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SECTORAL ACTIVITIES PROGRAMME

Working Paper

Vocational education and training in the chemical industry in Germany and the United Kingdom

Steffen A. Rogalski

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Preface

The chemical industry is a key industry for development. Some figures may show the scale of the industry. Fifteen European Union Member States sold €586 billion in 2004, with Asia following closely with €506 billion. Today, about 14 million workers are estimated to be employed in the chemical industry around the world. The European chemical industry is estimated to account for more than 10 per cent of world employment in the industry.

Since 2000, the European Union (EU) has endeavoured to become "the most competitive and dynamic knowledge-driven economy by 2010", a goal articulated in the Lisbon Agenda. The urgency of this task is illustrated by differentials between the EU and the United States. The EU's annual real growth in GDP has been consistently outpaced by the United States throughout 1990s. Average EU growth between 1992 and 2002 was 2 per cent, compared to 3.2 per cent in the United States. Research and development (R&D) spending in the EU (1.9 per cent of GDP in 2000) remains far below that of the United States (2.7 per cent). High technology products were 20 per cent of total exports from the EU in 2001, compared to about 30 per cent in the United States. The core objective of the Lisbon Agenda is to increase R&D investment and improve workers' vocational education and training (VET).

The chemical industry is dependent on continual innovation. The proportion of chemical industry sales devoted to R&D in European decreased in 2002, to 1.9 per cent, down from 2.4 per cent in 1995, which in turn depends, as noted above, on talented human capital. Since 1996, the numbers of chemistry graduates in the European chemical industry have fallen by about 10 per cent each year. Not only have the number of young people seeking chemistry degrees dropped, but more of those completing chemical science degrees are seeking careers outside the sector. This paper explores the preconditions and structures involved in supporting the entry of young people into the chemical industry, and keeping their skills current throughout their careers.

The author of this paper is Dr. Steffen A. Rogalski, with the aid of research assistant Simon Dicke. They are employees of the skills and training consulting firm, Qualifizierungsförderwerk Chemie (QFC) GmbH in Germany. They are to be congratulated for their work and the contributions to making a greater understating of the kinds of policies which could lead to the improvement of VET and social dialogue in the chemical industry in Germany, the United Kingdom, and Europe. The ILO hopes that this paper will provide an opportunity to consider how vocational education and training in the chemical industry can be improved in line with the ILO's Decent Work Agenda.

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The conclusions of the Tripartite Sectoral Meeting on Best Practices in Work Flexibility Schemes and their Impact on the Quality of Working Life in the Chemical Industries in Geneva, 2003 direct the International Labour Office (ILO) to identify best practices of vocational education and training (VET) programmes that can help companies keep pace with economic and technological change. This study aims to identify good practices in VET in the chemical industry that illustrate the essential educational and training elements that boost worker employability and capacity to deal with technological advances. This study focuses on practices and policies in Germany and the United Kingdom, with some examples from other European countries.

Keeping up with technological change and creating innovation are the keys to success in the chemical industry. This means that VET should be responsive to the challenges of globalization, but also should enhance the research and development (R&D) capacities of the industry. This allows companies to stay competitive in a rapidly changing marketplace.

According to the European Commission in its review of the Lisbon Agenda (2004b), there is overwhelming evidence that R&D investments promote labour productivity and support innovation. VET is an effective tool to address unemployment amongst young workers and to retrain older workers to keep up in a fast changing industry. However, VET alone cannot resolve all social and labour problems in our society.

Some case studies demonstrate that R&D results in bringing innovative products to the market, leading to company growth and maintaining or increasing employment in the industry (Kinkel et al., 2004). As investments in both R&D and VET improve economic prospects for chemical firms, they can also enhance their value in national and regional economies. Edelgard Bulmahn, German Minister of Education and Research, observed the following at the German-British Forum in London in October 2004:

> In the whole world, countries with the largest investment in qualifications, research and development have succeeded the highest economic growth. These countries are Sweden, Finland and the United States, for example. (Bulmahn 2004, part II of the speech.)

Therefore, the issues discussed in this paper include:

- whether VET programmes are designed to meet the demands of innovation;
- what conditions are needed for sustainable VET; and
- how VET can become a part of workers' lives to keep them working in the chemical industry.

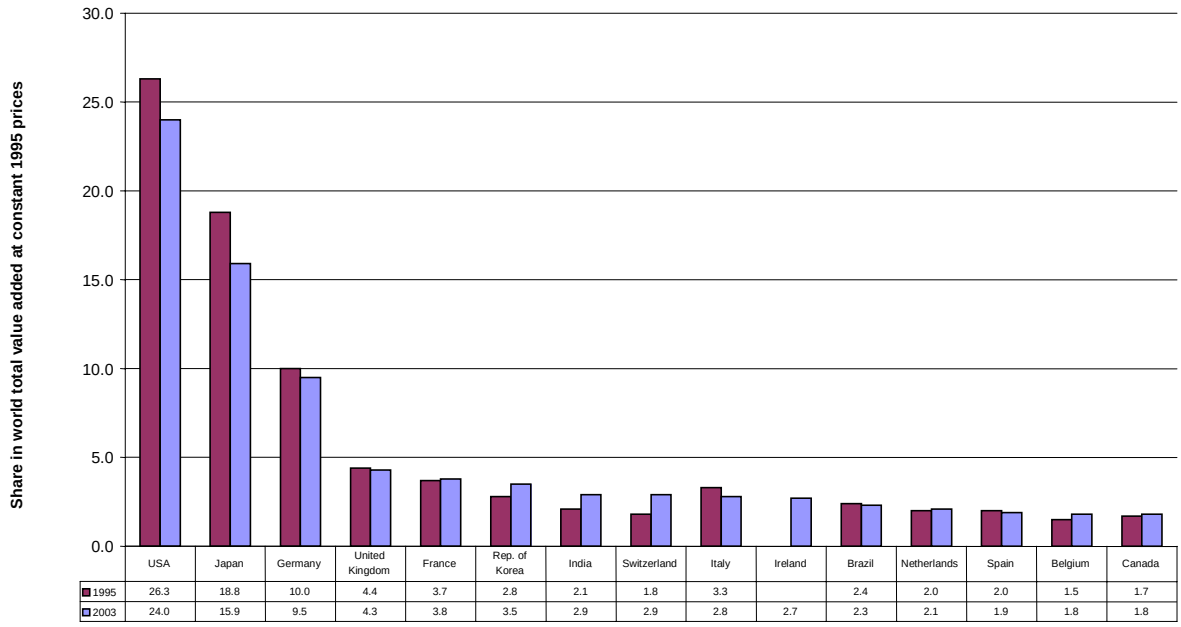
1. European chemical industry

1.1. European chemical industry today

According to the *International Yearbook of Industrial Statistics*, 2005 (figure 1.1), 15 chemical producing countries accounted for 84.2 per cent of world chemical production in 1993. This figure has remained constant over time, with only a 2 per cent decrease to 82.2 per cent in 2003.

Between 1995 and 2003, the top five world chemical producers also remained unchanged. They were the United States, Japan, Germany, the United Kingdom, and France. The United States alone accounted for about one-quarter of world chemical production (26.3 per cent in 1995; 24.0 per cent in 2003). Seven EU Member States (in order of production volume: Germany, France, Italy, Ireland, the Netherlands, Spain, and Belgium) accounted for 28.9 per cent of world chemical production (figure 1.1).

Figure 1.1. World leading chemical producers in 1995 and 2003

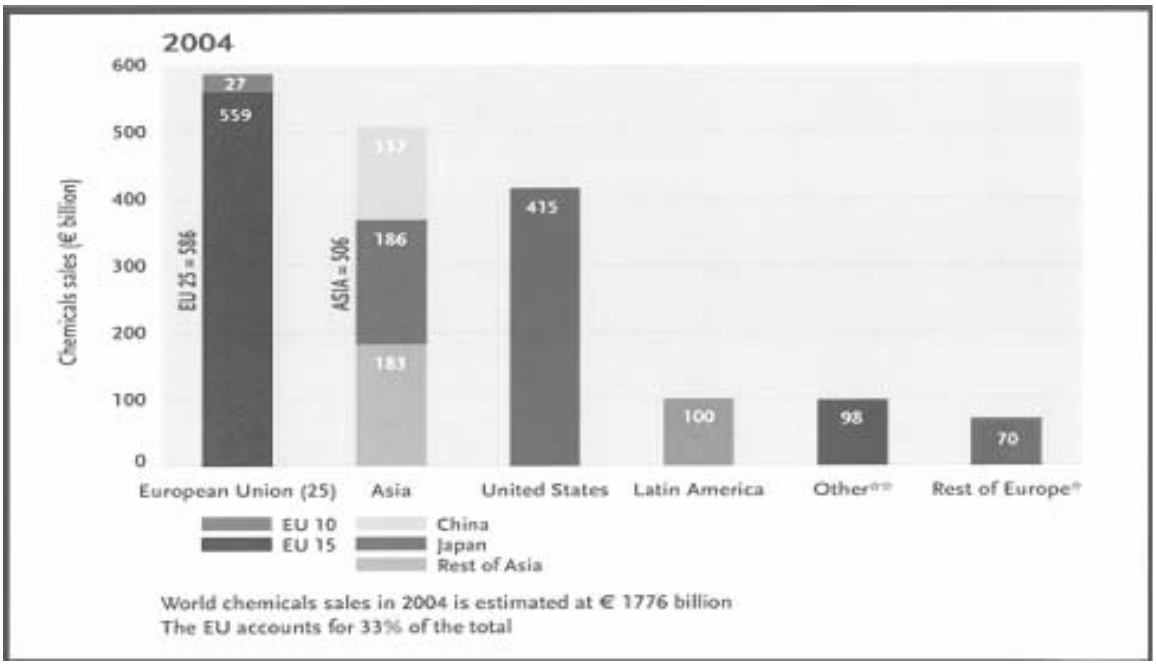


	USA	Japan	Germany	United Kingdom	France	Rep. of Korea	India	Switzerland	Italy	Ireland	Brazil	Netherlands	Spain	Belgium	Canada
1995	26.3	18.8	10.0	4.4	3.7	2.8	2.1	1.8	3.3		2.4	2.0	2.0	1.5	1.7
2003	24.0	15.9	9.5	4.3	3.8	3.5	2.9	2.9	2.8	2.7	2.3	2.1	1.9	1.8	1.8

Source: United Nations Industrial Development Organization (UNIDO): *International Yearbook of Industrial Statistics*, p. 64.

Another figure demonstrates the scale of the European chemical industry. Figure 1.2 shows the geographic breakdown of world chemical sales in 2004. The chemical industry in 25 European Union (EU) Member States generated €586 billion in 2004. This is €80 billion more than Asia's gross sales, and 171 billion more than US sales.

Figure 1.2. Geographic breakdown of the world chemical sales, 2004



Definition: Rest of Europe* = Switzerland, Norway and other Central and Eastern Europe (excluding the new EU ten countries); Other** = including Canada, Mexico, Africa and Oceania.

Source: American Chemistry Council (ACC) and European Chemical Industry Council (CEFIC).

The strength of the European chemical industry lies in its high value added. As table 1.1 shows, manufacturing of basic chemicals and manufacturing of plastic products (25.2) accounted for roughly one-third of the value added of the chemical industry in the EU in 2001. By contrast, the manufacture of man-made fibres (24.7) and of pesticides and other agro-chemical products (24.2) are marginal in terms of value added in the EU, with a share of 1-2 per cent each. Germany was the largest contributor to the total value added in the EU production of basic chemicals, due to its specialization in this area. France was the main contributor to value added for pesticides and other agrochemicals (24.2) and soap, detergents, cleaning polishing (24.5).

Table 1.1. Employment and value added of European chemical industry, 2001

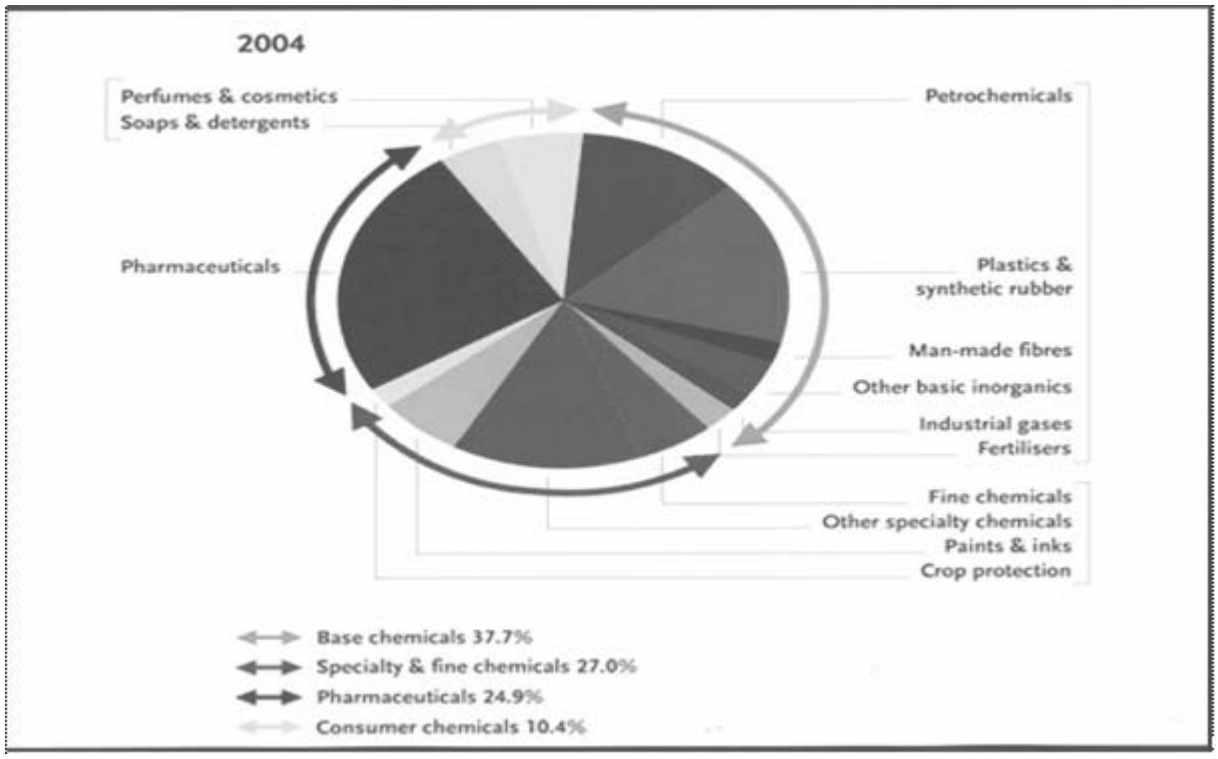
	Employment at EU level	Employment at EU level (share in %)	Value added at EU level (in billion EUR)	Value added at EU level (share in %)	Main contributor to value added	Member State where sector is:	
						Most important	Least important
Chemicals and chemical products (24 excluding 24.4) of which:	1 342 000	45%	107.6	60%	Germany	Ireland	Malta
Basic chemicals (24.1)	642 000	21%	59.7	33%	Germany	Ireland	Malta
Pesticides, other agro-chemical products (24.2)	23 000	1%	2.4	1%	France	France	Ireland
Paints, vanishes, printing ink and mastics (24.3)	177 000	6%	11.5	6%	Germany	Germany	Latvia
Soap, detergents, cleaning, polishing (24.5)	261 000	9%	16.9	9%	France	Poland	Finland
Other chemical products (24.6)	188 000	6%	14.0	8%	Germany	Netherlands	Latvia

	Employment at EU level	Employment at EU level (share in %)	Value added at EU level (in billion EUR)	Value added at EU level (share in %)	Main contributor to value added	Member State where sector is:	
						Most important	Least important
Man-made fibres (24.7)	52 000	2%	3.1	2%	Germany	Slovakia	Malta
Rubber and plastic products (25) of which:	1 647 000	55%	71.6	40%	Germany	Latvia	Ireland
Rubber products (25.1)	359 000	12%	16.2	9%	Germany	Latvia	Latvia
Plastic products (25.2)	1 288 000	43%	55.3	31%	Germany	Latvia	Ireland
Chemical industry (24 + 25; excluding 24.4)	2 990 000	100%	179.0	100%			
Manufacturing (section D)	34 249 000	–	1536	–			
Share of chemical industry in manufacturing (D)	8.70%	–	11.70%	–			

Source: Eurostat (Structural Business Statistics – SBS).

Another explanation for the strength of the European chemical industry can be found in the structure of sales, as shown in figure 3. High profit sectors such as pharmaceuticals and the specialty and fine chemicals sectors accounted for 51.9 per cent of overall sales. Highly profitable sectors compensate for losses in less profitable sectors.

Figure 1.3. Sectoral breakdown of EU chemical industry sales, 2004



Source: European Chemical Industry Council (CEFIC).

1.2. Competitive pressures on the industry

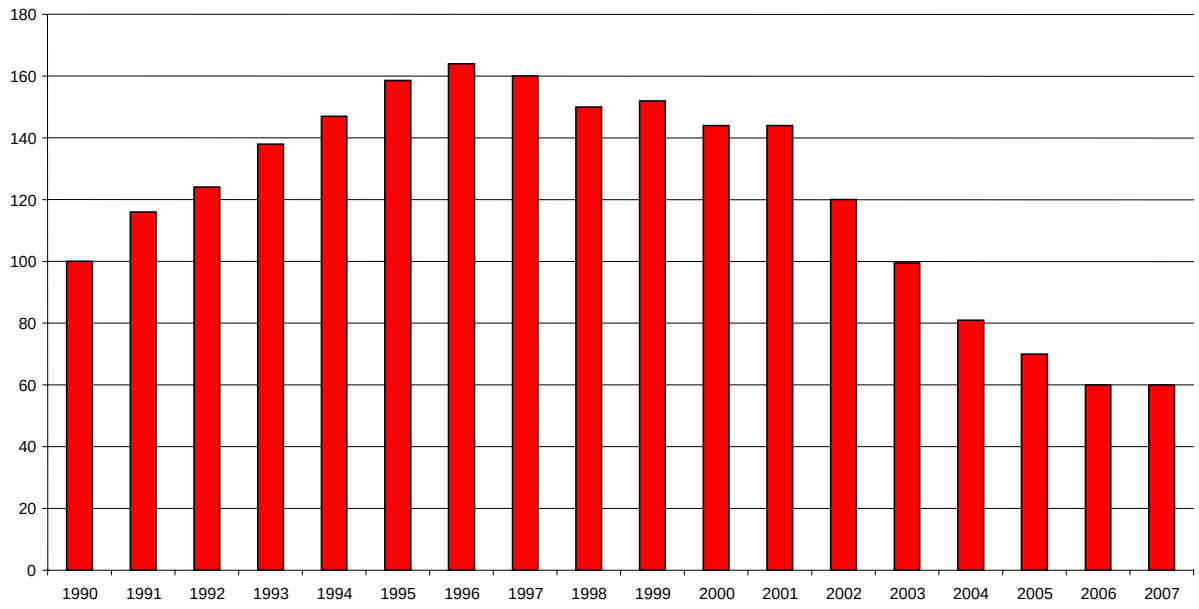
The chemical industry faces constant pressure to increase its competitiveness. A German study documented growing pressure on the chemical industry due to declining prices of chemical products, increasing imports, the emergence of new markets, decreasing productivity, and increasing demands on R&D investment. Globalization also has increased competition among chemical firms worldwide for the best talent in the marketplace. Success in the chemical industry is directly linked to how chemical firms increase productivity and pursue innovation. The study stressed the need to raise public awareness about the chemical industry, and called on public and political institutions to work together to improve VET in the area of chemical education and to reduce the social and economic obstacles that hamper innovation (ZEW/NIW, 2005).

Workers also are challenged to continually improve their skills so they can remain competitive in fast-moving labour market. Historian Paul Kennedy, in his 1994 book "Preparing for the Twenty-First Century" observed that major innovations in production will produce new economic developments and the need for higher and better qualifications will increase accordingly.

1.3. Shortage of chemical engineers

In 2004, the European Chemical Industry Council (CEFIC) study, "Horizon 2015", concluded that there are not enough chemistry undergraduates to sustain future developments in the European chemical industry. As shown in figure 1.4, the number of chemistry graduates in major European countries has fallen by about 10 per cent per year since 1996. The CEFIC predicts that the number of chemical and industrial chemicals graduates will drop to about 60 per cent of that in 1990, a trend they are concerned may continue.

Figure 1.4. Chemical and industrial chemicals graduates in major EU countries, 1990-2007 (Index: 1990=100)



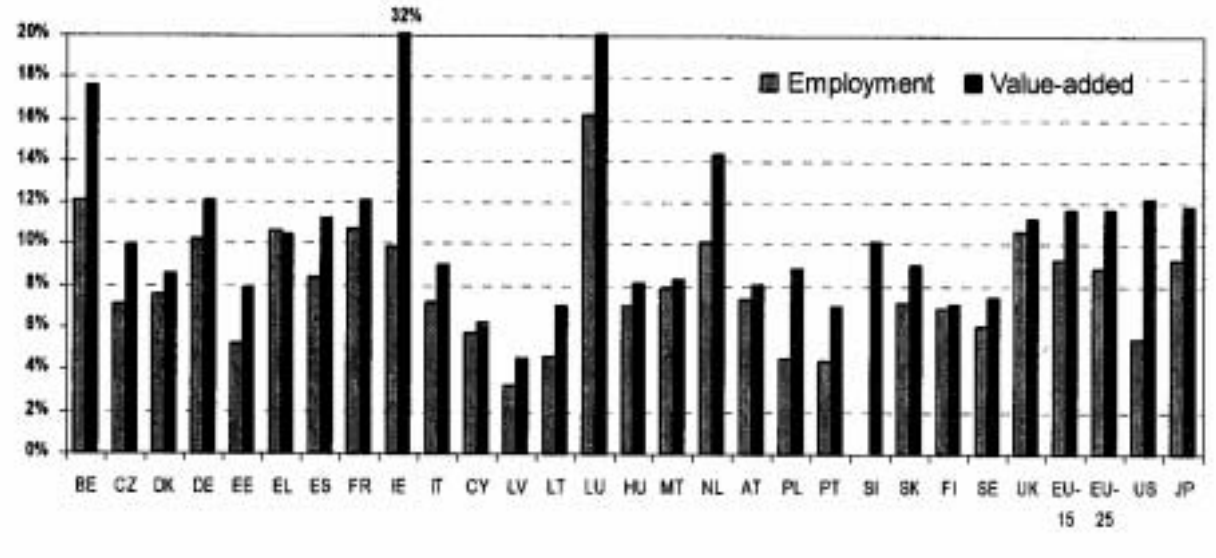
Source: European Chemical Industry Council (CEFIC).

1.4. Workforce characteristics of the European chemical industry

1.4.1. Overall employment

The current composition of workforce gives an indication of what VET will be needed to meet future challenges in the chemical industry. In 2001, nearly 3 million workers were employed in the European chemical industry, according to Eurostat's Structural Business Statistics (SBS). This represents almost 9 per cent of the total number employed in the manufacturing industry, a larger proportion than in the United States (5.5 per cent), but slightly smaller than those in Japan (9.3 per cent). In 2001, the European chemical industry generated €179 billion, a share of just under 12 per cent of the total manufacturing industry. The higher share of value added in the EU is due to the relatively high level of productivity per person employed. Figure 1.5 shows a correlation between employment and value added in EU Member States.

Figure 1.5. Employment and value added in the chemical industry in EU Member States and the United States and Japan, 2001, as a percentage of manufacturing (NACE, Rev. 1, section D)



Source: Eurostat.

The majority (55 per cent) of workers in the European chemical industry are working in the manufacture of rubber and plastic products, which are highly labour intensive sectors. As turnover and value added are high in the large chemical producing countries, they account for the highest employment in absolute terms. The following table shows that 26 per cent of all workers employed in the EU chemical industry are in Germany, followed by France and the United Kingdom with 14.6 per cent each. Over 80 per cent of the chemical industry workers in Luxembourg and Malta are employed in the manufacture of rubber and plastic products. In all other Member States, workers are almost equally spread between the manufacture of chemicals and chemical products (see table 1.2).

Table 1.2. Turnover, value added, employment and apparent labour productivity in the chemical industry in the EU, 2001

Turnover – in million EUR	Belgium	Czech Republic	Denmark	Germany	Estonia	Greece	Spain	France	Ireland	Italy	Cyprus	Latvia	Lithuania	Luxem-bourg	Hungary	Malta	Nether-lands	Austria	Poland	Portugal	Slovenia	Slovakia	Finland	Sweden	United Kingdom	EU-16	EU-25
Chemical industry	31 787	6 510	5 866	170 686	352	2 531	44 350	109 276	22 237	80 294	171	154	564	1 730	4 310	122	37 916	9 618	11 867	4 904	1 881	1 796	6 866	10 596	86 288	624 941	663 691
Share in total EU-25 chemical industries (%)	4.9	1.0	0.9	26.1	0.1	0.4	6.8	16.7	3.4	12.3	0.0	0.0	0.1	0.3	0.7	0.0	5.8	1.5	1.8	0.8	0.3	1.1	1.6	13.2	95.6	100.0	
Chemicals and chemical products (24 excluding 24.4)	24 025	3 177	2 806	114 053	213	1 638	27 801	72 443	21 003	46 908	95	89	281	640	2 304	32	31 795	5 002	6 828	2 755	905	1 020	4 458	7 076	54 285	416 685	432 122
Share in total chemical industry (%)	76	49	48	67	60	65	63	66	94	58	56	58	50	37	53	26	84	52	58	56	48	57	65	67	63	67	66
Rubber and plastic products (25)	7 763	3 333	3 060	56 632	140	893	16 549	36 833	1 234	33 386	75	65	283	1 090	2 006	90	3 121	4 616	5 039	2 148	976	776	2 408	3 520	32 003	208 256	221 569
Share in total chemical industry (%)	24	51	52	33	40	35	37	34	6	42	44	42	50	63	47	74	16	48	42	44	52	43	35	33	37	33	34
Value added at factor cost – in million EUR																											
Chemical industry	6 494	1 453	2 014	50 088	43	731	11 724	25 024	10 171	18 342	58	61	96	453	947	61	7 766	2 891	5 176	1 266	409	365	2 208	3 090	25 688	169 843	178 976
Share in total EU-25 chemical industries (%)	3.7	0.8	1.1	28.4	0.0	0.4	6.6	14.2	5.8	10.4	0.0	0.0	0.1	0.3	0.5	0.0	4.3	1.6	2.9	0.7	0.2	0.2	1.3	1.7	14.5	96.2	100.0
Chemicals and chemical products (24 excluding 24.4)	4 558	689	740	30 804	10	435	6 704	14 392	9 703	8 819	28	30	45	97	490	10	5 776	1 339	2 644	623	184	188	1 227	1 893	13 707	102 719	107 515
Share in total chemical industry (%)	70	47	37	61	24	60	57	58	95	48	49	50	47	21	52	16	74	46	51	49	45	53	56	61	53	60	60
Rubber and plastic products (25)	1 936	764	1 275	19 285	33	296	5 021	10 631	468	9 524	30	30	51	356	457	51	1980	1 552	2 531	643	225	165	980	1 197	11 981	67 124	71 461
Share in total chemical industry (%)	30	53	63	39	76	40	43	42	5	52	51	50	53	79	48	84	26	54	49	51	55	47	44	39	47	40	40
Number of workers employed																											
Chemical industry	70 323	96 858	34 232	768 881	4 685	18 270	223 423	435 105	21 190	348 610	2 140	4 499	10 403	4 912	53 754	2 390	94 089	46 196	185 830	40 543		30 451	30 260	48 768	414 371	2 618 523	2 990 183
Share in total EU-25 chemical industries (%)	2.4	3.2	1.1	25.7	0.2	0.6	7.5	14.6	0.7	11.7	0.1	0.2	0.3	0.2	1.8	0.1	3.1	1.5	6.2	1.4		1.0	1.0	1.6	13.9	87.6	100.0
Chemicals and chemical products (24 excluding 24.4)	40 305	34 235	10 090	376 182	1 379	8 844	100 950	192 263	11 589	138 476	922	2 061	3 865	892	20 701	382	56 770	16 483	78 082	15 625		15 657	12 713	22 575	181 706	1 204 813	132 747

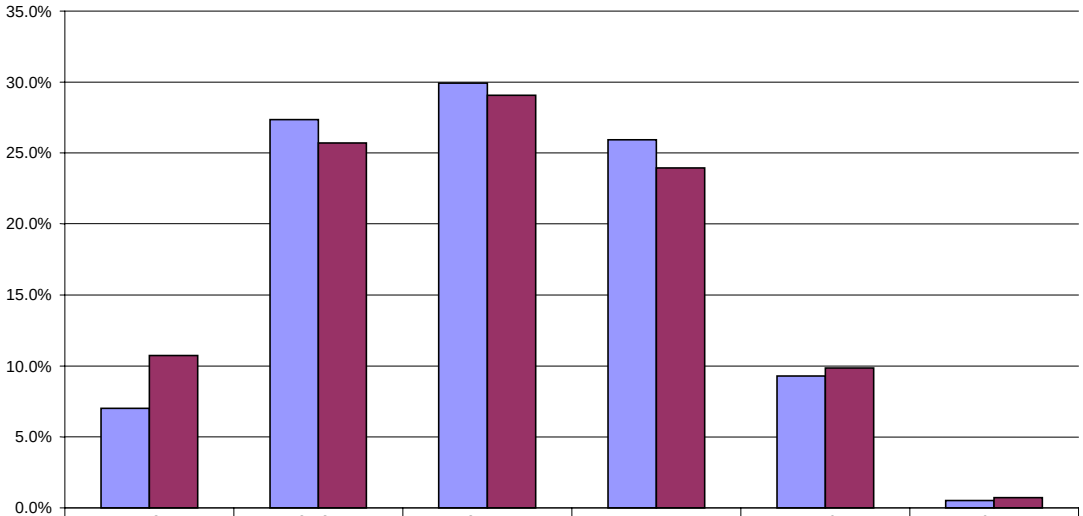
Turnover – in million EUR	Belgium	Czech Republic	Denmark	Germany	Estonia	Greece	Spain	France	Ireland	Italy	Cyprus	Latvia	Lithuania	Luxem-bourg	Hungary	Malta	Nether-lands	Austria	Poland	Portugal	Slovenia	Slovakia	Finland	Sweden	United Kingdom	EU-16	EU-25
Share in total chemical industry (%)	57	35	29	49	29	48	45	44	55	40	43	46	37	18	39	16	60	36	42	39		51	42	46	44	46	45
Rubber and plastic products (25)	30 018	62 623	24 142	392 699	3 306	9 426	122 473	242 842	9 601	210 134	1 218	2 438	6 538	4 020	33 053	2 008	37 391	29 713	107 748	24 918		14 794	1 7547	26 193	232 665	1 413 710	1 647 436
Share in total chemical industry (%)	43	65	71	51	71	52	55	56	45	60	57	54	63	82	61	84	40	64	58	61		49	58	54	56	54	55
Apparent labour productivity (value added per person) in EUR 1,000																											
Chemical industry	92.3	15.0	58.8	65.1	9.2	40.0	52.5	57.5	480.0	52.6	27.0	13.4	9.2	92.2	17.6	25.5	82.4	62.6	27.8	31.2		11.6	73.0	63.4	62.0	64.9	59.9
Chemicals and chemical products (24 excluding 24.4)	113.1	20.1	73.3	81.9	7.3	49.2	66.4	74.9	837.3	63.7	30.6	14.7	11.7	109.1	23.7	25.9	101.8	81.2	33.9	39.9		12.0	96.5	83.9	75.4	85.3	78.2
Rubber and plastic products (25)	64.5	12.2	52.8	49.1	9.9	31.4	41.0	43.8	48.7	45.3	24.3	12.4	7.7	88.5	13.8	25.4	53.1	52.2	23.5	25.8		11.2	55.9	45.7	51.5	47.5	43.2

Source: Eurostat (Structural Business Statistics – SBS).

The following figures and analyses will address EU chemical industry characteristics by age, skills, education, job type, and percentage of knowledge workers.

1.4.2. Workforce by age group

Figure 1.6. Workforce by age group in the European chemical industry in comparison with the total manufacturing industry, 2004



	15-24	25-34	35-44	45-54	55-64	65+
NACE 24	7.0%	27.4%	29.9%	25.9%	9.3%	0.5%
Total industry	10.7%	25.7%	29.1%	23.9%	9.9%	0.7%

Note: Data for the Netherlands are excluded.

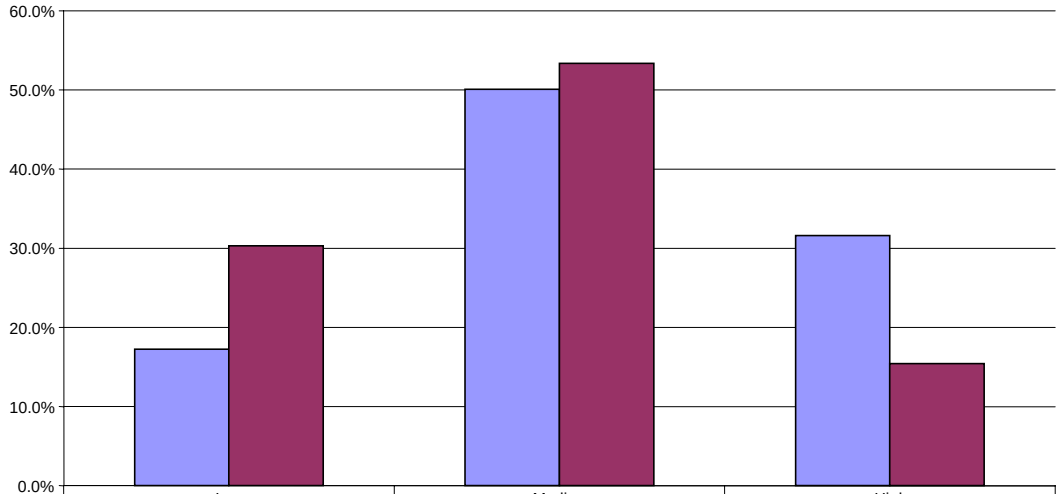
Source: EU Labour Force Survey, 1995-2005, EUROSTAT.

Significance:

- With respect to worker age distribution, the composition of the workforce in the European chemical industry is similar to that of the total manufacturing industry in Europe.
- The majority of workers are between 35 years old and 54 years old.
- There are slightly fewer workers in the European chemical industry over age 55 than in the total manufacturing industry.
- The proportion of young workers under 25 years old in the European chemical industry is less than that of the total manufacturing industry due to reductions in the number of young apprentices entering into the chemical industry. However, there are more workers between 25 years old and 34 years old because the chemical industry generally needs workers with a higher level of qualifications than the manufacturing industry.

1.4.3. Workforce by skills

Figure 1.7. Workforce by education in the European chemical industry in comparison with the total manufacturing industry, 2004



	Low	Medium	High
Chemicals industry	17.2%	50.1%	31.6%
Total industry	30.3%	53.3%	15.4%

Note: Data for the Netherlands are excluded.

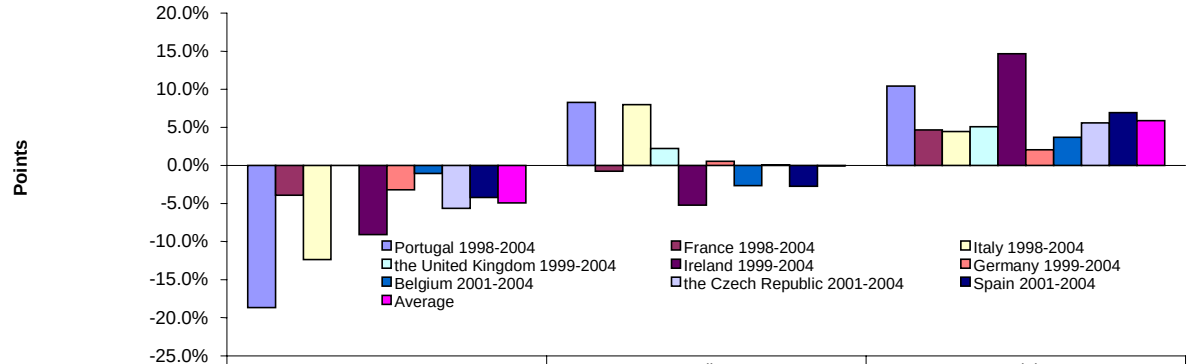
Source: EU Labour Force Survey, 1995-2005, EUROSTAT.

Significance:

- About half (50.1 per cent) of the workforce in the European chemical industry has attained a medium level of education (ISCED 3 or 4, i.e. upper secondary or post-secondary non-tertiary education).
- Nearly one-third of workers in the manufacture of chemicals and chemicals products have a tertiary education (ISCED 5 or 6), compared to 15.4 per cent in the total manufacturing industry.
- The proportion of workers with certificates of lower secondary education is low in the European chemical industry (17.2 per cent, compared to 30.3 per cent in the total industry). This reflects the fact that the chemical industry does not need many low-skilled workers due to the introduction of innovative production technology and automation.

1.4.4. Workforce by education

Figure 1.8. Variation of workforce by education level in the European chemical industry in selected countries and in selected years



	Low	Medium	High
Portugal 1998-2004	-18.7%	8.3%	10.4%
France 1998-2004	-3.9%	-0.7%	4.6%
Italy 1998-2004	-12.4%	8.0%	4.4%
the United Kingdom 1999-2004	0.0%	2.2%	5.1%
Ireland 1999-2004	-9.1%	-5.2%	14.6%
Germany 1999-2004	-3.2%	0.5%	2.0%
Belgium 2001-2004	-1.0%	-2.6%	3.7%
the Czech Republic 2001-2004	-5.7%	0.1%	5.6%
Spain 2001-2004	-4.2%	-2.7%	6.9%
Average	-4.9%	-0.1%	5.9%

Source: EU Labour Force Survey, 1995-2005, EUROSTAT.

Significance:

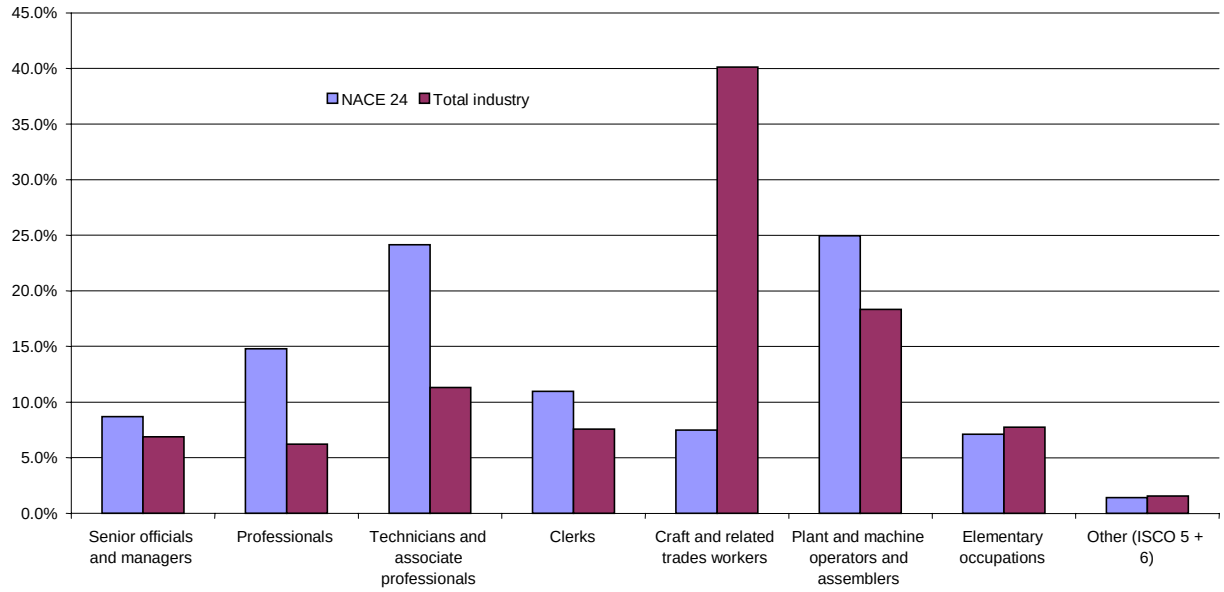
- In all countries included in the above figure, the share of workers with higher levels of education increased by 2.3 per cent between 1999 and 2004. During the same period, Ireland marked a dramatic increase of 14.6 per cent.
- The share of workers with a low level of education has decreased in the European chemical industry, particularly in Italy and Portugal (-12.4 per cent and -18.7 per cent, respectively).
- The percentage of workers with a medium level of education has remained almost unchanged, although this varies widely by country (a 5.4 per cent decrease in Ireland, but an 8.3 per cent increase in Portugal, for example).

1.4.5. Workforce by job type

The European chemical industry workforce is dominated by two major occupations listed in the International Standard Classification (ISCO): plant and machine operators and assemblers (ISCO 8, 24.9 per cent), and technicians and associate professionals (ISCO 3, 24.1 per cent). The remaining half of the workforce in the European chemical industry consists of:

Professionals (ISCO 2)	14.8 per cent
Clerks (ISCO 4)	11.0 per cent
Senior officials and managers (ISCO 1)	8.7 per cent
Craft and related trades workers (ISCO 7)	7.5 per cent
Elementary occupations (ISCO 9)	7.1 per cent

Figure 1.9. Workforce by occupation in the European chemical industry in comparison with the total manufacturing industry, 2004



Note: Data for the Netherlands are excluded.

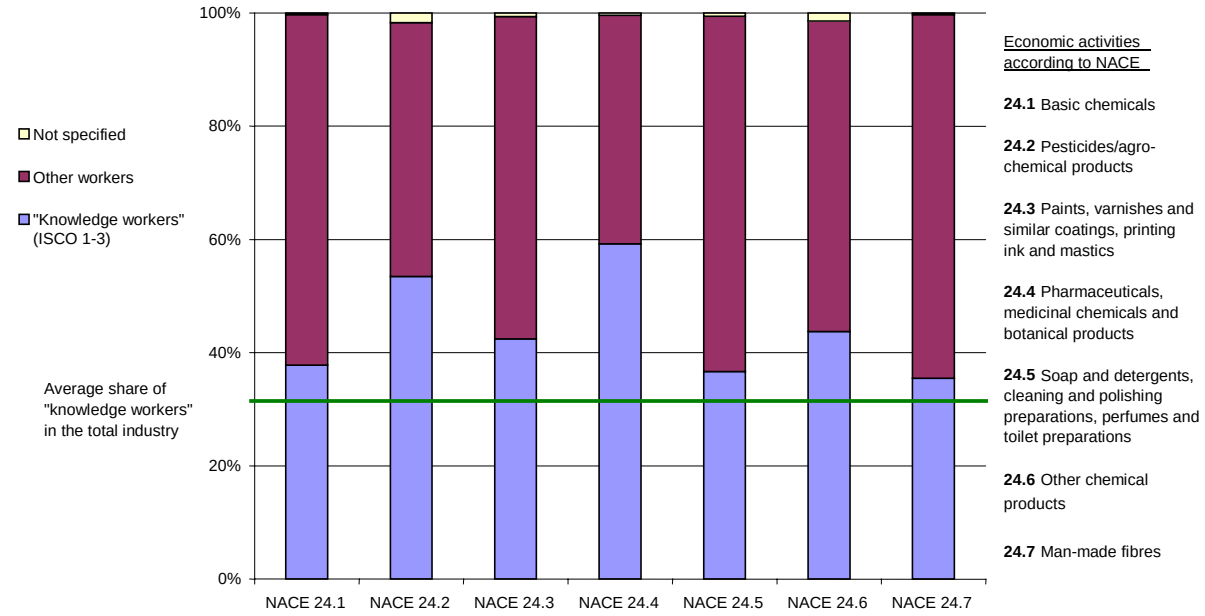
Source: EU Labour Force Survey, 1995-2005, EUROSTAT.

Significance:

- "Knowledge workers" (ISCO 1-3) – managers, professionals, and associate professionals – have increased in the European chemical industry to account for 47.6 per cent of the workforce, compared to 24.4 per cent in the total manufacturing industry.

1.4.6. Knowledge workers

Figure 1.10. Share of "knowledge workers" by sector in the European chemical industry, 2005



Note: Data for the Netherlands are excluded.

Source: EU Labour Force Survey, 1995-2005, EUROSTAT.

Knowledge workers dominate in the manufacture of pharmaceuticals, medicinal chemicals and botanical products (NACE 24.4), at 59.2 per cent of the entire workforce. They constitute 54.5 per cent of the workforce in the manufacture of pesticides and other agro-chemical products (NACE 24.2), 35.4 per cent of workers in the manufacture of man-made fibres (NACE 24.7), and 26.7 per cent in the manufacture of soap and detergents (NACE 24.5). In these sectors, the proportion of manual workers is higher than other sectors. Table 1.3 shows that the share of knowledge workers has been increasing in the European chemical industry. That is likely to grow, which will be discussed in Chapter 2.

Table 1.3. Evolution of the share of "knowledge workers" in the European chemical industry in selected countries in selected years

Evolution of the share of "knowledge workers" (ISCO 1-3) in the chemicals industry in selected countries			
	Share		Increase
	2000	2004	2000-04
Germany	42.0%	44.4%	2.4%
United Kingdom	53.5%	55.5%	2.1%
	1998	2004	1998-2004
France	45.9%	47.3%	1.4%
Ireland	37.2%	47.9%	10.7%
	1992	2004	1992-2004
Italy	31.9%	49.7%	17.8%

Note: Data for 2004, EU-25 without NL. Source: EU Labour Force Survey, 1995-2005.

2. VET in the chemical industry

2.1. Skill shortage and the role of VET at the European Union

A shortage of skilled workers has become a problem in the manufacturing in Western Europe, including the chemical industry. For example, the rapid expansion of the information and telecommunication technology (ICI) sector has created a strong demand for workers with computer skills who can develop and maintain online information systems and support e-commerce services. A shortage of ICI workers may affect the chemical industry, particularly in sales, marketing, research and development, and in the design and development of new products.

Continued shortages of these workers are anticipated to have the following effects. First, these shortages affect economic growth, accounting for a loss of about 1.5 per cent of GDP every year due to increased costs, deferred projects, and suboptimal worker productivity. Second, the increasing shortage of ICI skills has translated into higher worker turnover. In continental Europe, turnover has increased from 1-2 per cent in the early 1990s to 4-5 per cent in 2001. In the United Kingdom, turnover has increased from 7-8 per cent to nearly 20 per cent in areas of high demand. One positive impact of the skill shortage relates to working life. In addition to providing attractive compensation packages, companies compete for skilled workers by offering non-financial, lifestyle-related benefits, such as flexitime, home working, and work-life balance options.

VET can play a critical role in addressing skill shortages. For example, companies in Western Europe have been more proactive than their United States counterparts in developing on-the-job training. As a result, Western Europe averages 14 to 21 days of training a year, while United States companies provide an average of four to eight days of training. On-the-job training has become a prerequisite to worker retention. Companies providing over seven training days a year to their workers have a staff turnover half that of companies providing less than five training days a year.

2.2. Problematic areas in VET at the European Union

In the European chemical industry, employment opportunities for less-educated workers have been decreasing at the same time that there are not enough applicants for positions requiring higher levels of education. As the trend towards a knowledge-based economy grows, VET systems must better prepare employees to deal with the need to innovate and respond to technological changes.

VET systems vary considerably from one country to another in Europe, according to the FACE report (Cooke et al., 2004). Germany has developed a “dual system”, which enables apprentices to learn skills through working in the industry while they are enrolled in training at school to learn theoretical subjects. By contrast, the United Kingdom VET system allows apprentices to gradually upgrade their basic skills until they actually place for jobs.

VET in Europe is highly reliant on EU Member States’ national expenditures. According to Eurostat, support in 2000 for VET in the 25 Member States was, on average, 89 per cent from government sources, and 11 per cent from the private sector. States, therefore, have a vested interest in aligning VET with overall skill development, employment, and economic objectives. According to the OECD, the share of private spending in VET was less than 4 per cent in Denmark, Greece and Norway in 2004. Public

investment in tertiary education is relatively high in Belgium, Hungary, the Netherlands, Sweden and the United Kingdom, because these countries recognize the importance of higher education, particularly for sustainable development of the chemical industry (OECD, 2004, p. 233).

The EU's "Continuing Vocational Training Survey" (CVTS-2) found that in 1999 most of the Member States spent only 1 per cent of their GDP on VET. Even Sweden and the United Kingdom spent less than 10 per cent of the GDP. Other significant findings of the survey can be summarized as follows:

- On average, an employee in the EU received 12 hours a year of VET. Employees in the Netherlands and Denmark received 23 hours and 22 hours, respectively, while those in Germany and Italy received nine and six hours, respectively.

- An employee in the European chemical industry received 11 hours of VET a year, which is lower than the cross-industry average.

- In 15 selected Member States, 62 per cent of all employees received some kind of VET at work, of which 54 per cent received certified VET training courses.

- On average, about half of firms in 25 Member States have a VET certification system. In the Netherlands, 74 per cent of firms had a state-certified VET system, as did 68 per cent in Poland (CTVS 2: Eurostat, 2002, and Europäische Kommission, 2003).

- In Denmark, 75 per cent of employees used self-learning methods, which is the highest in the EU. By contrast, only 6 per cent of their counterparts in Italy had access to these high-tech learning tools.

The Lisbon Council, a Brussels-based think tank, released a report in 2006 on the education systems and skill sets of key Western European countries. France, the United Kingdom and Italy are not producing more university graduates as a percentage of the population than in the 1960s, while that proportion has actually decreased in Germany. It suggests that overall investment in education is insufficient and that the education systems in France and Germany are built on class divisions. The report holds up Finland and the Republic of Korea as successful examples of investment in education. The Republic of Korea has the highest rate of high school education among the main industrialized countries. Despite a declared desire to focus on innovation and technological change, the report warns that European educational outcomes put it at a competitive disadvantage with several Asian countries, which are turning out a highly skilled and cost-effective workforce.

2.3. Lisbon Agenda and VET

2.3.1. Goals of the Lisbon Agenda

The European Union's overall VET policies have important implications for VET in the European chemical industry. In 2000, the EU set itself the ambitious goal of becoming "the most competitive and dynamic economy by 2010". The objective and targets agreed to at the Lisbon meeting and, at subsequent spring summits in Stockholm (2001) and Barcelona (2002), seek to transform European economic performance over a decade, while simultaneously protecting welfare systems and combating social exclusion. As a complement to the traditional "community method" of legislation, a new "open method of coordination" was adopted for the Lisbon Agenda. This open method provides a central role for the European Council, which is slated to meet every spring to address economic and social questions. The agenda aspires to spread best practices and achieve greater

convergence on EU guidelines and sets specific timetables for achieving objectives. It also establishes indicators and benchmarks with other economies as a means of comparing best practices; translates EU guidelines into national policy by setting specific targets; and requires periodic monitoring, evaluation and peer review.

A set of goals from the Lisbon Agenda that relates to VET includes the following:

- **Information society.** Specific objectives for e-commerce include:
  - adopting a legal framework for e-commerce in 2000;
  - fully liberalized telecommunications markets by 2002;
  - more competition in local access networks by 2001;
  - all schools to have internet access in 2001 and all teachers to be skilled in internet use in 2002;
  - internet access to basic public services by 2003;
  - an e-Europe Action Plan specifying targets for interconnected low-cost, high-speed internet and telecommunication networks in all EU countries.
- **Research.** Designed to promote innovation and ensure attractive prospects for top talent, targets include:
  - a Community patent regime by 2002, providing EU-wide protection;
  - a European innovation scoreboard by June 2001, with indicators for benchmarking national research and development (R&D) policies identified by June 2000;
  - pooling EU R&D resources through the voluntary networking of national research programmes;
  - a high-speed trans-European electronic network linking research centres, universities and libraries before 2002;
  - removing barriers to mobility for researchers by 2002;
  - using tax policies, venture capital and European Investment Bank support to improve the climate for private research investment, R&D partnerships and high-tech business start-ups.
- **Small businesses.** Small companies will be promoted as key engines of job creation, through the investigation of mechanisms that would lower the cost of doing business and reduce bureaucratic obstacles. The Council and Commission will undertake a benchmarking study of the time and costs needed to set up companies, the volume of risk capital invested, numbers of business and science graduates and variety of training opportunities.
- **Macroeconomic policy.** To improve policy coordination, the EU will produce a report by spring 2001 that assesses the contribution of public finances to growth and employment and evaluates whether adequate measures are being taken to:
  - alleviate tax pressure on workers, especially the unskilled and low paid;

– improve the employment and training incentive effects of tax and benefit systems and redirect public spending to support R&D, innovation and information technology (IT);

– assure the long-term sustainability of public finances, assessing in particular the impact of aging populations.

- **Social model.** Measures are outlined in two areas:

  – *Education.* The number of 18-24 year olds not receiving further education or training should be halved by 2010, with schools and training centres turned into multi-purpose local learning centres. European guidelines should define new basic skills for lifelong learning, including information technology, social skills, foreign languages and entrepreneurship. An EU information technology diploma will be introduced to promote digital literacy and a common curriculum vitae format to promote mobility.

  – *Employment.* The central aim is to raise EU employment levels to 70 per cent by 2010, from 61 per cent in 2000, and to increase the number of employed women to 60 per cent, from 51 per cent in 2000.

2.3.2. Reviews of the Lisbon Agenda

Since 2000, the ambition goals set by the Lisbon Agenda were hampered by continuing slow economic growth and high unemployment in many Member States. In March 2003, the European Council reviewed progress on the Lisbon Agenda. Subsequently, the Commission has highlighted four "priority action areas" where new actions are needed at the national and EU level:

- **Education and research.** The Commission called for investment in higher education to be increased from just under 1.3 per cent of GDP to 2 per cent of GDP by 2010, and for improved mathematics and foreign language teaching in schools. It also asked Member States to set clear targets for overall R&D spending for 2010, for R&D to account for a greater share of state aid and structural funds and to establish a European Institute for Technology by the end of 2007.

- **Encouraging small- and medium-sized enterprises.** The report calls for 'one stop shops' to help potential entrepreneurs meet administrative requirements for setting up businesses. It also enjoins member states to reduce by half the time required to set up a business, to introduce entrepreneurship classes in schools and to reduce notification requirements for some forms of minor state aid.

- **Employment.** The report calls for employment or training opportunities for all young people within six months of leaving school or university (and within 100 days by 2010). It also promotes the provision of childcare to ensure national targets are met, and the implementation of active aging measures to extend working lives and increase part-time work.

2.4. Skilled and low-skilled migration

Managing skilled migration is one of the most difficult and contentious issues in the EU. It is also a key component of Europe's long-term competitiveness. However, public hostility towards immigration and difficulties in devising common policies may undermine the EU's ability to attract the most qualified immigrant workers. Since the 1990s, many EU Member States have initiated policies to attract high-skilled immigrant workers. They

have facilitated the entry and settlement of key workers in many sectors, including the chemical and pharmaceutical sector. Although some Member States have relatively high unemployment rates, there are still shortages of high-skilled workers. In addition, the EU's working age population is anticipated to decline by about 20 million by 2030. The prospect of a shrinking and aging workforce has focused greater attention on increasing skilled immigration. Boosting economic migration is regarded as an important strategy for promoting competitiveness and making progress on the Lisbon Goals related to economic reform. Despite growing interest in the EU, it is nevertheless hard to implement and coordinate effective polices at the EU level. Nearly all Member States have seen public hostility to immigration increase in recent years. It is likely to be difficult at the EU level to balance this hostility with the continued need to attract enough of the right workers to fill the right jobs.

In addition, there is even less agreement on the appropriate scale of low-skilled migration and how best to manage it. According to the OECD, many governments face four major issues in managing low-skilled immigration and the related social problems of low-skilled immigrants. First, governments face a potential trade-off between ensuring an adequate supply of low-skilled workers while moving towards a more highly skilled workforce. However, there has been buoyancy in low-skilled and labour-intensive sectors. Because an increasingly well-qualified and ageing resident workforce is unlikely to meet demand, demand is likely to grow for low-skilled migrant workers. Second, increased globalization and outsourcing of work may not reduce domestic demand for low-skilled workers significantly. Third, public and trade union pressure may hinder attempts to meet the demand for low-skilled immigration through legal channels. Hostility is generally higher towards low-skilled than high-skilled workers. Trade unions are concerned that low-skilled workers would undercut wages and working conditions and be more likely to use welfare services. Finally, where legal migration is insufficient to meet local demand, and controls on undocumented entry and working are not effective, significant irregular migration would occur. Large numbers of irregular workers are exploited and work in poor conditions, with little recourse to protection. They are also likely to undercut wages and depress working conditions.

Examples from Spain and the United Kingdom demonstrate different approaches to managing low-skilled migration. Spain has recently made the transition from large-scale emigration to immigration. Migrant workers can enter Spain legally, either through the general annual quota of around 10,000 or through seasonal worker programmes. However, due to Spain's position at the edge of Europe, an ongoing labour demand/supply mismatch and a thriving informal sector, the county has attracted large numbers of irregular immigrants. In the United Kingdom, the policies for a managed migration system are biased towards highly skilled workers. There is an assumption that workers from the new Central and Eastern European EU Member States will fill existing demand for low-skilled workers. However, it is questionable whether these workers will continue to do low-skilled jobs. Employers in labour-intensive sectors have expressed concern that such policies will deny them workers. However, the lack of future opportunities for low-skilled migration is likely to add to the estimated 500,000 illegal immigrants in the United Kingdom unless labour market conditions change or immigration controls improve dramatically.

Migration is likely to be a key factor in Europe's long-term competitiveness. Unless the Member States devise ways to bring in necessary workers legally, labour shortages may continue and irregular immigration may increase.

2.5. What skills are needed?

Three major skill needs are recognized in the European chemical industry: one for current production workers or relatively low-skilled workers, one for high-skilled or

knowledge workers, and one for young workers who are about to enter into the chemical industry.

2.5.1. Skills required for low-skilled workers

The United Kingdom's Skills Networking Group for the chemicals industry emphasizes a "clear need to identify skills standards for the chemical industry as a whole" in order attain a higher level of qualifications and licences to operate (Skills Network Group, 2004, p. 13). In September 2005, the United Kingdom's Chemical Industry Association's (CIA) Joint Statement on Skills reported that 71 per cent of adults in the United Kingdom chemical workforce were qualified to NVQ Level 2. The report argued that the chemical industry needs to increase the number of workers with NVQ Level 3 qualifications. [1]

Table 2.1. Definition of National Vocational Qualification (NVQ) levels in the United Kingdom

Levels	Description
Level 1	Competence that involves the application of knowledge in the performance of a range of varied work activities, most of which are routine and predictable.
Level 2	Competence that involves the application of knowledge in a significant range of varied work activities, performed in a variety of contexts. Some of these activities are complex or non-routine and there is some individual responsibility or autonomy. Collaboration with others, perhaps through membership in a work group or team, is often a requirement.
Level 3	Competence that involves the application of knowledge in a broad range of varied work activities performed in a wide variety of contexts, most of which are complex and non-routine. There is considerable responsibility and autonomy. Responsibility for or guidance of others is often required.
Level 4	Competence that involves the application of knowledge in a broad range of complex, technical or professional work activities performed in a variety of contexts and with a substantial degree of personal responsibility and autonomy. Responsibility for the work of others and the allocation of resources is often present.
Level 5	Competence that involves the application of a range of fundamental principles across a wide and often unpredictable variety of contexts. Very substantial personal autonomy and often significant responsibility for the work of others and for the allocation of substantial resources features strongly, as do personal accountabilities for analysis, diagnosis, design, planning, execution and evaluation.

Source: Qualifications and Curriculum Authority, United Kingdom.

The United Kingdom also has a special skills network system, known as "Sector Skills Councils" (SSCs), which the United Kingdom Government strongly supports as a way to promote VET. The SSCs consider overall national skills needs and organize training by economic sector. "Cognet" is the SSC that is owned by and operated for the United Kingdom chemical industry. Chemical firms work together to develop and implement a "Sector Skill Agreement". Its recommendations to improve VET in the chemical industry include recommendation No. 2 which states that:

> Cognet, working with the Skills Network Group and other national and regional bodies, should develop a Gold Standard for the chemicals industry. Initially this should include a Licence to Operate – including the skills needs associated with the Sustainable Development agenda – and Productivity, with special focus on upskilling to NVQ Level 3. It should clearly articulate the specific skills and competencies needed to achieve the necessary standards in

[1] The National Vocational Qualification (NVQ) system in the UK is a work-related, competence-based qualification system. Based on national occupational standards, as shown in table 2.1, these standards are statements of performance that describe what competent workers in a particular occupation are expected to be able to do.

both these areas, as well as the resources needed to achieve them. The Gold Standard should then be extended to achieve Innovation, in consultation with the Chemistry Leadership Council's Futures and Innovations Groups, and in particular the Innovation Task Force. Companies and training providers should then work in partnership to structure and deliver accredited training programmes based on the Gold Standard. Cognet should seek to persuade the Government to align funding with accredited qualifications under the banner of the Gold Standard for the industry. (SSCs, p. 5.)

Cognet directs chemical companies to –

> … report skill shortages in particular academic disciplines – particularly in the chemical sciences – and gaps in management, leadership and communication skills in their workforce. In the future, the industry is likely to need fewer but more highly skilled and technology-literate employees operating in more flexible ways and having strong management and communication skills. The objective should be a workforce upskilled to NQV Level 3 as a minimum. There is a need for mechanisms to identify future skill needs. (SSCs, p. 11.)

2.5.2. Skills needed for skilled workers

The Innovation Task Force of the Chemistry Leadership Council in the United Kingdom frequently issues reports concerning research and technology priorities. They note that there are skill shortages in the chemical industry, particularly in:

- analytical chemistry;
- the development of high technology-oriented instrumentation;
- chemometrics, informatics, mathematical modelling and computational science (Skills Network Group, 2004, p. 12).

Cooke et al. (2004) points to the need for market-driven skills, especially those responsive to:

- increasing competition on prices, pressures from the market, and just-in-time of production;
- customization to respond to customer specifications;
- changes in work organization, such as flat management structure, teamwork and outsourcing.

European chemical firms have undertaken a variety of strategies to address the skills needed by teams of employees, including:

- upgrading VET in the context of the entire work organization;
- increasing project-orientated VET;
- increasing specializations;
- increasing process simulations in production;
- increasing alignment with human resources management (CIWES, 2004a, p. 48).

2.5.3. Skills needed for young chemical engineers

In 2004, the World Chemical Engineering Council (WCEC) surveyed over 2,000 young European chemical engineers across 63 countries about the skills considered most necessary at work. The five skills identified as most important were:

- ability to work effectively in a team;
- ability to gather and analyze information;
- ability to communicate effectively with team members and supervisors;
- ability to learn on their own (self-learning).

These young chemical engineers also felt they could have received better academic preparation in (1) how to communicate effectively, (2) quality management methods, (3) project management skills, (4) management skills, and (5) business-oriented thinking (WCEC, 2004). Cooke et al. (2004) echoed their view stating:

> … [F]ewer chemical engineers are needed for research and a broad spectrum of professional tasks waits for the graduates. In contrast, study programmes are still too orientated towards technical knowledge, while soft skills and marketing/business orientation are lacking. The study meticulously lists differences between relative importance that the worlds of education and of work attribute to skills and competences and shows, to a large extent, the academic world lags behind needs of the work place. (Cooke et al., 2004, p. 11.)

2.6. VET priorities at the company level

Strengthening worker competencies and integrating worker experiences and work-related knowledge is known as organization learning or institutional learning. This is a substantial part of company-level VET in the European chemical industry. The German chemical firm, Chemetall, in Frankfurt am Main, takes an integrated approach to VET in order to develop young workers with practical skills. Workers are expected to learn theories and instantly apply them to work. Training requires workers to acquire all possible skills that might be needed for performance in a multi-skill work environment. In addition, worker skill assessment is closely linked to human resources management. Each worker has to face an individual personnel and skills assessment based on an outside standardized evaluation system developed by Hogeschool van Utrecht (Cooke et al., 2004, p. 76). VET has become a part of the company's human resources development's toolbox.

Box 2.1 summarizes the types of VET initiatives undertaken by European chemical firms. Their differing interests and needs related to VET reflect each company's strategy.

Box 2.1. Approaches to VET among European chemical firms

Akzo Nobel – VET to meet local needs

Akzo Nobel has decentralized its VET programme and allows each facility to customize VET programmes to meet local needs. In-house trainers develop specific VET themes. Company-wide VET programmes cover broader needs for the entire company. Most VET programmes now promote management skills. Traditional management training is dominant, but training to enhance worker competencies has been increasing. Occupational safety and health is one of the emphasized topics in VET.

BASF – Promoting VET through e-learning

BASF in Germany has spent €30.5 million on employee VET programmes and €75 million was spent for improving apprentices' skills. E-learning is widely used throughout the company. More than 1,000 employees have participated in Master of Business Administration programmes through e-learning. In the context of massive organizational restructuring, VET programmes help employees acquire multiple skill sets and re-training for new assignments.

Beiersdorf AG – Encouraging global teamwork

For over 25 years, Beiersdorf AG has offered a VET programme called "Beyond Borders" to train young people for international positions through the acquisition of practical experience in finance, marketing and supply chain management. Its VET programme is closely related to courses at universities. In addition, the company also offers all its employees a human resources management programme called "Meeting Point VET"

(Treffpunkt Weiterbildung). It covers a wide range of topics, including learning about supportive working environments, and improving communication, language and IT skills.

BOC Group – VET linked to performance appraisal

An integrated industrial gas firm in Germany, BOC provides its employees with comprehensive career guidance. Each year, the strengths and weaknesses of each unit are assessed to target improvements for the following year. Employees have regular discussions concerning their aspirations, prospects and development. The company develops an individual development plan for all employees designed to meet employee needs for skill development and therefore company needs. Employee performance is assessed through 360-degree appraisals. The company also offers numerous opportunities for career and personnel development. In the workplace, employees participate in on-the-job training to develop practical skills required for their jobs. Employees can improve their skills by secondments to other workplaces within the company. Employees can also take advantage of e-learning, as well as traditional classroom-based trainings.

Degussa – VET through on-the-job training

Degussa's VET programmes cover 1,700 employees worldwide. In Germany, 400 employees participate in on-the-job training, 360 participate in custom-made VET programmes and 340 participate in distance e-learning programmes. These programmes are co-financed by the company and employees who wish to participate. Re-matching qualifications to work is underway. At production sites in Germany, a Total Productive Management (TPM) system is at the core of VET programmes. Systematic learning is the cornerstone of the TPM training. Materials for training and the operation guides of all machines and computer systems are provided by the company.

In 2004, Degussa provided 2,100 apprentices with 38 different professional jobs at its 27 sites in Germany. The company also provided 71 young people with special programmes to complete their school education in an eight to ten month programme. Seventy per cent of those who successfully finish the programme are expected to take apprenticeships with the company.

Schering – VET and knowledge mobility increases organizational learning

Schering offers a full range of VET programmes to its employees, through the VET consulting service unit of the company's Human Resources Development Department. Basic programmes include foreign language courses, communication skills training and specific subjects to meet work needs.

The company organizes special congresses and seminars as part of its Total Quality Control (TQC) effort. It now individualizes VET programmes to meet employee needs through e-learning and smaller size training courses.

One important theme in VET is institutional learning. The company is working to disseminate professional experiences and skills normally "owned" by particular employees to other employees in different work areas, especially production and marketing. The company is also sharing institutionalized knowledge across units to give employees a better overall picture of their company. Through this kind of transparency, knowledge mobility within the company is increased. The mobility of knowledge and skills is also promoted among different facilities across the globe, which has led to increasing the mobility of employees across specializations. Some employees have transferred from the chemical to the pharmaceutical business within the company for a limited time periods. This has made it possible for employees to acquire new competencies and has spurred communication between different units that had not existed before.

Source: Qualifizierungsförderwerk Chemie (QFC) GmbH.

2.7. How to increase skilled workers?

After an in-depth evaluation of many VET case studies, the CIWES group (Weiterbildungssystem in der chemischen Industrie) made major recommendations on the organization of VET in the German chemical industry, shown in box 2.2. The German approach aims to increase transparency about the supply and demand of skilled workers to mitigate labour market problems stemming from mismatching skilled workers in the chemical industry.

Box 2.2. CIWES Study Group recommendations on effectively organizing VET in the chemical industry in Germany

- Modularizing VET in the chemical industry within the overall frameworks of EU's VET systems, including the European Qualification Framework (EQF) and European Credit Transfer System for Vocational Education and Training (ECVET).
- Increasing the networking of players involved in VET.
- Further developing Quality Management and Certifications.
- Increasing transparency in VET to synchronize supply and demand of skills.

Source: CIWES, 2005.

2.8. Pressure for more flexibility in VET

Catching up with technological and economic change is a primary challenge for VET. VET systems have become increasingly more flexible to respond to these forces and they must continue to demonstrate their adaptability in the face of continuing change.

In the European Commission, "flexibility" is a key word in the reform of VET systems across the EU. A Technical Working Group for "Making learning attractive and strengthening links to working life, research and society at large" identifies key areas where flexibility must increase, including:

- promoting modular and active curricula;
- adopting teaching methods that increase the motivation of people to learn;
- enhancing individual learning models;
- providing guidance and counselling;
- improving credit accumulation and transfer processes;
- validating formal/informal learning (European Commission, 2003, p. 11-3; also see Leney, 2004, p. 73).

The main challenges to realizing flexibility in VET in Europe are a heterogeneous knowledge landscape and the existence of many non-standardized and non-transferable qualifications because these qualifications are linked to national VET systems. Too many different skills and knowledge systems in the absence of a guidance system for lifelong learning and career development make international career movement difficult.

2.9. Social partnership in VET

One successful VET project in the social partnership model is the Foundation for Further Training (WBS, Weiterbildungs-Stiftung) in the German chemical industry. WBS was founded in 1993 to help chemical workers and companies adapt to new economic and educational developments. The WBS's VET programmes apply for all workers who are employed in the industry, including the blue-collar workers, so that both low-skilled workers and high-skilled workers in production could improve their skills to meet the needs in the future. A primary objective is to promote transparency in VET through:

- individual counselling on qualifications and competencies;

- individual profiling of qualifications and perspectives for professional career development;
- addressing worker competencies in the context of departmental and corporate frameworks:
- mitigating the mismatch of skills supply and demand;
- planning for and providing VET programmes for future qualifications;
- advising on organizational learning;
- developing VET systems;
- developing human resources management system in conjunction with VET programmes.

Further, the WBS helped the chemical industry with practical VET publications and materials on topics such as English for laboratory personnel, responsible care, the future of laboratory work, and terminology for human resources management. The role of social partners must be noted in quality control activities. A Kaizen project, developed by Japanese business partner, NOK, was transplanted to Freudenberg in Germany in 1992. At Freudenberg, the Kaizen system called GROWTH was introduced in production and waste material management. Later, it was also introduced to several other branches of Freudenberg, e.g. the rubber production branch called "Freudenberg Dichtungs- und Schwingungstechnik" (seals and vibration control). GROWTH has been successful because the company and trade union have worked together to customize the Kaizen concepts to their own needs. The key to success was the creation of an open communication system between workers and management, transforming the traditional corporate hierarchy to a flat structure model. According to production site managers, the GROWTH process made it possible for workers to improve through continuous learning and the instant application of knowledge and experiences learned in production. Managers noted that the GROWTH system led to: (1) better understanding between workers and management, as well as among workers themselves; and (2) enhanced teamwork learning that resulted in a higher quality work product, and therefore increased customer satisfaction.

2.10. E-learning

E-learning is another effective means to respond to the need for flexibility in VET. The appeal of e-learning reflects an increasingly hectic and complex work environment. Some workers work in isolated circumstances, but the work itself is interrelated to economic and technical environments within the company (Hübner/Wachtfeitl, 2000). Some e-learning networks in the chemical industries include:

- the United Kingdom's Royal Society of Chemistry Database of Training Opportunities in Continuing Professional Development to compliment the European Chemistry Thematic Network (www.chemsoc.org/careers/cpdindex.htm). In order to supplement e-learning, the Royal Society of Chemistry also provides career advice and career development programmes for its member chemists;
- internet sites sponsored by the Society of German Chemists such as www.jahr-der-chemie.de and www.chemie4you.de. These provide chemists with extensive information on chemical education, career development, numerous study reports and job postings.

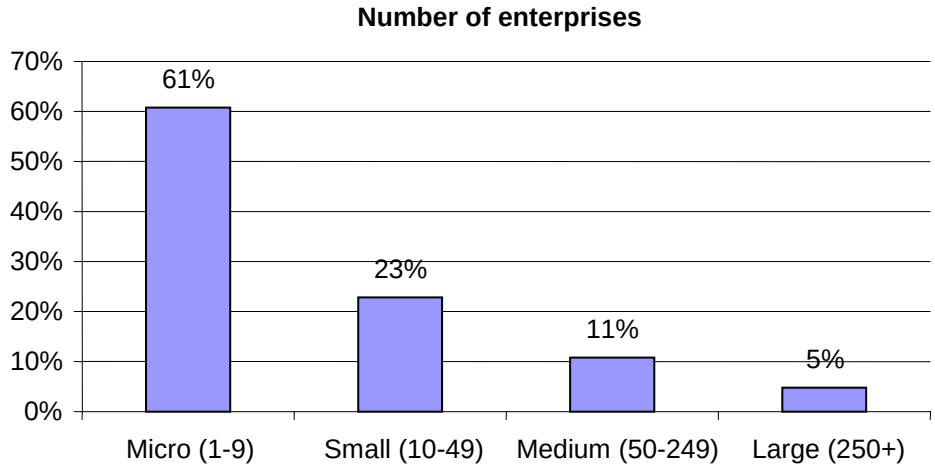
2.11. Trade union initiatives

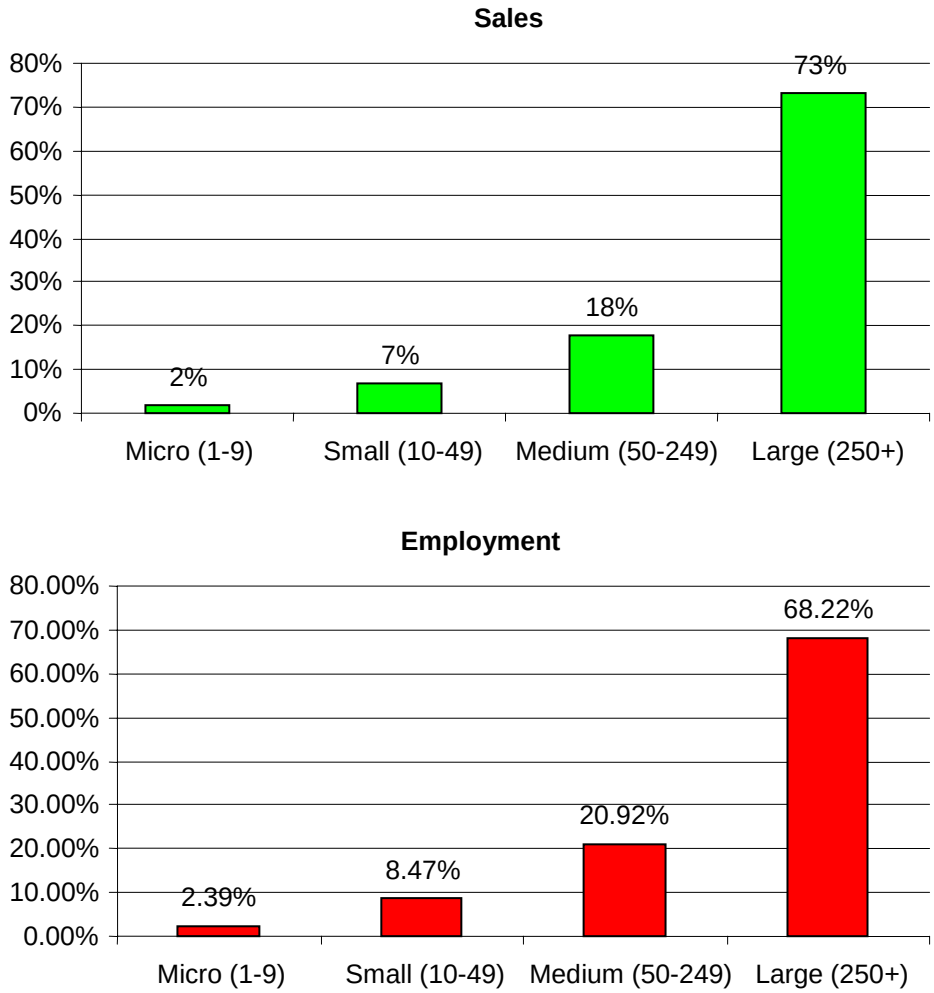
Social partners in Europe have begun to use e-learning as a tool to improve chemical worker competencies through lifelong skill and knowledge improvement. Since 2001, the German Confederation of Trade Unions (DGB), with the German Government, has promoted a project called LeA (www.dgb-lea.de) to promote learning and skills acquisition through the internet. Through LeA, German trade unions have launched a Kom-Netz project to motivate workers to increase their competencies to enhance career prospects. This project involves the DGB's affiliated unions, including the German Metalworkers Industrial Union (IG Metall), which also represents textile and cloth and wood and plastic workers in Germany, and the German Mining, Chemical and Energy Industrial Union (IG BCE). The Kom-Netz project takes a practical approach, and its web page offers information and resources to meet workers' learning needs. However, e-learning becomes more meaningful when it is combined with traditional learning in classroom and certifications.

2.12. VET in micro to medium-sized chemical firms

According to the European Chemical Industrial Council (figure 2.1) there were approximately 15,000 micro-chemical enterprises (firms with fewer than nine employees), accounting for 61 per cent of companies in the European chemical industry. Micro-chemical firms accounted for only 2 per cent of overall sales. Together, micro and small (fewer than 49 employees) chemical firms totalled 26,000 enterprises, accounting for about 10 per cent of overall employment in the industry. By contrast, large chemical firms (more than 250 employees) accounted for merely 5 per cent in the total numbers of enterprises, but employed almost 70 per cent of the overall workforce in the European chemical industry and accounted for 73 per cent in the overall sales.

Figure 2.1. Number of enterprises and sales by employment size in the European chemical industry, 2004





Source: *Facts and figures: The European chemical industry in a worldwide perspective*, July 2005, European Chemical Industry Council (FEFIC).

In 2001, the European Centre for the Development of Vocational Training (CEDEFOP) issued a second report concerning vocational training research, which discussed structural problems related to recruiting low-skilled and high-skilled workers at the small- and medium-sized enterprises (SMEs) in the chemical industry. It stated that:

> … [T]raditional SMEs […] prefer to recruit lower-skilled workers and do not offer adequate training: high skilled or motivated young people will move to larger firms or to growing high-tech SMEs […]. Thus a dual labour market for SMEs may emerge: traditional SMEs need low-skilled workers, and innovative and growing SMEs need high-skilled workers, especially in the knowledge-intensive service sectors […]. (Descy/Tessaring, 2001, p. 181.)

At SMEs in the chemical industry, VET is primarily on-the-job training. Because of the size of these companies, it is extremely difficult to provide workers with adequate high tech training. However, when SMEs' lines of business fall within high tech areas, workers are more likely to receive adequate training. The CEDEFOP 2001 study states:

> In most cases, VET serves to develop skills to meet short-term demands, and VET is primarily conducted through on-the-job training and other informal training means. However, high-tech-based SMEs have been increasingly dependent on formal VET methods such as external training institutions or new forms of training supported by ICTs [Information and Communication Technologies]. (Descy/Tessaring, 2001, p. 188.)

European case studies found that on-the-job training is especially effective in SMEs. All workers at every level of a company share their specific knowledge about technical installations and production processes with co-workers. This learning method is more effective than simply learning particular work roles, because it allows workers to see their roles in the context of the entire production process, thus enhancing teamwork (Fischer/Röben (Eds.) 2004, p. 17).

2.13. Lifelong learning

2.13.1. Overview of lifelong learning (LLL)

The European Union has been promoting lifelong learning (LLL) for all workers, and the European chemical industry has been taking a lead role to foster this. In 2000, the European Commission issued a "Memorandum on Lifelong Learning" which laid out a framework for LLL. The Memorandum requires all workers to acquire new basic skills on their own. It stresses the importance of teaching all workers how to learn new skills by themselves (self-learning methods). The Memorandum suggests major changes in the VET infrastructure, including:

- increasing investment in human resources management;
- adopting innovations in teaching and learning;
- acquiring effective learning skills;
- restructuring guidance and counselling;
- enabling home-based learning.

In order to maintain high-level skills for knowledge-based economies, the EU Member States have emphasized more VET through lifelong learning, and the European chemical industry is attempting to form a Europe-wide skills standard for chemistry to promote this approach. For example, the European Chemistry Thematic Network Association (ECTN) is developing a Europe-wide qualification of "Eurobachelor" in chemistry, and has launched a database on training called "Continuing Professional Development" (CPD) (www.chemsoc.org/careers/cpdindex.htm).

Ryan (2003) states that there are three central attributes of the LLL agenda: universal learning, the primacy of the individual learner, and innovation in the content and methods of learning. The United Kingdom is a principal source LLL models and policies (box 2.3).

Box 2.3. Lifelong learning policies in the United Kingdom

1. Universal learning

In the United Kingdom, the case for universal learning has two dimensions: across individuals and across life cycles. All workers must embrace this new learning culture. In life cycle terms, workers must rely less on initial learning and learn more as adults. For adults, that means more training to upgrade skills, retraining, and, as necessary, remedial training in basic skills.

National Learning Targets: By 2002, 50 per cent of economically active adults will have achieved level three qualifications, vocational or general. Actual attainment was 45 per cent in 1998 and the proportion of non-learners in the adult population should be reduced by 7 per cent for the period 1998-2002. Relevant programmes include: Get On, Read Write Plus, funds for basic skills courses and summer schools, New Deal 25+ and Work-based Learning for Adults, the Adult and Community Learning Fund (public funds for innovative community-based activities with learning content in deprived areas), and labour market programmes offering education, training and work experience primarily to long-term unemployed adults.

2. The role of the individual

Programmes include: the Career Development Loan (1988- present), which are subsidized commercial loans to individuals to cover course fees; Training Tax Credits (to 2000), which involved income tax deductibility of fees for courses leading to recognized qualifications; "Learndirect" (1998-present), an educational and career support website offering advice and guidance to adults; and Youth Training Entitlement (1999-present), which allows unqualified 16 and 17-year-old employees to be paid one-fifth time off work for learning, subject to negotiated agreements.

3. Innovation in learning content and methods

Programmes include: National Vocational Qualifications (1987-present), a certification of work-based employee competence, including accreditation of prior and informal learning; University for Industry (2000-present); online provision of distance learning in vocational and basic skills, and guidance in choice of learning options; Learning and Skills Council (2001-present) national and local coordination of the provision and funding of training for over-16 year olds; contracts for learning services with specialized providers and employers, for-profit and non-profit; and the creation of IT-based learning centres in new locations, including shopping malls, sports clubs.

4. Trade unions

Programmes include Union Learning Representatives (1998), which outlines the rights of unions to appoint workplace representatives to encourage and support employee learning in workplaces with union recognition; and the Union Learning Fund (1998-present), which are public funds for union-sponsored projects in support of members' learning.

Source: Paul Ryan, "Lifelong learning: Potential and constraints with special reference to policies in the United Kingdom and Europe," ILO Skills Working Paper No. 15, p. 5. 2003.

Increasing investment in human resources is the best way to recognize the importance of Europe's most important asset – workers. In this context, the Government of the United Kingdom introduced the Investors in People programme in 1991, stating:

> The programme provides employers with a national standard of training needs analysis and those companies wishing to be recognized as an Investor in People must conform to this standard. It helps to maximize business performance by linking the training and development of employees to an organization's business objectives. The standard is based on four main principles:
>
> - Senior management makes a commitment to develop all employees to achieve business objectives
> - The employer regularly reviews its business objectives and plans how to achieve them by developing the skills of teams and individual employees
> - The employer trains and develops individuals from the time they are recruited and throughout their employment
> - The employer evaluates the investment in training and development and assesses the impact of the training on improved effectiveness. (Ryan, 2003.)

2.13.2. European social partners' Joint Position Paper on LLL

In 2004, the European social partners in the chemicals industry discussed standards related to VET and LLL. The European Chemical Employers Group (ECEG) and the European Mine, Chemical and Energy Workers' Federation (EMCEF) released a Joint Position Paper on Education, Vocational Training and Lifelong Learning in the European Chemical Industry. In this paper, European chemical social partners highlight the lack of highly qualified chemical workers, stating:

> A lack of skills is already faced by the chemicals industry, at least in some European countries and in some areas of the industry, as a reality, despite the high levels of unemployment in many European countries. EMCEF and ECEG believe such shortages hinder

> economic growth as well as positive development of European labour markets. […] Changes in technology used in workplaces are increasingly frequent, organization of the working process changes more often, and therefore the way to work is subject to frequent alterations. This highlights the need for an even more flexible structure within the companies, which itself is again the reason for an increase in the demand for highly qualified staff. (ECEG/EMCEF, 2004.)

One outcome of the Joint Position Paper is that European chemical social partners have agreed to exchange best practices for VET. The full text of the Joint Position Paper is reprinted in Appendix 1.

In September 2005, the joint working group on Education, Training, and Lifelong Learning of the social partners in the European chemical industry discussed ways of collecting and disseminating good practice across the industry. The EMCEF emphasized that the ECEG must invest more than 3 per cent of workers' salary on VET programmes in order to meet the goals of the Lisbon Agenda. The EMCEF also proposed that workers should have the right to participate in continuing education and VET during regular working hours. VET course topics that the EMCEF recommended for inclusion are responsible care, quality management, and risk management. To fulfil these goals, the EMCEF proposed that employers:

- establish promotional programmes for newly employed workers;
- increase internal learning opportunities;
- introduce a standardized certification of worker competencies system;
- create social partner-initiated Sectoral Education Centres, which would also help small and medium-sized chemical firms to increase their opportunities for participating in VET (EMCEF, 2005a).

3. Standardization of skills

3.1. Towards the standardization of skills

Since the end of the twentieth century, governments, social partners and chemical education experts have been concerned about the impact of economic structural changes and globalization, which would require workers to obtain higher levels of education and higher-level skills in order to compete with rivals in a globalized market.

For example, in 1997 the United Kingdom's Royal Society of Chemistry and the Council for Industry and Higher Education commissioned a study on the future of higher education in chemistry. The study pointed out the urgent need to conduct skill surveys and examine the standardization of qualifications for chemistry throughout the Europe (Roberts 1998). In 2001, the British chemical industry stated that the industry was in transition. Innovation is vital for future success, but many challenges must be addressed. Workers need to acquire higher skill levels, yet time and resources for VET are limited. The number of students majoring in science, technologies, mathematics, and chemistry has declined since mid-1990s. In addition, the overall standard of education has been deteriorating. The United Kingdom chemical industry needs to fill these skills deficits and upgrade workers' skills to a higher level. The industry also needs to recruit a more diverse workforce (CIGT, 2002, p. 4).

The United Kingdom Government and chemical industry struggled with how to assess skills and competencies in the context of current and future needs that are difficult to predict. One approach to this complex issue is in-depth studies among all stakeholders in the chemical industry to analyze current and future skills requirements. In Germany, the Ministry for Education and Research took a lead role in forming a research network called FreQueNz, which aims to gather information to assess the emerging trends in skills needs in order to draw up a vision for future needs (www.frequenz.net).

The Federal Institute for Vocational Training (BIBB) in Germany also conducted numerous studies on the overall VET system in the German chemical industry. These studies were made available to the public through CIWES (Weiterbildungssystem in der chemischen Industrie). The primary finding was that VET must adapt to new market developments. Some occupations are no longer required by the chemical industry and the Government needs to provide these surplus workers with retraining to make them marketable in other economic sectors. The studies also found that VET public institutions need to address demands for different skills and provide training in a more flexible way than in the past. Possibly the most important finding of the studies is that articulating a standardized set of skills would increase the mobility of the workers throughout the national economy, including the chemical industry. (CIWES 2004c) Similar recommendations have been made by other Member States in the EU. In short, this has led in the direction of standardization of skills and VET systems throughout the EU.

3.2. Standardization of qualification system

The European Credit Transfer System for Vocational Education and Training (ECVET) would be the impetus towards the full-scale standardization of qualifications for all workers in Europe, although this is still under discussion at the EU. Once the ECVET is implemented, it is expected to promote labour mobility in a European market where currently different national qualification systems hinder worker movement.

Since the implementation of the European Credit Transfer System (ECTS) for higher education (table 3.1) the transparency of higher academic credits has increased at the EU level. However, experts are concerned that the path will be much more difficult for the adoption of ECVET (Leney, 2004, p. 223). Box 3.1 summarizes the current qualification transferring system in the EU.

Box 3.1. Standardization of qualifications at the European Union

Europass

The sole European Community framework for the transparency of qualifications and competences (Decision No. 2241/2004/EC of the European Parliament and the European Council of 15 December 2004).

"Creation of a personal, coordinated portfolio of documents to be known as 'Europass', which citizens can use on a voluntary basis to better communicate and present their qualifications and competences throughout Europe." (EU, 2004, p. 7.)

Two Europass documents contain self-declarations. Templates and instructions are accessible for anyone at the dedicated Europass portal (http://europass.cedefop.eu.int) or from national Europass centres.

Europass CV

Enables citizens to communicate in a clear and comprehensive way their competences. It is the "backbone" of the Europass. Other documents can be attached to it.

The Europass Language-Portfolio contains:

- a language passport, in which its owner describes his/her language skills according to European standards;
- a detailed language biography to record the owner's experiences in each language;
- a dossier to illustrate language skills.

Three other Europass documents are filled in and issued by qualified organizations.

Europass Mobility

Certifies in a common format any organized period of learning (e.g. work placements, semesters in a university degree programme) that its holder has attended abroad.

It is filled in by the home and host organizations involved.

Europass Diploma Supplement

Received by graduates of higher education institutions along with their degree or diploma.

Facilitates a sound appreciation of the diploma, specifying what the latter means in terms of knowledge and competences acquired by its holder and describing the nature, level, context, content and status of the studies.

Europass Certificate Supplement

Attached by the relevant authorities to a vocational certificate.

Clarifies the professional qualifications of the holder of the certificate.

Source: Qualifizierungsförderwerk Chemie (QFC) GmbH.

Table 3.1. European Credit Transfer System (ECTS) for higher education

	Outcomes	ECTS credits
Short cycle (within the first cycle) qualification	Qualifications that signify completion of the higher education short cycle (within the first) are awarded to students who: ■ have demonstrated knowledge and understanding in a field of study that builds upon general secondary education and is typically at a level supported by advanced textbooks; such knowledge provides an underpinning for a field of work or vocation, personal development and further studies to complete the first cycle;	Approximately 120 ECTS credits

	Outcomes	ECTS credits
	■ can apply their knowledge and understanding in occupational contexts; ■ have the ability to identify and use data to formulate responses to well-defined concrete and abstract problems; ■ can communicate about their understanding, skills and activities with peers, supervisors and clients; ■ have the learning skills to undertake further studies with some autonomy.	
First cycle qualification	Qualifications that signify completion of the first cycle are awarded to students who: ■ have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study; ■ can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study; ■ have the ability to gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues; ■ can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences; ■ have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.	Typically include 180-240 ECTS credits
Second cycle qualification	Qualifications that signify completion of the second cycle are awarded to students who: ■ have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context; ■ can apply their knowledge, understanding and problem-solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study; ■ have the ability to integrate knowledge, handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements; ■ can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously; ■ have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.	Typically include 90-120 ECTS credits, with a minimum of 60 credits at the level of the 2nd cycle
Third cycle qualification	Qualifications that signify completion of the third cycle are awarded to students who: ■ have demonstrated a systematic understanding of a field of study and mastery of the skills and methods of research associated with that field; ■ have demonstrated the ability to conceive, design, implement, and adapt a substantial process of research with scholarly integrity;	Not specified

	Outcomes	ECTS credits
	■ have made a contribution through original research that extends the frontier of knowledge by developing a substantial body of work, some of which merits national or international refereed publication; ■ are capable of critical analysis, evaluation and synthesis of new and complex ideas; ■ can communicate with their peers, the larger scholarly community and with society in general about their areas of expertise, and can be expected to be able to promote, within academic and professional contexts, technological, social or cultural advancement in a knowledge-based society.	

Source: Bergen, 2005b, pp. 27-28.

4. Financing VET

4.1. Public financing system

According to Eurostat, on average, 89 per cent of financing for VET in the 25 Member States came from the government and 11 per cent came from the private sector in 2000. States, therefore, have a vested interest in aligning VET with overall skill development, employment, and economic objectives. According to the OECD, in 2004, the share of private spending in VET was less than 4 per cent in Denmark, Greece and Norway. Public investment in tertiary education is relatively high in Belgium, Hungary, the Netherlands, Sweden, and the United Kingdom, because these countries recognize the importance of higher education, particularly for sustainable development of the chemical industry (OECD, 2004, p. 233).

In Europe, the financing of VET systems varies from one country to another, and frequently relates to the national skill education system. In France and Sweden, for example, the state takes an exclusive role in financing VET. In Germany, however, it is a relatively cooperative approach, and in the United Kingdom, it is a "market-based" financing system. Additionally, the participation of social partners in the conceptualization of VET has added to national variations in financing VET in the EU.

France has established one of the most striking financing systems in Europe to promote VET, the quota levy system. This system obliges companies to spend a certain percentage of worker salaries for VET, in accordance with the number of employees. Companies with more than ten employees must spend 1.6 per cent of their employees' gross salaries for VET programmes. Companies with fewer than ten employees are obliged to spend 0.4 per cent of gross salaries for VET programmes. If companies cannot allocate the required amount for VET (often small- and medium-sized companies), the balance will be paid by funds publicly maintained for VET (e.g. Organisme Paritaire Collecteur Agréé – OPCA). OPCAs are covenants of partnership endorsed by the state to collect and manage obligatory contributions from companies to finance VET programmes. OPCAs are created by agreements between industry and companies with equal contributions from all parties. Since 1993, 250 funds have been launched as the result of successful partnerships between the government and social partners. The fund administration rules dictate what programmes should be covered, what procedures applicants must follow, and what groups may apply to the fund. In 2001, 99 OPCAs spent €3.8 billion. About half the fund was used for VET at small- and medium-sized enterprises, about 30 per cent for young workers active in the labour market, about 15 per cent for educational leave, and 4 per cent for "Capital de temps de formation" which is a VET fund created by agreements. Many VET French experts have credited the system with increasing the rate of VET participation (Expertenkommission Finanzierung Lebenslangen Lernens, 2004, p. 159).

The United Kingdom takes a market-orientated approach in combination with promoting the National Vocational Qualifications (NVQ) system. In 1990, the Investors in People (IiP) programme was started to spur corporate investing in VET along with Government financial support. When companies join the programme and set up VET programmes according to IiP standards, they receive a certificate from the relevant authority. The programme now includes 25 per cent of all workers, or about 5.5 million individuals, and includes the participation of more than 11,000 small- and medium-sized enterprises with less than 50 employees. Between 1994 and 1995, the United Kingdom Department of Education and Skills (DfES) spent £2 million on the IiP programme.

Another VET incentive scheme is the Career Development Loan (CDL) programme. The CDL is a loan scheme for workers who wish to pursue VET programmes, and the loan

amounts range from £330 to £8,000 for up to two years. The DfES covers interest payments until workers finish paying back the loans. Between 2001 and 2002, £15 million was loaned. The CDL enables workers to take management and technical courses, National Vocational Qualification (NVQ) courses, and Open University and post-graduate programmes.

4.2. Financing in VET at small- and medium-sized enterprises

Since 2001, the Government of the United Kingdom has been promoting Small Firm Development Accounts (SFDAs), which aim to increase VET opportunities at small- and medium-sized enterprises with fewer than 50 employees. When SMEs want to secure financing for VET programmes, they must open an account at the Centre for Enterprise (CfE). SMEs can also organize VET programmes with trainers from CfE who will analyze the skills needed by each company. SMEs can receive the subsidies from the Government to run VET programmes for their employees, up to 50 per cent of the total costs of the VET programme, but not to exceed £150 per person (Expertenkommission Finanzierung Lebenlangen Lernens, 2004b, Chapter 3).

Germany takes a similar approach to promote VET at SMEs. In Brandenburg, in eastern Germany, the Government has been running a VET programme since 1992 for SMEs, called Qualifizierung in KMU. This programme aims to address unemployment problems and to advance economic restructuring after German unification. The programme covers SMEs with fewer than 250 employees. It includes innovative schemes to stabilize the labour market, including traditional skill training for production workers, business management skills for running a business in a capitalist economic context, and lifelong learning tools (called Lernzeitorganisation). The German Mining, Chemical and Energy Industrial Union (IG BCE) has partially financed a programme to assist SMEs in the chemical, rubber and paper industries to:

- introduce a systematic approach to design and develop VET programmes that complement human resources management skills;
- evaluate the effectiveness of VET programmes;
- advocate for the necessity of VET programmes for SMEs and collaborate with management to support VET programmes through:
  - the introduction of leave for skill-improvement education, in line with local law;
  - co-financing VET programmes and organization of VET programmes with local governments;
  - explaining the value of new learning arrangements and tools to management and local governments (Tarifvertrag zur Qualifizierung, also know as Qualifizierungstarifvertrag Chemie 2004).

4.3. Financing for individual learning

In the United Kingdom, Individual Learning Accounts (ILAs) were introduced nationwide in mid-2000. Ryan (2003) explained that ILAs were a striking policy innovation because individuals held accounts with a public agency in their own names to which they, the Government, and (optionally) employers made contributions to be used for learning services. ILAs constitute a partial voucher system, part of a wider policy of

encouraging individuals to increase their savings and investments through tax-free savings accounts and personal pensions funds, divorced from employer involvement (Box 4.1).

Box 4.1. Individual Learning Accounts (ILAs) in the United Kingdom

Individual Learning Accounts (ILAs) were funds held in the name of an employed adult (age 19 and above) to be used for approved learning activities, general or vocational. The Government contributed an initial £150 to each account, and the individual at least £25. Employer contributions were invited as well, to be treated as a non-taxable fringe benefit for the employee and a tax-deductible outlay by the employer (as long as all employees were eligible). A discount of 20 per cent (80 per cent for IT-related learning) was offered on course fees up to the first £500 of spending from an account. At least one in ten ILAs was to involve a priority learner category (skill shortages, SMEs, the unskilled and non-employee returners to work). ILAs performed well in volume terms: £2.5 million worth were opened during the first year, against £1 million expected. Nevertheless, the Government suspended the programme as of November 2001, citing evidence of the fraudulent use of ILAs by training providers to fund low quality courses irrelevant to individual needs, and even to milk public funds without providing any learning services at all.

Source: Paul Ryan, "Lifelong learning: Potential and constraints with special reference to policies in the United Kingdom and Europe," ILO Skills Working Paper No. 15, p. 14.

5. The role of collective agreements in VET

Social partners play important roles in promoting VET and improving workers' skills. For example, the German Federation of Chemicals Employers Associations (BAVC) and IG BCE have participated in a programme called "Qualifications Initiative for the Chemicals Industry" (QCI – Qualifizierungsinitiative Chemische Industrie) to foster VET through collective agreements. The 2004 collective agreement focuses on social partner initiatives, which enable chemical firms to have more freedom to meet their particular needs for VET. The methodology of assessing qualification demands and human resources management techniques was particularly considered. In line with a 2004 collective agreement at the industrial gas plant of Linde AG, seven qualifications in six production sites were considered and 42 new competences were created.

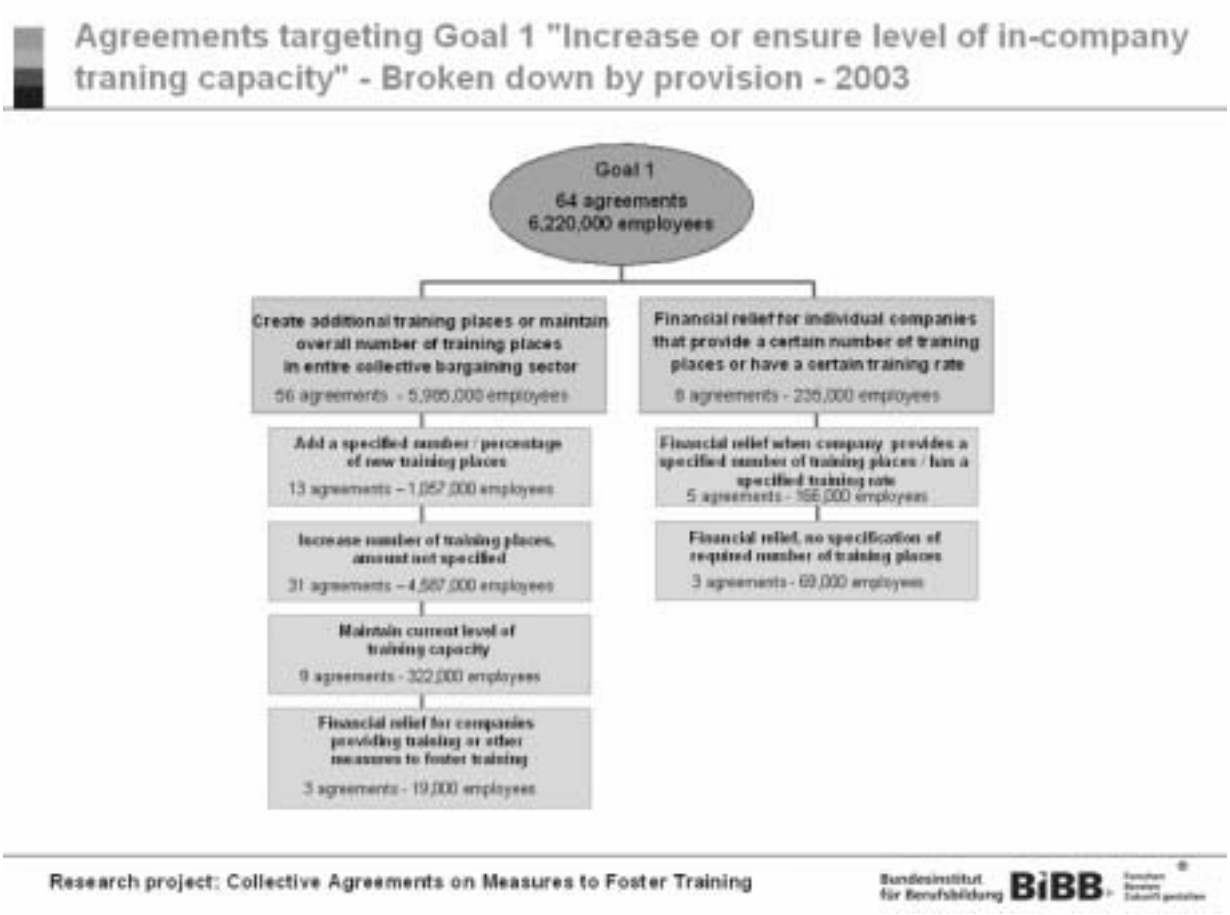
5.1. The role of collective agreements in fostering VET

Beicht and Berger (2004) emphasized the important role collective agreements can play in ensuring adequate training opportunities and increasing worker employability. In Germany, 121 collective agreements on training were developed in 2003, about twice as many as in 1996. These collective agreements applied to some 10 million workers throughout Germany, including the chemical industry.

The study sampled 64 collective agreements involving 6,220,000 workers. As figure 5.1 shows, the collective agreements demonstrate two means of promoting VET: (1) collective agreements can have stipulations to maintain or increase in-company training capacity level; and (2) agreements can secure financial resources for VET programmes by relieving the financial burden on companies when a certain number of workers participate in VET programmes. Most of collective agreements state a goal of increasing the number of training places. However, only one-quarter of the agreements specify either a concrete number of training places to be created or an overall target number of training places.

The study also found that in most cases, the respective firm had either to increase its number of training places by a certain percentage, or to achieve a specified training rate in order to qualify for financial assistance, often in the form of financial relief upon meeting the specified goal. The most common form of relief is a reduction in the amount of the training allowance the companies must pay.

Figure 5.1. Increase or ensure level of in-company training capacity – broken down by provision of the collective agreements, 2003.



5.2. How to increase in-company training places

The primary aim of collective agreements is to maintain or increase in-company training capacity levels. The chemical industry in western Germany, for example, negotiated a collective agreement to increase the number of training places on offer (box 5.1).

Box 5.1. Securing VET through collective agreements

Section 1 – Training places on offer

(1) As provided in this collective agreement, employers in the chemical industry shall undertake to increase the number of training places they offer.

(2) The size of the increase for the 2004 training year shall be 1.7 per cent of the reference number for the 2003 training year as calculated under section 3.

(3) The parties to this collective agreement shall take up negotiations on the question of future increases through the year 2007 in conjunction with the respective round of wage negotiations.

Section 2 – Supporting measures

(1) The implementation of this obligation shall be coordinated at the national level and supported through the use of suitable measures that are in line with conditions in the respective company and region, and that actively incorporate the regional round table for labour market issues. Supplementary to this collective agreement, the parties hereto have issued separate recommendations for such measures.

(2) Employers and works councils may arrange for deviating training allowances in order to harmonize differences in training allowances within training networks when this is done in accordance with

section 76, paragraph 6, of the Industrial Constitution Act (Betriebsverfassungsgesetz) and with the approval of the parties to the collective agreement.

Section 3 – Base numbers

(1) For the purposes of this collective agreement, a training place on offer is the advertising of a training contract or the offering of a training contract to an individual applicant for trainees as defined by the Vocational Training Act. Students enrolled in "dual" courses of study (courses of study that are integrated into vocational training programmes, colleges of advanced vocational studies, or commercial colleges) and the programs complete a contract for measures aimed at preparing youth for vocational training or at integrating them, including measures under the collective agreement to foster the integration of young people. This also includes training places offered by training facilities on behalf of enterprises in the chemical industry or an employers' association in the chemical sector.

(2) The reference number under section 1 for the entire 2003 training year shall be calculated using a standardized method for the geographical area covered by this collective agreement. Employers shall be required to report the number of training places they have on offer for the 2003 training year to their employers' association by 31 October 2003. After coordinating the results with respective state districts, the employers' associations shall forward them to the parties of the national collective bargaining agreement. These parties shall determine the binding base numbers in December 2003.

(3) The number of training places on offer in the following training years shall be determined correspondingly.

Section 4 – Standard rule

Should the number of training places made available for the 2004 training year fall short of the number committed to under section 1, the parties to this collective agreement shall immediately enter into negotiations with the aim of improving the number of training places on offer.

Source: Beicht and Berger, "Current trends in collective agreements aimed at fostering training," Federation Institute for Vocational Training (BIBB), Germany, 2004.

5.3. Time account

The German collective agreement allows the trade union and the company to decide how VET will be organized. The agreement also includes contingencies for restructuring. The German chemical collective agreement has introduced a "time account" for the purpose of VET. Time accounts are used for contingencies such as plant closures and corporate restructuring, and funds for them are collected from workers' overtime pay or supplementary allowances. Tax and social security contributions on this payment are exempted. Where a long-standing time account system exists in a given chemical company, such resources can be used for higher education.

Key features of VET programmes in the collective agreement between BAVC and IG BCE in the German chemical industry include:

- Widening the definitions of competences and skills needed for work so VET programmes can operate flexibly at the company level to meet current and future needs in accordance a company's circumstances
- Introducing a cost-sharing arrangement between workers and management on VET programmes in limited circumstances
- Expanding the use of outside VET consulting services and specialized VET institutions when VET programmes are needed immediately
- Introducing time account rules for organizing VET to avoid further costs to chemical companies (BAVC/IG BCE, 2003a).

6. Conclusion

Why do highly skilled workers matter so much to the chemical industry? The chemical industry is a key industry in most countries. It is strategic, as it supplies chemical products to other key manufacturing industries. This relationship underpins its importance to the sustainable development of national economies. The growth of the chemical industry is an indicator of the development of national economies. High tech chemical products are not only essential to ensure high investment returns to shareholders, but also a driving force to further advance the chemical industry. To survive the keen competition in the globalized chemical business, chemical firms require highly qualified workers.

In Europe, the chemical industry remains a key industry. Although total production has been gradually decreasing, the chemical industry in the 25 European Union Member States sold almost €600 billion in 2004, which was the higher than any other region. This is due to the industrial structure of the European chemical industry. High value-added sectors dominate in the sectoral breakdown of total sales in the European chemical industry, with specialty, fine chemicals and pharmaceuticals contributing nearly half of total sales. In order to continue profitability, high value-added sectors need to grow. These segments of the European chemical industry have the greatest need for highly qualified workers.

In the European chemical industry, about 56 per cent of workforce is between the ages of 35 and 54. The most common occupations in the European chemical industry are plant and machine operators and assemblers (24.9 per cent) and technical and associate professionals (24.1 per cent). By contrast, in the overall manufacturing industries, over 40 per cent are line workers. These figures illustrate the importance of higher level of skills in the European chemical industry. However, concern is growing about the decreasing number of well-qualified chemicals graduates, which has fallen by around 10 per cent since 1996. The possibility exists that these shortages will become much more serious over the next five years.

Demand for highly-skilled workers is a complex phenomenon, and varies from production workers to knowledge workers. First, production workers need to improve their qualifications to meet the higher levels of skill and knowledge qualifications needed to perform their work. The United Kingdom chemical workforce that is qualified to the National Vocational Qualification (NVQ) Level 2 accounts for about 70 per cent of the overall production workforce. These workers need to improve their qualification levels.

Second, the ability to multi-task and to apply multiple skills has become a daily work requirement for knowledge workers in the European chemical industry. These workers need to acquire additional theoretical knowledge and pragmatic skills to apply this knowledge to innovative ways of delivering high value-added results. The scope of competence for these knowledge workers has been expanding. Teamwork has also become a norm in the work organization. Knowledge workers need to acquire a broader range of management, leadership and communication skills to work effectively and productively with team members. They also need to become more familiar with overall production processes and methods.

Overall, skills needed by workers are increasingly determined by customer needs. The industry desires those skills and areas of expertise that enable chemical firms to develop more competitively priced products and to be able to manage pressure from competitors and demands from customers. As the market evolves, the skills required by the market will change, so therefore workers must adapt to the realities of “no job for life, and no skills for life”. As companies constantly adapt to meet the needs of the marketplace, chemical

workers must also increase their adaptability and flexibility in order to maintain their value over their working lifetimes. They must keep their skill base competitive.

Examples of VET policies from European chemical firms show that no universally effective VET strategy exists to keep the workforce updated to the highest levels. VET policies differ from country to country, and from one chemical company to another. For example, Akzo Nobel puts its VET policy emphasis on meeting local needs. The world's largest oil and chemical multinational firm, BASF, is trying to promote VET throughout its global operations by e-learning.

In contrast, medium-sized European chemical firms are attempting to improve their employees' competencies by devising human resources management systems that link employee competencies with a personnel appraisal system. In some companies, in-house standardized VET programmes are available throughout the global corporate network, simplifying the task of finding the best-qualified employees anywhere in the company. National borders are increasingly irrelevant with respect to VET programmes within companies. Relatively smaller multinational chemical firms place quality control at the centre of VET. They also emphasize organizational learning to maximize the benefits of institutionalizing the knowledge and experiences of individuals amongst a broad range of employees. Organizational learning benefits companies by increasing the transparency of skill availability and thereby the mobility of the workforce. This enables companies to create flexible human resources management systems, and allows companies to optimize job matching and competence.

Another issue for the European chemical industry is how VET operates in small- and medium-sized chemical firms. These firms are the backbone of the European chemical industry, with micro-chemical firms accounting for 61 per cent in the European chemical industry in 2004. For these firms, recruiting a highly skilled workforce is the greatest challenge. Small- and medium-sized European chemical firms have benefited most from lifelong learning programmes that improve workers' basic skills with a smaller financial burden to the company.

Standardization of competencies in the European Union may also help the European chemical industry address the shortage of skilled workers. However, it is too early to assess the EU's attempts to standardize qualifications. The core standardization of qualifications is at the heart of the European Credit Transfer System for Vocational Education and Training (ECVET), which is still under discussion at the EU. The chemical industry is assessing how the European Credit Transfer System (ECTS) for Higher Education and the ECVET will benefit the industry. At a minimum, it is expected improve the mobility of chemicals graduates throughout the Europe and contribute to the resolution of the high-skills shortage in the chemical industry.

Sustainable VET depends on the availability and management of financial resources. One common VET financing system in Europe is the quota levy system. In France, all enterprises are obliged to allocate and spend a certain percentage of workers' wages for VET. By contrast, the United Kingdom takes an incentive approach to financing VET, appealing to the industry's pursuit of increased effectiveness and quality. VET funding systems in the United Kingdom attempt to be efficient and effective. They are not unduly complex to operate and funds flow easily between the funding body and the training providers, and they are designed to have the effect that the Government desires.

Examples from the German chemical industry illustrate two important roles that collective agreements between workers and management play in promoting VET. The primary goal is to maintain or increase VET training capacity levels by increasing the number of training places. Another goal is the assurance of financial resources, thus reducing the initial financial burden on companies. Through collective agreements, chemical companies that provide VET are eligible for financial relief upon meeting

requirements regarding the number of workers they train. Companies have to increase the number of training places by a certain percentage or achieve a specified training rate in order to qualify for the relief, which usually comes through a reduction in the amount of the training allowance they have to pay. Because collective agreements are an accord between workers and management, good industrial relations will tend to foster the best practices in VET. Striving for good industrial relations is one of the primary mandates of the ILO's Decent Work Agenda to promote social dialogue. Findings in this study indicate that further strengthening this social dialogue in the chemical industry will foster VET.

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Appendix 1

Joint Position Paper on Education, Vocational Training and Lifelong Learning in the European Chemical Industry between the European Chemical Employers Group (ECEG) and the European Mine, Chemical and Energy Workers' Federation (EMCEF)

Joint Position Paper on Education, Vocational Training and Lifelong Learning in the European Chemical Industry

The European Chemical Employers Group (ECEG) and the European Mine, Chemical and Energy Workers Federation (EMCEF)

having in mind that

- the European chemical industry
  - ranks first by size in the world,
  - is the second largest industrial sector in Europe,
  - employs 2 million people directly in Europe and an even larger number of employees are dependent on the chemical industry indirectly,
  - is composed as well of large multinational companies as of many successful small and medium sized entities,
  - has a positive trade balance, playing a key role for the export position of the European economy as a whole,
  - contributes by its innovations and activities to the success of many other sectors and the European economy as a whole,
  - is one of the sectors that develops voluntary commitments in order to promote continuous improvements in health, safety and environment
- the chemical industry has one of the highest proportions of knowledge based/intelligence intensive work places, a higher proportion of highly educated and trained staff than most other manufacturing industries and not only very large and innovative research and development operations, but also a high need for well trained, responsible staff in all of its operations due to its sophisticated production processes in many areas. This need is already reflected in the continuous commitment of the industry through its voluntary Responsible Care programme and is as well already addressed by companies, employees and their representatives in many ways, which was highlighted in 2003 by the memorandum of understanding signed by **ECEG**, **EMCEF** and CEFIC on Responsible Care and the foundation of a "Joint Monitoring Group Responsible Care". One of the tasks of this Group is to exchange information on training schedules and programmes for employees in Health, Safety, and environmental areas.
- a lack of skills is already faced by the chemical industry, at least in some European countries and in some areas of the industry, as a reality, despite the high levels of unemployment in many European countries. **EMCEF** and **ECEG** believe such shortages hinder economic growth as well as positive developments of European labour markets. They might indeed become a danger to the so-called Lisbon-Goals agreed upon at the Lisbon Council in 2000 to make the "European Union the most competitive and dynamic knowledge-based economy in the world, capable of economic growth with more and better jobs and greater social cohesion".
- this being even more the case as future demands for qualifications of employees of the chemical industry will rise continuously. The proportion of higher qualified staff has already risen during the last decades, and this development will continue and might even be accelerated further. Changes in technology used at workplaces are increasingly frequent, organization of the working process changes more often, and therefore also the way to work is

subject to frequent alterations. This highlights the need for an even more flexible structure within the companies, which itself is again the reason for an increase in the demand for highly qualified staff. An positive attitude towards processes of lifelong-learning will be necessary for the industry as well as for employees in order to secure future success of the sector as a whole within the European economy as well as the employability of its employees.

declare their common interest in highlighting the importance of high education levels, good standards of vocational training and a commitment of industry and employees to further vocational training and lifelong learning throughout the entire working life in order to secure the innovative strength of the industry as well as the employability of the actual and possible future employees of the industry.

ECEG and **EMCEF** agree that joint action on these subjects has to be promoted. Thereby they identify tasks both for the industry and the employees and their respective representatives – on company level, regional, national and European level. Furthermore there are tasks to be dealt with by public or semi-public institutions, if possible together with the Social Partners, which has to be decided on the basis of the different national systems and traditions in this area within the European Union.

Image of the chemical industry

It is important that conditions are created to avoid prejudicial policies towards the development of the chemical industry and to strengthen the positive image of chemical industry to the general public and to the youth in particular; an open and transparent policy and communication from the chemical industry can help to achieve this.

General education – schools and universities

A first area for action is the general education in schools and universities as well as the specific education in chemicals and other natural sciences.

Here, of course, one of the key tasks for the public institutions in the individual member countries is to secure a high level of general education for all citizens as well as an open and fair approach of this education towards natural sciences, technology in general, a basic understanding of economic developments and good standards in communication skills.

National employers organizations and unions as well as CEFIC and many individual companies are already offering support to schools, universities and individual teachers in this area in order to improve education programs, teaching material and technical knowledge of the teachers. ECEG and EMCEF consider that these programmes should be continued and intensified wherever possible.

A reinforced exchange of experience between the partners of such programmes across Europe should be an aim of all participants, in order to allow good practice and successful strategies to penetrate into as many projects as possible.

Vocational education and training, lifelong learning

ECEG and EMCEF are both convinced that vocational training, regularly and appropriate further training and lifelong learning over the entire working life is essential, not only for companies in order to maintain successful, productive and efficient, but also for each employee in order to maintain his or her employability.

Employers within the European chemical industry therefore have a strong interest in offering opportunities for their employees for an initial as well as further vocational training in accordance with the requirements of the specific jobs dealt with by the employees and to motivate employees to participate in this training.

Employees within the European chemical industry have the same strong interest in looking after their individual vocational skills and in investing in these qualifications in order to keep their employability at the highest possible level.

ECEG and EMCEF and their respective national affiliates will support both employers and employees in these processes, which are marked by a shared responsibility.

They both ask for better, more transparent and flexible frameworks regarding European and national regulations governing vocational training and education as well as for the public funding supporting the activities in these areas.

Joint working group

ECEG and EMCEF have decided that a Working Party should analyse the following subjects in more detail, possibly including the writing of a report on these subjects:

- a more in-depth analysis of the status quo regarding skills, qualifications, vocational (further) training and lifelong learning within the industry;
- an exchange of information and good practice of the different national systems of education, vocational (further) training and lifelong learning in order to support the further development in these areas.

Helsinki, 10th September 2004

ECEG Hans Paul Frey President	EMCEF Hubertus Schmoldt President
Paul Clerinx Chairman Steering Committee	Reinhard Reibsch General Secretary

Appendix 2

Definitions

Skills definitions are used for this paper are as follows.

Assessment of skills: Classification ISCED 1997

To assess the level of skills acquired through formal education the international standard classification of education (ISCED) is used in the EU Labour Force Survey, which is:

- ISCED 0 – PRE-PRIMARY EDUCATION: Programmes at level 0 (pre-primary) defined as the initial stage of organized instruction. Upon completion of these programs, children continue their education at level 1 (primary education).
- ISCED 1 – PRIMARY EDUCATION OR FIRST STAGE OF BASIC EDUCATION: Programmes at level 1 is designed on a unit or project basis to give students a sound basic education in reading, writing and mathematics along with an elementary understanding of other subjects such as history, geography, natural science, social science, art and music. In some cases, religious instruction is featured. The core at this level consists of education provided for children, the customary or legal age of entrance being not younger than five years or older than seven years. This level covers, in principle, six years of full-time schooling.
- ISCED 2 – LOWER SECONDARY EDUCATION OR SECOND STAGE OF BASIC EDUCATION: The contents of education at this stage are typically designed to complete the provision of basic education which began at ISCED level 1. In many, if not most countries, the primary educational aim is to lay the foundation for lifelong learning and human development. The programmes at this level are based on a more subject-oriented pattern using more specialized teachers and more often several teachers conducting classes in their field of specialization.
- ISCED 3 – (UPPER) SECONDARY EDUCATION: This level of education typically begins at the end of full time compulsory education for those countries that have a system of compulsory education. More specialization may be observed at this level than at ISCED level 2 and often teachers need to be more qualified or specialized than for ISCED level 2. The entrance age to this level is typically 15 to 16 years. The educational programmes included at this level typically require the completion of some 9 years of full-time education (since the beginning of level 1) for admission or a combination of education and vocational or technical experience.
- ISCED 3A: Programmes designed to provide direct access to ISCED 5A;
- ISCED 3B: Programmes designed to provide direct access to ISCED 5B;
- ISCED 3C: Programmes not designed to lead to ISCED 5A or 5B.
- ISCED 4 – POST-SECONDARY NON TERTIARY EDUCATION
- ISCED 4 captures programmes that straddle the boundary between upper secondary and post-secondary education from an international point of view, even though they might clearly be considered as upper secondary or post-secondary programmes in a national context. These programmes are not regarded as tertiary programmes. They are often not significantly more advanced than programmes at ISCED 3 but they serve to broaden the knowledge of participants who have already completed a programme at level 3. Typical examples are programmes designed to prepare students for studies at level 5 who, although having completed ISCED level 3, did not follow a curriculum which would allow entry to level 5, i.e. pre-degree foundation courses or short vocational programmes. Second cycle programmes can be included as well.
- ISCED 4A: See text for ISCED 3
- ISCED 4B: See text for ISCED 3
- ISCED 4C: See text for ISCED 3

- LEVEL 5 – FIRST STAGE OF TERTIARY EDUCATION (NOT LEADING DIRECTLY TO AN ADVANCED RESEARCH QUALIFICATION): This level consists of tertiary programmes having an educational content more advanced than those offered at levels 3 and 4. Entry to these programmes normally requires the successful completion of ISCED level 3A or 3B or a similar qualification at ISCED level 4A. They do not lead to the award of an advanced research qualification (ISCED 6). These programmes must have a cumulative duration of at least two years.
- ISCED 5A: Programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements.
- ISCED 5B: Programmes that are practically oriented/occupationally specific and are mainly designed for participants to acquire the practical skills and know how needed for employment in a particular occupation or trade or class of occupations or trades, the successful completion of which usually provides the participants with a labour market relevant qualification
- ISCED 6 – SECOND STAGE OF TERTIARY EDUCATION (LEADING TO AN ADVANCED RESEARCH QUALIFICATION): This level is for the tertiary programmes which lead to the award of an advanced research qualification. The programmes are therefore devoted to advanced study and original research and not based on course-work only. They typically require the submission of a thesis or dissertation of publishable quality which is the product of original research and represents a significant contribution to knowledge. They prepare graduates for faculty posts in institutions offering ISCED 5A programmes, as well as research posts in government, industry, etc.

For more information, consult with http://forum.europa.eu.int/irc/dsis/employment/info/data/eu_lfs/Related_documents/ISCED_EN.htm and http://www.uis.unesco.org/TEMPLATE/pdf/isced/ISCED_A.pdf.

Variations of ISCEDs

Because the above education standards (variable ISCED2D) are relatively new and it has been only available since 1998, the following training standards (variable ISCED1D) are still often used.

ISCED1D	Highest level of education or training successfully completed	ISCED level
Low	At most lower secondary	ISCED 0-2
Medium	Upper secondary	ISCED 3-4
High	Tertiary	ISCED 5-6

Source: http://forum.europa.eu.int/irc/dsis/employment/info/data/eu_lfs/Related_documents/ISCED_EN.htm (19/10/2005).

"Job type": ISCO-88

According to Eurostat, a "job" can be defined "… a set of tasks and duties executed, or meant to be executed, by one person. […] A set of jobs whose main tasks and duties are characterized by a high degree of similarity constitutes an occupation." (http://europa.eu.int/comm/eurostat/ramon/documents/isco_88/ISCO_88_intro.pdf (19.10.2005))

In the context of this study, "job type" is regarded as equivalent to occupation. In the EU Labour Force Survey, occupations are classified according to the international standard classification of occupations ISCO.

ISCO is not only based on the concept of "job" but also on the concept of "skill", which comprises both skill level and skill specialization. ISCED categories have been used in order to define four broad ISCO skill levels (cf. table below). Still, this does not exclude that skills necessary to perform the tasks and duties of a given job have actually been acquired through informal training and experience.

ISCO major groups		ISCO skill level
1.	Legislators, senior officials and managers	Not available
2.	Professionals	4th
3.	Technicians and associate professionals	3rd
4.	Clerks	2nd
5.	Service workers and shop and market sales workers	2nd
6.	Skilled agricultural and fishery workers	2nd
7.	Craft and related trades workers	2nd
8.	Plant and machine operators and assemblers	2nd
9.	Elementary occupations	1st

Source: Eurostat, http://europa.eu.int/comm/eurostat/ramon/documents/isco_88/ISCO_88_intro.pdf (19.10.2005).

Sectoral working papers [1]

	Year	*Reference*
The Warp and the Web Organized production and unorganized producers in the informal food-processing industry: Case studies of bakeries, savouries' establishments and fish processing in the city of Mumbai (Bombay) (Ritu Dewan)	2000	WP.156
Employment and poverty in Sri Lanka: Long-term perspectives (Vali Jamal)	2000	WP.157
Recruitment of educational personnel (Wouter Brandt and Rita Rymenans)	2000	WP.158
L'industrie du textile-habillement au Maroc: Les besoins des chefs d'entreprise et les conditions de travail des femmes dans les PME (Riad Meddeb)	2000	WP.159
L'évolution de la condition des personnels enseignants de l'enseignement supérieur (Thierry Chevaillier)	2000	WP.160
The changing conditions of higher education teaching personnel (Thierry Chevaillier)	2000	WP.161
Working time arrangements in the Australian mining industry: Trends and implications with particular reference to occupational health and safety (Kathryn Heiler, Richard Pickersgill, Chris Briggs)	2000	WP.162
Public participation in forestry in Europe and North America: Report of the Team of Specialists on Participation in Forestry	2000	WP.163
Decentralization and privatization in municipal services: The case of health services (Stephen Bach)	2000	WP.164
Social dialogue in postal services in Asia and the Pacific: Final report of the ILO-UPU Joint Regional Seminar, Bangkok, 23-26 May 2000 (Edited by John Myers)	2000	WP.165
Democratic regulation: A guide to the control of privatized public services through social dialogue (G. Palast, J. Oppenheim, T. McGregor)	2000	WP.166
Worker safety in the shipbreaking industries: An issues paper (Sectoral Activities Department and InFocus Programme on Safety and Health at Work and the Environment)	2001	WP.167
Safety and health in small-scale surface mines – A handbook (Manfred Walle and Norman Jennings)	2001	WP.168

[1] Working Papers Nos. 1-155 are not included on this list for reasons of space, but may be requested from the Sectoral Activities Branch (SECTOR), Social Dialogue, Labour Law, Labour Administration and Social Activities Department, Social Dialogue Sector, International Labour Office (ILO).

	Year	*Reference*
Le rôle des initiatives volontaires concertées dans la promotion et la dynamique du dialogue social dans les industries textiles, habillement, chaussure (Stéphanie Faure)	2001	WP.169
The role of joint voluntary initiatives in the promotion and momentum of social dialogue in the textile, clothing and footwear industries (Stéphanie Faure)	2001	WP.170
La situation sociale des artistes-interprètes de la musique en Asie, en Afrique et en Amérique latine (Jean Vincent)	2001	WP.171
The social situation of musical performers in Asia, Africa and Latin America (Jean Vincent)	2001	WP.172
Guide sur la sécurité et hygiène dans les petites mines à ciel ouvert (Manfred Walle and Norman Jennings)	2001	WP.173
Seguridad y salud en minas de superficie de pequeña escala: Manual (Manfred Walle and Norman Jennings)	2001	WP.174
Privatization of municipal services: Potential, limitations and challenges for the social partners (Brendan Martin)	2001	WP.175
Decentralization and privatization of municipal services: The perspective of consumers and their organizations (Robin Simpson)	2001	WP.176
Social and labour consequences of the decentralization and privatization of municipal services: The cases of Australia and New Zealand (Michael Paddon)	2001	WP.177
1st European Forest Entrepreneurs' Day, September 16, 2000 (European Network of Forest Entrepreneurs ENFE)	2001	WP.178
The world tobacco industry: trends and prospects (Gijsbert van Liemt)	2002	WP.179
The construction industry in China: Its image, employment prospects and skill requirements (Lu You-Jie and Paul W. Fox)	2001	WP.180
The impact of 11 September on the aviation industry (Peter Spence Morrell and Fariba Alamdari)	2002	WP.181
The impact of 11 September on the civil aviation industry: Social and labour effects (Prof. Peter Turnbull and Geraint Harvey)	2002	WP.182
Employment trends in the tobacco sector in the United States: A study of five states (Maureen Kennedy)	2002	WP.183
Tobacco: An economic lifeline? The case of tobacco farming in the Kasungu Agricultural Development Division, Malawi (Michael Mwasikakata)	2002	WP.184
A study of the tobacco sector in selected provinces of Cambodia and China (Yongqing He, Yuko Maeda, Yunling Zhang)	2002	WP.185

	Year	*Reference*
Child performers working in the entertainment industry: An analysis of the problems faced (Katherine Sand)	2003	WP.186
Informal labour in the construction industry in Nepal (Kishore K. Jha)	2002	WP.187
The construction labour force in South Africa: A study of informal labour in the Western Cape (Jane English and Georg Mbuthia)	2002	WP.188
Social dialogue in health services – Case studies in Brazil, Canada, Chile, United Kingdom (Jane Lethbridge)	2002	WP.189
Teachers and new ICT in teaching and learning modes of introduction and implementation impact implications for teachers (Chris Duke)	2002	WP.190
Best practice in social dialogue in public service reform: A case study of the Norwegian Agency for Development Co-operation (NORAD) (Torunn Olsen)	2002	WP.191
Best practice in social dialogue in public service emergency services in South Africa (Bobby Mgijima)	2003	WP.192
Case studies in social dialogue in the public emergency services – Argentina (Laura El Halli Obeid and Liliana Beatriz Weisenberg)	2003	WP.193
Employment trends in the tobacco sector: Selected provinces of Bulgaria and Turkey (Roska Ivanovna Petkova and Nurettin Yildirak)	2003	WP.194
How to prevent accidents on small construction sites (Illustrated by Rita Walle)	2003	WP.195
Sectoral trends: A survey (Katherine A. Hagen)	2003	WP.196
The impact of the restructuring of civil aviation on employment and social practices (Bert Essenberg)	2003	WP.197
Raising awareness of forests and forestry. Report of the FAO/ECE/ILO Team of Specialists on Participation in Forestry and the FAO/ECE Forest Communicators Network	2003	WP.198
Teaching and the use of ICT in Hungary (Eva Tót)	2003	WP.199
Violence and stress at work in the postal sector (Sabir I. Giga, Helge Hoel and Cary L. Cooper)	2003	WP.200
Violence and stress at work in the performing arts and in journalism (Sabir I. Giga, Helge Hoel and Cary L. Cooper)	2003	WP.201
Making ends meet: Bidi workers in India today. A study of four states	2003	WP.202
Civil aviation: The worst crisis ever? (Bert Essenberg)	2003	WP.203

	Year	*Reference*
Informal labour in the construction industry in Kenya: A case study of Nairobi (Winnie V. Mitullah and Isabella Njeri Wachira)	2003	WP.204
Violence and stress at work in the transport sector (Bert Essenberg)	2003	WP.205
The impact of Severe Acute Respiratory Syndrome (SARS) on health personnel (Christiane Wiskow)	2003	WP.206
How we work and live. Forest workers talk about themselves (Bernt Strehlke)	2003	WP.207
Workplace violence in service industries with implications for the education sector: Issues, solutions and resources (Richard Verdugo and Anamaria Vere)	2003	WP.208
International migration of health workers: Labour and social issues (Stephen Bach)	2003	WP.209
Violence and stress at work in financial services (Sabir I. Giga, Helge Hoel and Cary L. Cooper)	2003	WP.210
Violence and stress in hotels, catering and tourism sector (Helge Hoel and Ståle Einarsen)	2003	WP.211
Employment and human resources in the tourist industry in Asia and the Pacific (Travel Research International, London)	2003	WP.212
Democracy and public-private partnerships (Jerrold Oppenheim and Theo MacGregor)	2003	WP.213
Social dialogue in the public emergency services in a changing environment (Bulgaria) (Pavlina Popova)	2003	WP.214
Training of machine operators for mechanized wood harvesting. A study carried out under the EU-funded ERGOWOOD project (Bernt Strehlke and Kristin Warngren)	2004	WP.215
Social dialogue in the public emergency services in a changing environment (Bulgaria) – pdf, 150k (Pavlina Popova)	2004	WP.216
Public emergency services: Social dialogue in a changing environment: A study on Japan (Minawa Ebisui)	2004	WP.217
Academic tenure and its functional equivalent in post secondary education (Donald C. Savage)	2004	WP.218
Study of the Kerala Construction Labour Welfare Fund (R.P. Nair)	2004	WP.219
The Joint FAO/ECE/ILO Committee: Fifty years of international cooperation in forestry (T.J. Peck and E.G. Richards)	2004	WP.220
La permanence et son équivalent fonctionnel dans l'enseignement postsecondaire (Donald C. Savage)	2004	WP.221
Academic employment structures in higher education: The Argentine case and the academic profession in Latin America (Garcia de Fanelli)	2004	WP.222

	Year	*Reference*
An introduction to labour statistics in tourism (Dirk Belau)	2004	WP.223
Labour implications of the textiles and clothing quota phase-out (Hildegunn Kyvik Nordas)	2005	WP.224
Baseline study of labour practices on large construction sites in Tanzania (coordinated by the National Construction Council, Dar es Salaam)	2005	WP.225
Informal construction workers in Dar es Salaam, Tanzania (Arthur Jason)	2005	WP.226
Prospects for micro, small and medium enterprises in the food and drink industries in Guyana (Abdul Rahim Forde)	2005	WP.227
Alimentation et boisson au Burkina Faso: au delà de la survie (Dié Martin Sow)	2005	WP.228
Social dialogue in education in Latin America: A regional survey (Marcela Gajardo and Francisca Gómez)	2005	WP.229
Good industrial relations in the oil industry in the United Kingdom (Dr. Chris Forde, Dr. Rob MacKenzie, Dr. Mark Stuart, Dr. Rob Perrett)	2005	WP.230
The future of civil aviation in Africa: Restructuring and social dialogue (Bert Essenberg)	2005	WP.231
The issues of fatigue and working time in the road transport sector	2005	WP.232
Privatization of energy in the Argentine Republic	2005	WP.233
Social dialogue in the health sector: Case study Ghana (Dr. Delanyo Y. Dovlo)	2005	WP.234
Social dialogue in the health sector: Case study Bulgaria (Dr. L. Tomev, Dr. N. Daskalova, Ms. T. Mihailova)	2005	WP.235
Social dialogue in the health sector: Case study Philippines (Institute of Health and Policy and Development Studies, Manila)	2005	WP.236
Industrial relations in the oil industry in Nigeria (Sola Fajana)	2005	WP.237
Industrial relations in the oil industry in South Africa (Shirley Miller and Tanya van Meelis)	2005	WP.238
Industrial relations in the oil industry in Mexico (Carlos Reynoso Castillo)	2005	WP.239
Corporate structural change and social dialogue in the chemical industry (Yasuhiko Kamakura)	2006	WP.240
Privatización de la energía en la Republica Argentina Perdidas y Ganancias (Asociación del Personal Jerárquico del Agua y la Energía, APJAE)	2006	WP.241
Vocational education and training in the chemical industry in Germany and the United Kingdom (Steffen A. Rogalski)	2006	WP.242