentrated with larger employers. In the manufacture of computers nearly 80% of workers are employed in companies with 250 and more staff. In the manufacture of electronics and electronic components this figure approaches 60%. Large companies draw employees into large-scale production, which weakens development and innovation know-how typical of small and medium-sized enterprises.

Tertiary qualifications holders, in particular, opt for employment in larger companies that normally offer higher pay levels and better career growth opportunities, but their work is then less creative and their specialisation more narrow. The creative potential of talented workers becomes disintegrated due to this phenomenon, and the CR's ambitions to achieve a stronger position in research and development in this sector are endangered.

ICT manufacture will continue to be exposed to the effects of **legislative changes** of which the most important are EU directives concerning environmental protection, product life-cycle (the need to address the issue of repurchasing used products and recycling input materials when the product is being designed and developed), and restrictions on the use of selected chemicals in manufacturing. Legislative changes have a major impact on changes in the demand for skills in production, technologies and development, and non-manufacturing activities. The requirement for enhancing skills will concern virtually all types of job – related to production, development, technology, purchase and logistics. Another major factor behind a change in demand for skills concerns the techniques of managing supplier-consumer relations.

In view of the expected increase in costs (e.g. according to a study carried out by Roland Berger Strategy Consultants[13], by 2010 a Czech worker will be four times more expensive than a Chinese worker, twice as expensive as a Romanian or Russian worker and nearly 50% more expensive than a Slovak or Polish worker). Furthermore, in view of the expected decline in the supply of the workforce with vocational and full secondary ("maturita") qualifications there will be a growing necessity to seek subcontractors for specific parts of the development or production process in other countries.

More extensive cooperation with other suppliers will increase demands placed on management, logistics and sales – i.e. particularly business, language, organisational and technological skills. Moreover, the proportion of services in the activities and revenues of manufacturers is expected to grow in years to come.

This will concern, above all, the actual trade and sales, logistic services, customer support and service. This can influence the demand for occupations and skills in two ways: there may be increased requirements for enhancing skills in jobs requiring technical education so that the aforementioned activities may be carried out in the appropriate quality and scope; there may also be an increasing demand for non-technical staff. In view of the scope of technical education and the better position such qualifications ensure in terms of employment in this sector, the first alternative is more favourable – also from the perspective of the education sector.

Manufacture of electrical machinery and apparatus

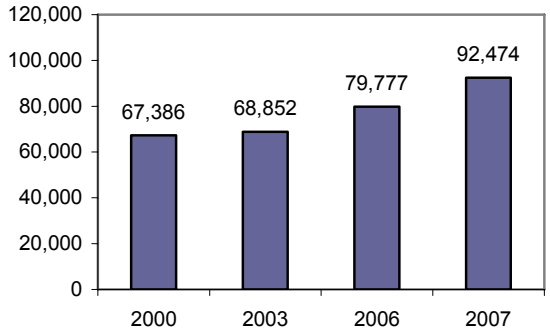
The manufacture of electrical machinery and apparatus (NACE 31) involves the production of electric motors, generators, transformers, cables, conductors, accumulators, batteries, lighting equipment and other electrical equipment. Together with the manufacture of ICT, optical and medical instruments it is denoted as "electrical engineering".

According to the EUROSTAT definition this industry ranks among medium high-tech economic sectors. In this sector the Czech Republic has a very good historic position and a relatively strong position and tradition in research and development.

As with ICT manufacturing, employment in this sector increased significantly in the last seven years – by 37%. The main reason for this growth was an increasing demand on the part of the largest employers – the automotive industry and mechanical engineering, construction and partly also energy. Production in the Czech Republic was expanded and therefore demand for employees increased.

[13] Roland Berger Strategy Consultants (2007).

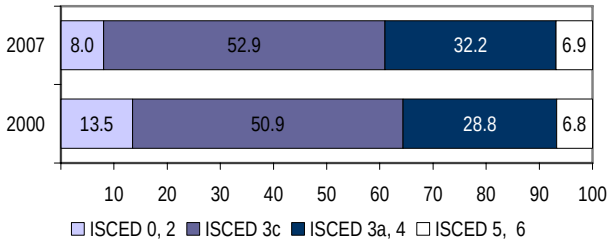
Figure 25: Employment in the manufacture of electrical machinery and apparatus (number of people)



Source: ČSÚ (2000); ČSÚ (2003b); ČSÚ (2006c); ČSÚ (2007b), own calculation

The education structure of the workforce in the manufacture of electrical machinery and apparatus (see Figure 26) reveals that the creation of new jobs has not changed qualification requirements in a major way. The considerable decline in the proportion of workers with basic qualifications was caused, above all, by modernisation of production lines, since their operation normally requires at least secondary vocational education (a vocational certificate).

Figure 26: Education structure in the manufacture of electrical machinery and apparatus (2000-2007, in %)



Source: ČSÚ (2000); ČSÚ (2007b), own calculation.

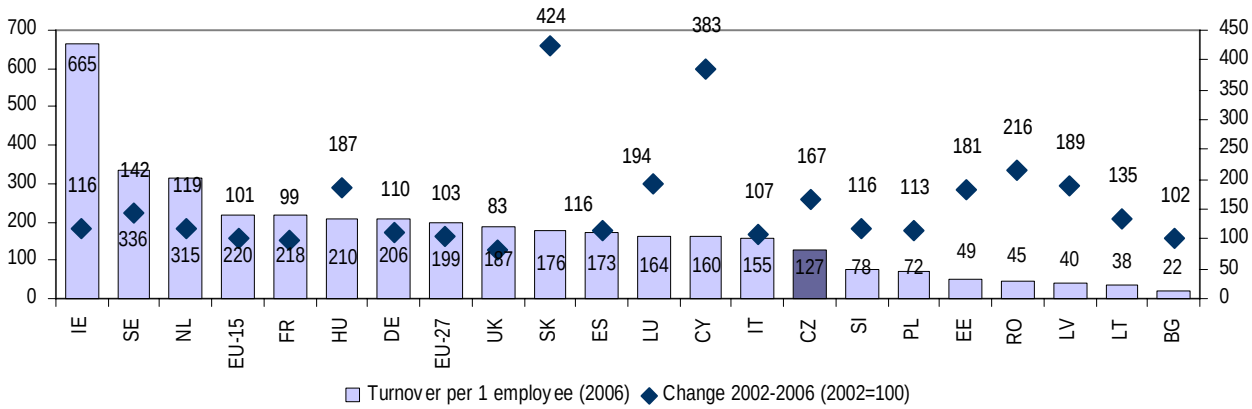
After seven years of a relatively dynamic development this sector in the CR retains a medium level of skills intensity with a large proportion of assembly work. The share of secondary qualifications holders in total employment increased to more than 85%. Unlike the ICT, optical and medical instruments manufacture there is not yet an increasing demand for workers with tertiary qualifications. The turnover per one employee in the manufacture of electrical machinery and apparatus in the Czech Republic reaches up to 60% of that in Germany and two thirds of this turnover in the UK. The figure for the CR is higher than in most Central and East European countries (see Figure 27).

The employment structure in the manufacture of electrical machinery and apparatus in the Czech Republic consists of some two thirds of production workers (particularly ISCO 72 – metal, machinery and related trades workers and ISCO 82 – stationery equipment operators and assemblers). In terms of comparison with selected developed West European countries these occupational groups have about twice as large proportions in total employment. Despite the strong tradition in development the employment of scientists and engineers (particularly ISCO 21 and 24) is below the average – in the UK and in Germany it is a few times higher. In Hungary it is also twice as high than in the CR. Of these countries the CR has the largest proportion of skilled technicians (particularly ISCO 31 and 34), and, conversely, a very low proportion of unskilled workers (ISCO 9) in total employment. However, in terms of innovation potential and R&D activities, technicians (ISCO 3) are not of key importance for the industry and they cannot fully make up for the shortage of scientists and engineers. (see Figure 28).

In the upcoming years the manufacture of electrical machinery and apparatus will be influenced by the following major trends:

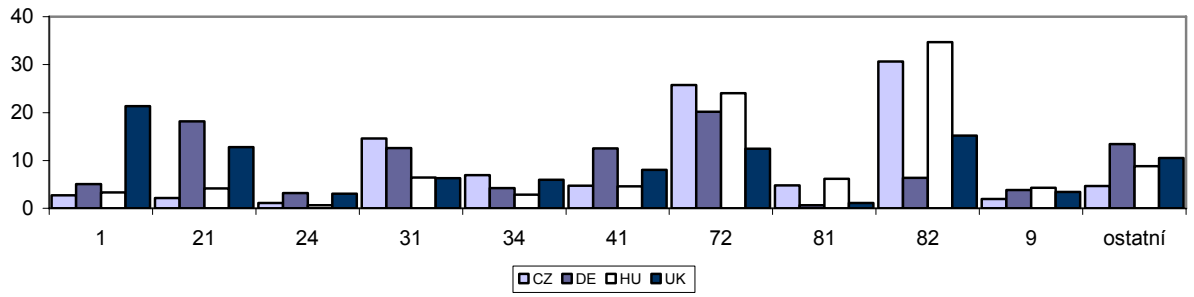
The development of manufacture in the auto industry that envisages another major impulse as the third plant for the production of passenger vehicles (Hyundai) should open at the end of 2008. Moreover, electrical and electronic components will represent an increasingly important part of the value of a car and its price. The most important components will include hybrid drives and brake control systems including advanced electronics. Demand for qualifications in electrical engineering will therefore become stronger in the car industry itself. Consequently, there will be a growing interest in workers with electrical engineering qualifications and knowledge in other user fields. It is likely that demand in this respect will exceed supply and that companies will have to address this situation by more intensive in-service training and qualification enhancement schemes for selected employees.

Figure 27: Annual turnover per 1 employee (2006, in thousand EUR) and its increase in % in the manufacture of electrical machinery and apparatus (2002-2006)



Source: EUROSTAT (2002b); EUROSTAT (2006e), tables: sbs_na_preli, sbs_na_2a_dfdn, 6.8.2008.

Figure 28: The most frequent occupations in the manufacture of electrical machinery and apparatus (proportion in % in total employment)



Source: EUROSTAT (2007b), own calculation.

There will be a worldwide **increase in demand for turn-key projects in the energy sector** that will be pulled by an increase in demand for energy (particularly electricity) in absolute terms and for new energy generation sources in the Czech, European and, most importantly, developing markets (particularly in the so-called BRIC – Brazil, Russia, India and China). At the same time it will be necessary to modernise and renovate the existing energy equipment and transmission networks in the CR and in Europe to meet energy efficiency and fuel savings requirements.

Some occupations that are of key importance for this area (development and design of equipment for the generation of electricity) experienced a relatively steep decrease in demand on the part of employers. This had a negative impact on the interest in the relevant field of study on the part of students. As in the energy supply sector, the age structure is unfavourable and the supply of skills will not satisfy the future demand on the part of many enterprises. **Changes related to legislation, outsourcing and a greater emphasis on accompanying services**, which are analysed in the previous chapter, will have a similar impact on occupations and skills in this area.

However, a further growth of the sector in terms of overall employment is less likely. This growth will be counteracted by both a change in the conditions and the overall environment that will lower the level of attractiveness of the CR for new investors, and by the demographic development and the expected decrease in the inflow of new graduates. The deteriorating cost situation will also have an effect (wages, energy, exchange rate development). This will constantly force enterprises to increase labour productivity or, possibly, to move parts of production to cheaper locations. All this will tend to have a negative effect on total employment – even in the event that skills and technology intensive investment projects are placed in the CR in the upcoming years.

The following development may be expected in terms of demand for occupations and skills in the manufacture of electrical machinery and apparatus.

Stagnation and a possible slight decrease in total employment caused by continuing automation and companies' efforts to pursue cost optimisation of their production. The largest decline in demand for the workforce may be expected in the group of production workers and assemblers where companies will see the largest room for cost savings and increased automation levels. **Demand for engineers and technicians** specialised in electrical and mechanical engineering is likely to grow slightly. This will bring the CR closer to developed countries in terms of employment structure. Demand for workers with tertiary qualifications in electrical and mechanical engineering is likely to exceed supply in the long term as well.

The expansion of activities associated with the development of new products and technologies will not have such a major impact on total employment as compared to the growth in demand for the **workforce in non-manufacturing units** (purchase, logistics, quality, customer services and sales). Availability of these workers with full secondary and tertiary qualifications will be one of the key factors of the competitiveness of manufacturing companies in years to come.

2.3. Preparation of human resources for skills-intensive occupations

The development of economies with a great proportion of technology and knowledge-intensive industries largely depends on the availability of the workforce with tertiary education. A high proportion of people with tertiary qualifications constitutes a competitive advantage for the entire society and for each individual. Tertiary education expands the range of employment opportunities, and it has a positive impact on earnings. In terms of economic development tertiary education holders are beneficial mainly for the development of science and technology, and for application of new knowledge in practice. For the proportion of the workforce with tertiary qualifications the Czech Republic ranks among countries below the EU average (see Chapter 1.2), although the situation is improving thanks to a wider range of educational opportunities.

Entry into tertiary education

As Table 4 illustrates, the number of those admitted to full-time/on-site studies at higher education institutions and tertiary professional schools increase year-on-year. In view of statistical reporting methods it is more accurate to mention numbers of studies and not numbers of students, as in 2005/06 the number of enrolments in studies was reported (students could be admitted to more than one institution). In 2005 the number of students/studies increased as compared to 2000 by nearly 41%. Along with the number of students the ratio of those admitted to studies to the number of the 18-to-19-year-olds also increases (from 31.3% in 2000 to 44.5% in 2005). This is a gross rate of entry into tertiary education as the numerator includes all those admitted regardless of age. The positive development of the gross rate of entry is the result of not only the increasing capacity of tertiary education, but also the unfavourable demographic situation – i.e. a decline in the absolute number of the population aged 18/19.

Table 4: The capacity of full-time/on-site studies in tertiary education in the CR

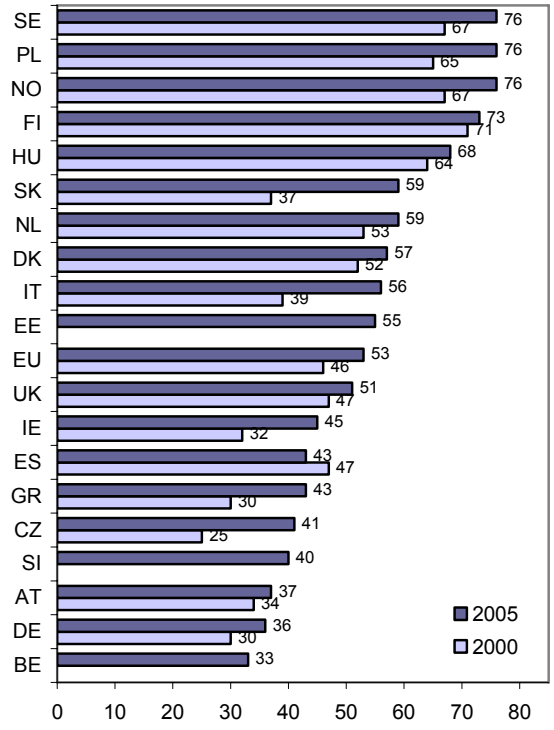
	2000	2005
Newly admitted	**41,947**	**58,955**
Gross entry rates	31.3%	44.5%
Ratio to the graduates of "maturita" studies in previous school year	66.8%	69.6%

Note: Tertiary education includes studies at higher education institutions and tertiary professional schools. Source: ÚIV (2007c), tab. B7.1.4.

One important indicator of the capacity of tertiary education is the proportion of newly admitted students/studies in the number of secondary education graduates with "maturita", as the "maturita" examination is still one of the prerequisites for access into tertiary education. The proportion of newly admitted students/studies in the number of those who achieved "maturita" in the previous year was 69.6% in 2005, which was an increase by nearly 3 p.p. in comparison with 2000. The far slower dynamics of this indicator as compared to the indicator expressing the proportion of new enrolments in the 18/19-year-old population (3 p.p. vs. 13 p.p.) is the consequence of an increase in the absolute number of "maturita" holders thanks to expanding capacity of this type of studies and a decrease in the interest in vocational programmes.

For the international comparison the indicator of the **net entry rate into tertiary education** is used. It expresses the proportion of people who entered tertiary education in the population of a given age. The indicator of the net entry rate (NER) is monitored separately for two levels of tertiary education - ISCED 5A and ISCED 5B. In the CR programmes at ISCED 5A can be studied at **higher education institutions**. This level covers both Bachelor and Master programmes. Programmes at ISCED 5B level are offered by tertiary professional schools.

Figure 29: The net entry rate into Bachelor and Master study programmes ISCED 5A (%)

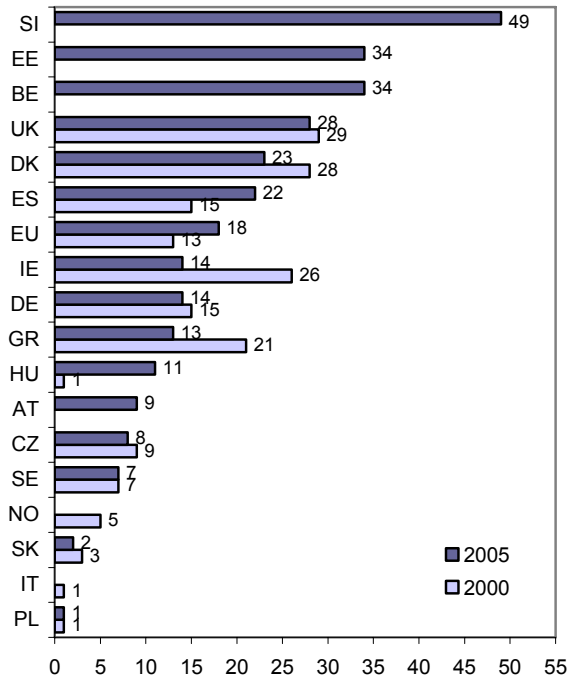


Note: EU – non-weighted average from the data available. Source: OECD (2007a), tab.C2.5.

As Figure 29 illustrates, there was quite a robust change in the NER into tertiary education at Bachelor and Master levels in 2000-2005 in the CR (from 25% to 41%), which was the fastest increase after Slovakia and Italy. Nevertheless, the CR still lags behind most EU countries in a major way. Out of 18 member countries for which data are available only four countries ranked lower on the scale in 2005. Sweden along with Poland scored the best results (76%), the worst situation was in Belgium (33%). The EU average was 53%.

The lower ranking of the CR as regards the development of tertiary education at ISCED 5B level – i.e. studies at **tertiary professional schools** - is clear from Figure 30. The NER into these programmes is among the lowest in the EU. In 2000 it was 9%, in 2005 one percentage point less, i.e. 8%. This decrease was offset by the aforementioned increase in the NER into programmes provided by higher education institutions. A similar unfavourable development in terms of inflow into this type of tertiary education occurred in most EU countries for which data are available. Of 11 countries only Hungary and Spain scored better (from 1% to 11% and from 15% to 22% respectively). Slovenia shows the highest level of development of this level of education (49 %).

Figure 30: The net entry rate into tertiary education ISCED 5B (%,)



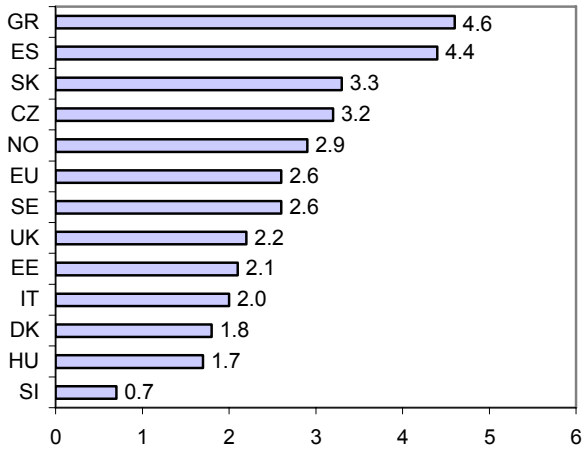
Note: EU – non-weighted average of data available. Source: OECD (2007a), tab.C2.5.

Short study programmes provided by tertiary professional schools (TPSs) do not have a long tradition in the CR. The establishment of these institutions was made possible as late as 1995 when an amendment to the Education Act was passed. However, this type of study had been piloted since 1992/93. Most TPSs were set up in 1996/97 at secondary technical schools. Only a few of them were established as independent legal entities. The number of newly admitted students has been decreasing since 2004. The reason is, first of all, the expanded provision of higher education institutions, and also the fact that students at TPSs pay tuition fees while students at public HEIs do not. Another reason is that this educational path does not enable continuing study Master degree programmes. The unclear prospects of this type of

study also play a negative role. There is discussion on a possible transformation of these institutions. Those TPSs that meet certain criteria might be transformed into non-university higher education institutions – i.e. those that only provide Bachelor degree programmes – and the other ones would be merged with secondary schools.

Data on the NER rate into **Doctoral programmes** (ISCED 6) are only available for eleven EU member countries and Norway. These data clearly illustrate that countries with a lower level of economic development show a larger interest in and accessibility of Doctoral studies as compared to countries with higher economic standards. Greece, Spain and Slovakia rank at the top of the scale according to the NER into Doctoral programmes. The CR with 3.2% of Doctoral students ranks fourth on the scale. Countries with more developed economies show a far lower rate, although a large proportion of the population is involved in tertiary education. These countries include Sweden, the Netherlands, the UK, and, most importantly, Denmark, that ranked the lowest among developed EU countries for the entry rate into Doctoral programmes (1.8 %).

Figure 31: The net entry rate into Doctoral programmes ISCED 6 (%, 2005)



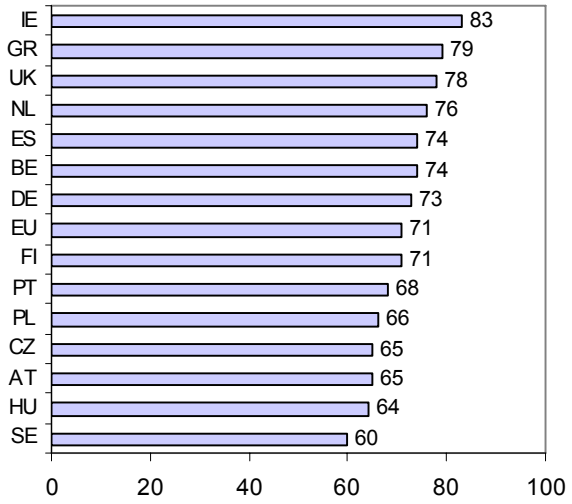
Note: EU – non-weighted average from data available. Source: OECD (2007a), tab.C2.4.

The NER into tertiary education differs for **men and women**. For tertiary education of ISCED 5B type the difference is twofold in favour of women. Women had a 12% NER into tertiary professional education in 2005, while for men it was only 5%. This is largely due to the structure of educational provision with a predominating proportion of programmes focused on humanities in which women are traditionally more interested. Over a half of students in full-time/on-site programmes at TPSs are enrolled in three programmes: healthcare, business and administration, teacher training and social care. The proportion of female students in teacher training programmes was 90%, in business programmes it was 75%.

There is more balance in terms of gender in higher education. The NER of female students was 44% and it was 39% for male students in 2005. The ratio turns in favour of men in Doctoral programmes. In 2005 3.7% of men of the relevant age group entered Doctoral programmes, but there were only 2.6% of women (UIV, 2006b, table E2.4, own calculation). A research career in the CR is still more attractive for men as compared to women. This is not so in all EU countries. In Spain, for example, 4.6% women entered into this type of education, and only 4.2% of men. A larger proportion of women in Doctoral programmes was also in Italy, although the difference was not so large (2.1 % vs. 1.9 %) and in Sweden (2.7 % vs. 2.3 %). (OECD, 2007a, table C2.4).

The inflow of the workforce with tertiary qualifications into the labour market depends not only on the number of students admitted, but also on the **rate of success in graduation**. International comparisons are facilitated by means of an indicator of survival rates. This indicator expresses the ratio of students who completed tertiary education in the given year to the number of students who commenced studies in the year corresponding to the standard length of studies.

Figure 32: Survival rate in tertiary education (%, 2004)



Note: EU – non-weighted average from data available. Source: OECD (2007a), tab.A3.6.

The CR ranks among the countries at the bottom of the scale for the survival rate in tertiary education. In 2004 only 65% of students completed their studies successfully. Students in Sweden, which is among the countries with the highest NER into tertiary education, achieved even a lower score (60%). Conversely, students in Ireland are the most successful in completing their studies (83%).

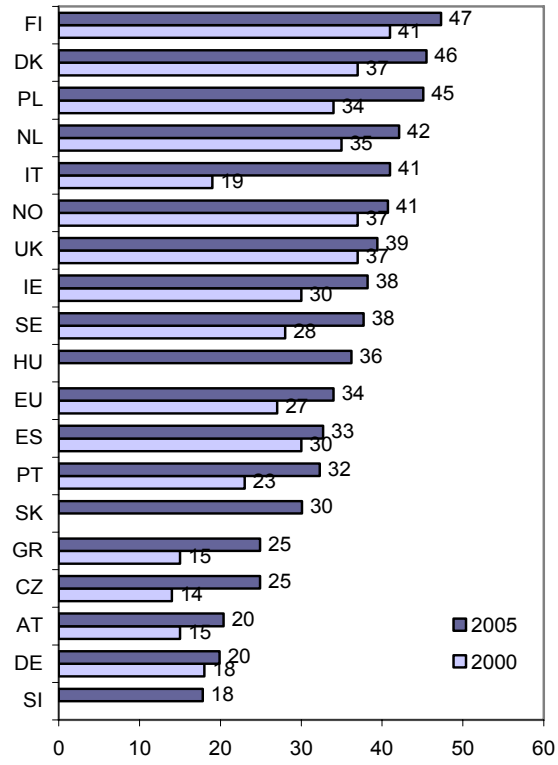
There may be a number of reasons for the low survival rate in tertiary education. These may range from a wrong choice of the study programme, through overrating one's capabilities to a change in one's personal situation that makes it impossible to graduate with success. However, failure means waste of both public and private resources. This is why the causes of failure should be identified for individual programmes, and ways of addressing them should be sought. It is still an individual's initiative that should be the decisive factor – starting from good study performance at secondary school, going on to critical assessment of study aptitudes and professional interests, and ending with a responsible attitude to studies at the relevant higher education institution or a tertiary professional school. The quality of teaching staffs at secondary schools as well as universities is also important, and so is the quality and accessibility of guidance services, support from the family, and the possibility for students from disadvantaged social backgrounds to obtain financial support.

Tertiary education graduates

The combination of the low inflow rate into tertiary education and the low survival rate places the CR in an unfavourable position within the EU in terms of the number of graduates. In 2005 the proportion of higher education graduates in the

population at an age typical of graduation (23-24 years) was only 25%, which is far below the EU average (34%). In connection with the expansion of educational opportunities the CR experienced a positive development in this area. It is one of three countries that scored the largest increases as compared to 2000. Italy achieved the best rating as the number of graduates per 100 people in the relevant age group increased by 20 in 2005. In the CR and in Poland the increase was by 10 graduates per 100 people in the relevant age group. In spite of this positive development the situation in the CR is still much worse compared to developed EU countries. In 2005 over 45% of the population at the relevant age graduated in Finland, Denmark and Poland.

Figure 33: Tertiary graduation rates - ISCED 5A (%)

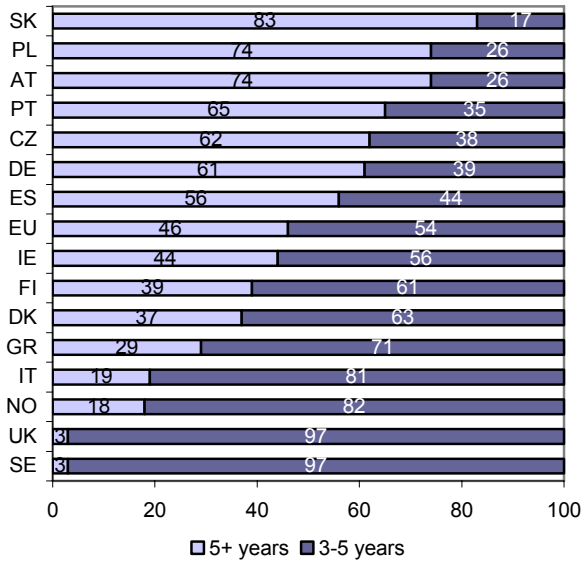


Note: EU – non-weighted average from data available. The data for Finland are for 2004. Source: OECD (2007a), tab.A3.2.

The structure of graduates in terms of the length of studies points to differences in education systems in various EU member countries. The CR ranks among the countries where it is still more common to study longer programmes – i.e. those lasting five or more years (see Figure 34).

In the CR the proportion of graduates of Master programmes in the total number of higher education graduates was 62% in the year 2005, graduates of Bachelor programmes accounted for 38%. It is evident that a portion of these Bachelor degree holders continue studying follow-up Master programmes. Success in admission – i.e. the ratio of applicants to those admitted to full-time Master studies was only 45% in 2006/2007, while the rate of success in admission to Bachelor programmes was 72% (ÚIV, 2007b, table B7.3.82). The low rate of success in admission to Master studies is largely influenced by the low rate of success in admission of graduates of non-university higher education institutions who want to continue studying at Master level at universities. Another reason is a lower rate of success in admission proceedings to long (non-structured) study programmes, particularly in law (27%) and medicine (42%) (ÚIV, 2007b, table B7.3.10). Similar proportions of graduates of short and long programmes as in the CR occur in Germany. On the other hand, in Sweden the proportion of graduates of programmes lasting 5 and more years is negligible (only 3%).

Figure 34: Structure of graduates of ISCED 5A study programmes according to length of studies (%, 2005)



Note: EU – non-weighted average from data available. Source: OECD (2007a), tab.A3.2.

The supply of short study programmes at public higher education institutions in the CR began to expand particularly after 2000 following an amendment to the Higher Education Act. This amendment established a more solid framework for a transfer to structured studies. Another impulse was the CR's signing of the Bologna declaration that sets out introduction of a two-level system of tertiary education as one of its objectives.

However, most institutions do not yet conceive Bachelor studies as independent programmes focused on practice. Rather, they tend to see them as a theory-focused first level of Master studies. There will have to be further developments before studies are genuinely structured into two levels. This process is supported by programmes co-funded from EU resources. Moreover, it is one of the objectives of tertiary education reform that is under preparation. Its main propositions are contained in the so-called White Paper on Tertiary Education. At present there is professional discussion on the proposed reform the main pillars of which should form the foundations of a new law on tertiary education institutions.

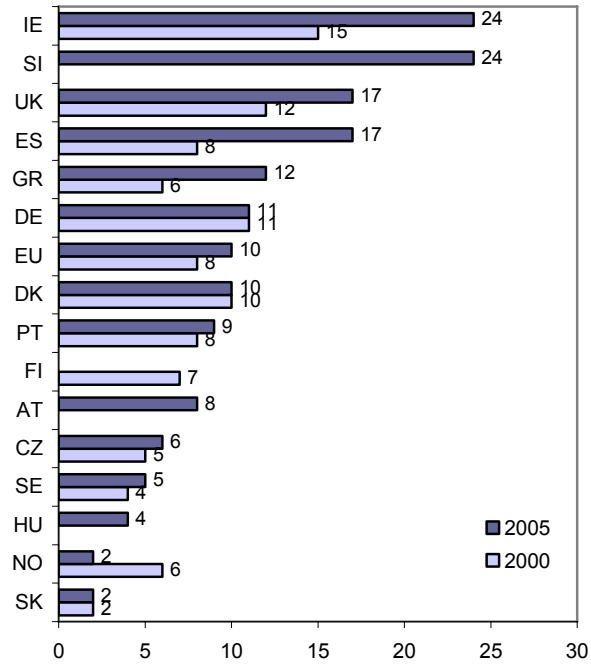
The White Paper proposes that Bachelor programmes should undergo a fundamental change so as to be focused on the development of key competencies ensuring employability immediately after graduation. Study programmes should therefore contain practice-oriented courses, students should be involved in applied research both within institutions and in cooperation with commercial partners. Major employers who operate in the relevant regional and local labour markets should be more involved in teaching.

If the attractiveness of Bachelor programmes for young people is to be enhanced it is necessary not only to improve their quality, but also to clarify the position of the graduates in the labour market. As the skills intensity of certain occupations increases due to the massive penetration of ICT into all

sectors of the economy, and as there are growing requirements for active communication in foreign languages, it may expected that this level of education will increasingly be demanded in jobs for which secondary qualifications sufficed in the past.

The limited importance of study programmes at ISCED 5B level that are provided by **tertiary professional schools** in the CR is reflected, among other things, in a low proportion of their graduates in the relevant age group. This proportion increased from 5% (2000) to 6% in 2005. Since the inflow of students into this type of education has decreased, we may expect a negative trend in the proportion of graduates in the relevant period of time. A certain lack of clarity as regards the position of this type of tertiary education is apparent in a number of EU member countries, not only in the CR (see Figure 35). In Finland, for example, there was not a single graduate in 2005. On the other hand, Slovenia had 24 graduates per 100 people in the relevant age group. In view of the inflow of students (see Figure 30) this country envisages further development of this type of education.

Figure 35: Tertiary graduation rates - ISCED 5B (%)



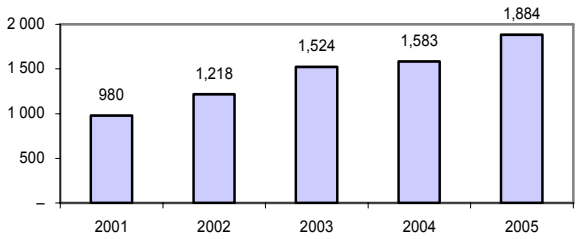
Note: EU – non-weighted average from data available. Source: OECD (2007a), tab.A3.2.

Overall, the number of graduates of tertiary education in relation to the population at an age typical of completion of this education shows a growing trend in the CR. This is apparent from the fact that the level of this indicator nearly doubled between 2000 and 2005 for graduates of higher education institutions, and it remained virtually the same for graduates of tertiary professional schools.

The proportion of graduates of Bachelor and Master degree programmes in the relevant age group was 25% in 2005, the proportion of graduates of tertiary professional education was 6%. Since such positive developments can be seen in essentially all countries for which data are available, the gap between the CR and these countries did not get much smaller. In terms of comparison with countries with the best figures in this respect (e.g. Finland or Denmark), the CR's lagging behind is virtually the same (e.g. some 22 graduates of ISCED 5A programmes per 100 people of the relevant age group).

As concerns the preparation of experts in research and development it is important to expand the provision of **Doctoral studies** (ISCED 6). The number of graduates of Doctoral programmes in the CR rose considerably – it more than doubled between 2001 and 2005. In 2001 Doctoral studies were completed by 980 persons, while in 2005 it was as many as 1,884 (see Figure 36). In spite of this very positive development the CR does not fare well in terms of international comparison.

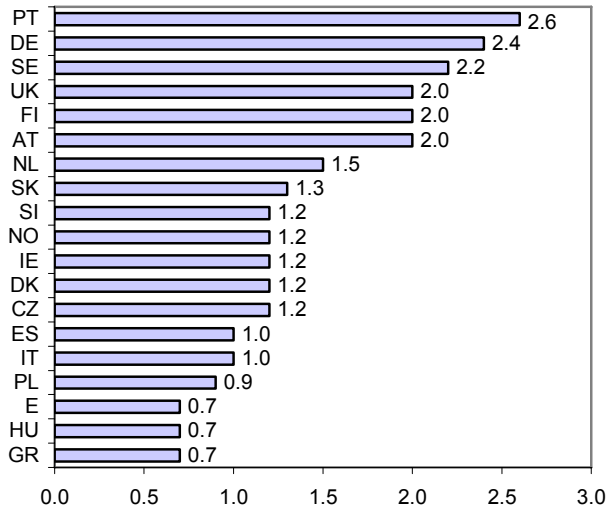
Figure 36: Number of graduates of Doctoral studies



Source: ÚIV (2007c), tab.B7.1.5.

The proportion of Doctoral graduates in the population at an age typical of completion of this education was only 1.2% in the Czech Republic in 2005. This is twice as low a figure than in Germany. On the other hand, there are countries in the EU where the level of development of Doctoral studies is 50% lower than in the CR. These countries include, for example, Greece, Hungary or Estonia (only 0.7% of the relevant age group completed Doctoral studies in 2005).

Figure 37: The proportion of graduates of Doctoral studies in the population at an age typical of graduation (%, 2005)



Source: OECD (2007a), tab. A3.1

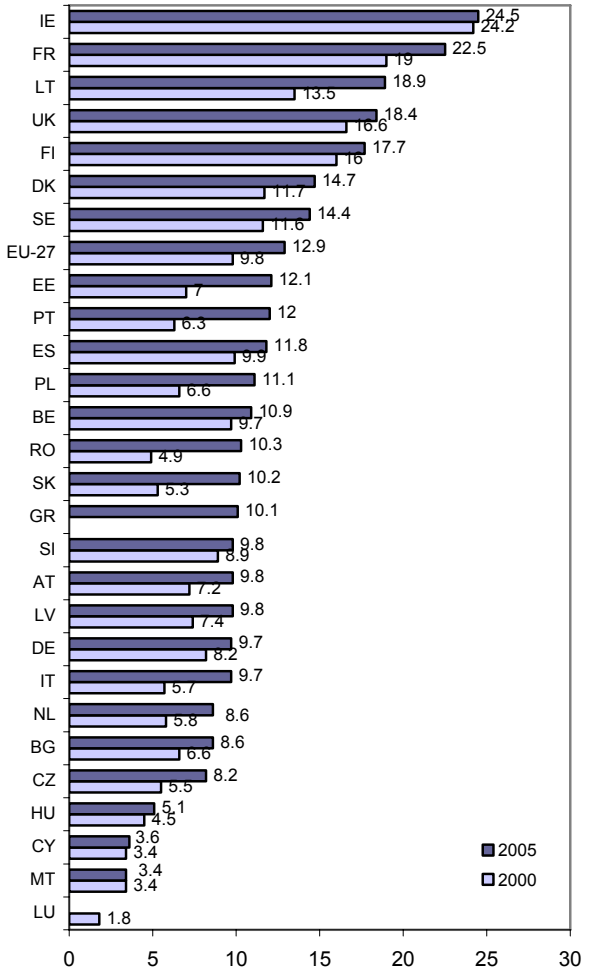
Science and technology graduates

Graduates of science and technology (S&T) programmes at higher education institution and tertiary professional schools, and Doctoral graduates in these disciplines, represent the most important potential for the development and application of new scientific and technological knowledge. As one of the objectives of the Lisbon process the European Union has set out to increase the number of graduates of S&T programmes by an average of 15% by 2010 (compared to 2000). At the

same time, it called on all member states to concentrate on boosting interest in these disciplines on the part of women.

Graduates of tertiary education constitute a potential inflow of human resources for the technology development. Whether this potential will be transformed into a real supply of graduates will depend, above all, on what jobs graduates will take up and whether they will enter employment in the country where they studied. This means that the potential of individual countries in this respect is affected by migration. The effect is normally positive in developed countries that offer better opportunities for self-actualisation and higher pay levels, while it is negative in countries with poorer economic standards.

Figure 38: The proportion of graduates of tertiary studies in science and technology per 1,000 persons aged 20-29

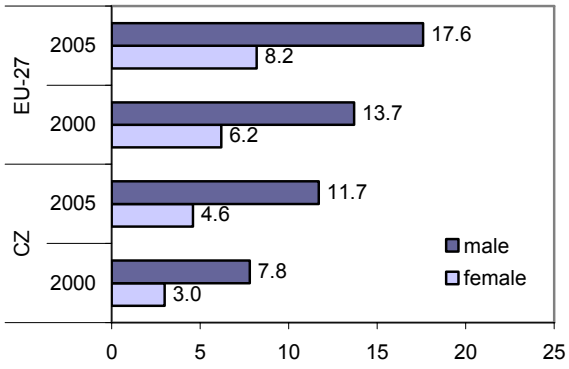


Source: EUROSTAT (2007e), 23. 7. 2008.

The CR ranked below the average in EU terms (see Figure 38) as regard the proportion of S&T graduates in the relevant age group both in 2000 and in 2005. Although the proportion of graduates per 1,000 persons aged 20-29 was gradually increasing (from 5.5 ‰ to 8.2 ‰), this increase was faster in the EU on average. This means that the gap between the CR and the EU average slightly increased. In 2000 the difference was, on average, 4.3 graduates, in 2005 it was 4.7 graduates. If we compare the CR with Ireland that constantly occupies the top position for this indicator (with over 24.5 graduates per 1,000 people aged 20-29) or with France (22.5 graduates in the same year), the gap is enormous. Only three EU member countries scored lower than the CR in 2005: Malta (3.4 graduates), Cyprus (3.6 graduates) and Hungary (5.1 graduates). The unfavourable position of the CR is influenced by a generally lower proportion of tertiary education students as compared to the EU average, and also by the low survival rate in S&T tertiary programmes.

It is evident that the objective of the Lisbon strategy to increase the number of S&T graduates has already been achieved or even surpassed in most EU countries. However, there has not been success in attracting more women to these programmes. In terms of gender representation the difference between the number of men and women among S&T graduates has tended to increase in the CR. In 2000 there were 3 graduates of these programmes per 1,000 women at the age of 20-29, while there were 7.8 men in the same group. The difference was 4.8 persons. In 2005 the difference was 7.1 persons in favour of men (4.6 women and 11.7 men). As Figure 39 illustrates, the gap also increased in EU average terms. In 2000 the difference in the number of female and male graduates was 7.5 persons in favour of males, while in 2005 it was 9.4 persons. It is clear that there is less success in attracting women to study these fields as compared with men.

Figure 39: Numbers of male and female graduates of science and technology programmes in tertiary education per 1,000 persons of the same gender aged 20-29, 2003



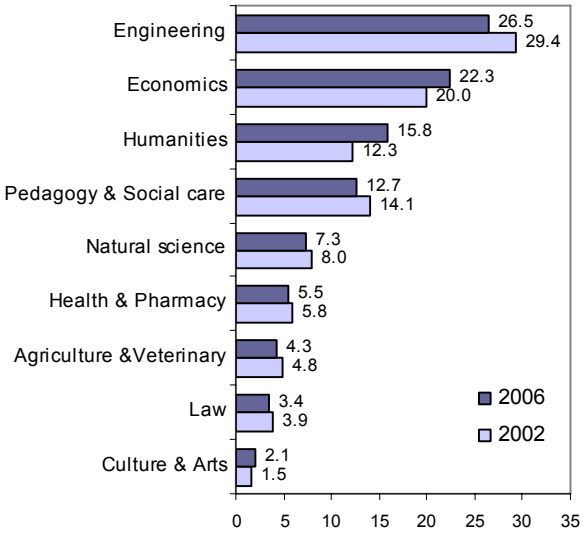
Note: EUROSTAT (2007e), 23. 7. 2008.

The student interest in various fields of study changes in the CR. The proportion of students enrolled in technology dropped from 29.4% in 2002 to 26.5% in 2006. A similar downward trend was observed in science, although the drop was not so considerable (from 8% to 7.3%). In no way can this problem be solved by softening study requirements. It is important to increase attractiveness of these programmes by offering a wider range of professional subjects, making the studies more flexible, providing for better laboratory and technical facilities, ensuring closer cooperation with industry, expanding the opportunities for studies abroad, etc. Educational institutions and employers have recently pursued certain promotional activities in order to increase interest in these disciplines.

Interest in as well as prerequisites for studying various disciplines are, in most cases, established as early as during secondary education. How well students are prepared for studies of these demanding programmes depends on the quality of secondary schooling. Interest in science and technology can also be stimulated by guidance services. Well thought-out ways of cost sharing on the part of students would both increase their responsibility for taking a decision

on a field of study and intensify their efforts to successfully complete the studies.

Figure 40: The structure of enrolments according to fields of study in the CR (%)



Note: The structure is expressed by means of the proportion of enrolments, not the proportion of students, as at 31 October of the relevant year. Source: ÚIV (2004); ÚIV (2007b), tab.F3.7, own calculation.

One indirect source of evidence revealing the level of interest in various disciplines is the results of admission proceedings at higher education institutions. As in most cases students file several applications in one particular year and take entrance examinations at several institutions of the same or complementary focus, there is a large difference between the number of those admitted (i.e. those who succeeded in the admission proceedings) and those enrolled. Adopting a simplistic view, this difference may be seen as a preference for an institution and a field of study. At all public and private higher education institutions the best ratio of the enrolled to the admitted was reported in law (95%), the worst ratio was in economics (only 63%). In technology disciplines some 85% students who were admitted also enrolled. In science the proportion was some 71% (ÚIV, 2007b , tab. F3.7, own calculation). It may be stated that, from this perspective, there is more interest in technology as compared to science.

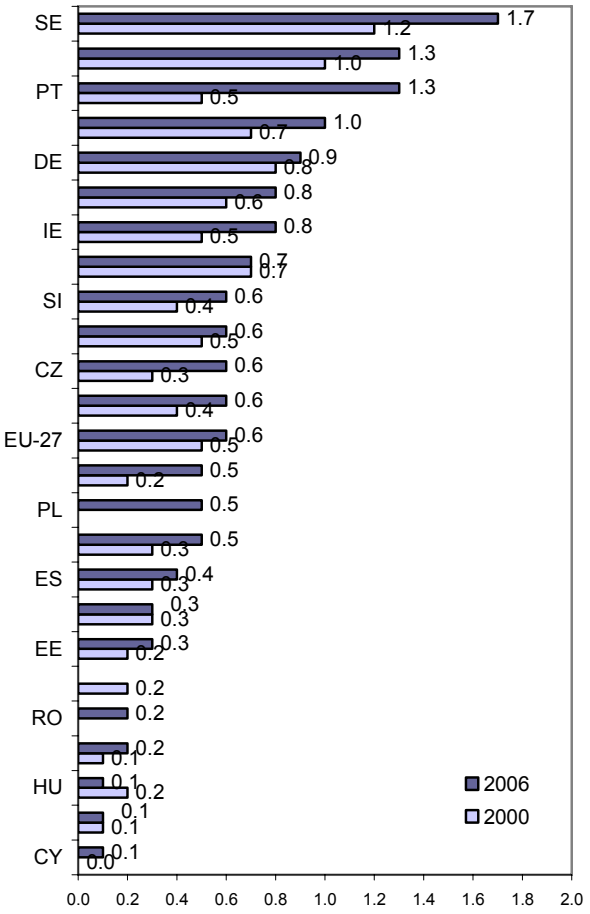
Success in admission proceedings (expressed as a proportion of those admitted in the number of those who turned up for the proceedings) is above the average level in technology and science programmes. In 2006 approximately 70% of applicants were admitted to public and private higher education institutions. In science it was 71% and in technology as many as 90%. (ÚIV, 2007b , tab. F3.7, own calculation). The high rate of success is partly the result of the fact that the capacity of some institutions/faculties providing technical education is far larger than the number of applicants. This is why some institutions/faculties abandon admission proceedings and all applicant with "maturita" can enrol. However, this approach to admission leads to a high drop-out rate in initial years of these study. There may be several reasons for dropping out of studies. They include the study demands or a lack of interest in the discipline that does not meet the student's preferences. There is no statistical data on drop-outs, it is therefore impossible to assess the success of students in various disciplines.

Doctoral graduates in science and technology

Doctoral graduates are those from whom the largest contribution to the development of knowledge and new technologies is expected. For the proportion of Doctoral graduates in S&T the CR ranks at around the EU-27 average level. In 2006 there were 0.6 successful graduates per 1,000 people aged 25-34 in the CR. The country caught up with the EU-27 average figure for 2000 where the indicator only reached up to 60% this figure. The attractiveness of this demanding type of study is somewhat affected by the fact that scientific and research work is often not properly remunerated.

The highest number of graduates in 2006 was reported by Sweden (1.7), Finland and Portugal (both 1.3). However, the data for these countries cannot stand comparison with other countries as Doctoral graduates also include graduates at lower levels of Doctoral studies. Education systems in most EU countries do not have these levels. Germany and Austria have the most favourable proportion of Doctoral graduates (0.9 and 0.8 graduates respectively). It is beneficial for the competitiveness of the EU as a whole that there is a positive development trend in all countries – the proportions of doctoral graduates in S&T increased between 2000 and 2006 everywhere except Hungary.

Figure 41: The number of Doctoral graduates in science and technology per 1,000 people aged 25-34

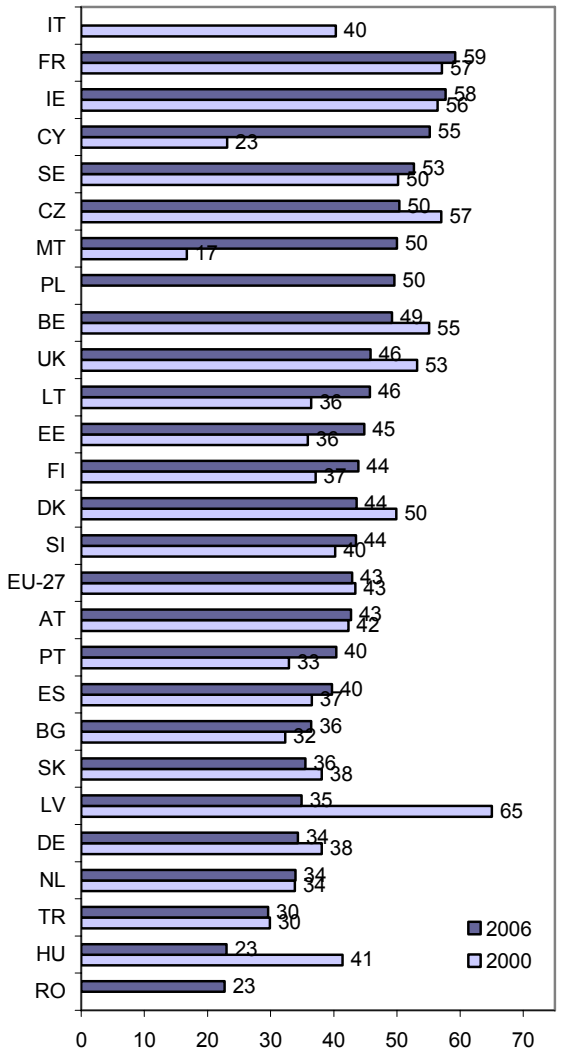


Source: EUROSTAT (2000b), EUROSTAT (2006d), tab. educ_itertc, 23.7.2008.

Although the number of Doctoral graduates in S&T increases, their proportion in the overall number of graduates of Doctoral studies has fallen. This negative trend as regards

the proportion of Doctoral graduates in S&T was also apparent at EU-27 average level, although it was far less intensive. In the CR this proportion dropped from 57% in 2000 to 50.4% in 2006, while the EU-27 average figure fell from 43.4 % to 42.9 %. In spite of this decrease the CR ranks among the countries with the highest proportion which, however, is the result of the generally low number of Doctoral graduates (see Figure 42). Higher figures as compared to the CR were achieved by France (59.2 %), Ireland (57.7 %) and Sweden (52.7 %). However, the data for Sweden are not comparable due to the aforementioned reasons.

Figure 42: The proportion of Doctoral graduates in science and technology in the total number of Doctoral graduates (%)



Source: EUROSTAT (2000b), EUROSTAT (2006d), tab. educ_itertc, 23.7.2008.

Mobility of tertiary education students

Student mobility testifies not only to aspirations for a higher quality of education than that provided by universities in the home country, but also to aspirations to improve one's language competencies and to become familiar with the culture and customs of other countries. In addition to enhanced quality, student mobility in the EU is expected to provide a major contribution to the so-called European citizenship that is associated with mutual understanding and the knowledge of the languages and cultures of other member countries.

Mobility concerns not only students, but also academic staff and study programmes. These are manifestations of internationalisation and globalisation of tertiary education. Although this process is largely expected to bring positive effects, there are certain concerns about a possible brain drain, the departure of the most talented students and prominent academics. The danger of a brain drain is faced, above all, by less developed EU countries, and also by the EU as a whole as it competes for high quality students and professors with the USA in particular. This is why international and national initiatives aim, apart from eliminating major barriers to mobility, at strengthening the competitiveness of national systems of tertiary education. The objective of the EU in this area is to create, as part of the Bologna process, a European Higher Education Area. The countries that joined the Bologna process have undertaken to reform their tertiary education systems so as to achieve a higher level of compatibility of national systems while respecting their autonomy and diversity.

The attractiveness of tertiary education for foreign students in various EU countries is illustrated in Table 5. There are countries whose share in the European tertiary education market exceeded 5%. This market is composed of the total number of students coming from the EU-27, the European Economic Area and new candidate countries who study in one of these countries and who are not its citizens. Besides the 27 EU member countries the European tertiary education market includes Norway, Iceland, Liechtenstein, Croatia, Macedonia and Turkey.

The UK together with Germany cover the largest portion of the European tertiary education market. In 2006 the UK had a 28% share, the share of Germany was 23%. In this year France occupied a relatively important place in this respect, although its share was much lower – less than 9%, and so did Belgium and Austria (nearly 6%). The CR had a 3% share in this market, which is comparable with Italy.

Table 5: Main exporters in the European tertiary education market (in %)

	1998	2006	2006–1998
UK	32.5	28.0	-4.5
Germany	28.6	23.1	-5.5
France	10.9	8.8	-2.5
Belgium	5.7*	5.9	0.2
Austria	6.3	5.7	-0.6
Czech Republic	0.7	3.2	2.5

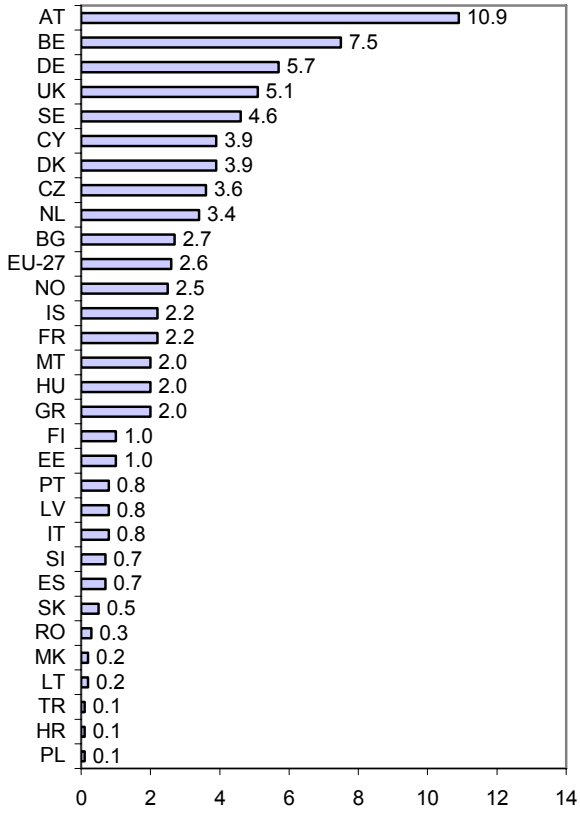
Source: EUROSTAT (1998), EUROSTAT (2006d) table: educ_thmob, 27. 6. 2008, own calculation

Although the five countries mentioned above maintain their exclusive positions in the EU, their rating weakened in 2006 as compared with 1998 (except for Belgium). The largest decrease occurred in Germany (by 5.5 p.p.) and in the UK (by 4.5 p.p.). This reflects the fact that students' destinations are becoming more diversified in favour of other EU member countries, particularly Sweden and the Netherlands. The share of these two countries saw the highest increase in the period under review. In 2006 the Netherlands reached up to 4.3% and Sweden to 3.7%. None of these two countries speaks an internationally used language. It is apparent that, in the given period, tertiary education institutions expanded their provision of programmes or at least courses delivered in a language that is used globally. As English is becoming the Esperanto of tertiary education, we can assume that this language was English. Relatively small countries have thus begun to follow a trend pioneered, in the EU, by Belgium. One prerequisite for an inflow of foreign students is, in addi-

tion to high quality education, a generally welcoming attitude to foreigners on the part of society.

In 2006 the CR witnessed the most dynamic growth in its share in the EU tertiary education market since 1998. The share went up from 0.7% to 3.2%. However, this positive trend does not reflect a major expansion in the proportion of programmes or courses delivered in an international language, but it is the result of a growing interest on the part of students who are capable of studying in the Czech language. The advantage in this case is that they do not have to pay for their studies. The proportion of citizens of the Slovak Republic in the total number of foreign students reached 67% in 2006, there were 4.4% of Russian students and 3.1% of Ukrainians (ÚIV, 2007b, own calculation based on table F2.3). Moreover, the establishment of branches of foreign universities in the Czech Republic has a certain positive impact on the inflow of foreign students. These are attractive for them as the quality of education they provide is comparable with that of foreign universities, but the costs are lower than in their home countries.

Figure 43: Foreign students from the countries of the European tertiary education market (%, 2005)

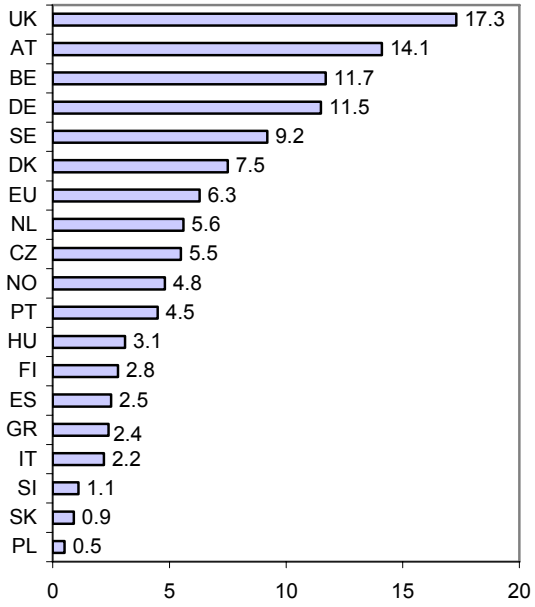


Note: Liechtenstein has a specific position with the share of foreign students reaching nearly 80%. Source: EUROSTAT (2005c), Table: educ_thmob, 27. 6. 2008.

The proportion of foreign students in the total number of students in individual countries of the European education market is illustrated in Figure 43. According to these data the level of openness of tertiary education in the CR towards foreign students was above the EU average, which was 2.6% in 2005. The proportion of foreign students in the CR was 3.6%. The largest proportion was reported by Austria – nearly 11%. The UK, which has by far the highest number of foreign students, ranks fourth (5.1%) due to the size of its internal tertiary education market. Countries with the least open systems of tertiary education (with the lowest interest on the part of foreign students) are Poland, Croatia and Turkey.

The attractiveness of tertiary education in EU member countries and in Norway for students from all over the world is illustrated in Figure 44. According to the proportion of foreigners in the total number of students in tertiary education (ISCED 5- 6) the UK was the most attractive country. In 2005 there were roughly 17% foreign students in the overall number of students at tertiary level of education. In the CR this proportion was 5.5% - i.e. below the EU average which was 6.3%. If we compare the data in the previous figure the differences reflect numbers of students from countries outside the European education market. The CR has a relatively high number of students coming from the former Soviet Union countries and Vietnam (ÚIV, 2007b, table F2.3).

Figure 44: Foreign students in tertiary education (%, 2005)



Source: OECD (2007a), tab. C3.1.

According to OECD data, the higher the level of education the larger the proportion of foreign students. This trend is also apparent in the Czech Republic. In 2005 the proportion of foreign students in programmes offered by tertiary professional schools (ISCED 5B) was only 1.2%, while the proportion of students in Bachelor and Master programmes (ISCED 5) was 5.9%. In Doctoral programmes the proportion was 7.2%. In Belgium, for example, these figures were 8.9 %, 13.1 % and 30.8 %.

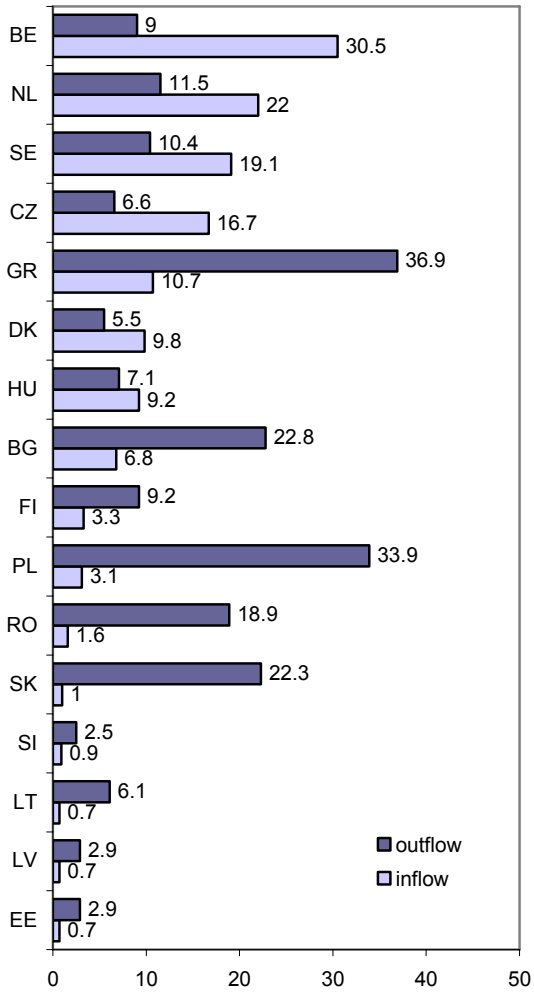
The openness of tertiary education is associated not only with an inflow of foreign students, but also with opportunities for students to undertake sections of studies abroad – i.e. an **outflow of students to foreign countries**. These opportunities are, to a large degree, limited by the availability of resources to fund the actual studies and the stay abroad (both private and public). The number of Czech students studying abroad is constantly increasing. In 2000 there were 3,300 Czech students enrolled in tertiary institutions in the European education area (EEA) and EU candidate countries. In 2006 the figure was twice as high (6,600). This can be attributed both to better partnerships between tertiary education institutions and to the improving financial situation of Czech

families. A growing number of households can afford to finance the studies and maintenance costs of students abroad. The chances to obtain a scholarship have also been improving.

The most frequent destination of Czech tertiary education students is Germany. In 2005 Germany hosted over a third (34.7%) of the total number of Czech students studying abroad – i.e. not only in the EEA and EU candidate countries. The second most frequent destination was the USA with 13.4% of Czech students, followed by France (9.3%) and Slovakia (6.2%) (OECD: Education at a Glance, 2007, tab. C3.3).

As Figure 45 clearly shows the CR is one of the EU countries where the number of foreign students from EEA and EU candidate countries exceeds the number Czech students studying in these countries. The figure illustrates the situation only in those countries that do not speak an international language.

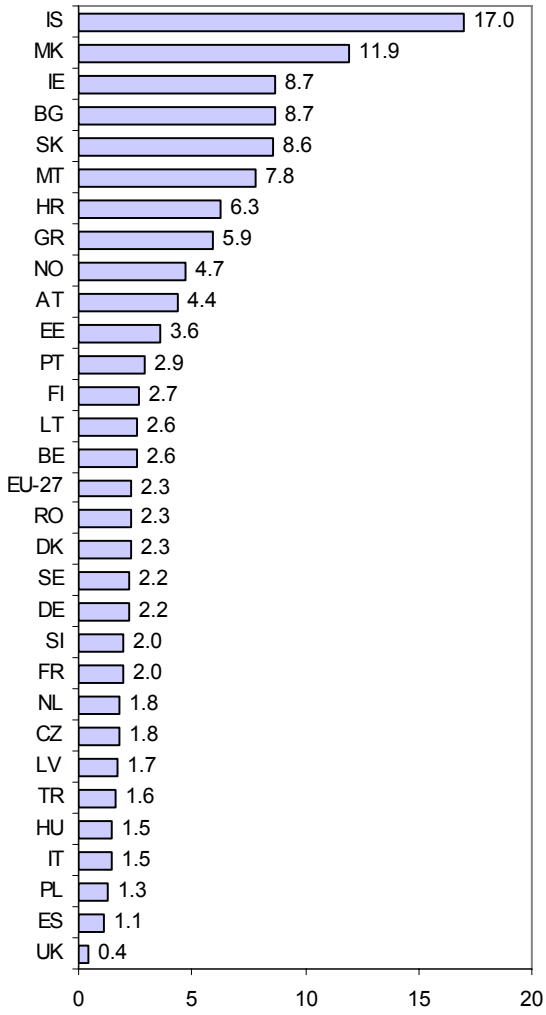
Figure 45: The openness of tertiary education in selected countries of the EU (in thousand, 2006)



Source: EUROSTAT (2006c).

There are 2.5 times more foreign students in the CR as compared to the number Czech students studying abroad. Only Belgium reported a larger difference (more than threefold). A majority of the selected countries show reverse figures – i.e. the number of students studying abroad is higher than the number of foreign students in the given country. The largest difference between these two figures can be seen in Slovakia, Romania and Poland where the number of foreign students accounts for less than one tenths of the countries' nationals studying abroad. This unfavourable ratio is evidence of a lack of attractiveness of the domestic education systems for foreign students and, conversely, great interest on the part of the home population in studying abroad. Hungary shows a well balanced situation where the number of students studying abroad is the closest to the number of foreign students.

Figure 46: Tertiary education students abroad (%, 2005)



Note: Liechtenstein has a specific position with the share of students studying abroad reaching nearly 77 %. Source: EUROSTAT (2005c), table: educ_thmob, 27. 6. 2008

The number of Czech citizens studying in countries within the European tertiary education market is on the rise - their proportion in the total number of Czech students increased from 1.3% in 2000 to 1.8% in 2005. However, the 1.8% proportion was reached in 2003 and since then it has not changed. For this proportion the CR ranks among the countries where the international mobility of domestic students is below the average. The EU average was 2.3%. Of all EU member countries Ireland and Bulgaria report the largest outflow of students (8.7%), the lowest outflow is reported by the UK (0.4 %).

3. Training in Enterprises

The chapter is divided into three subchapters. The first subchapter concerns the scope of training in enterprises, the main factors affecting the decisions of enterprises on the implementation of training, and the training costs. The second subchapter pays attention, above all, to participation in continuing vocational training (CVT) courses and to their content. The third subchapter sums up data on approaches to human resources development on the part of companies in the CR. The findings were obtained on the basis of case studies. The main focus of the studies was to examine the link between the approaches to human resources development and innovation activities carried out by companies, and to seek examples of good practice.

3.1 The approaches of enterprises to the training of employees

Generally, training is considered to be one of the key factors that affect the competitiveness of enterprises. Companies train their staff because they assume that such training will help them achieve corporate objectives. These objectives are formulated with a varying degree of specificity as, for example, increasing the profit, maintaining or increasing a share in the relevant commodity market, introducing innovations, enhancing labour productivity, etc.

Our analysis of companies' approaches to human resources development is based on the outcomes of the Continuing Vocational Education and Training Survey (CTVS) that is held regularly in six-year intervals in EU member and candidate countries under the methodological guidance and coordination of EUROSTAT. We use data from CTVS 2 that was held in 2000 where 1999 is used as a reference year, and data from CTVS 3 of 2006 where 2005 is used as a reference year.

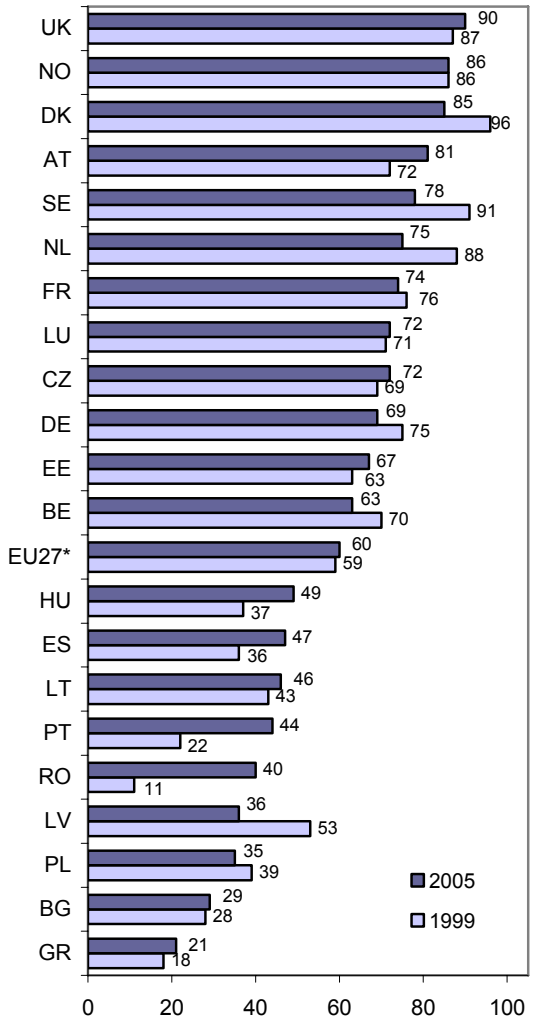
Enterprises providing continuing vocational training

Enterprises in member countries differ in terms of the attention they pay to the professional development of their employees. It is clear from Figure 1 that training in companies is more common in developed countries as compared with those with lower economic standards. In 2005 enterprises in the UK ranked first for their involvement in staff training (90% of companies), the last place was occupied by Greece where only 21% of companies provided training for their staff. The EU-27 average was 60%.

The proportion of companies that train their employees in the CR was 12 p.p. higher than the EU average – 72%. However, the CR still lags behind countries such as the UK, Norway, Denmark and Austria, as the proportion of enterprises that are located in these countries and train employees exceeded 80%.

The proportion of enterprises that train their employees changes over **time**. In the CR this proportion increased slightly between 1999 and 2005. As Figure 1 illustrates, in 2005 the proportion of companies implementing staff training was 3 p.p. higher than in 1999. Apart from the CR there was a favourable development in this respect particularly in those EU countries that were far below the average in 1999. Romania experienced the biggest improvement with a nearly fourfold increase in the proportion of companies that train their staff. Portugal followed Romania with a twofold increase. On the other hand, in most countries that ranked far above the average in 1999 the proportion of companies involved in the training of their employees decreased. The most considerable decline occurred in Sweden (from 91% to 78%) and the Netherlands (from 88% to 75%) – i.e. the decrease was 13 p.p. in both countries. In EU-27 terms these opposite trends resulted in the average hardly changing – it increased by 1 p.p. (from 59% to 60%).

Figure 1: Enterprises providing training for their employees (%, 2005)

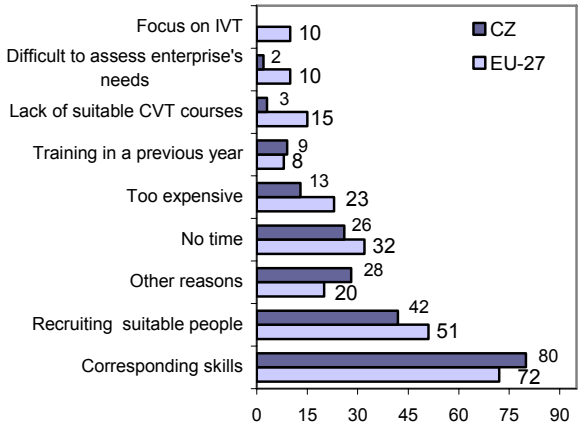


Note.: data sets of 1999 and 2005 for the CR are not fully comparable. Source: EUROSTAT (2005b); EUROSTAT (1999), table codes trng_ent03n a trng_cvts3_01, 15. 5. 2008, own calculation.

There may be several **reasons** why companies do not train employees in a particular year. According to CVTS 3 data the most frequent reason in EU-27 average terms is the conviction on the part of companies that their employees have the skills and competencies required to meet their existing needs and that companies recruit people with the required knowledge and skills. The third most common reason is the employees' heavy workload and limited time that can be devoted to training. The sequence of the reasons is similar in the CR, only the third place is occupied by "other reasons" as opposed to time-related reasons. In the CR 80% of companies that do not train their employees state as one of three main reasons the fact that the qualifications of the staff are appropriate; 42% of companies state as a reason that they

recruit persons with the relevant qualifications and 28 % of enterprises state a different reason. The sequence of reasons according to the percentage of companies that stated them among the three most important reasons is illustrated in Figure 2.

Figure 2: Reasons for not providing CVT (%, 2005)



Note: ÍVT – initial vocational education. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

It is interesting to see that considerable attention paid to training in the previous year is not a very frequent reason for lack of training in the following year. This reason was only stated by 8% of companies as one of the three most important reasons in EU-27 average terms. In the CR this reason was slightly more frequent (9% of enterprises). We may therefore conjecture that companies either do or do not pay attention to the training of their employees and that there are no great year-or-year changes.

The large proportion companies that do not train their employees (Greece, Bulgaria, Poland, Latvia) may reflect that fact that there is a match between the supply of and demand for skills in the local markets. Enterprises in these companies do not have difficulties finding persons with appropriate qualifications in the labour market and the qualifications of their existing employees fully meet their current occupational requirements. Another reason, which is less positive, is that the occupational requirements do not change and enterprises therefore do not feel the need to train their staff. This means, however, that enterprises in these countries will not implement innovations and their competitiveness will decrease unless they change their approach in this area.

In terms of international comparison the differences in the proportions of companies that are involved in the training of employees are influenced, to a large degree, by the **legislative environment** in various countries. This influence is either direct or indirect. Legislative provisions that regulate the terms of dismissing the existing employees have indirect influence. Stringent conditions, in other words the financial costs related to the dismissal of employees, prompt enterprises to invest more in the training of their existing staff. The necessity to invest in the current employees is also linked to the shortage of the workforce in the labour market that have the required qualifications. However, efforts to acquire new knowledge and skills on the part of employees come up against certain limitations consisting in the difference between the existing and the new occupational requirements. This particularly concerns originally low skilled jobs where the qualification requirements increased so that the existing employees are incapable of acquiring the new skills.

Legislation that regulates the obligations of enterprises in this area has direct influence. The obligations may concern all or only certain occupations. The Labour Code in the CR stipulates that the employer is obliged:

- to train employees to ensure their health and safety at work,
- to ensure that employees – graduates of secondary and tertiary education institutions – acquire appropriate work experience,
- to ensure that employees who enter employment without a qualification get initial (on-the-job) training,
- if need be, to provide on-the-job training to an employee who transfers to a new business unit or a new type of job (a new working method).

The employer is authorised to command an employee to take part in training so as to enhance his/her qualification. In some industries training and the potency for the practice of certain professions are regulated by laws or decrees (e.g. in healthcare, education, electrical engineering, transport, etc.).

In the CR the influence of the legislative environment is relatively strong. Evidence of this is the proportion of so-called mandatory training in the overall number of hours spent in continuing vocational training courses. In the CR the mandatory training in environmental protection and health and safety at work accounted for 20% of the overall number of hours. This placed the CR, together with the UK, at the top of the EU-27 scale. The EU-27 average was only 11%. Training in health and safety is certainly important, but it does not ensure any improvement in the professional competencies of employees. The scope of this training is also affected by staff turnover as each new employee must undergo this mandatory training. The content of CVT courses is dealt with further on.

The training provided by enterprises in individual countries is also influenced by the degree of **the state's involvement** in these matters, be it in the form of schemes that make it possible for companies to obtain subsidies for company training or in the form of various allowances that normally involve deduction of training costs from the tax base. In the CVTS 3 survey among companies there was a focus on identifying whether certain government policy measures affected the decisions on implementation of staff training. A list of measures the effects of which were ascertained is presented in Box 1.

Box 1 – Government policy measures affecting CVT:

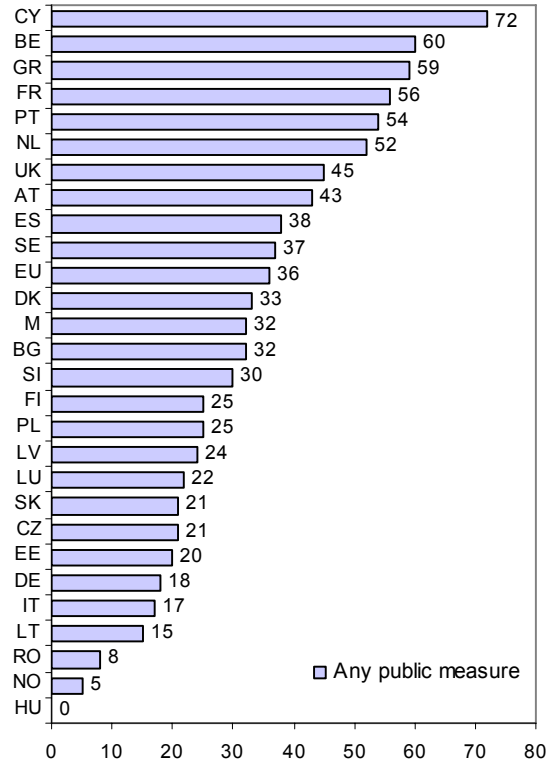
- publicly funded advisory service aimed at identifying training needs and/or developing training plans,
- financial subsidies towards the costs of training persons employed,
- tax relief on expenditure on training persons employed,
- procedures to ensure the standards of trainers (e.g. by national registers of trainers, assessment, etc.),
- provision of recognised standards and frameworks for qualification and certification.

Source: CSU (2006a)

The results have revealed (see Figure 3) that the approach to staff development on the part of Czech companies is influenced by these measures far less as compared to the EU average. In EU-27 average terms the measures implemented by the state as a whole influence 36% of companies that train their employees. In the CR it is only 21%. This clearly points to a lower level of involvement of the government of the CR in terms of financial support for training in enterprises or in terms of facilitating accessibility and quality of trainers in continuing vocational training. Over a half of

companies in Cyprus, Belgium, Greece, France, Portugal and the Netherlands were influenced by government policies in their decision-making about staff training. There are relatively large differences between these countries in the proportion of companies providing continuing vocational training. On the one hand there are countries where only a minority of enterprises train their employees (Greece, Portugal), on the other hand there are countries where training is provided by some three quarters of companies (the Netherlands, France).

Figure 3: The effects of government policies on CVT provided by enterprises (%, 2005)



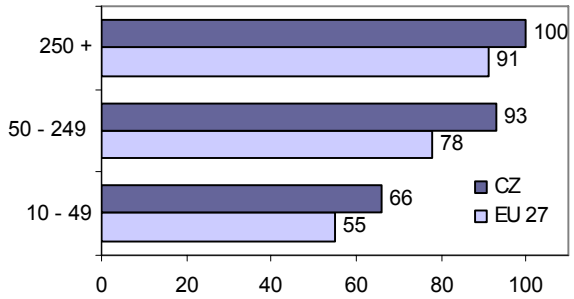
Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

In terms of the EU-27 average, enterprises are most affected by provision of recognised standards and framework for qualification and certification. These standards and frameworks make it easier for companies to identify training needs and, consequently, the scope of training provision. On average, this measure affects decisions of 20% of companies. In Portugal it is 49% and in the CR 19%. Financial subsidies for training are taken into account by an average of 17% of enterprises when they decide on CVT. In Cyprus it is 50% of companies, but in the CR it is only 1%. It is clear that only a small proportion of Czech companies reach up to direct financial assistance as compared with other countries. There may be several reasons for this ranging from the generally small amount of financial resources designated for this purpose through the difficult conditions that must be met to obtain such resources to high administrative costs that reduce the interest in this assistance on the part of enterprises. This measure received a similarly low score in other countries as well – e.g. in Germany, Poland and Slovakia (2%).

The remaining three measures have similar effects on decisions of companies in EU average terms. These are measures that guarantee the required standards of trainers (11% of companies), tax relief in the form of training costs deductible from tax base (10%) and free advisory services (9%). As regards tax relief, the low average effects are the result of the fact that this measure is not in place in 8 countries. Apart from the CR this concerns, for example Finland as a representative of the developed world, and Hungary as a representative of post-communist countries. The influence of advisory services as well as the guarantees concerning the quality of trainers is negligible in the CR. The former measure only influenced 2% of companies, the latter 3% of companies. The main reason for this is that these measures are not well developed. Free advisory services were only provided as part of broader schemes – e.g. the Standard scheme administered by the CzechInvest agency. This scheme was implemented as part of the Operational Programme Human Resources Development in the 2004-2006 period. It was co-funded from the European Social Fund and the national budget.

Another factor that influences the proportion of enterprises providing staff training in various countries is the **occurrence of large companies**. Empirical surveys clearly reveal, over the long term, that companies with a larger number of employees pay more attention to their training. This was also confirmed by the CVTS 3 results. In EU-27 average terms 91% of companies with over 250 employees provided training for their staff. Training was also provided by 78% of medium-sized companies (i.e. with 50-249 employees), but only by 55% companies with up to 49 employees (see Figure 4).

Figure 4: Enterprises providing training for their employees according to size (%, 2005)



Note: EU 27 is a non-weighed average from available data – data for Ireland are missing. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

In the CR all companies in the 250+ size category train their employees. This proportion was only reported by three other countries – France, Cyprus and Sweden. The proportion of medium-sized companies (i.e. with 50-249 employees) providing training was also very high in the CR. It was 93%, while the EU average was only 78%. It is apparent from the data for various EU countries that in the countries where the culture of staff training and development is well established – i.e. countries with a generally higher proportion of companies involved in such activities – the differences between the size categories are relatively small (the UK, Norway). In the CR the difference between large and medium-sized companies is, on the whole, negligible (7 p.p.), but there is a significant difference between medium-sized and small enterprises in this respect (27 p.p.).

There are several factors that cause small companies to lag behind. The most important ones include their financial situation that is normally worse than that of larger companies, more difficulties in fitting in for an absent worker, and generally smaller attention paid to staff development. This is associated with the fact that small companies normally cannot

employ a human resources specialist. Small companies must therefore rely more on informal learning, collegiality and non-formal relations at the workplace that have a positive impact in terms of enhancing the knowledge and skills of individual employees. Moreover, these companies also rely on the employees' identifying themselves with the enterprise, which can result in self-education efforts in their free time.

In the CR, as in other new member countries, the proportion of companies training their employees is also affected by the inflow of investors from developed countries. Foreign owners or co-owners bring human resources policies that are common in their countries and that are normally more systematic as compared to the policies of Czech business owners. The influence of the foreign owner and that of the company size are intertwined to a degree, as foreign investors normally show interest in large companies (see Matoušková, Kofroňová, 2006).

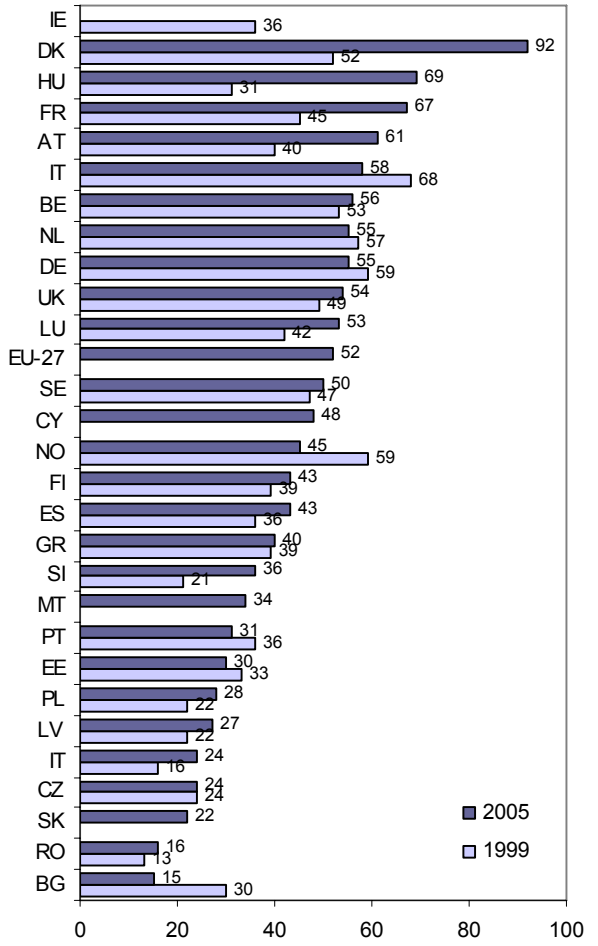
Empirical surveys also revealed the positive influence of **innovation** on staff training in companies. The CVTS 3 data for the CR show that 87 % of companies that introduced innovation in 2005 implemented staff development activities in that year. The proportion of enterprises that were not involved in innovation was only 67 %. It is therefore evident that the larger the proportion of innovative companies, the larger the proportion of companies implementing training in a given country.

It is clear from the above that, in the CR, 13% of enterprises that implemented innovation in the given year did not train their employees. This is because some companies could provide the necessary training to their staff in the year before the innovation was introduced, and also because not all innovations require staff training. We may assume that there is a difference between technical and non-technical innovations in terms of training requirements. Technical innovations linked to the introduction of a product or process (production methods, logistics, distribution or support activities) normally require more training as compared to non-technical innovations that concern organisation and marketing. Technical innovations require that the employees in the relevant jobs should familiarise themselves with new technological processes either in training courses or through on-the-job training so as to achieve the necessary quality of production and labour productivity. Training is delivered in the period of implementing innovations – this is why there are year-on-year fluctuations. International comparisons based on data for merely one year should be interpreted while taking this possible distortion into account.

Expenditure on training

The training cost of companies depend on the scope and structure of the training provided. It is clear from the comparison of expenditure per one hour of training for one participant in 2005 and 1999 that the situation in the CR is stable – i.e. that the expenditure on training expressed in PPS remained the same at 24 PPS. This makes the CR the only country that did not show any change in this expenditure. In most EU countries for which data are available for both years the training costs increased (16 countries), in some countries they decreased (6 countries). Hungary experienced the steepest increase with expenditure per one hour of training more than doubled. Conversely, in Bulgaria the costs decreased by 50%. In 2005 the costs per hour ranged from 92 PPS (Denmark) to 22 PPS (Slovakia). The CR occupies the second place after Slovakia for the cheapest training courses. In terms of international comparison old member countries fare better as the level of this indicator is above the EU-27 average. Out of new member countries Hungary was the only one that stands comparison with these countries.

Figure 5: Costs per one hour of training (PPS)



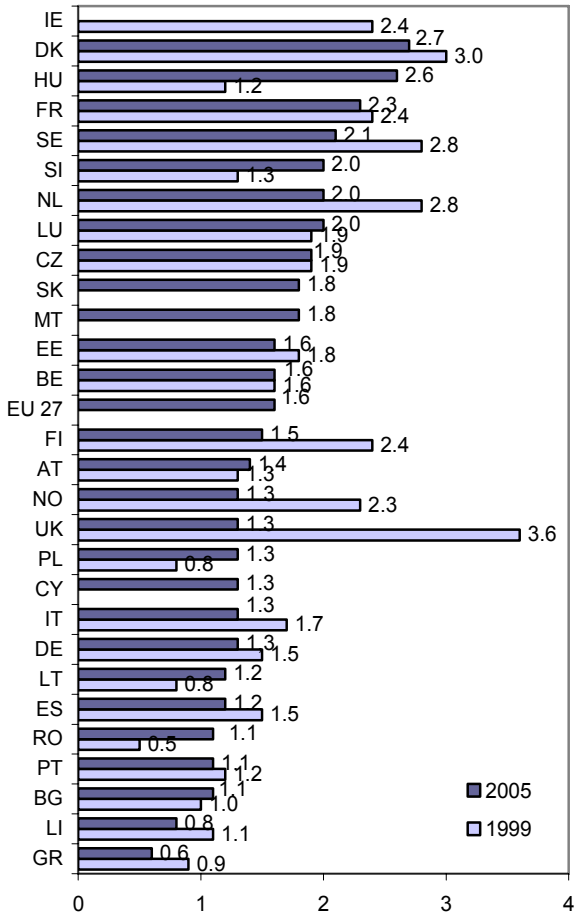
Note: EU-27 is a non-weighed average from available data. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation

One important indicator for international comparison is the ratio of training costs to total labour costs. If the indicator of training costs per hour reflects how "expensive" these courses are, then the ratio of these costs to total labour costs illustrates the importance attributed to staff development policies by companies in individual countries. In the CR this ratio was 1.9% both in 1999 and in 2005. Belgium reported a similar stability. The most frequent trend in the EU in general was a decrease in the ratio of CVT costs to total labour costs. Out of the countries for which data are available for both years a decrease was reported by 14 countries, and only 8 countries scored an increase in this ratio.

It is interesting to compare the development of costs per one hour of training with the development of the ratio of training costs to total labour costs. EU member countries can be divided into three groups based on this comparison. The first group consists of countries where costs per one hour of training increased, but the ratio to total labour costs decreased. This means that total labour costs rose more quickly than the costs of one hour of training. This group is composed of eight member countries

(Denmark, Finland, France, the UK, Sweden, Spain, Greece, Latvia).

Figure 6: The ratio of training costs to total labour costs (%)



Note: EU-27 is a non-weighed average from available data. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

The second seven-member group consists of countries that experienced both an increase in costs per a course hour and the ratio to total labour costs (Austria, Luxembourg, Hungary, Poland, Slovenia, Lithuania, Romania). The total labour costs in these countries grew more slowly than the costs per one hour of training. The third group that can be characterised by a decrease in both the training costs per hour and the ratio to total labour costs included five member countries (Germany, Italy, Portugal, the Netherlands, Estonia). Three member states have a specific position in terms of the development of these two indicators. They are the CR where the two indicators did not change, and Belgium which reported an unchanged ratio of training costs to total labour costs, but an increase in the costs per one course hour. The third country is Bulgaria where the costs per course hour decreased, but the ratio to labour costs increased. This means that in Bulgaria there must have been a faster decrease in total labour costs as compared to the decrease in costs per course hour.

As Box 2 clearly shows total training costs consist of three cost items: direct costs, the costs of wages of the participants during course attendance and the difference between contributions paid to and from funds designated to support continuing education and training.

Box 2: Costs of training courses as part of CVTS 3 survey

1. direct costs
(a) payments to external organisations and external trainers,
(b) travel, accommodation and meals of the trainees (participating employees),
(c) wages of internal trainers (full-time and part-time),
(d) facilities/equipment/aids;

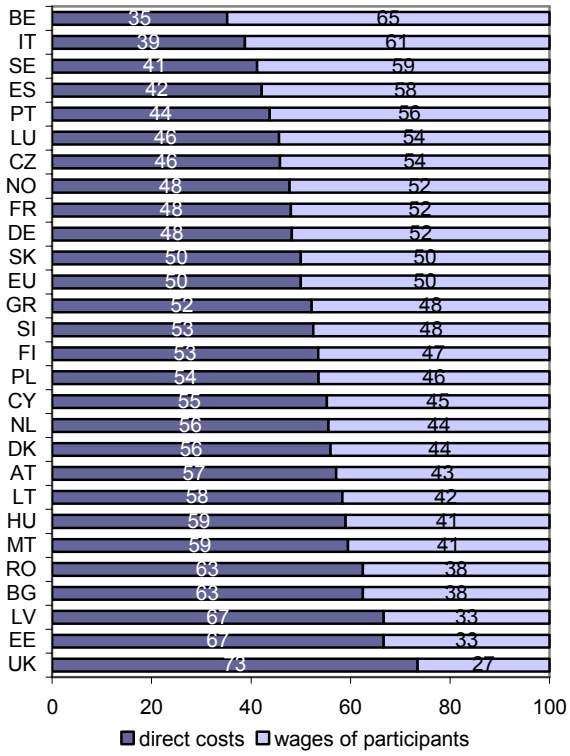
2. wages of participating employees during their training;

3. difference between contributions paid by companies to national or regional funds for continuing vocational training and contributions received for staff development from these or other funds.

Source: ČSÚ (2006a).

If we consider only direct costs and the wages of the trainees, in 2005 these two cost items had the same (i.e. 50%) share in total costs per course hour in EU-27 average terms. However, this match was only achieved in Slovakia. In most countries the share of wage costs of the trainees was lower than the share of direct costs. Out of EU-27 countries for which data was available this situation occurs in 15 countries. (see Figure 7).

Figure 7: The structure of costs per course hour in CVT (%, 2005)



Note: EU-27 non-weighed average of available data. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

The largest proportion of direct costs was reported by the UK (73%). Latvia and Estonia followed (67%). The CR is among nine countries with a higher proportion of wage costs. The proportion of wage costs in the total costs of course hour was 54% in the CR, the largest proportion was reported by Belgium (65%) and Italy (61%).

3.2 Forms and scope of training in enterprises

The training of employees implemented by enterprises takes various forms. The CVTS 3 survey examined the degree to

which five various modes of vocational training were implemented. These modes are presented in Box 3.

Box 3 – Forms of continuing vocational education

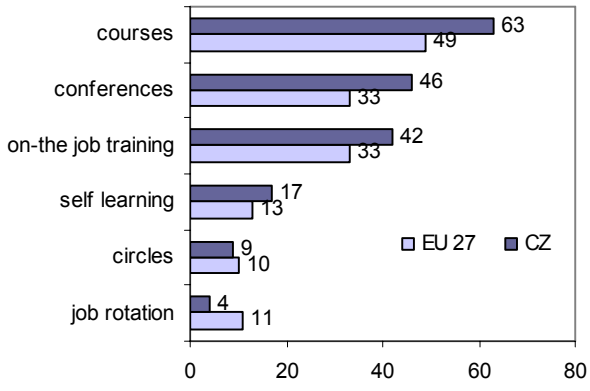
- Continuing vocational training courses
- On the job training
- Job rotation
- Learning circles
- Quality circles
- Self-learning
- Attendance at conferences, workshops, trade fares and lectures

Source: ČSÚ (2006a).

Vocational training **courses** are the most frequent form of staff training in the CR and in EU average terms. In the CR 63% of enterprises trained their employees in courses, and in EU-27 it was 49%. However, courses do not represent a universal mode of training. This form of training is not used by 9% of companies in the CR and 11% in the EU on average. Nevertheless, courses clearly prevail over other modes of training. The second most frequently used form of training – i.e. sending employees to conferences, workshops and other similar events – concerned 46% of companies in the CR and the EU average was 33%. The least frequent modes of training are job rotation which was implemented by a mere 4% of enterprises in the CR, and quality or learning circles (9% of companies in the CR).

Implementation of various modes of vocational training of employees depends, to a large degree, on the nature of predominating business activities. Not all forms can be used in the same scope in companies with a different business focus. A lower level of intensity in using a certain mode suggests its lower level of universality (job rotation), but also differences in organisation and corporate culture. We may assume that quality and learning circles are more frequent in companies characterised by a certain degree of decentralisation of management and decision-making where great emphasis is placed on a degree of economic independence of business units or teams.

Figure 9: Enterprises implementing individual modes of staff training (%, 2005)



Note: EU 27 is a non-weighted average of available data – data for Ireland and France are missing. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

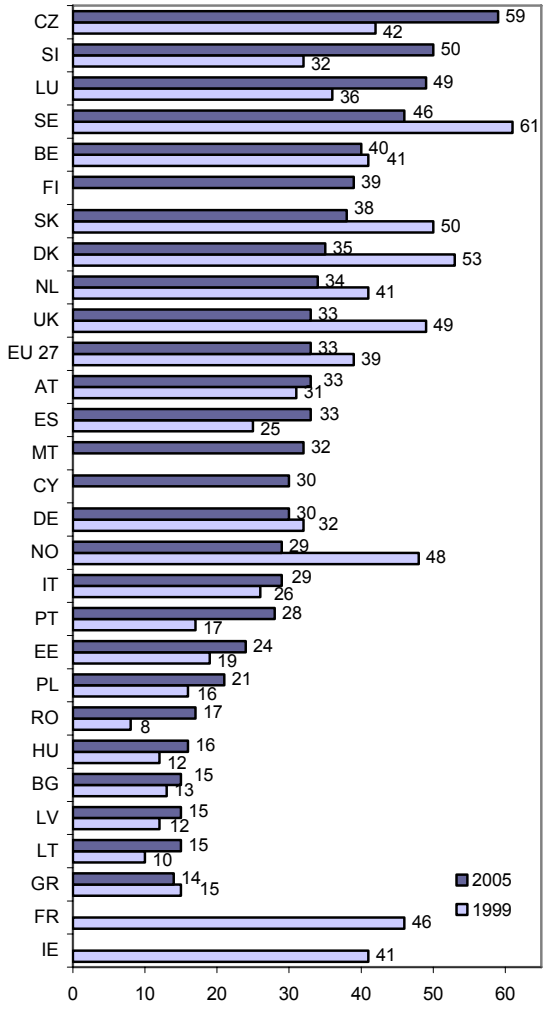
Figure 9 clearly shows that the differences in the use of various forms of training are larger in the CR as compared to the EU average. The difference between the most frequent mode and the least frequent mode – i.e. in the CR this concerns courses and job rotation – is six fold, while the difference between courses and learning or quality circles in the EU is fivefold.

Although the proportion of companies involved in staff development is an important indicator, it provides no information as to the proportion of employees who undergo training. Participation in training is analysed based on data on participation in continuing training courses. The number of course participants is the number of people who attended one or more CVT courses. Each person is calculated only once, regardless of the number of courses in which he/she participated in the given year.

Participation in continuing vocational training courses

Continuing vocational training (CVT) courses represent the most widespread form of training in enterprises. The data stated in Figure 10 illustrate that the CR ranks higher for the proportion of employees in CVT courses as compared with the EU average. This difference is even larger as compared to the proportion of enterprises implementing CVT courses.

Figure 10: Participation in CVT courses (% of employees in all enterprises)



Note: EU-27 is a non-weighted average – data for France, Ireland, Italy, Slovenia and Finland are missing. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

In 2005 there were 59% of employees participating in CVT courses in the CR, while the EU average was only 30%. This twofold difference can be attributed to factors described

earlier, particularly to the scope of mandatory education and the establishment of new companies particularly due to the inflow of foreign investors. As distinct from the proportion of enterprises implementing staff training we cannot find any other country in the EU that would report a proportion of participants in CVT courses that would be higher than that in the CR. Luxembourg (49%) and Sweden (46%) are the closest to the CR on the scale, but their figures are lower by 10 and more percentage points.

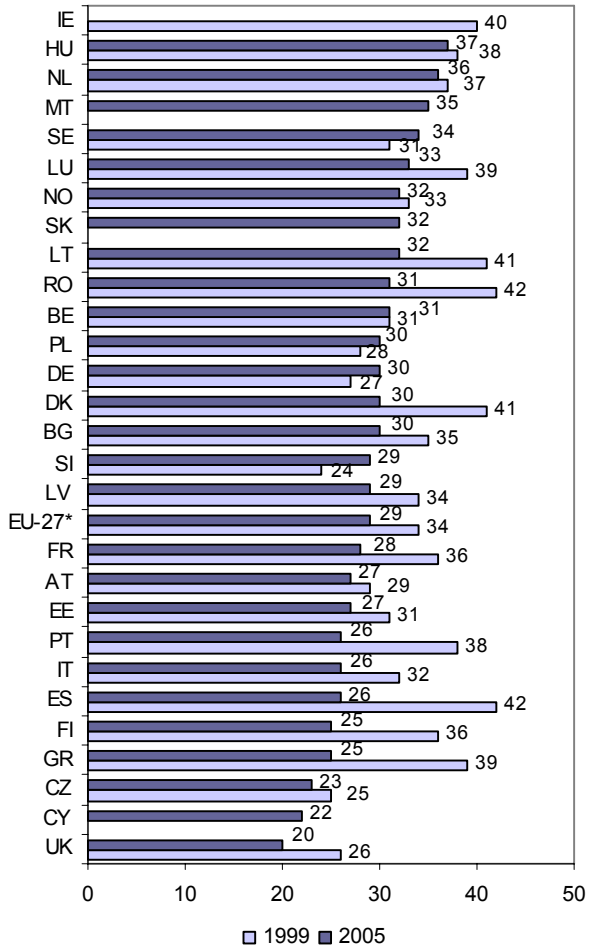
In EU-27 average terms the proportion of participants in CVT courses decreased between 1999 and 2005 by 6 p.p. (from 39% to 33%), although the proportion of companies implementing training increased slightly (by 1 p.p.). This negative development can be attributed, above all, to those countries which reported a decrease in the proportion of companies implementing staff training and, consequently, a decrease in the proportion of participants in CVT courses. This development was typical of Denmark which scored a robust decrease by 18 p.p. (from 53% to 35% of employees), and also of the UK (a decrease by 15 p.p. from 61% to 46%). These are countries where participation in courses in 1999 was far above the average. Even after the decrease in 2005 it remains at an above-average level, but the difference is not so significant. The UK is an exception where participation in CVT courses dropped to an average level.

The CR ranked among the countries with a positive development in the proportion of participants in CVT courses in the total number of employees. The proportion of employees participating in CVT increased from 42% in 1999 to 59% in 2005. Slovenia and Luxembourg reported a similar positive trend with 18 p.p. and 13 p.p. increases respectively.

Apart from participation, the scope of the courses is also important – i.e. the number of hours the trainee spent on a course. Only the actual course hours are calculated, not, for example, time spent travelling to the course location, etc. The length of training measured as the length of **paid working time** spent by one participant in CVT courses in 2005 was shorter, in EU-27 average terms, than in 1999. In 1999 the average number of hours per one participant was 34, in 2005 it was only 29 hours. A similar decrease (although lower) occurred in the CR – from 25 to 23 hours. Thanks to this the gap between the CR and the EU-27 average was reduced. In 1999 the average length of participation in training in the CR was 9 hours shorter than that in EU-27, in 2005 the difference was only 6 hours. It is apparent that companies in the CR provide training to a larger number of employees but for a shorter period of time. Enterprises try to increase the efficiency of training – i.e. to reduce the period of time during which the employee is paid his/her wage but does not work due to participation in a training course. In this way the intensity of training increases (see Figure 11).

The training of employees is not implemented only during paid working hours. Some employers train their employees for free, but the trainees are not entitled to their wages. Training can take place either during working hours and the employee does not get paid for this period of time, or outside working hours. The number of **unpaid hours** spent on courses is relatively low. In 2005 it was less than 2 hours (1.8) per one participant. The data are only available for the Czech Republic, it is therefore impossible to assess whether or not this approach to training is common in the EU and to what extent it is frequent in the CR as compared to EU-27 average. We may only state that the number of hours accounts for less than one tenth of the paid working hours spent on courses.

Figure 11: The average number of hours one participant spends in CVT courses (%)



Note: EU 27 * is a non-weighted average of available data. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

As regards the improvement of knowledge and skills the **content of CVT courses** is important. As part of CVTS 3 the course hours were divided into nine groups that are presented in Box 4. When a company could not place a course within a particular category, the closest category or the category of "other fields of training" was chosen.

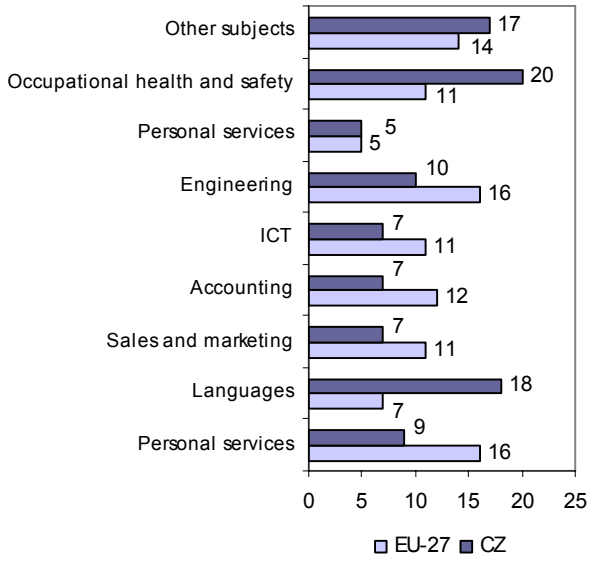
Box 4 – The content of CVT courses:

- languages (foreign and mother tongue),
- sales and marketing,
- accounting, finance; management and administration and office work,
- personal development; working life,
- computer science and computers use,
- engineering, manufacturing and construction,
- environment protection and occupational health and safety,
- personal services; transport services; protection of property and persons; military,
- other training subjects.

Source: CSU: A questionnaire on vocational education for 2005

In EU-27 average terms, most attention was paid to fields concerned with engineering, manufacturing and construction, and to personal development. Out of the total number of course hours 16% was devoted to each of these two topics. The situation in the CR is somewhat different. The largest proportion of course hours (20 %) goes for training in environmental protection and health and safety at work – i.e. training (health protection) that is mandatory by law (see Figure 12).

Figure 12: The content of CVT courses (%, 2005)

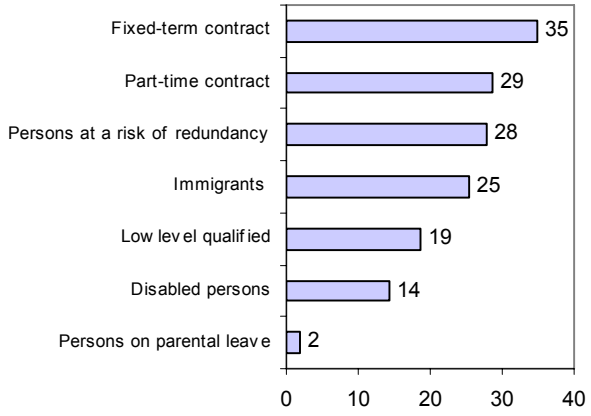


Note: EU-27 is non-weighted average of available data. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

In terms of improvement of professional knowledge, employees in the CR get most opportunities in the area of foreign languages. Foreign languages accounted for 18% of the total number of course hours. Another category that receives considerable attention in training is engineering, e.g. operation and maintenance of automated systems, quality control and development of new materials and products. Courses focused on these issues accounted for 10% of the total number of course hours. From the perspective of international comparison it is clear that, in the CR, considerable attention is paid to the acquisition of transferable competencies (languages), which is similar to other new member countries. In developed countries preference is given to acquisition of business-specific competencies, and language skills are expected to have been acquired during initial education.

If training is to be effective, it must be "tailor-made". The extent to which training – i.e. CVT courses – are adjusted to the training needs and capacities of selected **specific groups of employees** is illustrated on Figure 13. Courses should be adjusted both in terms of content and the pace of instruction and teaching methods. This is particularly true if they are intended for foreign nationals and people with basic qualifications. As for disabled people, adjustments depend on the nature of their disability and often concern modification of training facilities or materials. As concerns the training of employees with part-time employment contracts and parents on parental leave it is important to schedule courses so as take account of their time constraints. One specific group consists of employees at risk of becoming redundant. In such cases emphasis is placed on retraining or, if the actual number of employees is higher than required, on self-presentation skills that should facilitate search for a new job. Employees with fixed-term contracts are more likely not to be offered any adjustments in terms of training. These people are more likely to face discrimination as regards their placement in training courses. If the company does not intend to extend their contracts or conclude permanent contracts, the likelihood is very high that they will not be sent on a course.

Figure 13: CVT courses adjusted for specific groups of employees (%, 2005)



Source: ČSÚ (2005).

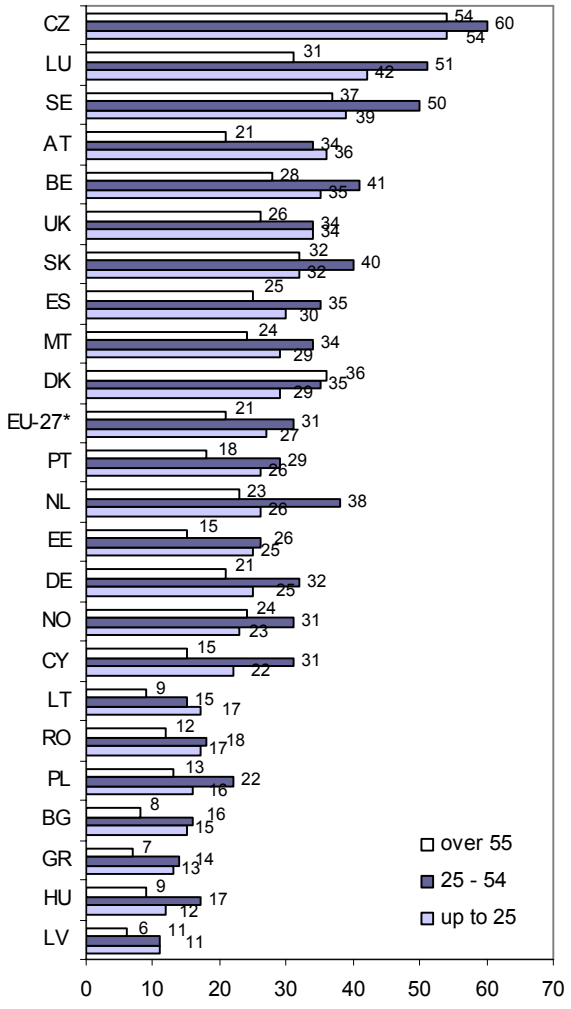
Enterprises in the CR pay most attention to persons with so-called "atypical" employment contracts – i.e. fixed-term and part-time employment contracts. Of the total number of enterprises that have employees with these types of contract 35% provide specific or adjusted CVT courses to employees with fixed-term contracts and 29% provide these courses to part-time staff. Possible adjustments to courses for these two groups of employees are very easy. Least attention is paid to employees on parental leave. It may be assumed that, in view of the growing tensions in the labour market, enterprises will focus more on this group that constitutes a very valuable source of the workforce.

As the population is ageing and the age limit for retirement is rising, it is not a positive finding that participation in CVT courses of employees aged over 55 is very low as compared to the 25-54 age group (CVTS 3 data do not make it possible to work with other age groups). The **groups of employees on the top and bottom of the age scale** receive less training as compared to the age group in the middle. In EU average terms, there were 27% of employees aged up to 24 participating in CVT, 21% of employees aged over 55, and 31% of employees aged from 25 to 54. In all EU countries the highest rate of participation in CVT is in the 25-54 age group. The only exception is Austria where this is true of the up to 24 age group. The general trend that employees up to 24 show a higher participation in CVT courses than the over 55 age group is confirmed by all EU countries except Denmark (29% vs. 36%), and Slovakia together with the CR where the rate is the same for both age groups.

The considerably lower rate of participation in training of the population at a pre-retirement age as compared to the population at the onset of their work careers can be explained by return on investment in education. This rate of return decreases along with an increasing age due to a shorter period of time during which investors (enterprise, individual) reap the benefits of the training. Apart from this, there may also be certain unwillingness on the part of elderly people to adapt to

new requirements and take part in training although the employer gives them the opportunity. Moreover, discrimination on the part of enterprises may also play a role in this respect. As regards young employees, their lower rate of participation in training as compared to the 25-54 age group results from the belief that, due to the short period of time that has elapsed since their completion of initial education, their knowledge and skills are in line with the current requirements and the degree to which their human capital has become obsolete is considered to be negligible.

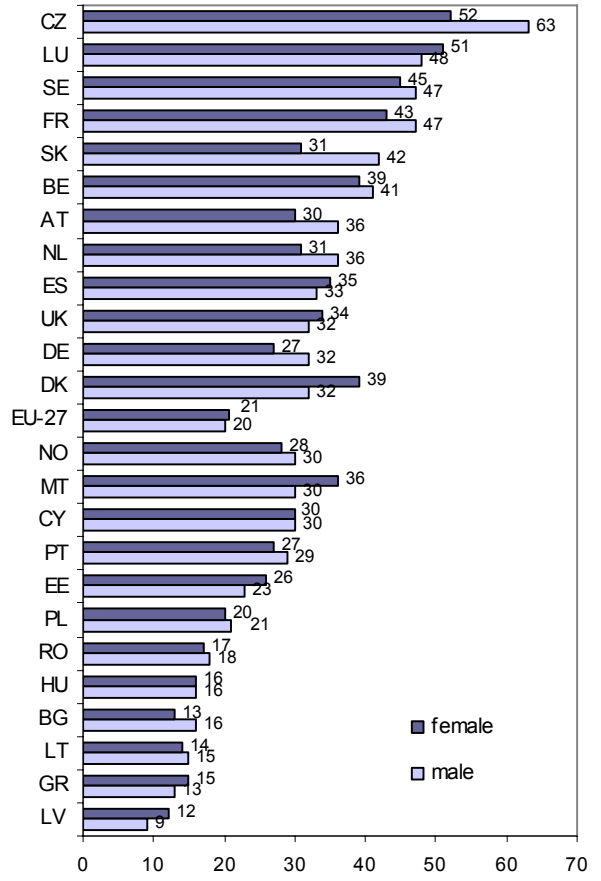
Figure 14: Participants in CVT courses according to age (%, 2005)



Note: EU-27 is a non-weighted average of available data - data for France, Ireland, Italy, Slovenia and Finland are missing. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

In EU-27 average terms there was a comparable rate of participation in CVT courses for **female and male employees** in 2005. Roughly 30% of employed men and women participated in CVT in 2005. However, this average figure that confirms gender equality in access to CVT courses conceals relatively large inequalities within individual countries (see Figure 15). Cyprus is the only country where there was gender equality in access to CVT courses. Other five countries reported a difference of 1 p.p. always in favour of men (Belgium, Lithuania, Hungary, Poland, Romania). The largest differences in the participation of men and women can be found in the Czech Republic and Slovakia – 11 p.p. in favour of men. Moreover, the CR has the highest rate of participation in CVT courses. Of the total number of employed males 63% were involved in CVT courses and 52% of females.

Figure 15: Participation of men and women in CVT courses (%, 2005)



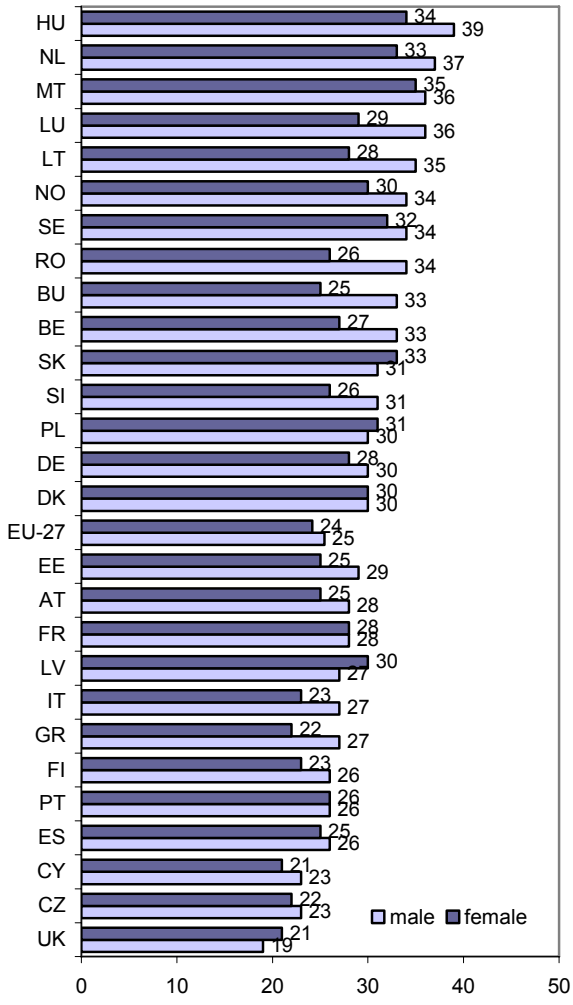
Note: EU-27 is a non-weighted average of available data. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

There may be a number of reasons for gender inequality. These include objective ones consisting in a different employment structure – it is far less common for women to hold position where training is mandatory (drivers, electricians, welders) as well as position where training is more frequent (managers). There are also subjective reasons in that when decisions are taken on participation in CVT courses preference is given to men. In no way can this difference be attributed to women being less willing to undergo training. On the contrary, in training where attendance largely depends on an individual's decision women are more proactive. Evidence of this is, for example, data on training ascertained as part of the Labour Force Survey. They reveal that in the four weeks before the survey 6.2% of women aged 25-64 were involved in training, while it was only 5.9% of men in the same age group. This difference was even larger in previous years. Inequality in participation in staff training in companies can also lead to inequality in terms of career progression, and also in terms of a move from fixed-term to permanent contracts (OECD, 2006).

Gender differences are also apparent in the number of hours one participant spends in CVT courses. In EU-27 average terms there were 29 hours per one participant in

CVT courses. For males it was 30 hours, for females 28 hours. However, there are three countries in the EU where the number of hours was equal for men and women. These are Denmark (30 hours), France (28 hours) and Portugal (26 hours). In three countries women spent more time in courses than men: in Latvia the difference was 3 hours (30 vs. 27), 2 hours in Slovakia (33 vs. 31) and 1 hour difference in Poland (31 vs. 30 hours).

Figure 16: Number of hours spent in CVT courses for men and women (%, 2005)



Note: EU-27 is a non-weighted average of available data. Source: EUROSTAT (2005b), 15. 5. 2008, own calculation.

Although the CR ranks among countries with relatively large gender differences in terms of participation in CVT courses, the difference in the number of hours is negligible. Women spent on average 22 hours on these courses in 2005, for men it was 23 hours. This is mainly because courses are normally designed for both men and women, the decisive factor being a position in employment. The actual period of training depends, above all, on how difficult it is for the participants to acquire the relevant knowledge and skills - i.e. on the gap between the existing and expected level of knowledge and skills. The greater the progress that is to be achieved, the longer the training should be. This assumption leads to a hypothesis that in the CR there is a milder progress in the level of knowledge and skills as compared to the EU average, and that the expected progress is comparable for men and women, although there may be a different starting level.

Compared to 1999 the CR showed a considerable decrease in the number of hours spent in CVT courses per one participant. In 1999 women spent an average of 27 hours on CVT courses, for men it was 24 hours. It means that not only did the length of courses decrease (for women it was by 5 hours, for men by 1 hour), but the length of training evened up due this decrease in the number of hours spent on courses by females. In 2005 men spend one hour more on courses than women, while in 1999 women's participation was 3 hours longer compared to men.

3.3 Case studies in innovative enterprises

The objective of the case studies was to identify and evaluate the ways in which innovative companies approach human resources development, what staff management and development systems they employ and with what results, and how the employees are involved in business innovation processes. A total of 11 case studies were carried out. An overview of industries where the enterprises operate and the number of cases studies carried out in the relevant industry are presented in Box 5.

Box 5 – Industry structure and the number of case studies
Enterprises were assigned to industries based on the nature of predominating business activities.
Manufacture of motor vehicles (NACE 34), 4 studies,
Manufacture of food products and beverages (NACE 15), 2 studies,
Manufacture of textiles (NACE 17), 2 studies,
Manufacture of electronic equipment and medical instruments (NACE 32-33), 1 study
Manufacture of chemicals (NACE 24), 1 study.
Publishing and printing (NACE 22), 1 study.

Note: In view of the need to use statistical data for previous periods enterprises in this part are assorted in line with the old "OKEČ" (NACE) classification and not the new CZ-NACE system. Source: Industry classification of economic activities (OKEČ), CSO 2008.

The larger proportion of enterprises in the automotive industry was the result of a higher incidence of innovation activities in this industry. According to the outcomes of CSO studies the automotive industry ranks among top innovating industries in the Czech economy. These case studies were carried out mostly in large companies that are more likely to develop and apply their own strategies for human resources development. The structure of enterprises explored according to their size is presented in Table 1.

Table 1: Case studies in enterprises according to size category

Company size	Number of companies
SME's (10-249 employees)	3
Large (250-999 employees)	4
Very large (1000+ employees)	4

Source: Braňka, J. (2008).

In order to carry out a comparative analysis and to assess human resources development and innovations strategies in companies in view of the current and expected challenges in the given industry, enterprises were divided into groups according to qualification requirements and innovation activities. The so-called Puttick grid was used for the purpose of classification[14]. The grid not only takes account of the com-

[14] Warwick Institute for Economic Research (2006).

pany size and business area, but it also examines the links between the complexity and focus of the products and the type of final customer.

The matrix distinguishes between two major characteristics: **product complexity** (the volume of various technologies and components that constitute inputs in production and affect the manufacturing demands and qualification requirements) and **the level of uncertainty for the relevant product** (the size of the target market and the risk of loss of sales/customers the producer faces in the market). If a standard product or service is concerned and it can be supplied to a large group of customers, the risk is smaller. If it is always necessary to adjust the product or services to meet the needs of a specific customer ("made to order"), the risk faced by the company in the market is objectively higher.

Puttick grid is used here for assessing changes in qualification requirements for human resources. The more complex and specialised the product and the smaller and more exclusive the target group is, the higher the qualification requirements. Requirements for innovation are also higher as innovative activities must be more complex and cannot only be focused in one direction (e.g. only product innovation). Generally, the portfolio of innovations must be the most comprehensive and complex in companies placed in the top left corner on the grid (see Figure 17) .

The grid distinguishes four types of product according to product complexity and the level of uncertainty. **Super value goods** have a long innovation cycle, high research and development costs and higher requirements for skilled workforce. Apart from being demanding in terms of product innovation itself, these products must meet high standards in the area of processes. Marketing is also important (personal approach to potential customers, the target group is normally of a moderate size and the loss of one customer can be very dangerous for the company.

Consumer durables which include, for example, cars and consumer electronics, have an innovation cycle of similar length as super value goods. As regards development, they also have high requirements for skilled workforce. Production mostly takes place in large batches, and therefore process improvements are of great importance for company competitiveness.

Fashion goods (often made to order) benefit from a good knowledge of the market. Key importance is attributed to specialisation and identification of the interests and needs of customers. This group includes activities in the area of industrial design and planning. These are products with a high level of uncertainty in terms of sales (bespoke products the demand for which is less stable and certain).

Commodities, also described as common consumption goods, are normally produced in large batches or on a mass scale. Focus on process innovation is therefore very important. The competitiveness of commodities, of all segments, is the most dependent on price.

Basic characteristics of selected companies and their positioning on Puttick grid

The selected companies were described by a comprehensive set of characteristics that cover their area of operation (industry), the nature of innovations that are of decisive importance, and the position in the production chain. As the approach to human resources development on the part of companies is to a large degree influenced by whether or not the company is owned by Czech or foreign capital, this information is also provided.

For the sake of anonymity there is no data about the exact number of employees, although the company size also plays a major role as regards approaches to human resources development (HRD). The position of the company on the Puttick grid is also influenced by what activities the companies perform as part of their production programme, what emphasis they place on various activities and by the proportion of various types of innovation.

Case study 1 (CS 1): manufacturer of painting materials designed particularly for small customers (the proportion of industrial customers is some 30%). As the company states, marketing innovations are of particular importance. However, thanks to market as well as legislative trends the company is forced to focus on product innovations as well. As regards the production chain it is involved in all its components except logistics (it has in-house development and manufacturing, and also controls marketing activities). The company is owned by Czech natural persons.

CS 1 is positioned in the "Commodity" quadrant on the grid. However, it is dependent, to a relatively large degree, on small customers and faces the threat of cheaper imports, which constitutes a higher risk.

Case study 2 (PS 2): manufacturer of industrial textiles that are supplied exclusively to manufacturers of transport vehicles. Process innovations are of key importance as they facilitate cost reduction and better quality control. In view of the growing demand on the part of customers the company intends to further strengthen its development unit. The company is owned by foreign capital.

It is commodity production by nature, but the proportion of in-house development and innovation is high. The sales risk is also high as the company is dependent on a small number of potential customers.

Figure 17: Puttick grid complemented by link to innovation

	High ← Product complexity → Low	
Uncertainty: Low ↑ High	**Super value goods** Example: aircraft industry, manufacture of specialised electronics Comprehensive nature of innovation	**Fashion goods** Example: part of the clothing and footwear industry, entertainment industry/multimedia, activities related to design Marketing/product nature of innovation
	Consumer durables Examples: cars, consumer electronics Product/process nature of innovation	**Commodities** Example: food stuffs, textiles and clothing (the larger part of the industry), small industrial products, standard components Process nature of innovation

Source: Warwick Institute for Economic Research (2006); adjusted to be used in the case studies of Braňka, J. (2008).

Case study 3 (CS 3): manufacturer in the automotive industry with an emphasis on in-house development. Product innovations are of major importance. The quality of processes is very high already and there is not so much space for further improvements. Marketing is also quite important, although the market development and segmentation do not yet make marketing innovation a priority. The company is owned by foreign capital.

There is a medium level of uncertainty, particularly thanks to a good customer structure (diversification lowers the risk), and the quality of innovations and HDR is high. This places the company at higher positions among the companies under review in terms of product complexity.

Case study 4 (CS 4): manufacturer of electronic components that are used in several industries. Besides this the company has another manufacturing programme focusing on medical technology where it has its strongest development unit. Product and process innovations predominate. The company is owned by several Czech natural persons.

The company is placed in the segment of super value goods, the nature of innovations is complex. The risks within this segment is medium, because company production is sufficiently diversified.

Case study 5 (CS 5): manufacturer in the automotive industry, again with an emphasis on in-house development. The company considers product innovations to be the most important and has a well-developed system of incentives for employees to present improvement proposals. It does not stress marketing due to its customers structure. The company is owned by foreign capital.

The company has a large-batch production with a medium level of uncertainty and complexity. It strives to raise the level of complexity by a larger involvement of research and development in all areas of the manufacturing process.

Case study 6 (CS 6): manufacturer of beverages, the food industry. In-house development is a matter of course in this case, but it does not place very high requirements on the size of the development unit. Monitoring market trends and good marketing are activities that are very important for competitiveness of the company. The company is owned by foreign capital.

Product complexity level is of course low and the market risk is still small, threats are insignificant and the target group is relatively stable. No big changes are expected in the labour market.

Case study 7 (PS 7): manufacturer in the automotive industry, in the so-called „aftermarket". This involves "non-brand" components that can substitute for more expensive original components for repair and servicing purposes. Due to customer requirements and legislation the company is pushed towards robust product innovations. The pressure is not so strong in processes and marketing, therefore there is not so much focus on these areas. It is a joint-stock company (owners not specified).

The proportion of development in the business activities is not so significant, and the target market is relatively stable – the risk and complexity levels are therefore low/medium.

Case study 8 (CS 8): manufacturer in the food industry producing bakery goods. Product innovations in combination with marketing innovations are considered as the most important by the company. The company is not so much pressurised by requirements for changes in processes. It is owned by a foreign capital.

The market risk is small and the level of complexity is also relatively low. This makes the company a typical supplier in the commodity segment.

Case study 9 (PS 9): manufacturer in the textiles industry. The products have an extensive use ranging from interior textiles through sports goods to the car industry. This affects the nature of innovations – product innovations are very strong and rely almost exclusively on in-house development. Moreover, marketing is very important (link to customers and identification of their needs). It is a joint-stock company (owners not specified).

This means that the product complexity level is higher, and the risk is relatively low thanks to diversification. The company is positioned on the borderline between commodities and consumer durables.

Case study 10 (PS 10): supplier for the automotive industry with a partial focus on metal processing and mechanical engineering. The pace of innovation is very high, particularly in mechanical engineering (frequent product innovations). The company is also very proactive in marketing. Efforts are made to diversify the portfolio and alleviate dependence on supplies for the automotive industry. It is a joint-stock company (owners not specified).

There is a medium level of complexity and the same is true of innovation. However, the customer portfolio is not balanced and the dependence on the stagnating automotive industry and mechanical engineering increases the risk.

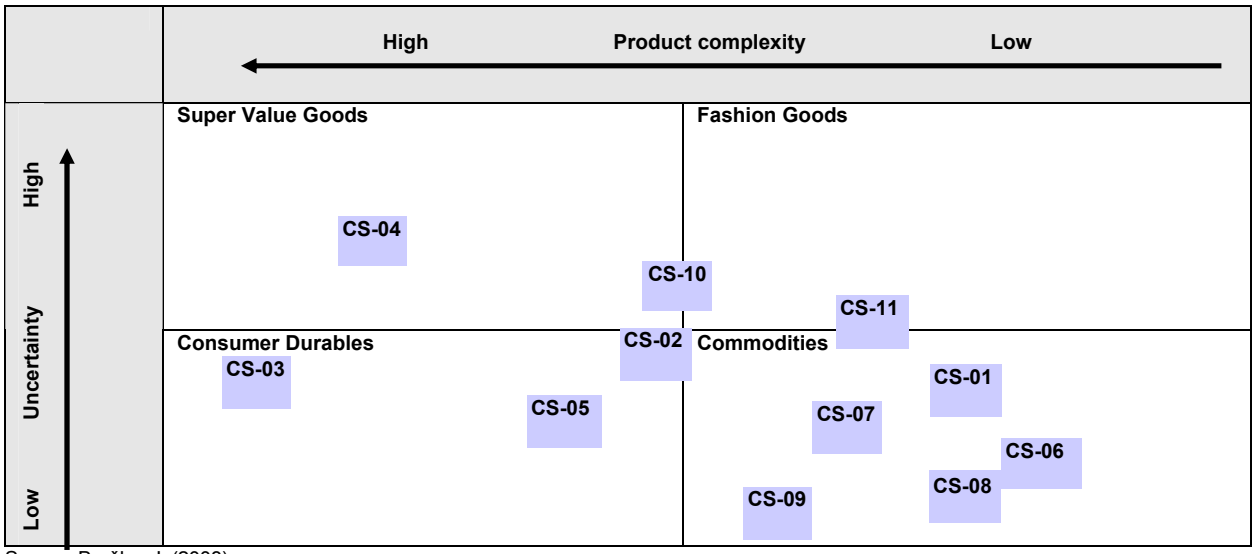
Case study 11 (PS 11): publisher of printed materials. The study was implemented at a selected unit (distribution) and combined with an analysis of the human resources department. Innovations are focused on products and marketing here. Various business units cooperate on this type of innovation. Process and organisational innovations will have a large potential in forthcoming years. The company now begins to invest more in optimisation of these areas (it was not so much pressurised to do it earlier). The company is owned by foreign capital.

The company is positioned on the borderline between commodities and fashion goods – print in itself is more on the commodity side, but the competition from multimedia significantly increases the risk in the segment.

Most companies under examination are placed in the bottom quadrants on Puttick grid. This points to the fact that they manufacture products and provide services in customer segments that allow for large volumes of sales and where the risk of losing customers is lower. On the other hand, some two thirds of the enterprises show a lower to medium level of complexity of production, and therefore qualification requirements are often not so high.

The overview provided above clearly shows that business conditions are changing and, in many cases, market risk is expected to grow. This will require innovations in the portfolio as well as in HRD. All companies that were examined as part of this study have their in-house development units and often provide for all components of the value chain up to sales and marketing. The importance of

Figure 18: Position of enterprises on the matrix



Source: Braňka, J. (2008).

in-house innovations and development varies among the companies. However, it can never be described as below the average – if we compare the position and innovation activities of the company with what is considered to be a good competitive strategy in view of the shape of the industry (see Figure 18).

One important step as part of carrying out the case studies was to define major factors affecting various industries and to assess how they impact upon human resources development in the companies – in other words, what measures the companies should take to maintain or improve their competitive market position.

Case studies in the automotive industry

In this case large-batch production is increasingly seen as a prerequisite for competitiveness. There are two reasons for this. One of them consists in rising costs of acquisition of production lines, the second reason is the increasing investment in the research and development of new vehicles. Cars are products where the pace of product innovation is very high. One of the trends in the near future will be an increasing share of electronic components in the total price of the vehicle (an estimate is 40% in 2010[15]). For example the development of new engines or chassis units has become so demanding that even large concerns cannot do this just on their own – most enterprises are forced to cooperate either with their competitors or as part of their supplier chain.

The intensive demands related to development constitute one of the reasons that lead to large concentration efforts within the automotive industry. At the same time, as customer requirements increase and competition becomes more intensive, companies are constantly forced to seek ways of maintaining or reducing their costs. They may achieve this either by decreasing the manufacturing costs (particularly wages) – i.e. by moving manufacturing units to countries with cheaper labour force, by further automation or by more effective business management (process optimisation). The quality of processes is currently very high, particularly as regards final producers of vehicles and so-called Tier 1 suppliers (companies that supply to end car producers – i.e. they are "Category 1" subcontractors). However, in the following years it may be expected that demand for process innovations will grow in other parts of the supply chain as well.

As regards human resources, it was the automotive industry that was most involved in the development of system activities focused on elimination of growing problems in **recruitment of skilled workforce**. Companies face considerable problems as regards the jobs of designers, toolmakers, programmers of CNC machines and technologists –i.e. positions requirement an advanced level of skills, in some cases even tertiary education.

They see the main problem in tougher competition in the labour market as regard abovementioned key occupations. As the industry must put up with the consequences of the expected economic slowdown, the robust demand for some occupations, particularly those with medium-level skills, can be alleviated.

As for ensuring innovation and competitiveness, the priorities of companies **in the area of HR** will include:

- expanding the variability of employees – on-the-job training of production workers so that they can perform any job within their team or operation;
- strengthening development teams mainly from internal sources – systematic identification of production workers who have the potential to work in the development unit (particularly as technologists, designers);
- increasing quality control requirements – not only as regards input and output control, but continuous control during operations. Workers with quality management skills will be required for an increasing number of jobs;
- boosting investment in new manufacturing equipment – innovations in automation will be one of the means of increasing competitiveness. For example, the very efforts to ensure a degree of automation in quality control are mentioned in CS2 as innovation with large potential benefits. In terms of HR, these innovations will be promoted by technologists looking after the "machine fleet".

[15] Deloitte (2006).

An even closer cooperation between car producers and suppliers of machinery cannot be ruled out;

- changing occupational requirements – so-called "mechatronics" are the most frequently mentioned in connection with the car industry going electronic. These are workers with combined knowledge in the field electrical engineering (electronics) and mechanics (or mechanical engineering).

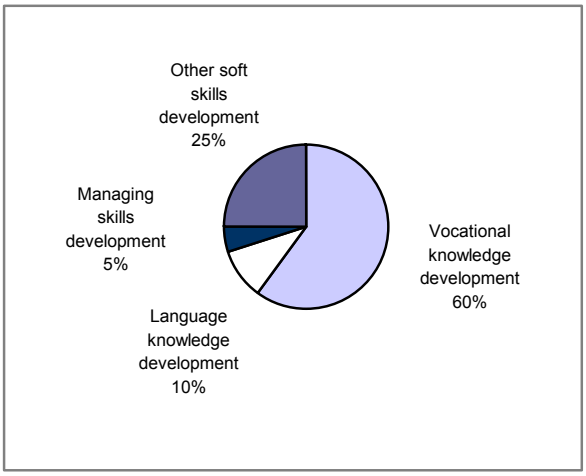
The employers in the automotive industry that were examined rank among leading enterprises in the whole manufacturing industry for the level of innovation intensity and human resources development. Roughly three quarters of employees are employed in manufacturing units, the rest can be more or less equally divided into the non-manufacturing (technical and administrative) and research and development categories.

Innovations are implemented in the development of new products, technological procedures, processes, organisational culture and environmental protection. Each of these types of innovation has specific requirements for the quality and training of staff.

Innovation management is very well developed. All employees are strongly encouraged or even required to present small improvement proposals. The assumption is that the employees best know their work environment and therefore represent the source of proposals for continuous improvement. In such a system innovation and change form an integral part of job description. This system that encourages innovation is based more on non-financial stimuli. The system also includes an innovation database that should facilitate transfer of good practices to other units. There are also arrangements for critical evaluation of innovation so as to ensure that innovation in one unit does not have a negative impact on a follow-up unit.

Enterprises in the car industry invest large amounts of resources in the training of their staff– up to 7% of their wage costs. Employees spends 6.5 days a year in training that is largely focused on further development of professional knowledge (see Figure 19).

Figure 19: The training content (an example of an employer in the automotive industry)



Source: Braňka, J. (2008).

Companies in the automotive industry that participated in this research showed a highly developed and sophisticated system for HRD and innovations. In years to come the HRD system will face even stronger challenges in view of the growing demands for innovative performance and, as a result, for human resources. Companies will have to cope with the problem of human resources ageing and with growing competition among employers in the Czech labour market.

Case studies in the food industry

At present, the main challenge for the **food industry** is the growing price of inputs, particularly energy. Producers must make strenuous efforts to justify price increases to vendors, particularly to retail chains, since the price of a number of food stuffs is perceived by consumers as an indicator of the retailer's price category. At the same time, they must seek to "educate" consumers who often see price as the only criterion for evaluating a product. This limits producers in introducing product innovations that offer higher quality to the customer (e.g. a lower content of artificial substances, etc.). Product innovations therefore must go hand in hand with marketing innovations, so that the consumer learns to recognise higher quality, to demand it and to be willing to pay for it. The expected further increase in the price of inputs will increasingly force producers to process innovations, although they will be, understandably, at a lower level as compared, for example, to the car industry.

As for legislation, we may expect that the following years will bring tightened demands for environmental protection, particularly at European level, that will be reflected in manufacturing costs. These demands will concern, above all, more effective handling of packaging and packaging waste, waste water treatment, reduction of waste from production, emissions and compliance with hygiene and manufacturing practices.

In the area of human resources the food industry will also face problems related to a deteriorating shortage of workers. However, in view of the overall lower qualification requirements for most manufacturing jobs it is likely that food manufacturers will not be forced to pursue extensive cooperation with schools or to arrange for extensive retraining courses.

Attention of enterprises in the food industry focuses on some **key occupations** that are important in terms of competitiveness. These are, most importantly, middle and higher positions: new product developers, technologist responsible for an optimal operation of manufacturing facilities and their modifications to fit the needs of new manufacturing schemes, brand managers in charge of brand innovation processes, account managers and marketing managers responsible for business activities, identification of trends, negotiation with partners and monitoring competition.

Thanks to intensive demands for practical experience in these occupations we may expect that it will be best for these enterprises to invest in the development of their own employees who may "grow up" to these key positions. At the same time – in view of the expected shortage of these occupations in the labour market – marketing activities focused on potential employees will be important (prestige of the company, jobs, pay, bonus system, etc.).

Companies often address shortages of manufacturing workers through recruiting foreign labour force. This is possible because of the generally lower qualification requirements. However, this approach cannot work over

the long term due to the economic development in countries from which these people arrive (Slovakia, Poland, Ukraine, Bulgaria).

The development of innovation and the need to stay competitive will generate more intensive **demands for the quality and skills of the workforce,** particularly in the following areas.

Marketing innovation in combination with product innovation will require extensive transfer of knowledge between business and technical occupations.

Organisational innovation will increase requirements for the flexibility of employees (the capacity to work on several projects, more variable work), and for better communication skills and initiative.

Technological innovation, that may also include innovations concerned with energy savings, the use of waste materials and waste heat etc., will be conditional upon the quality of technologists. Motivation on the part of employees to pursue partial improvements will also be very important.

Process innovation will need to be more formalised. The level of management complexity will increase due to organisational innovation, and the pressure for documentation and formal correctness of procedures will grow, among other things, as a result of legislative changes. As regards human resources, there will be stronger requirements for in-service training of employees.

In enterprises in the food industry the proportion of manufacturing occupations varies and most frequently ranges between 50 and 80%. The variability is largely caused by the degree of outsourcing. Some activities (particularly sales and distribution) are outsourced by manufactures to external suppliers, while they concentrate on production, technology and development. The companies that are being analysed are little forced to invest in human resources. They are currently good in satisfying the requirements mentioned above that the market environment, legislation and customers place on innovation and human resources. Growing cost on the one hand and tough negotiations on price terms with clients (particularly retail chains) on the other hand make it impossible to increase wages so as to attract a sufficient number of skilled workers. This situation may be addressed by means two types of measure:

Recruiting larger numbers of foreign workers who are willing to work for lower wages, and by means of this keeping labour costs at an acceptable level, or

Targeted efforts to increase labour productivity by means of outsourcing service activities and process and technology innovation.

In most companies (this is true particularly of small and medium-sized companies) the first alternative still predominates. However, this approach can only be adopted with short term prospects. Moreover, there is an increasing risks that, thanks to the low pace of innovation, these companies will increasingly lag behind competition. The following years will therefore bring about the need for food manufacturers to invest more in HRD.

Case studies in the textile industry

The textile industry in the CR is experiencing a very fierce competition with foreign imports and, in the case of clothing, tends to lose out in the long term. On the other hand, the textile industry has maintained a good position particularly as regards supply to other industries where it benefits from its know how, well-developed technology and skilled workforce. Supplies for the car industry are of major importance, supplies for furniture manufactures decline.

The quality of human resources is increasingly viewed as a problem. The fields of study that offer training for jobs in the textile industry are currently seen as the least attractive. Employers face particular difficulties filling new or vacant positions requiring secondary technical education. Retraining is lengthy and workers without theoretical background have lower chances of achieving a high level of professional skills and productivity. Another point is that jobs requiring secondary technical qualifications are very important in terms of quality improvement and technological innovation. This means that, in the long term, the quality of human resources can threaten the competitiveness of enterprises in the textile industry.

Czech clothing manufactures operate successfully on the market of functional clothing – particularly sports and protective garments. This segment, which involves a higher value added, allows for competition based both on quality and price.

However, the expectations are that these products will become a commodity and Czech manufactures will face difficulties competing on the basis of price. In terms of maintaining competitiveness it is necessary that companies pay attention to the following priorities:

A systematic development of employees so that they can satisfy more stringent requirements for quality management, process improvements and technological innovation, and so that the best employees have a chance to develop their capacities in order to progress to the level of developers and technologists.

Intensive cooperation with local partners - at enterprise-school level and also at enterprise-region level. The cooperation should be focused on securing a partner for education and training (development of a specific study programme for the needs of the company in exchange for future employment), and for cooperation in R&D.

As for **product innovation** it is necessary to focus on continuous quality improvement. Otherwise competitiveness may be endangered in 3-5 years term.

As concerns **processes** it is important that employees master a larger number and range of operations, and that companies use job rotation not only for addressing operational problems but also as an instrument for increasing the flexibility of employees, for their training and for preventing routine.

The enterprises in the textile industry that were analysed are forced by the situation in the industry to make major investments in innovation and human resources development. This is particularly true of the supplies for the car industry where the companies have to meet tough requirements for quality and processes. There are efforts to reinforce development teams, although the availability of individuals with appropriate qualifications is very limited. In the CR there is only one higher education institution that provides the required qualifications, and the chances of attracting employees working for other companies is very limited. There have not been major efforts to acquire skilled workers from abroad either.

Companies also expect a deteriorated situation as regards key manufacturing occupations. Secondary education focusing on the textile industry virtually ceased to exist and new employees must therefore be retrained as they have qualifications in other fields. There are basically three ways of addressing the lower level of availability of new production workers: increasing the level of automation, increasing the proportion of foreign employees and active cooperation with regional educational institutions and continuing training providers.

Unlike the food industry, textile companies that are part of the analysis tend to realise that increased efforts in the area of human resources development and technological and process innovation represent a pathway towards long-term competitiveness. The future will bring about a further toughening of requirements in most innovation areas. However, it is probable that this will not mean a need for fundamental changes in the companies under review. There is room for improvement as regards cooperation with secondary schools. It is necessary to seek a solution to the situation where, on the one hand, there is a lack of schools providing the required programmes, and, on the other hand, companies are not large enough so as to guarantee employment for graduates in the relevant region if a new secondary school was established there.

The case study in the chemical industry

The Czech **chemical industry** lags behind developed countries in terms of competitiveness, although the situation is improving due to inflow of foreign capital and continuing restructuring. The low innovation dynamics and slow increase in the proportion of products with higher value added are still viewed as a serious problem.

A major driver behind innovation is legislation, particularly regulations concerning environmental protection. Manufacture of chemical substances and paints is usually very demanding in view of environmental concerns. The actual handling of products is subject to special regulations. companies as well as end users are increasingly aware of the need to behave in an environmentally safe manner, and innovation in this area is therefore very important. It affects not only competitiveness, but it is a symbol of prestige for the manufacturers.

It is impossible to make a straightforward conclusion as to what type of innovation will be the most important for maintaining the market position in the long term. It is more likely to be a balanced mix of several approaches. It is expected that sales representatives and marketing officers will be increasingly important. Competition in the market will tend to become fiercer, particularly if the current boom in construction slows down. The importance of manufacturing jobs will tend to decrease slightly – companies will strive to reduce costs and perhaps will not refill certain vacated positions. Conversely, the expanding markets east of the Czech Republic will stimulate their own producers in the form of foreign investment (local branch offices or even manufacturing units) – this will, again, affect sales/management jobs as well production technologists' positions. In general, to manufacture a product at acceptable cost levels and to sell it will be an increasing problem in this segment, much more difficult than to develop a new one.

The chemical company analysed as part of the case study operates in all parts of the value chain – from development to preparation of finished goods. It has a strong development department as compared to companies in the industry in general. The department employs 10% of all employees. The proportion of sales, logistics and marketing jobs accounts for another 15%. Other specialised employees are designated for environmental management, for ensuring smooth operations and technological innovations in the manufacturing section.

At present the company faces the most severe difficulties in filling jobs in logistics and warehouse management. This is a consequence of the expansion of logistics and sales centres that lower the supply of the workforce available in the labour market. If, in the near future, the company cannot maintain the existing beneficial cooperation with wholesale warehouses, there will be a need for further organisational innovation – an increase of the number of sales people will be required together with and other changes emerging from the need to optimise warehouse management and internal logistics processes. The company expects that, in the future, it will be necessary to further reinforce key units, particularly development and sales. In manufacturing efforts will continue to ensure downsizing (natural departures without compensation).

From this perspective, and also in view of the analysis of the industry, this HRD strategy appears to be correct. However, the company is not yet facing a major problem related to insufficient supply of human resources. It is also possible that it might need to strengthen sales, marketing and logistics in order to maintain or improve its market position – i.e. the company will have to increase the number of staff who perform these servicing jobs. This may increase pressures for optimisation in manufacturing and cost savings. Moreover, natural departure of the workforce and the difficulties refilling their positions will result in demand for targeted training of employees and improvement of process management.

Management of human resources is based on the objectives of the company and its long-term vision (how it wants to operate in the market, what customers it wants to serve, what its economic objectives are). However, the company does not have a comprehensive HRD strategy, HRD techniques are not well elaborated and developed.

As with process innovation, HRD procedures and instruments have developed gradually in response to the need as it emerged. In Czech conditions this a rule rather than an exception. The company's problems do not lie in the area of in-house development and innovation. Rather, they tend to appear in sales, market knowledge, customer targeting, process improvement and timely adaptation to the changing situation.

The case study in the company manufacturing equipment for electrical engineering and medical instruments

Manufacture of equipment for electrical engineering and medical instruments is, along with the automotive industry, the fastest growing industry in the Czech Republic. This dramatic growth followed a crisis in the 1990s where Czech companies came up against fierce competition of world-known producers, and difficulties occurred accompanied by a downfall in production and loss of markets. Problems also consisted in different technical standards as compared with global competition.

However, the loss of thousands of jobs constituted a major potential for growth that started in 2000. Investors saw an extensive supply of skilled workers with practical

experience. This led to the creation of 25 thousand new jobs during period 2000-2007.

As with the textile industry there is a real threat of East European and Asian competition. Czech companies are now relatively well prepared to face it (thanks to foreign investors' interest they have better technology and the quality of production is of high standards in general). Still, the competitive position of Czech companies can deteriorate in the following couple of years due to growing price and wage levels. It is necessary to take account of the fact that this industry, unlike the automotive industry, does not enjoy such strong territorial links to the supplier network, because the components can be effectively supplied long distances.

Legislative changes will have a stronger impact on the sector. These will concern, above all, restrictions on the use of some chemical substances in production (REACH), and standards affecting product life cycle and management of electrical waste. Due to these factors and the generally very high pace of innovation manufacturers are forced to pursue product innovation in particular (including changes to the relevant manufacturing equipment). At the same time, the electrical engineering industry faces a large opportunity of new markets and a number of products that do not yet contain a major proportion of electronic components. The following types of innovation, in particular, will be a priority for these companies in terms of company competitiveness:

Product innovation – these will reflect both changing legislative requirements and increasing demands on the part of key customers. These include, above all, the automotive industry and OEMs (Original Equipment Manufacturers) in the electrical engineering industry for whom key suppliers provide components that are often intensive in terms of research, development and design. These companies are denoted as EMS – Electronic Manufacturing Services, and they have a relatively strong position in the Czech market and create large (and increasing) numbers of jobs.

As for the automotive industry, requirements for development become increasingly stronger. The reason is a growing proportion of electronic components in vehicles. These will be most frequently developed as part of cooperation schemes and they will place demands on the relevant innovation cycle in the industry (intensive development lasting up to several years, high demands for quality).

Process and organisational innovation. Czech producers are (in the end of 2008) characterised by overburdened manufacturing capacity. Enterprises have limited means to increase their manufacturing capacity. Human resource capacity is still exhausted. Electrical engineering companies, as those in the food industry, resort to a more extensive recruitment of foreign workers. However, this approach cannot work in the long term and also brings certain socio-cultural problems.

Technological innovation is introduced particularly to achieve labour savings. It takes the form of increased levels of automation in assembly operations and a more dynamic pace of labour productivity growth. Technological innovation is also prompted by growing demand and requirements for new products. It is an important instrument for maintaining the competitiveness of companies on global markets.

Human resources management – demand for key workers with qualifications in electrical engineering and in a combination of disciplines (particularly at tertiary level) will grow much faster than their supply.

The manufacturer of electrical engineering equipment and medical instruments that was examined employs approximately 60% of workers in manufacturing. The second largest unit is purchasing and logistics accounting for over 20% of total employment. The technology, development and sales units have each approximately 5% of employees, and the IT unit accounts for the remaining 5% of the staff. The employee structure in the company clearly illustrates what importance is attributed to logistics, the supply chain and its optimal functioning. The portfolio of customers is extensive and it covers various industry sectors from healthcare through telecommunications to the automotive industry.

The development and technologies together account for 10% of employment – in view of the company focus and types of customer this is fully sufficient at present. The company is currently facing a problem in attracting good quality employees in the region. They plan to address it by means of more intensive efforts to seek suitable workers in the Slovak labour market. Due to the language barrier and cultural differences the company is not considering recruitment of workers from other countries.

Product and process innovation is of key importance for the company. Innovation of products and the manufacturing technology focuses particularly on supplies to the medical equipment sector and partly telecommunications. In these areas the company feels the most urgent need to come up with new, innovative products. As for supplies to the automotive industry, the innovation in this context is more process-focused (quality, speeding up various activities, shortening the time of response to customer needs). There is not such a pressure for product innovation.

Product innovation is prompted by the development demand and the market. However, it is not a passive response to changing customer requirements. The company tries to forecast this development so that it can come up with an innovated product at a moment when the market is "ready" for it. These forecasts are the responsibility of the sales department (gathering suggestions from customers) and also of the development department (looking after technological innovation and trends and putting them into practice).

As for medical equipment and devices it is also necessary to improve the products so that they meet certification requirements laid down in the existing legislation and its amendments. The aim is to offer a better level of health protection than that required by the standards – the company's prestige and brands are at stake.

Employees are encouraged to pursue innovation by means of motivation instruments that are only linked to key events (development of a new product, etc.). Employees holding key positions (middle and senior management) are given tasks for the entire year to which motivational bonuses are attached. Their implementation is assessed biannually and annually. Employees at lower levels only get bonuses for meeting the relevant standards as part of their ordinary pay scheme.

Motivation to pursue small improvement proposals is fostered in the collective agreement and in the wage

scheme. There is remuneration for both presenting the improvement proposal and for its practical benefits. However, there has so far been very tiny response on the part of employees (only 2-3 proposals per year).

The company seeks to build its image in the eyes of potential employees. For example, it runs a scholarship programme for higher education students, and makes efforts to attract graduates with good prospects as early as during their studies at secondary schools and universities. The company expects that a generational problem caused by the retirement of key workers will occur in 5-10 years. First the company turns to its own ranks in order to replace workers in key positions. Therefore the importance of these positions is defined in terms of the company's competitiveness and requirements that workers occupying them should meet. The company designates employees who could proceed to these positions within a certain period of time, and develops plans for their training and development. The relevant employees are acquainted with these plans and the mix of "incentives" (wage and non-wage benefits, job content, working conditions, job image), image etc.), and they are motivated to get involved in personal development in line with the company strategic needs.

The case study in publishing and print

The **publishing and print** industry is heavily concentrated in the Czech Republic. In terms of market development and changes in the market structure the industry is very dynamic since a number of the media are interconnected and new ways of communication and presentation spring up. Mergers, acquisitions and new strategic partnerships are still relatively frequent as the market is not fully stabilised yet. The dynamic launch of new media in the news coverage, music and film changes the landscape of this industry and constitutes a major "driver" behind product and marketing innovation. The level of technology intensity in the sector is rising, while this affects the related requirements for skilled labour force. This is the result of a general trend towards more intensive use of modern technologies in all activities within printing and publishing industry – media production, content creation and distribution.

Media production is increasingly demanding. Product innovation contributes to this trend as new products cannot be made using older production equipment. This concerns printed media where the proportion of full-colour media is growing, and audio and video media where new data carriers emerge. Moreover, there are increasing demands for digitalisation and electronic data processing, and for relevance that is related to the shortening of production cycles (which requires increasing capacity and speed of production equipment).

Content creation is increasingly dependent on IT services in terms of technical solution and requires a growing proportion of IT skills and knowledge on the part of content creating workers. At the same time there is a growing interest in regional news coverage, which forces companies to invest in their regional branches, boost their independence and the capacity to create interesting and good quality news content.

The task of distribution, apart from effective logistics, is to maintain contact with customers and users. This area is still underdeveloped – particularly as regards news coverage. Sales monitoring, evaluation of the quality of the content and comparing it with that of the competitors, marketing effectiveness and building relationships with customers – all these will be the strongest trends in the following years. The importance of the relevant professions and units will increase. Distribution in a broader sense will include sales, marketing and customer care, which will result in specific requirements for innovation and qualifications.

Enterprises have not yet been forced to make major investments in human resources development. With the exception of certain specialised professions they have not felt a major need to stabilise their employees. However, the situation is gradually changing. Thanks to digitalisation of the industry the demand for IT professions and knowledge is generally growing, and there are expectations of shortages of specialists in printing technologies, etc. However, at present there is predominating demand for employees who can be easily trained on-the-job and who show high performance and flexibility levels. A systematic development of human resources is a less common approach due to reasons stated above, although requirements in this area will certainly increase in years to come.

Enterprises in this segment of the economy show a high level of employee turnover. It can reach up to 80%. The company that was part of the analysis achieved a certain level of stabilisation of human resources thanks to changes and innovation carried out in previous years. The current level of turnover is assessed as good (around 60%). The human resources and other departments make efforts to decrease it further. Candidates for jobs are normally required to have no more than secondary qualifications. Flexibility, teamwork capacity, commitment and independence are the decisive qualities.

Professional skills include PC skills and the capacity to work with the CRM system that the company plans to implement. This will include not only technical mastering of the system, but also, and most importantly, understanding the new corporate approach and meeting communication and business requirements. As the requirements for employees are defined in relatively broad terms, the company is not yet facing major problems filling vacancies. It has good experience cooperating with recruitment agencies and it is viewed as a prestigious employer.

Decisions on innovation are the responsibility of each department. This concerns all types of innovation – product, organisational, process and marketing. Other important figures are heads of regional branches. A major change in organisation and processes was initiated two years ago. This innovation was focused on decreasing the turnover level, improving the performance of regional branches, enhancing the knowledge of customers and their requirements, increasing the value added for customers by means of product bonuses and a general sharpening of customer focus. This first round of innovation should be followed by a second one the main objective of which will be the purchase and implementation of the CRM system.

Staff training is the responsibility of the human resources department. They look after training particularly as regards its organisation, assess training requirements in terms of the content and capacity, and identify external trainers.

Apart from mandatory training courses (health and safety at work, fire protection and driver training) which the company fosters by means of its own e-learning system, employees can participate in other types of training courses. The company does not have centrally developed and detailed staff training plans. Courses are more of an ad hoc nature implemented based on needs identified by various departments. Most training courses are run by external lecturers or training organisations.

The company also uses a bonus scheme that makes it possible for the employees to undergo further training in selected areas – soft skills, PC work, foreign languages, etc. A senior staff member "nominates" a subordinate for the bonus, and the costs of the course are covered from the HR department budget. Language courses constitute an exception where 50% cost coverage is normally required from the employee.

As with the previous case in the food industry this study confirms that HRD is attributed a relatively small importance in the industry, and it is not linked to strategic goals of the company. While major emphasis is placed on innovation, companies currently do not reinforce the link between innovation and HRD. However, requirements for employees' skills will certainly grow in the future, mainly as a result of organizational and process changes that will require better training and a more systematic approach to human resources development.

Conclusion

The quality of human resources as a factor affecting the competitiveness of the Czech Republic was examined in three sections. The first section concerns the knowledge and skills of the fifteen-year-old population and the educational attainment structure and mobility. The second section analyses differences in the quality of the workforce according to industries, and deals with issues related to future requirements for skills in the Czech labour market and to the tertiary education of individuals. The third section focuses on the continuing education and training provided by enterprises and on the approaches to human resources development on the part of selected innovative companies.

Knowledge and skills of human resources

The level of competencies achieved by the fifteen-year-old population in reading, mathematical and scientific literacy reflects, above all, the quality of the system of basic (primary and lower secondary) education. Moreover, it provides information about this population's capacities for lifelong learning and for finding a good position in the labour market. The results of the PISA 2006 survey show that the CR has relatively good scores in scientific and mathematical skills that are at a level above the OECD average. As for reading literacy, however, the scores are below the average. The proportion of fifteen-year-old pupils who achieved three highest levels of **scientific literacy** accounts for one third of pupils in the CR. This is far less in terms of comparison with the highest-ranking countries that, apart from Finland (over 50% of pupils), include Japan and the Netherlands. On the other hand, this result is still above the OECD average (29%). The largest contribution to the development of technology and skills-intensive fields can be expected from those whose competencies are at the highest level of scientific literacy. There are only several percent of these pupils in each country. The highest percentage of these (4%) can be found in Finland – i.e. the country that scores the best results in general. The CR has the same proportion of these pupils as, for example, Germany (1.8%).

As for **mathematical literacy,** over one third of pupils in the CR reached three highest levels. This means that the CR took an excellent fourth place on an imaginary scale of European countries. The largest proportion of pupils with mathematical competencies at the highest level can be found in Belgium (6.4 %). The CR does not differ significantly from the best countries (6%). Pupils with above-average results represent a major potential for the development of the sciences and technology. However, detailed results points to certain problems that largely originate in the methods of instruction. In scientific literacy, for example, Czech pupils are excellent in applying the knowledge they acquired (particularly in physics and chemistry), but they are far worse when it comes to identification of scientific issues or the use of scientific evidence. This testifies to the fact that **education towards scientific thinking** is neglected and it should receive far more attention. A greater emphasis on scientific education would certainly contribute towards the attractiveness of subjects associated with these competencies. Our pupils do have good results, but, as compared with OECD countries, their interest in working in science and technology disciplines is below the average. The current methods of instruction do not motivate them to go on studying natural sciences and technology. In fact, the reverse tends to be true.

There is a somewhat different picture when it comes to representation of pupils in the top categories of **reading literacy.** Finish pupils, again, reach the best scores with a large lead ahead of the other countries. In Finland nearly one half of pupils have the knowledge and competencies typical of the two highest levels of reading literacy, and nearly 17% achieve scores in the fifth category. The CR with 28.5% of pupils in these literacy categories ranks below the OECD average. However, the proportion of pupils in the best (fifth) category is slightly higher (9.2 %) than in some countries with above-average scores. Pupils with the lowest (i.e. first and lower) levels of literacy will face major difficulties when seeking to integrate into social and working life. While the OECD average of these pupils is 20%, the CR and Slovakia score far above this average. Approximately one fourth of pupils in these two countries only have competencies up to the first category of reading literacy. As distinct from this, Finland is far ahead of other countries for its negligible proportion of pupils with such limited competencies (some 5%). These findings are alarming in view of the fact that employers increasingly require key competencies from potential employees, whilst a large number of young people do not even reach the basic level of these competencies.

The overall trends in the **development of the results** of PISA in 2000, 2003 and 2006 suggest that the position o the CR changed very little from 2000 in terms of international comparison. The changes are not statistically very important and therefore cannot be seen as a reliable confirmation of a certain trend.

The development of the average level of mathematical literacy in the Czech Republic in 2000-2003 can be assessed as very favourable. However, the testing in 2006 did not confirm this trend, there was no further improvement – on the contrary, the scores worsened, although the change was not statistically important. In 2003-2006 the CR saw a slight increase in the proportion of pupils who achieved the highest level of mathematical literacy – level 6 (from 5.3 % to 6.0 %). However, what is more significant and important is the drop in the proportion of pupils in the second and third best category – i.e. level 5 (from 12.9% to 12.3 %) and level 4 (from 20.8 % to 19.1 %). The total proportion of pupils in the three leading categories therefore decreased from 39.1 % to 37.4 % - i.e. by 1.7 p.p. The proportion of pupils in the lowest categories of mathematical literacy in the CR is not favourable either. From 2003 to 2006 the proportion of pupils who scored no higher than level 2 increased by 3 p.p., while the highest increase occurred among those who scored lower than level 1 (by 2.2 p.p.). This is the second largest increase in the proportion of pupils with very bad performance among the countries under review. These two trends suggest that, on the one hand, it is necessary to pay attention to nurturing interest in mathematics not only in the most talented pupils, but also in the large group of pupils who are able to reach above-average results provided they get good guidance and motivation. On the other hand, we should not forget to support pupils with poorer performance who might even fail to achieve the basic competencies for successful employment.

The development of **scientific literacy** can only be assessed in the 2000-2003 period, since the 2006 scores are not comparable due to methodological changes in the testing. Scientific literacy is traditionally one of the strengths of the Czech education system. However, if we compare the ranking of

countries, the results achieved by the CR from 2003 remain the same or are even worse as compared to other countries. It is also true in this case that the suggested trend of a growing the gap between the best and the worst performing pupils can pose a risk in the future.

As concerns the average level of **reading literacy** the Czech Republic's scores worsened by 9 p.p. from 2000 to 2006. However, the difference is not statistically important. There is a clear trend of growing gaps between different performance levels. The proportion of pupils who reached the best level (level 5) increased from 7.0 % to 9.2 %. However, there was a decrease in the proportion of pupils who acquired results at the other two top levels. At level 4 this decrease was from 19.8 % to 19.3 %, at level 3 it was even larger – from 30.9 % to 24.5 %. The proportion of pupils who failed to achieve the basic level of reading literacy increased from 6.1% to 9.9% and the proportion of pupils at level 1 also went up from 11.4 % to 14.9 %. This news is very bad for Czech education. Students who are unable to carry out basic tasks related to reading literacy have limited chances of succeeding in higher grades and can face major difficulties finding employment in the future.

The level of dependence of pupils' scores on parents' education decreased significantly in all three domains that were explored. In 2000 13% of the differences in the scores in mathematical literacy could be explained by parents' education, while in 2006 it was only 6%. In scientific literacy there was a drop from 11% to 5% and in reading literacy the decrease was as large as from 14% to 3%. In all three cases the drop is the largest among the countries under review. A detailed analysis showed that although the net effects of parents' education decrease in the CR, there is an increase in the impact of other factors that jointly constitute the socio-economic status of a family. Specifically, there is a growing influence of parents' occupation and the family's cultural capital.

The educational attainment of the adult population of the Czech Republic is characterised by a high proportion of individuals that attained at least upper-secondary qualifications. In 2007 the proportion was nearly 91% of the population aged 25-64. Moreover, the CR shows a positive development of education mobility where the proportion of people with at most lower-secondary education in younger age groups is significantly lower than that in older age cohorts. However, the large proportion of people with upper-secondary education is offset by a low proportion of people with tertiary qualifications (in 2007 it was 14% as compared to 24% in the EU-27). In recent years there has been a major increase in the number of people with tertiary education which can be attributed to the growing capacity of tertiary education institutions, the transfer to the two cycle structure of studies and the expanded provision of Bachelor study programmes. In 2007 there were already as many as 17% of individuals with tertiary qualifications in the 25-29 age category as compared to the less than 10% in the 55-59 age group. Still, the proportion of the population with tertiary education in the CR is one of the lowest in Europe – and this is also true of younger age groups.

In view of the **projected development in the number of graduates** who will enter the labour market in the following five years a further acceleration of education mobility can be expected. Generally, the development in the number of graduates from 2001 until 2012 can be described as a gradual shift from lower to higher education categories. The process begins with a shift from upper-secondary education without "maturita" (ISCED 3C) to upper-secondary education with "maturita" (ISCED 3A), and then it continues, from 2006, with a more dynamic shift from upper-secondary with "maturita" to tertiary education. In 2007 nearly 35 thousand graduates of higher education institutions and tertiary professional schools entered the labour market, while in 2012 the forecast is nearly 62 thousand.

In average terms, working individuals are more educated than the population in general. However, the situation differs in various industries. In terms of comparison with other countries **people with tertiary qualifications** are more likely to find employment in the education sector. As regards the proportion of people with tertiary education, the situation in the real estate, renting and business activities sector and the financial intermediation sector is the closest to that in the EU-27. While there are expectations of positive development in the level of educational attainment, the structure of graduates according to fields of study will not be so favourable. In particular, there will be a low proportion of graduates of technical disciplines. This is one of the reasons for a low representation of people with tertiary qualifications in manufacturing industries.

Human resources for the knowledge economy

The industry structure of employment reflects the level of advancement and direction of an economy. In the Czech Republic it is **manufacturing** that, traditionally, accounts for the largest proportion of employment. In 2003-2007 total employment in manufacturing industries increased by 100 thousand people – particularly in the manufacture of motor vehicles, metalwork and the manufacture of electrical machinery and apparatus n.e.c. On the contrary, the textile and food industries had a negative impact on employment in manufacturing.

The largest relative increase in employment in the given period occurred in real estate, renting and business activities – nearly 23%. This industry should also expect the most intensive growth in employment **in the future**. By 2012 employment in this industry should go up by nearly 10%. Computer technology will make the largest contribution to this growth with an over 23% increase in employment by 2012. Growth will also occur in trade, repairs of motor vehicles, education, health and social work and other community, social and personal services. On the contrary, there will be a continuing decrease in employment in agriculture, mining and quarrying and electricity, gas and water supply. The trends are similar in the European Union.

The sector of **high-tech services** is associated with the development of modern technologies. In 2003-2007 employment in this sector grew by 7.5% in research and development, and by 3.3% in computer and related activities. Total employment in the sector decreased in this period by 5% - mainly due to restructuring and outsourcing taking place in large companies in the post and telecommunications industry. There are forecasts that **in the future** there should be a slight increase in employment particularly due to computer and related activities where it will grow by nearly 24%, and this sector will be the destination of IT specialists as a result of outsourcing from manufacturing industries. As compared to the EU the Czech Republic has a lower proportion of employment in high-tech services due to insufficient level of research and development and the aforementioned decrease in employment in post and telecommunications.

Medium high-tech manufacturing includes a total of five industries. Employment in all of them grew in the Czech Republic in 2003-2007. In this period it increased by more than 19 %. Forecasts until **2010** envisage a slight increase in employment in this sector that will be followed by a moderate decrease. Investment in the manufacture of motor vehicles and the relatively good prospects of electrical engineering will be factors most contributing to the increase. Conversely, the future level of employment in the sector will be negatively affected by the REACH legislation. However, despite the predicted decline the CR will maintain a leading position in the EU for the proportion of total employment in this sector, which is now 9% - i.e. 3.4 p.p. above the European average).

In the sector of **high-tech manufacturing** the largest growth in employment occurred in the manufacture of medical, precision and optical instruments. In 2003-2007 the increase was from 12 to 21 thousand. This industry also expects the highest growth rate in employment **in the future** –22%. In terms of EU comparison, the CR shows an above-average rate of employment in this sector – 1.8%, which is 0.7 p.p. above the European average.

A sectoral study evaluated in **energy supply** revealed that, in terms of requirements for the workforce, the biggest challenge consists in halting the decrease in interest in studies and employment in this segment. This lost of interest can be attributed to the low prestige of the sector. There are estimates that the shortage of skilled workers (i.e. the difference between available graduates of the relevant study programmes in 2008-2016 and the expected retirement figures) could reach up to 14 thousand, which is a quarter of the current employment.

The energy supply sector will increasingly face a qualitative problem: the requirements for the performance of many key occupations are changing and the education system will not be able to respond to these changes and adapt the relevant study programme with sufficient flexibility and speed. Graduates still have very good technical knowledge that is necessary - according to employers - but not sufficient for job performance. Graduates are particularly weak in understanding broader contexts of the production and distribution of energy and of trading. The low scope of analytical and interdisciplinary knowledge on the part of employees places limitations on companies as regards enhancing the quality of processes and eliminating drawbacks in various parts of the production and distribution chain. At the same time, as production technologies change, the focus of most study programmes on heavy-current electrical engineering turns out to be inappropriate. The best training for employment in the energy sector is that combining electrical and mechanical engineering with an extensive proportion of knowledge in automation and ICT.

Robust investments that are expected in energy supply in years to come and that will be focused on refurbishing, reconstruction or building energy units will increase demand for skilled workers in design and technology. The position of the Czech Republic in this respect is good at present, but this advantage is quickly diminishing due to a low level of interest in the relevant disciplines on the part of the younger population.

The manufacture of ICT and medical instruments ranks among industries with the most intensive increase in employment in the CR. In recent years, in particular, this growth was attributed to a more extensive recruitment of foreign nationals whose proportion in some manufacturers exceeds 40% of all employees. The growth in the industry was made possible by the comparative advantage of lower costs. In the following years this advantage can only be maintained by means of a robust increase in labour productivity or by a further increase in the proportion of foreign nationals in employment who will keep wage costs at an acceptable level.

As regards the manufacture of electronic components (particularly semiconductors), Czech enterprises are likely to maintain a good level of competitiveness in the long term. The reason is that the CR can offer both a base for research and development and sufficient human resources potential. Assembly plants of end manufacturers will be less competitive and jobs related to assembly will be cut. Companies will focus more on provision of follow-up services (logistics, servicing, sales, consultancy), or they will transfer production to locations with cost advantages.

Manufacture of electrical machinery and apparatus is a traditional Czech industry accounting for a large share of total employment. Its further development will be considerably influenced by growing demand on the part of the energy supply sector, and also on the part of the automotive industry and mechanical engineering. As for employment structure, the situation in this industry in the CR is close to that in developed countries, and labour productivity reaches some two thirds of what is common in Western Europe. However, as with the industry mentioned previously, production will be pushed out of the CR in years to come. Although this production has a large research and development potential, there is low probability that foreign companies might transfer manufacturing facilities to the CR on a large scale. The labour market with skilled professions is exhausted. The main problem is that only small numbers of graduates of electrical engineering programmes aim for this industry.

In terms of comparison with other EU member countries the Czech Republic still shows a very low **proportion of the population with tertiary qualifications**, although the number of those admitted to tertiary studies is constantly increasing. In the CR, the net entry rate into tertiary education provided by higher education institutions (ISCED 5A) reached 41% in 2005. Nevertheless, the EU average was 53%. Tertiary professional schools in the CR (ISCED 5B) admitted 8% of the population at the relevant age, while the EU average was 18%. As the gross entry rate into tertiary education in the population of graduates of full secondary education reached 70% in 2005, it is necessary to change focus from quantitative to qualitative issues.

The CR does not enjoy a long tradition of **short tertiary education programmes –** i.e. programmes offered by tertiary professional schools (TPSs) and Bachelor programmes. The position of tertiary professional schools within the tertiary education sector has not yet been stabilised. A potentially good solution is to transform high quality TPSs into non-university higher education institutions, and TPSs offering lower quality programmes would be merged with secondary technical schools. As a result, the development of short programmes would be fostered by means of Bachelor study programmes.

The highest level of education can be achieved through **Doctoral study programmes** (ISCED 6). In terms of a net

entry rate into this type of education (3.2% of the population in the relevant age cohort), in 2005 the CR ranked among countries with a relatively high level of accessibility of this level of education. In Sweden the value of the indicator was 2.6 %, in the United Kingdom it was 2.2 %.

In **terms of gender** women tend to predominate in the total number of those admitted to tertiary education. The far higher proportions of females in tertiary professional studies contribute a great deal to this situation. The net entry rate to TPSs in 2005 was 12% for women, while for men it was only 5%. This is caused by the fact that humanities and related disciplines that are preferred by women prevail in the provision of these schools. The figures tilt in favour of men no earlier than in Doctoral programmes where the net entry rate was 3.7% for men and 2.6% for women.

The CR faces the problem of a low rate of **completion of tertiary studies.** In 2004 the survival rate was only 65% while in Ireland, for example, it was 83%. As a failure to complete studies equals to a waste of resources, it is necessary to identify the reasons for this situation in various fields of study, and to focus on their elimination. The high survival rate along with the low net entry rate into tertiary education results in the CR lagging behind in terms of the proportion of graduates in the age cohort that normally completes tertiary education. In 2005 this proportion was only 6% for ISCED 5B programmes (in Ireland it was 24%), and 25% for ISCED 5A (in Ireland 38%). In Doctoral programmes the proportion was 1.2% in the CR as in Ireland, but in Germany it was 2.4%.

The largest contribution towards the development of economies with a high proportion of technology and skills-intensive industries is expected from **graduates of science and technology programmes.** However, in terms of comparison with the EU average the CR does not fare well in this respect either. The proportion of graduates of these fields of tertiary education per 1,000 persons aged 20-29 was only 6.2 in the CR in 2005, while the EU average was twice as high. The situation can only improve if the level of attractiveness of these disciplines increases (starting from basic and secondary education), if the quality of the studies is enhanced and if the level of pay in these occupations rises (it is particularly low in comparison with management positions).

Nevertheless, the proportion of students enrolled in science and technology programmes is currently very favourable. Those enrolled in technology programmes accounted for nearly 27% in 2006 and the enrolment in science was some 7%. This is affected by an above-average rate of success in admission proceedings (90% in technology as compared to the average of 70%). The reason is a low level of interest in technology disciplines on the part of young people in relation to the number of study places offered by the relevant institutions.

The CR occupies a good position in the EU as for the proportion of science and technology graduates in **Doctoral study programmes.** This is the only area of tertiary education where the figures for the CR are at the EU average level (0.6 graduates per 1,000 people at the relevant age). The CR ranks above average in EU terms for the proportion of these graduates in the total number of graduates (50% vs. 43%). However, this proportion is decreasing in the CR (from 57% in 2000), while the EU average is not changing.

Among EU countries the CR has a system of tertiary education that is relatively **attractive for foreign students**. Their proportion in the total number of students in the CR was 3.6% in 2005, the EU average was 2.6%. However, it should be mentioned that this figure is strongly affected by students who are able to study in the Czech language and therefore need not pay tuition fees. These are particularly Slovaks, but also Ukrainians and Russians.

The quality of education is also positively affected by the fact that students have opportunities to undertake a section of their studies abroad. Although these opportunities are expanding, the proportion of Czech students studying abroad in the total number of students is still very low. In 2005 only less than 2% of Czech students studied outside the CR, while there were 9% of Irish students studying abroad. The problem is both finance (the accessibility and level of scholarships is still very limited) and the willingness of higher education institutions to recognise examinations passed during studies in a foreign country.

Training in enterprises

Staff training in enterprises is a prerequisite for maintaining competitiveness. In 2005 72% of companies in the CR provided training to their employees – i.e. more that the EU average (60%) but less than, for example, in the United Kingdom where a certain form of staff training was implemented by 90% of companies. Three most frequent reasons why Czech enterprises do not train their employees are the following: the belief that the employees have the skills and competencies that meet the existing needs of the company; the company recruits people with the required qualifications; and other reasons. As regards the first two reasons companies in the CR do not differ from the EU average, the third reason is different. On average, enterprises in the EU stated employee's heavy workload and time constraints as the third reason.

The involvement of companies in staff development activities is influenced to a degree by the **state**. The state stipulates, by means of legislation, certain obligations for companies, and uses policy instruments to encourage them to take better care of employees' development. These state policy measures in the CR only influence 21% of companies, whereas the EU average was 36%. It is apparent that the CR lags behind in the implementation of measures such as financial support for the training in companies, tax allowances, provisions to guarantee the quality of trainers, etc.

In terms of international comparison the differences in the proportions of companies that train their employees are also affected by the presence of **large enterprises**. Empirical surveys confirm that large firms pay more attention to their staff development. In the CR staff training activities were carried out by all companies employing 250 and more people, the EU average was 91%. Employees of small enterprises have the lowest chances of taking part in staff development schemes, as only 66% of these companies in the CR had such schemes. The EU average was even lower – 55%. There is a number of reasons for this, the most important ones include limited finance, difficulties fitting in for an absent employee during his/her training, and a limited scope of demand (number of employees to be trained) that makes the course price per employee higher. Another reason is that small companies often cannot employ a person who would systematically deal with staff development issues. Small companies must therefore rely, to a larger degree, on the commitment and efforts of individual employees.

In the CR as in other new member countries of the EU, **foreign owners** normally have a positive influence in that they bring in more systematic human resources policies that are common in their home countries. The influence of foreign

owners is, to a degree, intertwined with the influence of company size, as it is usually large companies that are owned by foreign capital.

The training of employees takes various **forms**, the most frequent one being vocational training courses. In the CR 63% of companies implemented this form of training, the EU average was 49%. The second most frequent mode of training is participation of employees in conferences, workshops, etc. There were 46% of companies in the CR that employed this mode of training. In the EU it was an average of 33% of companies. There is roughly the same level of intensity in implementing on the job training. On the contrary, relatively rare approaches include , self-directed learning, quality or learning circles and job rotation. The mode of training depends on the company's predominating business activities and professions.

Another factor that is important for the operation of an enterprise is the **proportion of employees** who receive training. In terms of the proportion of employees participating in courses in the total number of employees in all companies the CR ranks far above the EU average. In 2005 59% of employees took part in a training course in the CR, whereas the EU average was only 30%. This special position of the CR is the result of the scope of mandatory training..

Enterprises pay more attention to **training efficiency** and the number of paid working hours spent on continuing vocational training courses is decreasing. In 1999 one participant in the EU spent an average of 34 hours on courses, in 2005 it was only 29 hours. A similar trend can be seen in Czech companies, although it is not so intensive. The number of course hours dropped from 25 to 23 hours in the same period.

One factor that is important for improvement of competencies is the **field of training**. . However, most courses in the CR are focused on health and safety at work and on environmental protection. A total of 20% of total courses hours were concerned with these issues. Language courses accounted for 18% of all training courses hours. As distinct from this, the highest number of course hours in EU average terms was devoted to the personal development of staff including business knowledge and courses focused on manufacturing procedures. Courses dealing with each of these topics accounted for 16% of all courses hours.

The chances of employees to participate in training courses change depending on **age**. In the CR as in the EU on average, most course participants fall in the 25-54 age category (60% and 31% respectively). In the CR the chances of he youngest (up to 24) and the oldest (over 55) groups are about the same (54%), while in the EU more attention is paid to young people up to 24 (27%). The participation rate of various age groups depends on the return on investment in training as viewed from the perspective of both the enterprise and the individual. The company takes account of this factor in deciding on whether or not to offer a training opportunity to an employee, and the individual considers it in making a decision on whether or not to make use of this opportunity.

While in EU average terms men and women have nearly the same rate of participation in training courses (20% for men and 21% for women), in the CR there are considerable **gender inequalities** in favour of men. In 2005 there were 63% of men participating in courses provided by enterprises, while there were only 52% of women. There are various reasons for this. The main ones include the fact that women to a far lesser degree perform jobs where regular training is an obligation (drivers, welders, etc.), and jobs where training is provided more frequently.

Case studies in eleven innovative enterprises revealed that all selected companies show a high level of innovative activities. Emphasis is placed particularly on product and related technological innovation. The standards in this area are very high. Companies have recently taken an increasing interest in organisational and process innovation. However, even companies with above-average innovative efforts often have business structures that are rigid and do not make it possible to respond flexibility to changing market requirements. Marketing innovation can be viewed as a certain weakness. Communication with customers, identification of their needs and their interconnectedness with in-house development can be seen as a weak point in Czech companies over the long term.

All companies do implement staff development activities in one way or another. However, their standards differ considerably. It is only recently that enterprises have begun to address shortages of skilled workers with greater efforts, and many of them still do not have well-developed systems for human resources development. The growing demand for industrial products and the dynamic increase in revenues in many industries meant that human resources development issues were somewhat pushed aside. At a moment when companies tackle primarily the issue of satisfying the needs of their customers, the only HR issue on which they often concentrate is how to ensure that they get enough workers.

This will undoubtedly change in the following years. Demand for products manufactured by many companies will tend to stagnate or even decrease. This will mean that attention will be turned to increasing efficiency and productivity. The same will occur in the area of human resources – the diminishing supply of skilled workers will require that more emphasis be placed on human resources development strategies and policies and the competitiveness of companies will far more depend on these approaches.

References

Academic Ranking of World Universities 2007: ARWU 2007, online, 21. 7. 2008, Internet: http://ed.sjtu.edu.cn/ranking.htm

Braňka, J: Lidské zdroje a inovace. Working Paper NVF-NOZV 1/2008. Praha, 2008.

CEDEFOP: Future Skill Needs in Europe – Medium-term Forecast Sythesis Report, Luxembourg, Office for Official Publications of the European Communities, 2008, p. 91, ISBN 978-92-896-0500-7

CZECHINVEST: Investiční projekty agentury CzechInvest, CzechInvest 2008, online, 11.9.2008, Internet: http://www.czechinvest.org/podpora-investic

Czesaná, V., Havlíčková, V., Kofroňová, O., Matoušková, Z.: Case study Czech republic. In: Pathways to work: Current practices and future needs for the labour market integration of young people. Projekt YOUTH Final report, Annex 2., p. 253-263, 2008.

Czesaná, V., Kofroňová, O., Vymazal, J.: Vybrané faktory rozdílů v účasti na dalším vzdělávání: výsledky dotazníkového šetření. Working Paper NVF-NOZV č. 4/2006. Praha, NOZV-NVF 2006.

ČSÚ: Projekce obyvatelstva do roku 2050, střední varianta (online publication 4020-03). Praha, ČSÚ 2003 (a)

ČSÚ: CVTS 3, 2005 (individual data)

ČSÚ: Dotazník o odborném vzdělávání za rok 2005. Internal material of ČSÚ 2006 (a).

ČSÚ: Informační společnost v číslech 2008, ČSÚ 2008 (a).

ČSÚ: Inovace v ČR v roce 2005 (online publication 9605-06). ČSÚ 2006 (b).

ČSÚ: Klasifikace zaměstnání KZAM R, ČSÚ 2008 (b), online, 21. 7. 2008, Internet: http://www.czso.cz/csu/klasifik.nsf/i/klasifikace_zamestnani_(kzam_r)

ČSÚ: Metodika klasifikace ISCED, ČSÚ 2008 (c), online, 21. 7. 2008., Internet: http://www.czso.cz/csu/klasifik.nsf/i/mezinarodni_klasifikace_ve_vzdelani_(isced97)

ČSÚ: Odvětvová klasifikace ekonomických činností (OKEČ), ČSÚ 2008 (d), online, 21. 7. 2008, Internet: http://www.czso.cz/csu/klasifik.nsf/i/odvetvova_klasifikace_ekonomickych_cinnosti_(okec)

ČSÚ: Přechod do důchodu podle výsledků ad hoc modulu 2006 Výběrového šetření pracovních sil (online publication 3123-07). ČSÚ 2007 (a).

ČSÚ: LFS, 2nd quarter 2000 (individual data)

ČSÚ: LFS, 2nd quarter 2000-2007 (individual data)

ČSÚ: LFS, 2nd quarter 2002 (individual data)

ČSÚ: LFS, 2nd quarter 2003 (b), (individual data)

ČSÚ: LFS, 2nd quarter 2004 (individual data)

ČSÚ: LFS, 2nd quarter 2006 (c), (individual data)

ČSÚ: LFS, 2nd quarter 2007 (b), (individual data)

ČSÚ: LFS, annual averages 2007 (c), (individual data)

Deloitte: Eye to the Future, Deloitte 2006, online, 20.8.2008, Internet: http://www.deloitte.com/dtt/article/0,1002,cid%253D118520,00.html

Department of Trade and Industry: ELECTRONICS 2015 – Making a Visible Difference, UK - Department of Trade and Industry, 2004, online, 5.8.2008, Internet: http://www.berr.gov.uk/whatwedo/sectors/electronicsitservices/publications/electronics2015/page20099.html

EUROSTAT: Methodology for HRST, on-line, 5.8.2008, Internet: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/hrst_st_base_an1.pdf

EUROSTAT: EU Labour Force Survey Database, User guide. Luxembourg, EUROSTAT 2006 (a).

EUROSTAT: Information society statistic, 2007 (a), (online database)

EUROSTAT: LFS, 2nd quarter 2000 (a), (microdata)

EUROSTAT: LFS, 2nd quarter 2000-2005 (microdata)

EUROSTAT: LFS, 2nd quarter 2003 (a), (microdata)

EUROSTAT: LFS, 2nd quarter 2003-2005 (microdata)

EUROSTAT: LFS, 2nd quarter 2004 (microdata)

EUROSTAT: LFS, 2nd quarter 2005 (a), (microdata)

EUROSTAT: LFS, annual average 2006 (b), (microdata)

EUROSTAT: LFS, annual averages 2006-2007 (microdata)

EUROSTAT: LFS, annual averages 2007 (b), (microdata)

EUROSTAT: Main Tables, Population and social conditions 2006 (c), (online database)

EUROSTAT: Population and social conditions, CVTS 2, 1999 (online database)

EUROSTAT: Population and social conditions, CVTS 3, 2005 - provisional data (b), (online database)

EUROSTAT: Population and social conditions, Education and Training 1998 (online database)

EUROSTAT: Population and social conditions, Education and Training 2000 (b), (online database)

EUROSTAT: Population and social conditions, Education and Training 2005 (c), (online database)

EUROSTAT: Population and social conditions, Education and Training 2006 (d), (online database)

EUROSTAT: Population and social conditions, LFS, 2nd quarter 2007 (c), (online database)

EUROSTAT: Population and social conditions, LFS, annual averages 2000-2007 (online database)

EUROSTAT: Population and social conditions, LFS, annual averages 2003 (b), (online database)

EUROSTAT: Population and social conditions, LFS, annual averages 2007 (d), (online database)

EUROSTAT: Population and social conditions. Structure of earnings survey 2002 (a), (online database)

EUROSTAT: Statistic in focus 97/2007 Population and social conditions: The transition of woman and men from work to retirement. Luxembourg, Eurostat 2007.

EUROSTAT: Structural Business statistics 2002 (b) (online database)

EUROSTAT: Structural Business statistics 2006 (e) (online database)

EUROSTAT: Structural Indicators – Innovation and Research, 2007 (e), (online database)

Festová, J.: Nezaměstnanost absolventů škol se středním a vyšším odborným vzděláním - 2004. Praha, NÚOV 2004

Gartner: European Companies Set to Provide the Biggest Growth Engine for Offshore Outsourcing, Gartner 2006, online, 2.9.2008, Internet: http://www.gartner.com/it/page.jsp?id=492218

Chamoutová D., Burdová J.: Nezaměstnanost absolventů škol se středním a vyšším odborným vzděláním – 2007. Praha, NÚOV 2007

ILO Bureau of Statistics 2003: statistical data, on-line, 12.8.2008, Internet: http://laborsta.ilo.org/

Incoma Research: Shopping Center & Hypermarket 2008, research report, 2008

International Institute for Management Development: IMD World Competitiveness Yearbook 2007. Lausanne, IMD 2007.

Kelblová L. a kol.: Čeští žáci v mezinárodním srovnání. České školství ve světle dlouhodobě zjišťovaných výsledků vzdělávání v mezinárodních šetřeních. Praha, ÚIV 2006.

Kleňhová, M., Vojtěch, J.: Úspěšnost absolventů středních škol ve vysokoškolském studiu, předčasné odchody ze vzdělávání. Praha, NÚOV 2007

Kleňhová, M.: Vývoj a projekce počtu absolventů podle skupin oborů (2001-2013), background paper for NVF-NOZV 2008.

Lapáček, M., Havlíčková, V.: Projekce zaměstnanosti v odvětvích do roku 2020 pro Českou republiku, Working Paper NVF-NOZV č.4/2007, ISSN 1801-5476. NVF-NOZV 2008.

Matějů, P.: Překážky adaptace terciárního vzdělání v České republice na vývoj směrem ke znalostní společnosti, background paper for NVF, NVF 2005.

Michalička, L., Baštýř. I., Fischlová, D., Vavrečková, J.: Statistické analýzy vývoje počtu IT odborníků. Příjmové komparace informatiků v ČR a v zahraničí. Monitoring volných pracovních míst IT odborníků na českém trhu práce. Svazek III., VUPSV 2006

Michalička, L., Kotíková, J., Stupnytskyy O.: Prognózování vzdělanostních potřeb na období 2007 až 2011. Working paper for project 1J020/04-DP1 Knowledge Society - Requirements on Human Resources Skills and Continuing Training, Praha, VÚPSV 2007.

MINISTERSTVO PRŮMYSLU A OBCHODU: Panorama zpracovatelského průmyslu a souvisejících služeb, Ministerstvo průmyslu a obchodu 2007

Warwick Institute fo Economic Research: Multi Sector Skill Study: Electronics Industry – Warwick Institute for Economic Research 2006, online, 12.9.2008, Internet: http://www.berr.gov.uk/files/file28948.pdf

NOZV, ČOK: Budoucí potřeba kvalifikované práce v elektrotechnickém průmyslu v období 2008-2020. NVF-NOZV 2008.

NOZV, VÚPSV: Projekce kvalifikačních potřeb na období 2008-12 as a part of project 1J020/04-DP1 Knowledge Society - Requirements on Human Resources Skills and Continuing Training, Praha, NVF-NOZV, VÚPSV 2008.

NOZV: Nerovnosti v přístupu ke vzdělávání II. Questionnaire survey as a part of project 1J005/04-DP2 Unequal access to education: the extent, sources, social and economic consequences, policy strategies, Praha, NOZV and Universitas 2007

NUOV: online, 25.7.2008, http://www.univ.nuov.cz/

OECD: Canberra Manual, Paris, 1995, on-line, 5.8.2008, Internet: http://www.oecd.org/LongAbstract/0,3425,en_2825_500777_2096007_119669_1_1_1,00.html

OECD: Education at a Glance 2007, ISBN 9789264032880, OECD 2007 (a).

OECD: Knowledge and Skills for Life: First Results from PISA 2000. OECD 2001 (a), publication on-line, 15.9.2008, Internet: http://www.pisa.oecd.org/dataoecd/44/53/33691596.pdf

OECD: Learning for Tomorrow's World – First Results from PISA 2003. OECD 2004 (a), publication on-line, 15.9.2008, Internet: http://www.pisa.oecd.org/dataoecd/1/60/34002216.pdf

OECD: PISA 2000: online database, OECD 2001 (b), online, 7. 8. 2008, Internet: http://pisa2000.acer.edu.au/index.php

OECD: PISA 2003: online database, OECD 2004 (b), online, 7. 8. 2008, Internet: http://pisa2003.acer.edu.au/index.php

OECD: PISA 2006: online database, OECD 2007 (b), online, 7. 8. 2008, Internet: http://pisa2006.acer.edu.au/

OECD: PISA 2006: Science Competencies for Tomorrow´s World. Volume 1: Analysis. Volume 2: Data. OECD 2007 (c), publication on-line, 15.9.2008, Internet: http://www.oecd.org/document/2/0,3343,en_32252351_32236191_39718850_1_1_1_1,00.html

Palečková J., Tomášek. V.: Učení pro zítřek. Výsledky výzkumu PISA 2003. Praha, ÚIV 2005.

Palečková, J. a kol.: Hlavní zjištění výzkumu PISA 2006. Poradí si žáci s přírodními vědami? Praha, ÚIV 2007.

Roland Berger Strategy Consultants: CEE 2016 – Vize top manažerů, 2007

U.S. Department of Labor: Career Guide to the Industry: Computer and Electronic Product Manufacturing, U.S. Department of Labor, 2005, online, 25.8, Internet: http://www.bls.gov/oco/cg/cgs010.htm

ÚIV: Motivace, aspirace, učení II: Hodnocení úrovně vzdělávání v ČR s ohledem na krajovou diferenciaci. Praha, ÚIV 2007 (a).

ÚIV: Motivace, aspirace, učení: Hodnocení úrovně vzdělávání v ČR s ohledem na krajovou diferenciaci. Praha, ÚIV 2006 (a).

ÚIV: Statistická ročenka školství. Výkonové ukazatele 2002/3. Praha, ÚIV 2004.

ÚIV: Statistická ročenka školství. Výkonové ukazatele 2005/6. Praha, ÚIV 2006 (b).

ÚIV: Statistická ročenka školství. Výkonové ukazatele 2006/7. Praha, ÚIV 2007 (b).

ÚIV: Statistická ročenka školství. Výkonové ukazatele 2007/8. Praha, ÚIV 2008.

ÚIV: Vývojová ročenka školství 2001/02-2006/07. Praha, ÚIV 2007 (c).

Úlovcová, H., Bubíková, M., Viceníková, T., Hyťha, P.: Předčasné odchody mladých lidí ze středního vzdělávání. Praha, NÚOV 2006

UNESCO , Institute for statistics: http://stats.uis.unesco.org/ (online database - 25. 4. 2008), indicator Gross enrolment ratio, UNESCO 2008

Vitásková, A.: Připravenost akademických pracovníků českého vysokého školství na měnící se nároky v oblasti vývoje a výzkumu: Analýza faktorů ovlivňujících vědeckovýzkumnou produktivitu akademických pracovníků, Praha, NVF 2006

Vořišek, J., Doucek, P., Novotný, O., Pecáková, I.: Lidské zdroje v ICT. Analýza nabídky a poptávky po IT odbornících v ČR — 2007, VŠE 2007

Zákon 96/2004 Sb. o nelékařských zdravotnických povoláních