Chapter 6

ICT SKILLS AND EMPLOYMENT

Two measures of ICT-skilled employment are developed in this chapter, one covering ICT specialists only and one that also includes basic and advanced intensive users of ICTs. The share of these two measures in total employment is calculated by industry. Many services industries have a very large share of such broadly defined ICT-skilled employment, as do certain manufacturing industries. The ICT-skilled employment share is also associated with higher levels of productivity. Four ways in which ICT skills needs can be satisfied, namely through education, training, outsourcing and immigration are examined, and the role of Internet recruitment is also considered.

Introduction

This chapter examines the diffusion of ICTs from the perspective of skills and employment.[1] It first builds up a picture of the demand for ICT skills across economic sectors, particularly those that employ people with ICT skills relatively intensively. In changing ways in which business is carried out, ICTs have led to productivity gains and new employment opportunities, with new demands in terms of workers' skills. In the past, the use of ICTs has often been measured in terms of ICT investment. Here it is investigated through actual use, *i.e.* by measuring the share of each sector's workforce that is likely to use ICTs directly to produce output. The chapter then addresses the supply of ICT skills, in particular the ways in which ICT skills needs can be satisfied: education and training, but also outsourcing and immigration. Finally it draws attention to Internet recruitment, which brings together ICT skills, use of ICTs and finding employment and filling jobs.

ICT skills: where in the economy are they found?

The following discussion takes a new approach to capturing the diffusion of ICTs throughout the economy by examining the level of their use and identifying the sectors that employ people with ICT skills relatively intensively. Two definitions of ICT skills are used, approximated by occupational data. One is narrow and corresponds to the first category of ICT skills described in Box 6.1, and one is broad and attempts to capture all three of the competency levels (*i.e.* ICT specialists as well as basic and advanced ICT users). These measures are then used to classify industrial sectors according to their share of ICT-skilled employment. The section concludes with a brief examination of these sectors' performance, relating the ICT-skilled employment measure to a productivity measure.

ICT-*skilled employment*

Methodology and classification

ICT-using sectors are identified here by their employment of ICT-skilled personnel, *i.e.* by the level of their actual ICT usage, rather than by investment in ICT capital. Industries are then grouped according to the ICT-skills specialisation of their workforce, or the industry's share of ICT-skilled employment (see van Welsum and Vickery, 2004).

The term "ICT employment" can be interpreted in two ways: *i*) employment in industries traditionally identified as belonging to the ICT sector (all occupations, even those with no use of ICTs); and *ii*) employment in occupations that use ICTs to various degrees across all industries. The focus here is on the latter.

The standard list of ICT occupations used to date in OECD publications[2] (previous editions of the *Information Technology Outlook*, the STI *Scoreboard* and *Measuring the Information Economy*), roughly refer to the first category (ICT specialists). The approach taken here in the broad definition is a first attempt to identify the sum of the three levels of ICT skills, *i.e.* both ICT specialists and advanced and basic ICT users. However, in the absence of formal guidance as to ICT content in the various occupational classifications used by countries, which are used to approximate skills,[3] occupations were chosen on the basis of an assessment of the degree to which workers are expected to use ICTs for their own output/production.[4]

The way in which ICT and/or IT occupations have been defined in other studies is illustrated in Annex Tables C.6.9 and C.6.17-to C.6.21. To be consistent with previous OECD publications, the

Box 6.1. Defining ICT skills

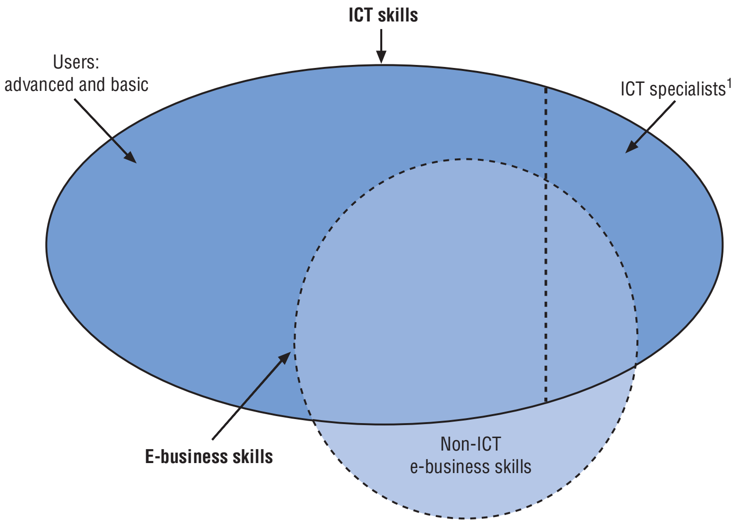
There is currently no commonly adopted definition of ICT skills, but efforts are ongoing to characterise the various types of ICT skills, for example through the European e-Skills Forum (2004). It is important to bear in mind that while the term "skills" refers to a set of capabilities, it may have different meanings for an employer or a jobseeker. We propose to distinguish three categories of ICT competencies:

1. ICT *specialists*, who have the ability to develop, operate and maintain ICT systems. ICTs constitute the main part of their job.
2. *Advanced users*: competent users of advanced, and often sector-specific, software tools. ICTs are not the main job but a tool.
3. *Basic users*: competent users of generic tools (*e.g.* Word, Excel, Outlook, PowerPoint) needed for the information society, e-government and working life. Here too, ICTs are a tool, not the main job.

Thus, the first category covers those who supply the tools, and the second and third categories those who use them. This chapter uses the first category for the narrow measure of ICT-skilled employment, and the sum of all three categories for the broad measure of ICT-skilled employment.

Finally, the term "*e-business skills*" is increasingly used. It refers to skills that are needed to exploit the business opportunities provided by ICTs, and in particular the Internet, to explore possibilities for new ways of conducting business, to enhance the efficiency of various types of organisations, and perhaps even to establish businesses (European e-Skills Forum, 2004). These skills play an increasingly important role in a company's competitiveness (see Chapter 3) and include both ICT specialist and ICT user skills, as well as non-ICT e-business skills (*e.g.* managerial and organisational skills).

The image below synthesises and combines the above descriptions of ICT skills:



1. Includes programmers, but also equipment and cable fitters, for example.

standard list of ICT occupations is used here for Europe and the United States for the narrow definition of ICT-skilled workers (similar to the ICT specialists group of Box 6.1) with some minor changes to the US list. The broad definition adds those who can be considered as advanced and generic users (see the tables in Annex C for details).

- Europe

The section on ICT employment across the economy and Figure 1.16 in Chapter 1 show that ICT-skilled employment has generally increased in EU15 countries under both the narrow and broad definitions (see Annex Table C.6.1 for a list of occupations included in these two measures). In 2002, the narrow share of ICT-skilled employment was comprised between 2.4% (Greece) and 5.0% (Sweden), and the share of broad ICT-skilled employment between 13.5% (Portugal) and 27.6% (United Kingdom).

Data from the European Labour Force Survey for 2002 are used to calculate the intensity of ICT-skilled employment by industry (using the three-digit ISCO88 classification and the two-digit Classification of Economic Activities in the European Community – NACE). The intensity of ICT-skilled employment is defined as the ratio of those employed under the narrow or broad definitions in an industry to total employment in the industry.[5]

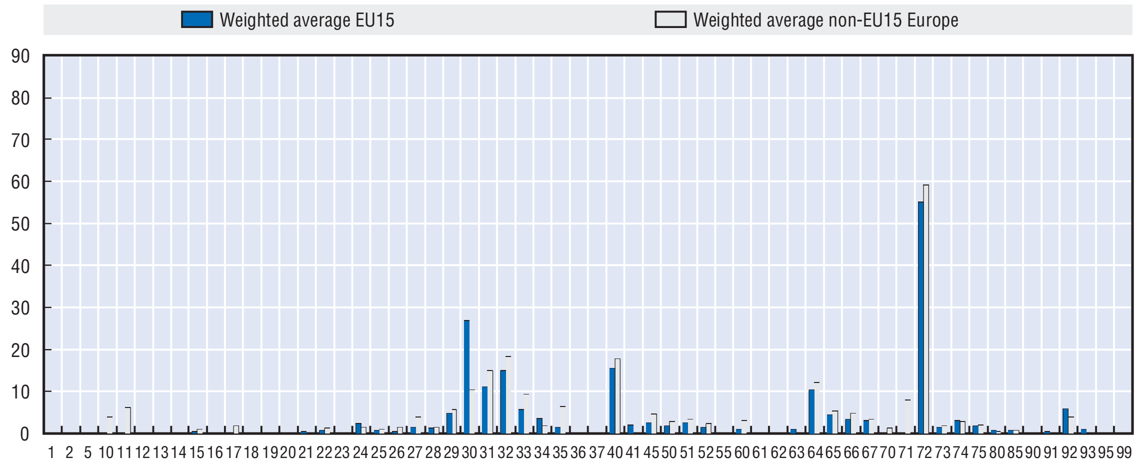
The use of ISCO88 presents some drawbacks. First, it is less detailed than the classifications available for countries such as the United States, Korea and Australia. As a result, electronic engineers cannot be included in the narrow definition, even though they may be heavily involved with jobs relating to ICT hardware, because ISCO88 does not distinguish this category separately. As a result, the narrow intensity ratios are likely to be somewhat lower than they otherwise would be. Furthermore, because it is an old classification, it may pose a problem for new occupations. While most countries are able to incorporate new job categories in their national classifications, it may not be possible to take them into account when recoding into ISCO88. For example, desktop publishers would be placed in ISCO88 category "3471 Decorators and designers", whereas some of the more detailed lists of occupations for other countries distinguish this as a separate category which can be included in the broad definition. Nevertheless, ISCO88 provides (more or less) comparable data for most European countries, and some of the involuntary exclusions or inclusions that result from the relatively higher level of aggregation may even out.

Figures 6.1 and 6.2 show the sectoral distribution of the weighted average across countries of the share of ICT-skilled employment in total employment, where the weights are calculated as the ratio of employment in industry *i* in country *j* divided by total employment in industry *i* across all countries.

In both figures, two sectors have a very high share of ICT-skilled employment in total employment. The first, 30:Manufacture of office machinery and computers, is also where the difference between

Figure 6.1. **Europe: share of ICT-skilled employment in total employment, narrow definition, by sector, 2002**

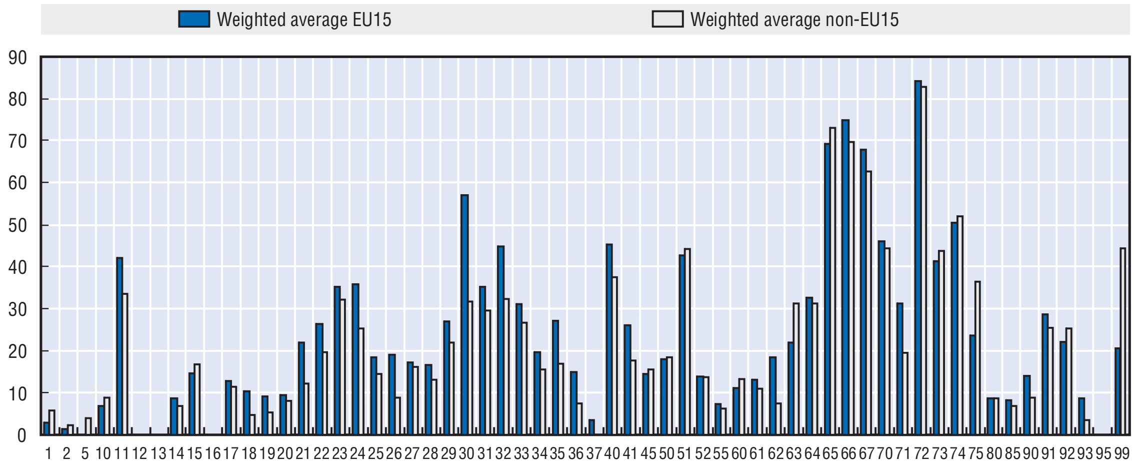
Percentages



Note: Data refer to 2002. Non-EU15 data refer to non-EU15 Europe: Iceland, Norway, Switzerland, Czech Republic, Hungary, Slovak Republic. As fewer data were available to calculate the ratios for non-EU15 Europe, outliers may have a relatively larger effect than in the EU15 distribution.
Source: OECD, based on EULFS (2003).

Figure 6.2. **Europe: share of ICT-skilled employment in total employment, broad definition, by sector, 2002**

Percentages



Note: Data refer to 2002. Non-EU15 data refer to non-EU15 Europe: Iceland, Norway, Switzerland, Czech Republic, Hungary, Slovak Republic. As fewer data were available to calculate the ratios for non-EU15 Europe, outliers may have a relatively larger effect than in the EU15 distribution.
Source: OECD, based on EULFS (2003).

EU15 and the rest of Europe is greatest. The other is 72:Computer and related activities. Non-EU15 Europe has a relatively larger share than EU15 countries of broad ICT employment in 99:Extra-territorial organisations and bodies.

The next step is to divide the distribution into industries with low, medium and high intensity of ICT-skilled employment. The classification obtained by ranking the weighted average of the intensity of ICT-skilled employment for EU15 countries is shown in Table 6.1. Sectors with an intensity of 30% and above are considered as high-intensity, those between 10% and 30% as medium-intensity, and those below 10% as low-intensity.[6]

A striking number of services sectors are included in the high-intensity group, mainly at or near the top of the ranking, along with some manufacturing sectors and wholesale trade. The medium-intensity group is dominated by manufacturing industries, but also includes retail trade and printing and publishing. The low-intensity group is dominated by primary industries and personal services industries (as opposed to business services industries which tend to be in the high-intensity group).

- United States

Data for the United States are taken from the Current Population Survey (CPS). The occupations included in the narrow definition are very similar to those used in previous OECD publications. For the broad definition, the same method was applied as for the European countries, and efforts were made to maximise comparability across countries, but without harmonising the classifications. See Annex Table C.6.2 for detailed information on occupations included in these aggregates.

Figure 1.16 in Chapter 1 shows the evolution of the ratio of these two measures to total employment. By 2002, narrow ICT-skilled employment accounted for 3.8% of total employment in the United States and the broad measure for 20.6%. The narrow measure was flat in 2000 and 2001 and declined in 2002; the broad measure started its decline in 2000.

Table 6.1. **Europe: classification of industries according to their intensity of broad ICT-skilled employment, 2002**

Decreasing order, percentages

NACE 2 digit	Industry	Intensity (%)
High-intensity		
72	Computer and related activities	84.2
66	Insurance and pension funding, except compulsary social security	74.8
65	Financial intermediation, except insurance and pension funding	69.2
67	Activities auxiliary to financial intermediation	67.9
30	Manufacture of office machinery and computers	57.1
74	Other business activities	50.4
70	Real estate activities	46.1
40	Electricity, gas, steam and hot water supply	45.1
32	Manufacture of radio, television and communication equipment and apparatus	44.8
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	42.7
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying	42.0
73	Research and development	41.3
24	Manufacture of chemicals and chemical products	35.9
31	Manufacture of electrical machinery and apparatus, n.e.c.	35.3
23	Manufacture of coke, refined petroleum products and nuclear fuel	35.2
64	Post and telecommunications	32.6
71	Renting of machinery and equipment without operator and of personal and household goods	31.4
33	Manufacture of medical, precision and optical instruments, watches and clocks	31.0
Medium intensity		
91	Activities of membership organisation, n.e.c.	28.6
35	Manufacture of other transport equipment	27.2
29	Manufacture of machinery and equipment, n.e.c.	26.9
22	Publishing, printing and reproduction of recorded media	26.4
41	Collection, purification and distribution of water	26.2
75	Public administration and defence; compulsary social security	23.6
92	Recreational, cultural and sporting activities	22.3
63	Supporting and auxiliary transport activities; activities of travel agencies	22.1
21	Manufacture of pulp, paper and paper products	21.9
99	Extra territorial organisations and bodies	20.5
34	Manufacture of motor vehicles, trailers and semi trailers	19.7
26	Manufacture of other non-metallic mineral products	19.0
62	Air transport	18.5
25	Manufacture of rubber abd plastic products	18.4
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	18.1
27	Manufacture of basic metals	17.1
28	Manufacture of fabricated metal products, except machinery and equipment	16.7
36	Manufacture of furniture; manufacturing n.e.c.	14.9
15	Manufacture of food products and beverages	14.7
45	Construction	14.5
90	Sewage and refuse disposal, sanitation and similar activities	14.0
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	14.0
61	Water transport	13.0
17	Manufacture of textiles	12.9
60	Land transport; transport via pipelines	11.2
18	Manufacture of wearing apparel; dressing and dyeing of fur	10.4
Low intensity		
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	9.5
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	9.2
80	Education	8.8
14	Other mining and quarrying	8.8
93	Other service activities	8.6
85	Health and social work	8.3
55	Hotels and restaurants	7.2
10	Mining of coal and lignite; extraction of peat	6.8
37	Recycling	3.6
1	Agriculature, hunting and related service activities	2.9
2	Forestry, logging and related activities	1.5
95	Private households with employed persons	0.4
5	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	0.0
12	Mining of uranium and thorium ores	0.0
13	Mining of metal ores	0.0
16	Manufacture of tobacco products	0.0

Source: OECD, based on EULFS (2003).

Figures 6.3 and 6.4 show the distribution of industries for the United States based on the intensity of ICT-skilled employment according to the narrow and broad definitions, respectively. The ICT-producing sectors have a high intensity, as do some of the services and retail sectors. Details of the distribution are given in Annex Table C.6.3.

Table 6.2 shows the 70 industries (out of 236) classified as high-intensity under the broad definition, *i.e.* with a ratio of ICT-skilled employment to total employment of over 30%, and the first 70 industries under the narrow definition (35 of the first 70 industries in the broad classification are also among the first 70 in the narrow classification). Many services sectors appear at the top of the list, as in the European classification. An interesting difference with the latter is the presence of quite a few retail sectors in the high-intensity group, whereas retail is classified as medium-intensity in the European distribution. Although this may be due simply to the difference in aggregation, for example, it is consistent with the idea that retail trade is more ICT-intensive in the United States than in Europe. The complete classification obtained on the basis of the broad definition is given in Annex Table C.6.3.

• Japan

Although the data provided by the Statistics Bureau of the Japanese Ministry of Public Management, Home Affairs, Post and Telecommunications is much less detailed (only 15 different occupations distinguished[7]), an attempt was made to repeat the same exercise as for Europe and the United States. Figure 6.5 gives the ratio of ICT-skilled employment to total employment by sector.

Annex Table C.6.4 classifies industries by ICT-skilled employment shares. Again, most services sectors have a high intensity of ICT-skilled employment. Some manufacturing industries seem to have somewhat lower intensities than in Europe and the United States, but this is probably due to the high level of aggregation in the occupational data, and the different aggregation of industries.

• Korea

Data on employment by occupation (three-digit KECO: Korean Employment Classification of Occupations) and industry (two-digit KSIC: Korean Standard Industrial Classification) were provided by the Work Information Center, Human Resource Development Service of Korea. Occupations to be included under the narrow and broad definitions of ICT-skilled employment were chosen on the same basis as for the other countries and efforts were made to maximise comparability, but without harmonising the classifications (see Annex Table C.6.5 for details).

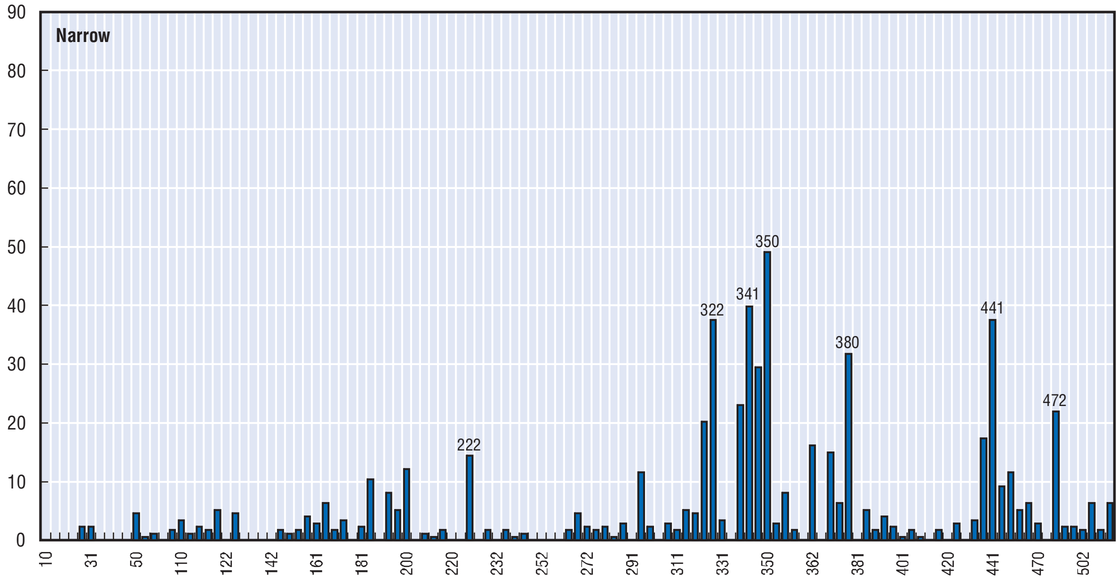
Annex Table C.6.6 classifies industries on the basis of their ICT-skilled employment intensity. As in other countries, most services industries and manufacturing of computers and office machinery are in the high-intensity category (over 30%). However, the distribution of industries across high-, medium- and low-intensity categories is more uneven than for other countries. In particular, relatively fewer industries are classified as having high intensity of ICT-skilled employment.

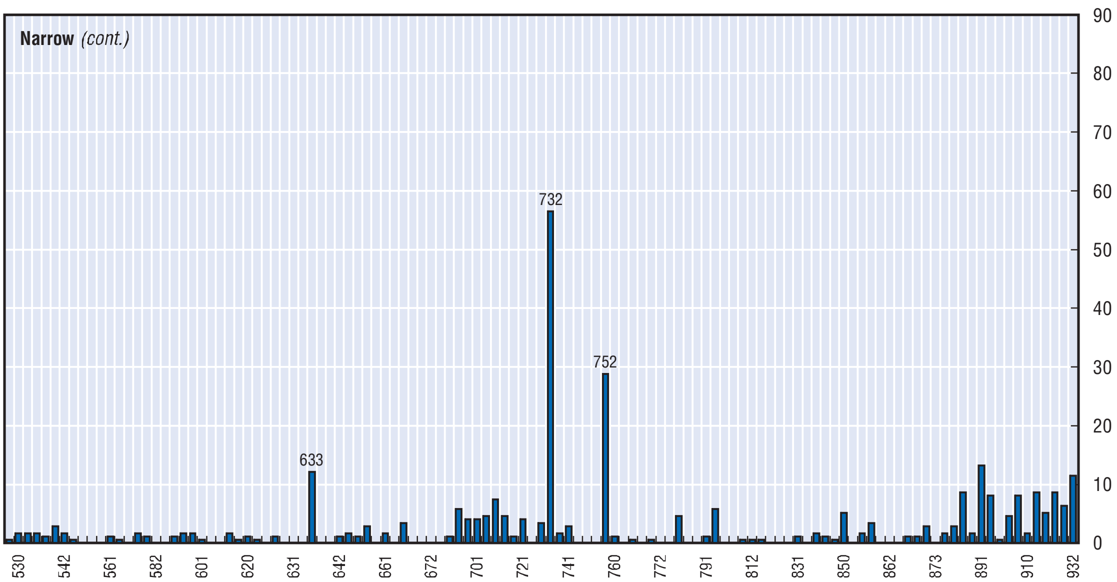
• Australia

The Australian Bureau of Statistics (ABS) provided aggregated data on employment by occupation by industry, based on four-digit ASCO (Australian Standard Classification of Occupations) and two-digit ANZSIC (Australian and New Zealand Standard Industrial Classification). The ABS collects labour force data on a quarterly basis and uses the ASCO (second edition) to classify occupations according to skills level and skills specialisation. Occupations were included in the narrow and broad definitions (see Annex Table C.6.7) on the same basis as for other countries and efforts were made to maximise comparability across countries, but without harmonising the classifications.

Annex Table C.6.8 classifies industries according to their intensity of ICT-skilled employment. As for most countries, services sectors dominate the top of the ranking. Some mining and extraction industries and related services are also classified as high intensity, *i.e.* with at least 30% of ICT-skilled employment. In contrast to most other countries, no manufacturing industries are ranked as high-intensity (although

Figure 6.3. **United States: share of ICT-skilled employment in total employment, narrow definition, by sector, 2002**

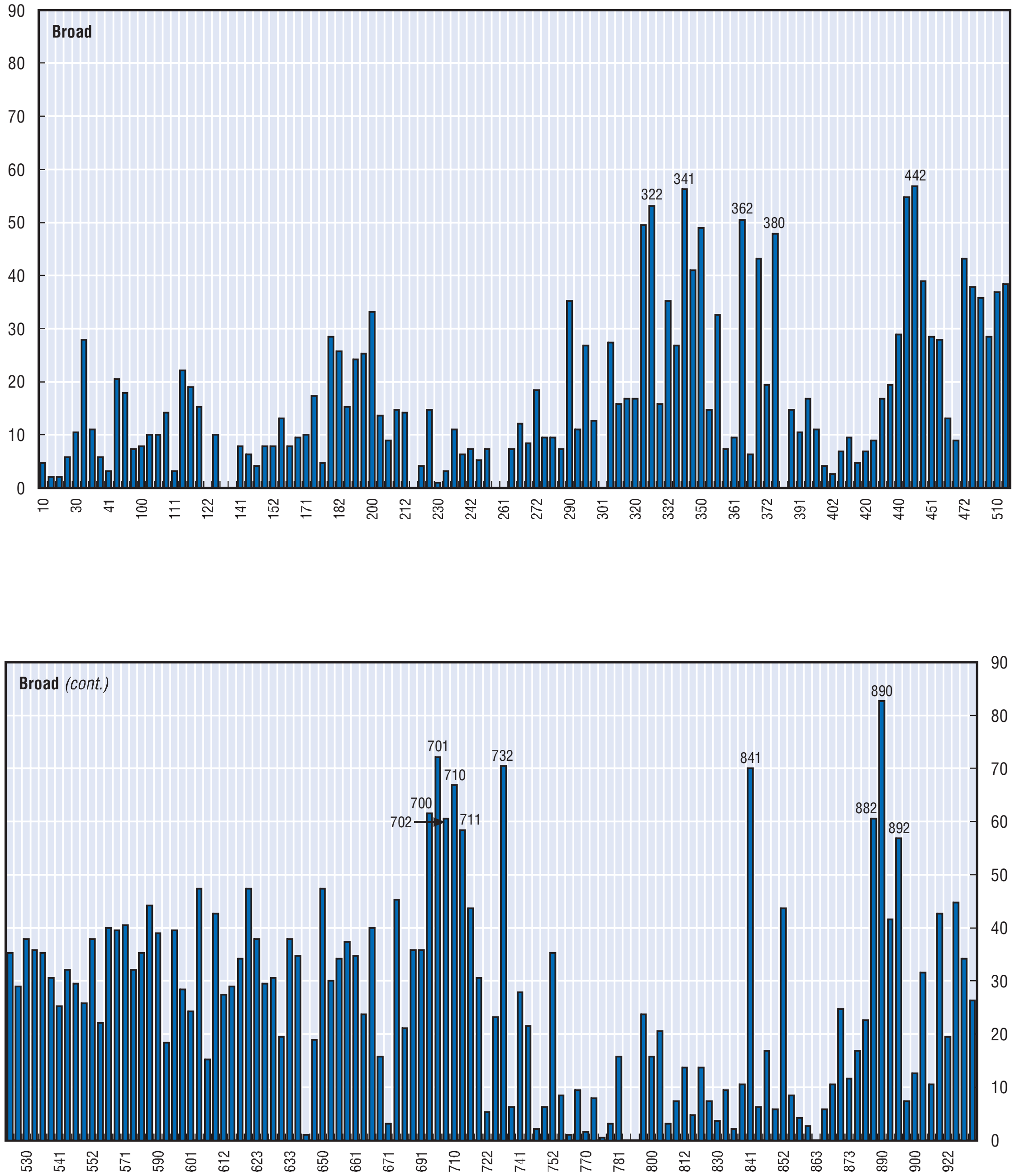




Note: 222: Leather products except footwear; 322: Computers and related equipment; 341: Radio, TV and communication equipment; 350: Not specified electrical machinery, equipment, and supplies; 362: Guided missiles, space vehicles, and parts; 380: Photographic equipment and supplies; 441: Telephone communications; 442: Telegraph and miscellaneous communications services; 472: Not specified utilities; 582: Stores, retail nurseries and garden; 602: Stores, dairy products; 633: Stores, radio, TV, and computer; 700: Banking; 701: Savings institutions, including credit unions; 702: Credit agencies (n.e.c.); 710: Security, commodity brokerage, and investment companies; 711: Insurance; 732: Computer and data processing services; 752: Electrical repair shops; 841: Legal services; 882: Engineering, architectural and surveying services; 890: Accounting, auditing, and bookkeeping services; and 892: Management and public relations services.

Source: OECD, based on Current Population Survey (CPS) (2003).

Figure 6.4. **United States: share of ICT-skilled employment in total employment, broad definition, by sector, 2002**



Note: 222: Leather products except footwear; 322: Computers and related equipment; 341: Radio, TV and communication equipment; 350: Not specified electrical machinery, equipment, and supplies; 362: Guided missiles, space vehicles, and parts; 380: Photographic equipment and supplies; 441: Telephone communications; 442: Telegraph and miscellaneous communications services; 472: Not specified utilities; 582: Stores, retail nurseries and garden; 602: Stores, dairy products; 633: Stores, radio, TV, and computer; 700: Banking; 701: Savings institutions, including credit unions; 702: Credit agencies (n.e.c.); 710: Security, commodity brokerage, and investment companies; 711: Insurance; 732: Computer and data processing services; 752: Electrical repair shops; 841: Legal services; 882: Engineering, architectural and surveying services; 890: Accounting, auditing, and bookkeeping services; and 892: Management and public relations services.

Source: OECD, based on Current Population Survey (CPS) (2003).

Table 6.2. **Top 70 high-intensity industries in the US classification under the broad and narrow definitions of ICT-skilled employment, 2002**

Descending order of intensity in percentages

Broad

	Industry		Broad	Rank
	Accounting, auditing, and bookkeeping services	890	82.7	1
✓	Savings institutions, including credit unions	701	72.3	2
✓	Computer and data processing services	732	70.6	3
	Legal services	841	70.1	4
✓	Security, commodity brokerage, and investment companies	710	66.8	5
✓	Banking	700	61.3	6
✓	Credit agencies, n.e.c.	702	60.5	7
✓	Engineering, architectural, and surveying services	882	60.3	8
✓	Insurance	711	58.4	9
✓	Management and public relations services	892	57.0	10
✓	Telegraph and miscellaneous communications services	442	57.0	11
✓	Radio, TV, and communication equipment	341	56.4	12
✓	Telephone communications	441	54.9	13
✓	Computers and rel. equipment	322	53.0	14
✓	Guided missiles, space vehicles, and parts	362	50.5	15
✓	Office and accounting machines	321	49.6	16
✓	Not specified electrical machinery, equipment, and supplies	350	48.8	17
✓	Photographic equipment and supplies	380	48.1	18
	Liquor stores	650	47.6	19
	Miscellaneous vehicle dealers	622	47.5	20
	Stores, dairy products	602	47.5	21
	Fuel dealers	672	45.3	22
✓	Environmental quality and housing programs administration	930	44.6	23
	Stores, retail nurseries and garden	582	44.2	24
	Libraries	852	43.6	25
	Real estate, including real estate-insurance offices	712	43.6	26
✓	Scientific and controlling instruments	371	43.1	27
✓	Not specified utilities	472	43.0	28
	Food stores, n.e.c.	611	42.5	29
✓	Public finance, taxation, and monetary policy	921	42.4	30
✓	Research, development, and testing services	891	41.6	31
✓	Electrical machinery, equipment, and supplies, n.e.c.	342	41.1	32
	Not specified wholesale trade	571	40.4	33
✓	Catalog and mail order houses	663	40.0	34
	Farm supplies	561	39.9	35
	Misc wholesale, nondurable goods	562	39.7	36
	Variety stores	592	39.4	37
✓	Electric light and power	450	39.0	38
	Mobile home dealers	590	38.9	39
	Metals and minerals, except petroleum	511	38.3	40
	Motor vehicles and equipment	500	37.9	41
✓	Stores, radio, TV, and computer	633	37.9	42
	Stores, apparel and accessory, except shoe	623	37.9	43
	Petroleum products	552	37.8	44
	Machinery, equipment, and supplies	530	37.7	45
	Jewelry stores	660	37.3	46

Narrow

	Industry		Narrow	Rank
✓	Computer and data processing services	732	56.8	1
✓	Not specified electrical machinery, equipment, and supplies	350	48.8	2
✓	Radio, TV, and communication equipment	341	39.7	3
✓	Computers and rel. equipment	322	37.3	4
✓	Telephone communications	441	37.2	5
✓	Photographic equipment and supplies	380	31.5	6
✓	Electrical machinery, equipment, and supplies, n.e.c.	342	29.6	7
✓	Electrical repair shops	752	28.6	8
	Household appliances	340	23.1	9
✓	Not specified utilities	472	22.0	10
✓	Office and accounting machines	321	20.2	11
	Radio and television broadcasting and cable	440	17.4	12
✓	Guided missiles, space vehicles, and parts	362	16.0	13
✓	Scientific and controlling instruments	371	15.3	14
	Leather products, except footwear	222	14.5	15
✓	Research, development, and testing services	891	13.5	16
✓	Stores, radio, TV, and computer	633	12.0	17
✓	Petroleum refining	200	11.9	18
	National security and international affairs	932	11.8	19
	Ordnance	292	11.8	20
✓	Electric light and power	450	11.3	21
	Soaps and cosmetics	182	10.2	22
✓	Telegraph and miscellaneous communications services	442	9.4	23
✓	Engineering, architectural, and surveying services	882	8.6	24
✓	Public finance, taxation, and monetary policy	921	8.6	25
✓	Environmental quality and housing programs administration	930	8.4	26
✓	Aircraft and parts	352	8.3	27
	Agricultural chemicals	191	8.2	28
✓	General government, n.e.c.	901	8.1	29
✓	Management and public relations services	892	7.8	30
✓	Security, commodity brokerage, and investment companies	710	7.2	31
	Medical, dental, and optical instruments and supplies	372	6.6	32
✓	Professional and commercial equipment and supplies	510	6.4	33
✓	Economic programs administration	931	6.4	34
	Electric and gas, and other combinations	452	6.3	35
✓	Electrical goods	512	6.1	36
	Paperboard containers and boxes	162	6.1	37
	Theaters and motion pictures	800	5.8	38
✓	Not specified retail trade	691	5.6	39
	Miscellaneous food preparations and kindred products	121	5.5	40
	Gas and steam supply systems	451	5.4	41
	Construction and material handling machines	312	5.3	42
	Industrial and miscellaneous chemicals	192	5.1	43
	Toys, amusement, and sporting goods	390	5.1	44
	Colleges and universities	850	5.1	45
	Human resources programs administration	922	4.9	46

Table 6.2. **Top 70 high intensity industries in the US classification under the broad and narrow definitions of ICT skilled employment, 2002** (*cont.*)

Descending order of intensity in percentages

Broad					Narrow				
	Industry		Broad	Rank		Industry		Narrow	Rank
✓	Professional and commercial equipment and supplies	510	36.9	47		Metalworking machinery	320	4.8	47
✓	Not specified retail trade	691	35.9	48		Funeral service and crematories	781	4.6	48
	Stores, Miscellaneous retail	682	35.9	49		Tobacco manufactures	130	4.6	49
	Scrap and waste materials	531	35.9	50		Iron and steel foundries	271	4.6	50
	Furniture and home furnishings	501	35.7	51	✓	Insurance	711	4.6	51
✓	Electrical goods	512	35.5	52		Nonmetallic mining and quarrying, except fuel	50	4.5	52
	Miscellaneous wholesale, durable goods	532	35.3	53		Executive and legislative offices	900	4.5	53
✓	Screw machine products	290	35.3	54	✓	Credit agencies, n.e.c.	702	4.4	54
✓	Electrical repair shops	752	35.3	55	✓	Banking	700	4.2	55
	Not specified machinery	332	35.3	56	✓	Advertising	721	4.2	56
	Hardware stores	581	35.3	57		Not spec manufacturing industries	392	4.2	57
	Gift, novelty, and souvenir shops	661	34.9	58		Pulp, paper, and paperboard mills	160	4.1	58
	Music stores	640	34.8	59	✓	Savings institutions, including credit unions	701	3.9	59
✓	Economic programs administration	931	34.2	60		Educational services, n.e.c.	860	3.7	60
	Gasoline service stations	621	34.1	61		Services incidental to transportation	432	3.5	61
	Stores, Book and stationery	652	34.0	62	✓	Catalog and mail order houses	663	3.5	62
✓	Petroleum refining	200	33.2	63		Grain mill products	110	3.5	63
✓	Aircraft and parts	352	32.5	64		Machinery, except electrical, n.e.c.	331	3.4	64
	Lumber and building material retailing	580	32.2	65		Printing, publishing, and allied industries, except newspapers	172	3.3	65
	Apparel, fabrics, and notions	542	32.1	66		Personnel supply services	731	3.2	66
✓	General government, n.e.c.	901	31.5	67		Engines and turbines	310	3.2	67
	Paper and paper products	540	30.5	68		Miscellaneous paper and pulp products	161	3.1	68
✓	Advertising	721	30.4	69		Water supply and irrigation	470	3.0	69
	Stores, furniture and home furnishings	631	30.3	70	✓	Screw machine products	290	3.0	70

Note: Industry sectors that appear in both groups are indicated by a tick mark.
Source: OECD, based on Current Population Survey (2003).

this may be due to differences in industry breakdown and the fact that manufacturing of computers and office machinery, for example, is not identified separately).

- Canada

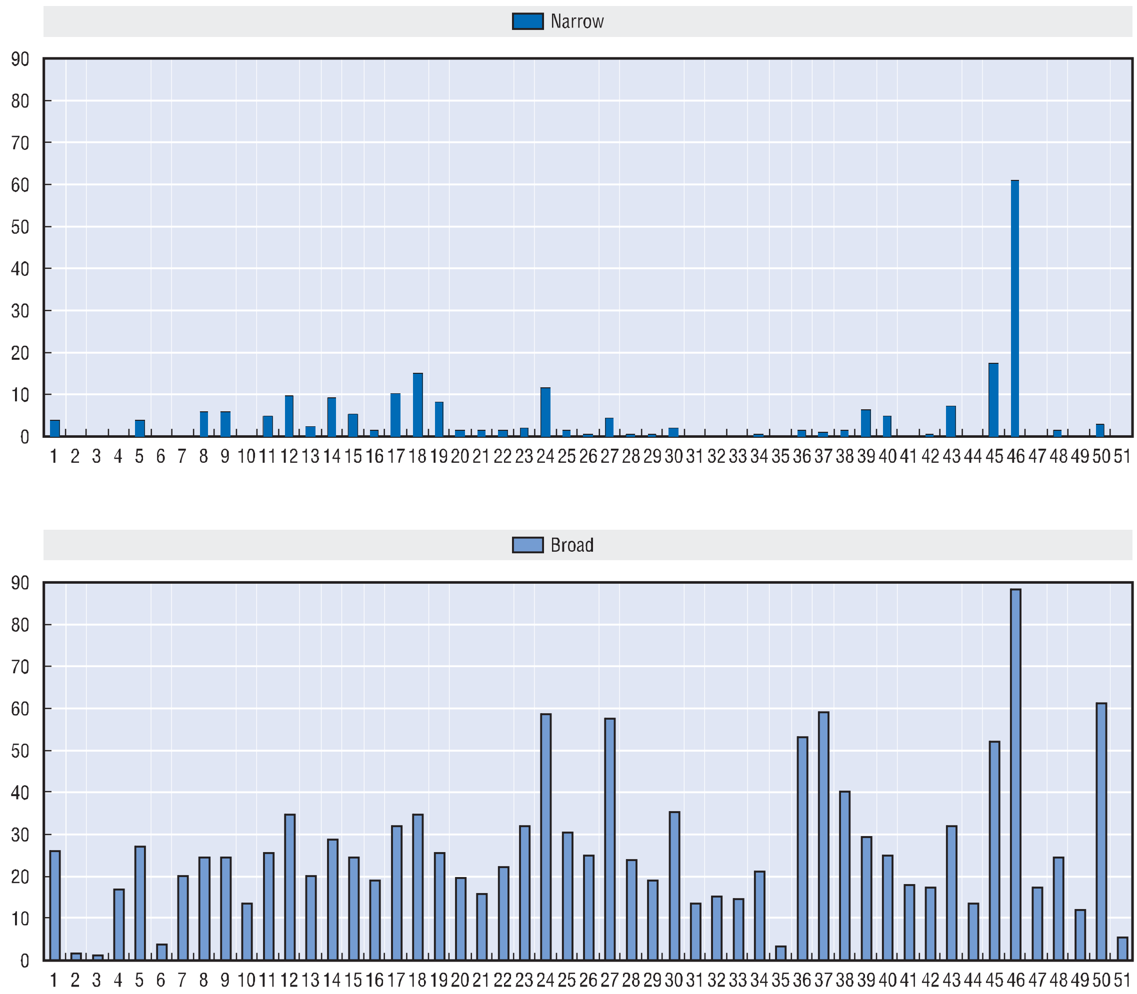
Habtu (2003), using results from Census Canada 2001 on the experienced labour force,[8] reports that in Canada in 2001, IT occupations represented 2.6% of total employment (see Annex Table C.6.9 for the definition of IT occupations) and was quite concentrated. The two largest groups, Systems analysts and consultants (26.6%) and Computer programmers and interactive media developers (24.9%) accounted for over 50% of total employment in IT occupations. Furthermore, IT workers tended to be: *i*) relatively young (36 years old on average, against an average of 39 for all employed workers); *ii*) highly educated (44% held at least a bachelor's degree against only 19.6% for all employed workers), with 72% having specialised in applied sciences, engineering and mathematics; and *iii*) earning relatively higher wages (mean earnings of CAD 45 500 in 2001 compared to CAD 28 000 for all employees). Finally, immigrant workers have come to play a larger and more rapidly increasing role in IT occupations than in total employment, accounting for 31.5%, compared to almost 20% overall. Just under half of the immigrants with IT qualifications arrived in the 1990s (and around one-third after 1996 during the high-technology boom), compared to only 30% of the overall immigrant population. However, these summary results hide sometimes large differences between occupations.

ICT-skilled employment and productivity in Europe

There has been considerable debate about productivity gains in ICT sectors and ICT-induced productivity gains in other sectors. For example, new-economy sceptics argue that productivity gains

Figure 6.5. **Japan: share of ICT-skilled employment in total employment, narrow and broad definition, by sector, 2002**

Percentages



Note: Industries with a high share include: 12: Chemical products, oil products, coal products, 18: Electronic machinery and instruments, 24: Electricity, gas, heat provision, water, 27: Communication, 30: Wholesale, 36: Finance, insurance, real estate, of which: 37: Finance, insurance and 38: Real estate, 45: Business services, of which 46: Information and research services, and 50: Public services. Annex Table C.6.4 provides the complete list of industries.

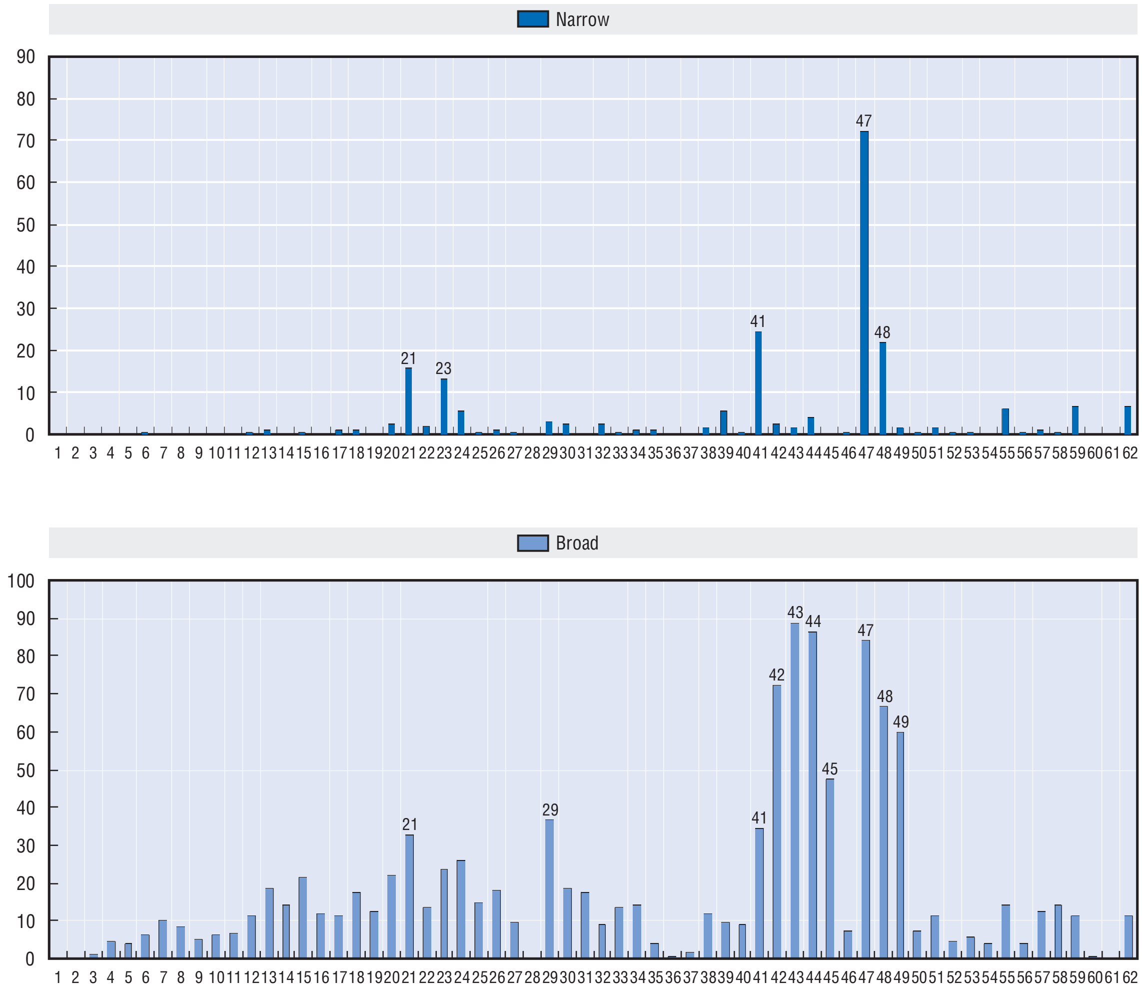
Source: OECD, based on data provided by the Japanese Ministry of Public Management, Home Affairs, Post and Telecommunications, Statistics Bureau, Labour Force Survey (2003).

over the past decade were due to very concentrated gains in manufacturing durables (especially industries producing computers and semiconductors) but not to sectors that invested in the use of ICT (US Department of Commerce [DoC], 2002). However, research on micro data tends to point to a positive link between IT and productivity even when the official aggregated statistics still point to a productivity paradox (US DoC, 2003a, p. 63), although the strength of the link differs widely in the available studies. Moreover, the mechanism by which IT positively affects productivity is difficult to pin down.

It is also important to examine the issue of productivity in the context of ICT skills. As DiNardo and Pischke (1997) note, computers are only productive when used in combination with certain types of

Figure 6.6. **Korea: share of ICT-skilled employment, narrow and broad definition, by sector, 2002**

Percentages



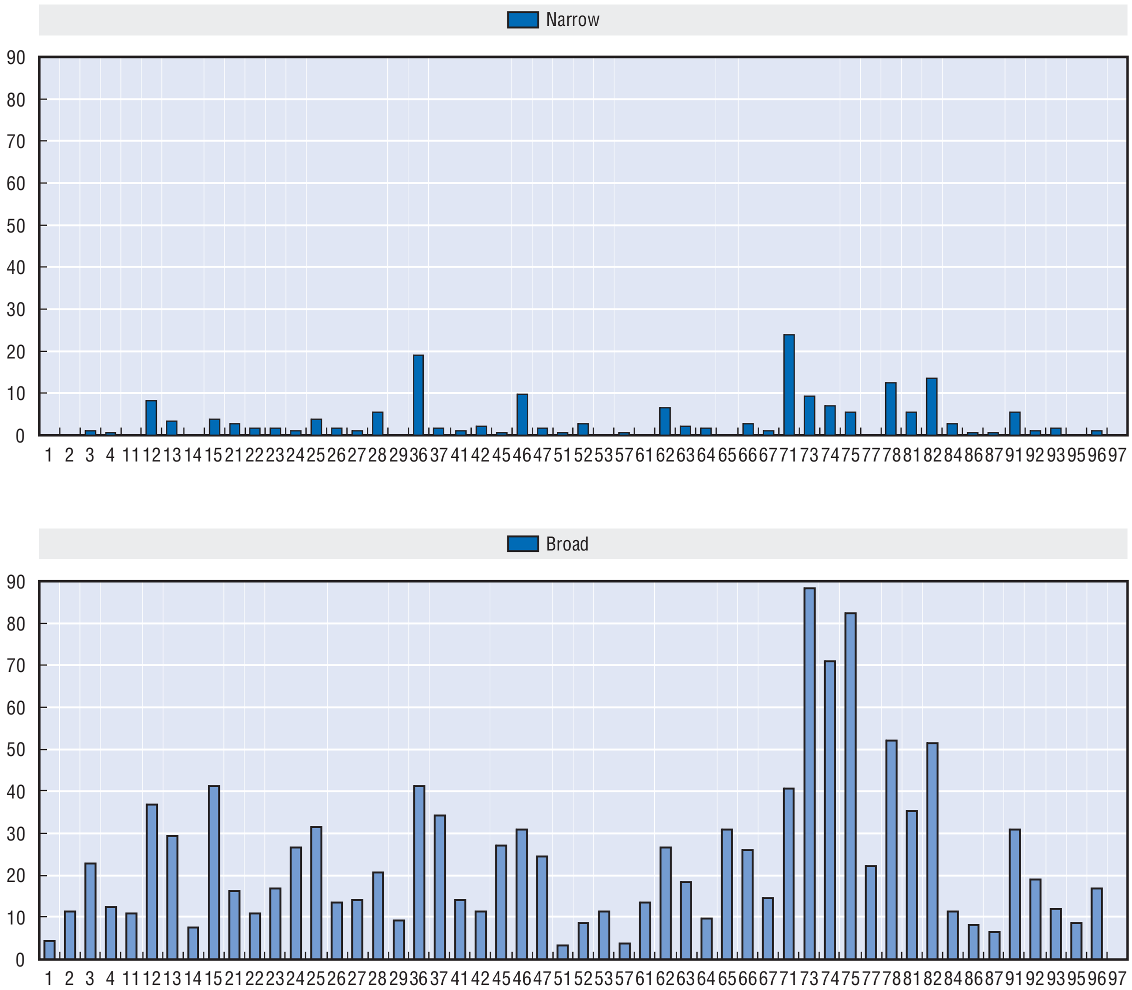
Note: Industries with a high share include: 21: Manufacturing of other machinery and equipment; 23: Manufacturing of electronic components, radio, television and communication equipment and apparatus; 29: Electricity, gas, steam and hot water supply; 41: Post and telecommunications; 42: Financial institutions, except insurance and pension funding; 43: Insurance and pension funding; 44: Activities auxiliary to financial intermediation; 45: Real estate activities; 47: Computer and related activities; 48: Research and development; and 49: Professional, scientific and technical services. See Annex Table C.6.6 for the complete list of industries.
Source: OECD, based on data provided by the Korean Work Information Center, Human Resource Development Service (2003).

skills (*e.g.* programming) and only have value for certain types of workers (*e.g.* empirical economists but not ballet dancers).

Furthermore, as Mann (2003) argues for the United States, more integrated use of ICTs is likely to lead to a second wave of productivity growth not only because of the increased adoption of ICTs owing to reductions in costs, but also because of changes in existing production and business processes. However, integration of ICTs will require the presence of an appropriate skills base. This is likely to be relevant outside the United States too. For example, van Ark *et al.* (2002) suggest that industry patterns of ICT diffusion in Europe are following a similar pattern to that observed in the United States, but at a slower pace. They also note that the greatest differences between Europe and the United States are in

Figure 6.7. **Australia: share of ICT-skilled employment, narrow and broad definition, by sector, November 2003**

Percentages



Note: Some of the industries with a high share are: 12: Oil and gas extraction; 15: Services to mining; 36: Electricity and gas supply; 46: Machinery and motor vehicle wholesaling; 71: Communication services; 73: Finance; 74: Insurance; 75: Services to finance and insurance; 78: Business services; 81: Government administration; 82: Defence; and 91: Motion picture, radio and television services. See Annex Table C.6.8 for the complete list of industries.

Source: OECD, based on data provided by ABS (2004).

the intensive ICT-using services industries. It is important for Europe to look very closely at these sectors in particular in order to advance the catching-up process.[9]

To study the question, data on gross value added per employee (Eurostat, NewCronos) are plotted against the measure of broad ICT-skilled employment (Figure 6.8). Data are available only for some European countries and some industries. Overall, there appears to be a positive, but relatively weak, relationship between productivity and the intensity of broad ICT-skilled employment. In most countries, NACE sector 72:Computer and related activities stands out, as it tends to combine a relatively high share of broad ICT employment in total employment with low gross value added per employee (although this may be due to output measurement problems in this sector).

Box 6.2. **Women, minorities and older workers in the IT workforce**

The Information Technology Association of America (ITAA) (2003b), using data from US Current Population Survey from 1996 to 2002, finds evidence of important differences in the presence of minorities in the IT workforce.* In 2002, women made up 46.6% of the US workforce but only 34.9% of the IT workforce (in 1996, they accounted for 41%). In addition, women obtained only 22% of the total degrees in computer science and engineering awarded in 2000. Similarly, African Americans accounted for 10.9% of the total US workforce in 2002 but only 8.2% of the IT workforce (down from 9.1% in 1996). Hispanic Americans are also under-represented in the IT workforce. They made up 12.2% of the total workforce in 2002 but only 6.3% of the IT workforce. Native Americans accounted for 0.9% of the total workforce and 0.6% of the IT workforce. See US DoC (1999), for example, for complementary analysis of these issues.

In Germany, the *Statistisches Bundesamt* (2002) compiled similar data on the distribution of men and women in the IT workforce. In 2001, women accounted for 44% of the overall workforce and 25.9% of the ICT workforce. There were differences within ICT occupations, with women accounting for 46.2% of telecommunications occupations, 15.4% of IT occupations and 39.2% of media occupations.

Habtu (2003) reports that in Canada in 2001, women accounted for 46.9% for all occupations but only 27% of total IT workers. Again there are differences within specific categories: women account for only 17.7% of software engineers, for example. Women also earned lower median earnings, CAD 41 100 against median earnings of CAD 45 500 for all IT workers.

Finally, it is generally thought that the position of older workers in the labour force as a whole is likely to deteriorate as a result of the increasing use of ICTs. First, it is believed that they have less ability and fewer incentives to acquire ICT skills and that there will be a growing mismatch between their skills and those that are in demand (which would reduce the value of their existing skills). Second, it is feared that the resulting lack of skills may cause a slowdown in the introduction of ICTs in jobs filled by older workers and slow a company's productivity growth and competitiveness. However, there has been no firm empirical evidence to confirm the alleged increasing competitive disadvantage of older workers in the labour market. In fact, Borghans and ter Weel (2002), using UK data and controlling for wage costs and the tasks to be performed, show that computer use does not depend on age. Still, they do find that older workers tend to have fewer computer skills than younger workers, but that the relevant age groups are 20-29 years old *versus* 30 years and older. It also appears that there are no specific labour market returns to having computer skills, so older workers' wages are unlikely to suffer. As for the position of older workers in the IT workforce, the ITAA (2003a), for example, reported that Americans aged 45 years and older accounted for 37.6% of the total workforce in 2002, but for only 29.4% of the IT workforce. Thus, while concerns about older workers have not, as yet, been confirmed by empirical studies, there may be cause for concern about their position in ICT occupations specifically.

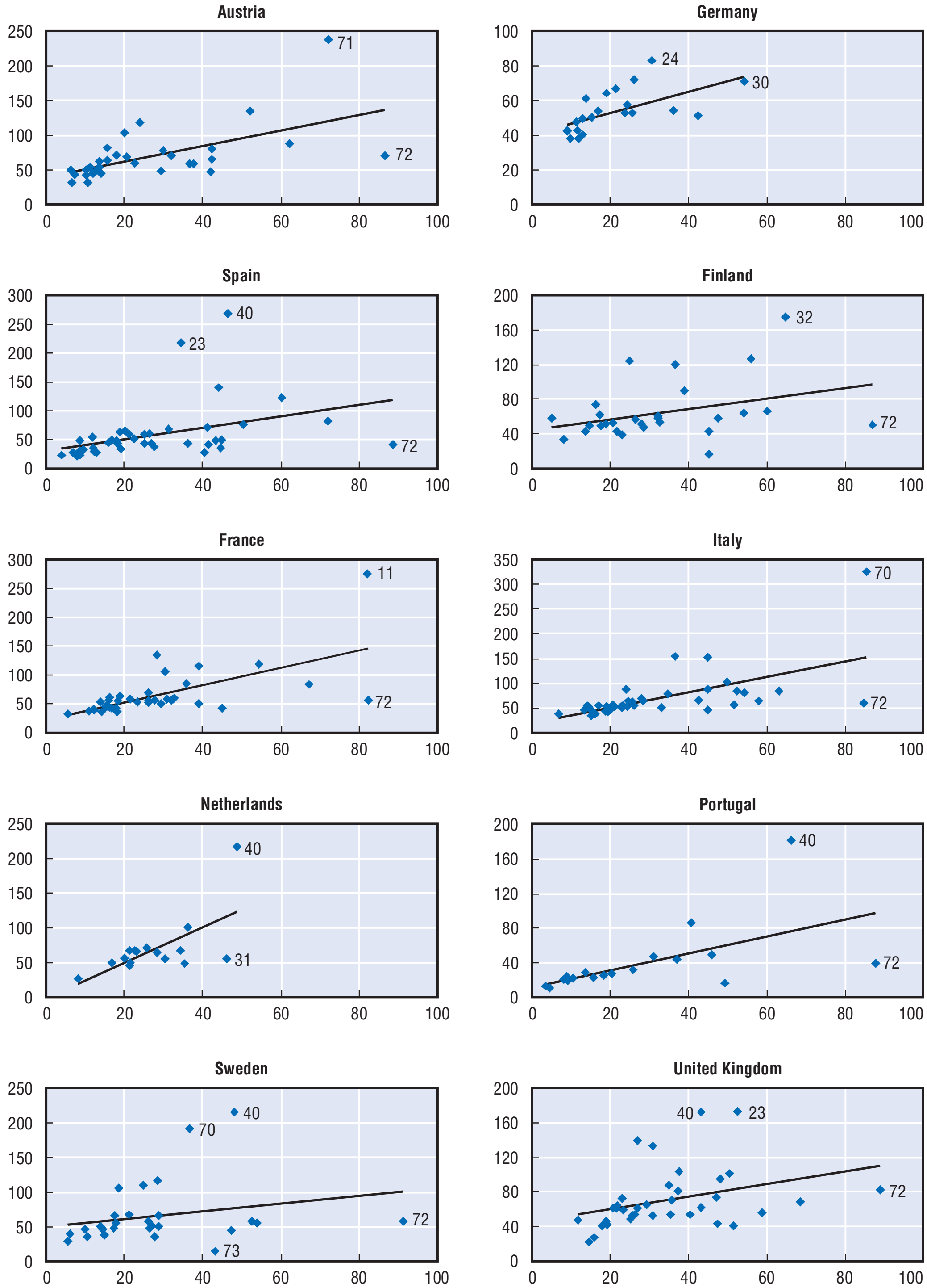
* The definition of the IT workforce used by the ITAA includes: programming/software engineering, technical support personnel, other, enterprise systems specialists, database development/administration, Web development / administration, network design/administration, digital media, technical writing.

However, the measure of ICT-skilled employment by sector does not necessarily provide an indicator of the amount of ICT work carried out in that sector. To the extent that sectors outsource such work, the relationship between the measure of ICT-skilled employment and productivity will be distorted. Sector 72 is likely to carry out such activities, with the (possible) productivity gains accruing to the sector that outsources them. Thus, sectors with low intensity of ICT-skilled employment may benefit from large ICT-induced productivity gains if they outsource ICT activities.

The following calculation was carried out. Gross value added per employee was regressed on the measure of broad ICT-skilled employment (and a constant). The results show that the coefficient on ICT-skilled employment is always positive and significant at least at the 5% level (except for Sweden), but the adjusted R^2 tends to be quite low. There thus appears to be a positive correlation between sectors with high value-added per employee and sectors with a high share of ICT-skilled employment (for details, see Annex Table C.6.10).

Figure 6.8. **Gross value added per employee and the share of ICT-skilled employment, broad definition, in total employment, selected EU countries**

Vertical axis in thousands of EUR per head, horizontal axis in percentages



Note: Some outliers have been removed: Germany NACE 23, Italy NACE 11, Sweden NACE 32 and United Kingdom NACE 11.
Source: OECD, based on EULFS and NewCronos, 2003.

ICT skills: how to get them and put them to work

This section examines first how individuals, firms and countries can acquire ICT skills, at various levels of complexity, and then looks at e-recruitment: a new method of using ICTs to match employers and jobseekers. The definitions of IT and ICT occupations used in this section are mostly based on those from the different national sources and may not match the definitions in the first part of this chapter.

Figure 6.9, based on the 2001 UK Skills Survey, shows the various means by which ICT skills of various levels of complexity are acquired. Respondents could choose from nine sources of learning.

For individuals, the main channels for acquiring ICT skills are: education, training (both on and off the job) and self-learning and practice at home. Almost 59% of respondents said they had a computer at home, and over 64% had used a PC at home for at least three years (Chapter 4 discusses diffusion of ICTs in households).

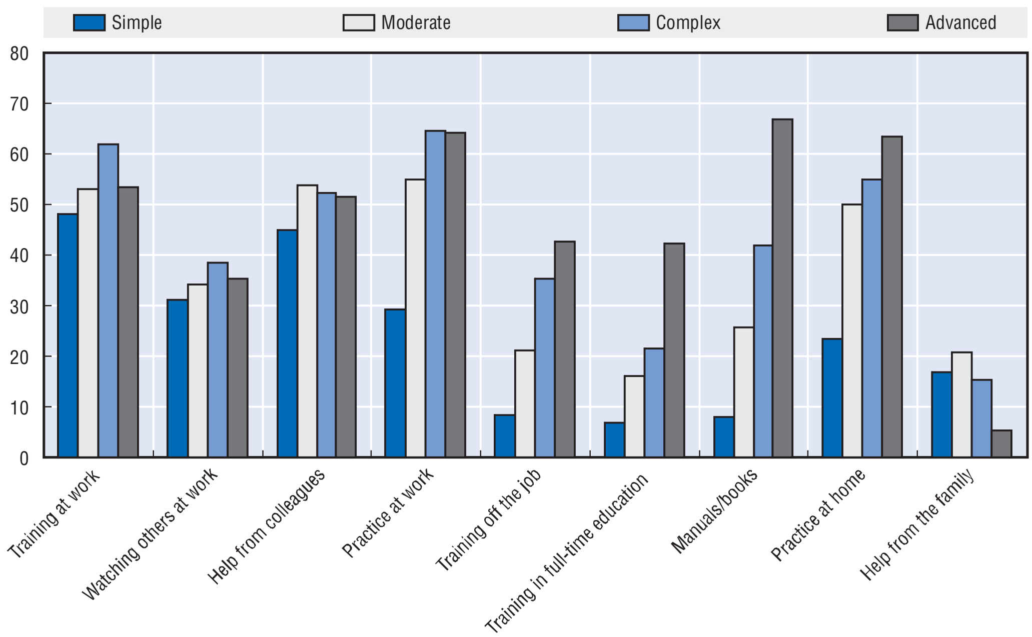
Firms can hire staff with sought-after skills directly (either on the domestic labour market, or from abroad, making use of visa arrangements where available), train and/or retrain existing staff, or outsource certain activities to those possessing the appropriate skills, either domestically or internationally.

Countries can satisfy the need for ICT skills, both in the narrow sense (ICT specialist skills) and the broad sense (including basic and advanced user skills), through education policies, training and lifelong learning incentives, and by allowing (often temporary) immigration of persons with skills that are in demand.

Although there is much debate surrounding the alleged existence of shortages in computer skills, there is currently little tangible evidence. The issue is complicated by the use of often unclear terminology (see Box 6.3). Furthermore, shortages and mismatches are also likely to depend on the

Figure 6.9. **Relative importance of various means of acquiring computing skills in the United Kingdom, by complexity of computing skills, 2001**

Percentages



Note: Respondents could give more than one answer.
Source: Felstead *et al.*, 2002.

Box 6.3. Shortages: what are they/how can they be measured?

While the existence of ICT skills shortages is often discussed, the nature of the alleged shortages is not always clear. In particular, the terminology employed tends to be quite loose. Partly as a result, there is little evidence demonstrating the existence or importance of such shortages. In addition, a distinction should be made between quantitative and qualitative shortages or mismatches. To structure the debate, the European e-Skills Forum (2004) proposes to define the various types of deficiencies as follows:

- **Shortage:** a quantitative lack of skilled people in the labour market.
- **Gap:** a competence shortfall between current and needed competence levels of personnel in companies or other organisations.
- **Mismatch:** a difference between the competence of the trainee or graduating student/learner and employers' expected competence needs. Mismatches are assumed to arise from inappropriate training and/or inappropriate course curricula.

Several variables can be used as possible indicators of skills shortages or tightness in the (IT) labour market, although none is very satisfactory: changes in wages, employment/unemployment rates, information from employers' surveys, information on vacancies (notably, the time it may take to fill them), even though the latter may be ill-adapted to rapidly growing and changing sectors such as the IT sector.

general economic climate, that of the ICT sector, and the stage of the business cycle, as well as the cycle of innovation and adoption of new technologies. The latter is likely to affect demand for different types of skills, particularly at the ICT specialist level. It is also probable that the way to satisfy the need for ICT skills depends on the skills levels in question. For example, while the diffusion of ICTs to households, schools and firms, aided by appropriate educational and training policies, is likely eventually to take care of at least basic ICT skills, changing needs for ICT specialist skills which depend, in part, on the introduction of new technologies, may be more likely to require industry- and/or technology-specific training and certification schemes (see OECD, 2002, Chapter 5).

Satisfying ICT *skills needs*

Education

Countries can use education policies to ensure that skills needs are satisfied in the long run. However, precisely because they are effective in the long term, they may not be appropriate for supplying specific (and advanced) ICT skills needs, which may change rapidly and considerably as a result of technological advances. While it can be argued that education can satisfy at least basic needs, Borghans and ter Weel (2003a, 2003b) argue that large investments in computer skills and educational programmes in order to teach pupils how to use computers are likely to be ineffective. They find no indication that computer skills are becoming a new basic skill and question whether they should be taught in schools at all. The survey results reported in Felstead *et al.* (2002) tend to support this, as relatively few respondents mentioned full-time education as a source of their computing skills (Figure 6.9). However, this may be due to the relatively recent introduction of ICTs in schools and their gradual integration into the classroom. As time goes by, more people are likely to use ICTs in school and may, as a result, indicate this as a source of at least their basic ICT skills.

While schools from primary level to universities are gradually being equipped with ICTs, the focus here is on upper secondary schools as the last stage between school and further education or work. Even when pupils' primary schools are not equipped with ICTs, they may enrol in secondary schools that are equipped and still acquire a certain level of ICT skills before entering higher education or employment.

This section looks at some of the new, detailed data on the integration of ICT equipment in the instruction of students at upper secondary schools collected in the OECD's International Survey of Upper

Secondary Schools (ISUSS) (OECD, 2004).[10] Table 6.3 shows, for the participating countries, various indicators of the extent to which students are likely to be familiar with ICTs and are likely to have at least basic ICT skills. The first three columns indicate the accessibility of ICTs for students and the next three indicate the timing and availability of certain ICT applications (standard software, Internet, e-mail). The average numbers of students per computer and the percentage of computers linked to the Internet and to local networks, respectively, can be taken as indicators of accessibility of ICTs. In 2001, Denmark, Sweden, Norway and Finland had a ratio of five students or fewer per computer and, on average, more than 90% of computers were connected to the Internet. Portugal, Spain and Mexico had the highest number of students per computer (over 14), and among the lowest percentages of computers connected to the Internet (53%, 61% and 27%, respectively). France and Italy also had low connectivity, both at 47%.

The latter part of the table shows that by 2001, in all of the countries participating in the survey, at least 90% of upper secondary students were attending schools where standard word processing and spreadsheet applications had been introduced. In 1995 this was the case in only three countries. In addition, at least 90% of upper secondary students in 2001 attended schools where the Internet had been introduced in all participating countries except Mexico. In 1995, the percentage of students exceeded 30% in only four of the sample countries (Finland, 57%; Denmark, 52%; Sweden, 43%; and Norway, 39%). The use of e-mail is somewhat less widespread (at least 90% of students in only nine of the sample countries) and also started from lower numbers in 1995 (less than 10% in over half of the sample countries).

Table 6.4 indicates the types of ICT skills students are likely to acquire in the schools that participated in the 2001 survey. In most countries, at least 90% of students attending schools in which students perform computer-related activities at least once a month operated a computer and used a word processor as part of their assignments. At least 75% of students sent, searched for and used electronic forms of information in 11 out of the 15 sample countries; in ten out of 15, at least 70% of the students used spreadsheet applications. The use of email varies from 79% in Finland to only 23% in Spain. Finally, the use of graphical applications and programme writing were less common in most countries.

It is important to bear in mind, however, that these averages may hide large differences according to type of school and geographical area. Furthermore, as only 15 countries participated in the survey, it cannot be regarded as representative of the OECD as a whole (in particular, the sample includes only one Anglo-Saxon country as the United Kingdom and the United States did not participate).

The introduction of ICT equipment in schools is not sufficient to incorporate ICTs into the learning process if teachers do not possess the appropriate skills. Indeed, use of ICTs in schools is disappointing, particularly when compared with the diffusion of ICTs in other parts of society (OECD, 2004; see also Chapter 4). The most frequently cited reasons were: *i*) problems in integrating the use of ICTs into classroom instruction; *ii*) finding enough time to schedule computer classes; and *iii*) recruiting ICT teachers. Nevertheless, the survey results show at least some evidence that students attending upper secondary schools in the participating countries are likely to acquire at least basic ICT skills.

• ICTs in schools in the United States

The US Department of Education (2003a) reports that in 2002, the ratio of students to instructional computers with Internet access in public schools was 4.8 to 1 (significantly down from a 12 to 1 ratio in 1998 when first measured). Moreover, 53% of schools with Internet access reported that students were allowed to use the computers outside of regular hours. Efforts to integrate the use of computers into classroom instruction are actively encouraged, and 87% of public schools with Internet access reported that either the school or the school district had offered teachers professional development to help them integrate use of the Internet into the curriculum in the 12 months prior to the survey. According to the US Department of Education (2003b), in 2001, 44% of children used computers and 42% the Internet to complete assignments. Finally, the "No Child Left Behind Act" supports the students who need it most, with USD 700 million earmarked for educational technology programmes in 2002-03.

Table 6.3. **ICT equipment in upper secondary schools, 2001**

				Percentage of upper secondary students attending schools where…					
	Average ratio of students to computers for students' use	Average percentage of computers connected to the Internet	Average percentage of computers connected to local area networks	… standard word processing and spreadsheet applications were introduced by 2001	by 1995	… Internet was introduced by 2001	by 1995	… an e-mail system accessible for teachers and students was introduced by 2001	by 1995
Belgium (Fl.)	7.5	68	59	100	83	100	9	66	3
Denmark	2.8	91	84	98	88	100	52	100	32
Finland	5.0	90	70	100	90	100	57	99	36
France	5.8	47	35	100	88	99	12	88	4
Hungary	10.2	68	49	100	80	100	18	99	14
Ireland	13.1	58	m	100	82	100	14	96	8
Italy	11.7	47	38	98	75	100	16	94	8
Korea	6.4	92	89	98	49	100	7	99	6
Mexico	16.5	27	25	99	65	76	9	66	5
Netherlands[1]	13.5	73	72	100	65	100	16	78	n
Norway	3.7	91	74	100	93	100	39	99	22
Portugal	14.4	53	41	94	85	95	22	89	11
Spain	15.5	61	46	93	73	98	14	66	2
Sweden	3.4	95	88	90	80	91	43	90	20
Switzerland	9.0	82	73	99	93	99	20	94	6

Note: The reported data are unweighted. m = data not available, n = near-zero number.
1. Country did not meet the national sampling requirements.
Source: OECD International Survey of Upper Secondary Schools Database, 2003.

Table 6.4. **Use of ICT equipment in upper secondary schools, 2001**

Average percentage of upper secondary students attending schools where principals reported that various computer-related activities form part of students' assignments at least once a month

	Operating a computer (saving files, printing, etc.)	Writing documents with a word processor	Making illustrations with graphical programmes	Calculating with spreadsheet programmes	Writing programmes	Communicating via e-mail with teachers and other students	Sending, searching for, and using electronic forms of information
Belgium (Fl.)	99	95	42	75	27	38	85
Denmark	99	99	68	88	14	74	96
Finland	97	96	64	61	19	79	96
France	94	91	58	88	13	44	86
Hungary	97	96	70	86	44	53	92
Ireland	87	87	66	62	13	34	67
Italy	90	89	56	78	47	39	68
Korea	90	92	46	68	14	86	91
Mexico	93	93	84	84	60	44	49
Netherlands[1]	99	99	39	63	9	48	82
Norway	99	99	66	82	21	67	88
Portugal	94	94	82	81	38	48	75
Spain	86	87	60	60	18	23	61
Sweden	96	97	61	73	30	87	91
Switzerland	93	91	57	70	14	52	82

Note: The data are unweighted.

1. Country did not meet international sampling requirements.

Source: OECD International Survey of Upper Secondary Schools Database, 2003.

• ICT in schools in Japan

By the end of March 2003, over 1.4 million computers were in use in Japanese schools for educational purposes (88.8% of the total number of computers in schools), resulting in an average ratio of 9.7 students per computer, an improvement over the 11.1 students per computer in the previous fiscal year. Nevertheless, these numbers mask differences by type of school. Table 6.5 shows the average number of students per computer by type of school for fiscal year (FY) 2001 and FY 2002. Furthermore, by the end of March 2003, over 98% of computers used for educational purposes were equipped with either a Windows or Mac operating system, and around 85% were connected to the Internet.

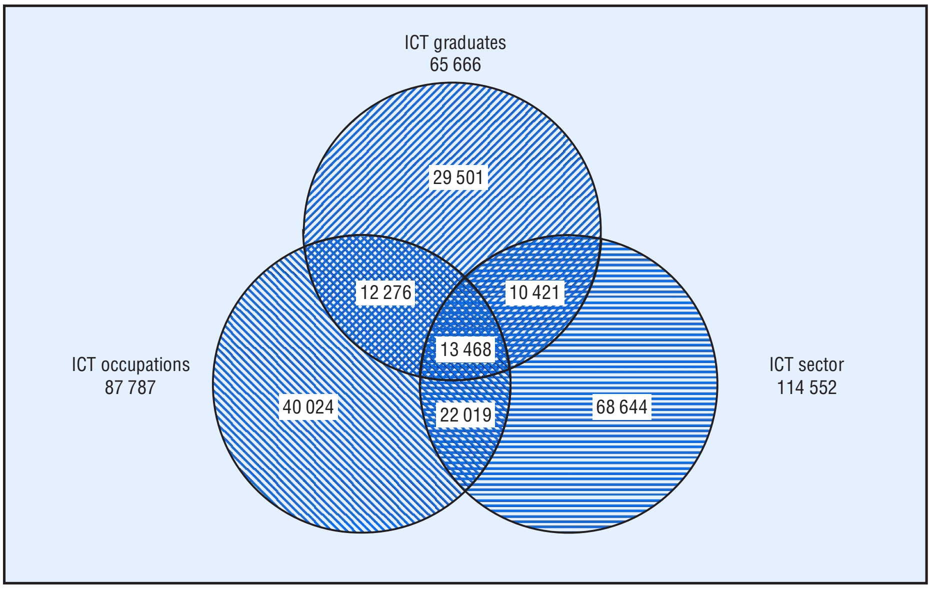
Table 6.5. **Average number of students per computer by type of school in Japan, FY 2001 and 2002**

	Total	Elementary school	Junior/lower secondary	High/upper secondary	Total special education	Schools for blind students	Schools for deaf students	Schools for handicapped students
03/02	11.1	15.0	9.3	8.4	5.1	2.2	2.0	6.2
03/03	9.7	12.6	8.4	7.4	4.0	1.1	1.5	4.8

Source: Japanese Ministry of Education, Culture, Sports, Science and Technology (2003).

When integration of ICTs into school instruction is combined with the general diffusion of ICTs among households, most people are likely eventually to acquire some basic ICT skills but not ICT specialist skills. It is questionable whether formal education is the appropriate vehicle for supplying these skills (OECD, 2002, Chapter 5). The Alliance for Information Systems Skills and the Information Technology National Training Organisation (AISS and ITNTO, 1999), for example, reported that formal education provided only some of the needed IT specialist skills (many graduates working as IT specialists had a non-IT-related degree, and many of those with an IT-related degree worked in jobs other than IT specialist jobs). Figure 6.10 illustrates the relationship between ICT degrees, ICT occupations and employment in the ICT sector in Denmark in 2002. It shows that only one in five ICT

Figure 6.10. **The Danish ICT labour market in 2002**



Source: Statistics Denmark (2003).

graduates was employed in an ICT occupation in the ICT sector. Just over 39% of ICT graduates had an ICT occupation and over 36% of ICT graduates were employed in the ICT sector.

The AISS/ITNTO report also indicated that the importance of industry certification schemes was increasing. It may be that tertiary education is ill-adapted to providing the often rapidly changing skills needed by ICT specialists and that multi-stakeholder partnerships (such as the Cisco Academic Networking Programme [CNAP], Career-Space and the GENIUS consortium[11]), industry certification schemes and various other forms of training may be more appropriate.

Training

Skills needs can also be satisfied through training. Felstead *et al.* (2002) (see above) found that in the United Kingdom training at work was an important source of learning. Employers can use on-the-job training to ensure that their workforce is equipped with the right skills for the company, and in particular to re-train personnel that lack the right skills, especially since rapid technological advances continually change skills requirements. Such training is likely to correspond to companies' needs, especially in cases where the employer provides the training directly or pays for it. Nevertheless, market failures may lead firms to underinvest in skills. OECD (2003b) discusses the policies aimed at overcoming these market failures.

Dickson *et al.* (2002) asked firms about internal skill gaps, defined as the difference between an establishment's current skills levels and what it thinks it needs to meet its business objectives. Both basic computing (30%) and advanced IT skills (30%) were mentioned by employers as occupational skill gaps (in particular for associate professionals and administrative/secretarial staff). Failure to train and develop figured prominently among the reasons for the existence of internal skill gaps (after lack of experience and *ex æquo* with lack of motivation). Employers' principal responses to internal skill gaps were to provide further training (89%) and to increase and/or expand trainee programmes (59%). Finally, firms also used training as a means to deal with 41% of hard-to-fill vacancies.

Training can also be used off the job to improve job opportunities for the unemployed. For example, many unemployment agencies run free or subsidised courses for jobseekers, often to ensure basic IT literacy skills and sometimes more advanced ICT skills.

- Computer skills in continuing vocational training in Eurostat countries

Results from the second Eurostat survey on continuing vocational training (CVTS2, 2003), defined as training measures or activities which are fully or partly financed by the enterprise for employees with a work contract, are summarised in Annex Table C.6.11. The data are relative numbers so that it is not possible to compare absolute numbers of hours spent on each type of training or across industries or countries. It appears that computer training is ranked relatively highly in Germany, France, Finland and Sweden. It is relatively less important in Italy, Bulgaria, Estonia and Lithuania. In terms of sectors, it is relatively most important in services sectors such as real estate, renting and business activities, and other community social and personal services, as it is ranked first or second in 18 out of 25 countries, and in financial intermediation (17 out of 25 countries). The relative importance of computer training in real estate, renting and business activities is also striking in EU15 countries, where it was the most important type of training in 12 of the 15 countries. Moreover, it appears that computer training is, overall, relatively more important in the EU15 and Norway than in the other European countries (where computer training tends to be relatively more important in other community, social, personal service activities).

- Computer skills training in Australia

A survey conducted by the Australian Bureau of Statistics (2002) found that 54.3% of all those who completed training courses in computer skills were female and 45.7% male. Those aged 35-44 represented around 29%, followed closely by those aged 25-34 (27.3%). There is relatively little difference between men and women by age group in completed computer training courses (plus or minus 0.4 or 0.5 percentage points) for each of the age groups, except for the group aged 45-54 where the difference is 1.1 percentage points.

A breakdown by employment status shows that around 83% of those who completed training courses in computer skills were wage or salary earners, just under 11% worked in their own business, and fewer than 6% were not working (a small residual percentage worked under other arrangements). Moreover, while for both wage and salary earners and those who work in their own business, computer skills were the fourth most important field of training (after management and professional, health and safety, and technical and para-professional), it was third for those who do not work (after management and professional and health and safety). Finally, 88.5% of wage and salary earners who completed training courses in computing skills found that the skills were transferable (*i.e.* could be used in a similar job for a different employer) but did not tend to induce a pay rise (90.8%).

Computer training varies substantially in importance among all fields of training across industries and across occupations, but it is never the most important field of training. Education, property and business services, government administration and defence, and finance and insurance account for the four largest shares of total computer training and together account for over 57% of total. These are also industries, along with wholesale trade, in which computer training is the second most important field of training (see Annex Table C.6.12 for details). By occupation, the concentration is somewhat greater. The two occupations with the largest individual shares of total computer training (professionals, and intermediate clerical, sales and service workers) account for almost 62% of the total, but computer training is only the third and fourth most important field of training, respectively (see Annex Table C.6.13 for details).

- IT training in Japan

Japan has two types of government-supported IT training programmes. Local governments support basic IT training courses (basic computer operations, e-mail, Word, etc.). In FY 2000 (ending March 2001) just over 100 000 people had enrolled in over 6 000 classes. By the end of FY 2001, the number had increased to just over 5 million and over 300 000 classes. The government also supports training for professional IT skills (Information and Communications Personnel Training Support System) which is organised by non-private organisations and public corporations. In FY 2001, 1 299 people enrolled in these courses and in FY 2002, 5 065.

Outsourcing

Skill deficiencies can also be met through outsourcing, either domestically or internationally. Although there are no official data measuring the extent to which outsourcing takes place (see Chapter 2), anecdotal evidence suggests that firms' inclination to outsource depends on the reasons for outsourcing: saving on costs, improving quality or filling a skill deficiency.

In a context of globalisation, market deregulation and rapid technological developments, firms increasingly resort to new organisational forms in order to face competitive pressures. Firms can reorganise through mergers and acquisitions, joint ventures and strategic alliances (see Pain and van Welsum, 2003, for example), but also by outsourcing. By concentrating on their core comparative advantage activities and outsourcing others, firms may increase their competitiveness through cuts in labour and capital investment costs and the exploitation of economies of scale. Outsourcing may also lead to more efficient organisation of firms and allow them to share and spread risk. Furthermore, rapid developments in ICTs provide increasing opportunities for outsourcing. In particular, "knowledge work' such as data entry and information processing services and research and consultancy services can easily be carried out via the Internet and e-mail, as well as tele- and video- conferencing (ICT-enabled services). Increasingly, activities such as call centres have also started to be outsourced. For example, when phoning to a call centre on a local telephone number in the United Kingdom, the person answering may well be located in Bangalore.

In light of the increasing interconnectedness of both people and countries, as well as the omnipresence of affordable and powerful ICTs, Millar (2002a) examined outsourcing practices in Europe, using the know-how of industry experts from leading international consultancies, in order to identify outsourcing trends and their implications for employment and the accumulation and distribution of skills. She reports mixed evidence regarding the degree of geographic flexibility. On the one hand, outsourcing contracts may involve short-term arrangements that are determined by the demand for particular technologies and the supply of specific skills. On the other hand, some geographical patterns emerged. For example, software development and support work tended to be contracted out to firms in Poland, the Czech Republic and clusters around capital cities with important services sectors such as Brussels, London and Madrid. The outsourcing of creative services[12] tended to concentrate in regions in southern Europe (Madrid again, Athens, Milan, the south of France), along with Germany and the United Kingdom. However, labour-intensive, low value-added processing work tended to be outsourced to cheap-labour peripheral regions. Outside Europe, India has emerged as a major outsourcing centre. It initially attracted outsourcing activities because of its low-skilled cheap labour (in particular for call centres), but it is now becoming a location for the outsourcing of more sophisticated, higher value-added business processes or IT consulting. Over the next few years, other locations in the region are likely to compete as low-cost locations (*The Economist*, 2003a, 2003b).

Most outsourcing involves routine tasks and is driven by a desire to lower costs, but some is for specialist activities. Millar (2002a) found that European firms tended to outsource within Europe, with low-skill tasks mainly going to low-cost locations. Thus, while the use of ICTs makes possible the redistribution of ICT-skilled employment, it appears to do so in ways that result in increased regional polarisation. This could have lasting consequences for both the distribution of ICT-skilled employment and the accumulation of skills across countries.

Geographical and cultural diversity may also create barriers to the internationalisation of organisational relationships. Asymmetric information between clients and suppliers, which is particularly common for electronic goods and services, and differences in (corporate) cultures and national rules and regulations impede the globalisation of activities. Nevertheless, these can be overcome by adopting special practices, by implementing various types of outsourcing arrangements, and, increasingly, by entering into alliances and joint ventures.

Differences in geographical developments are also driven by differences in employment regulations, industrial organisation and institutional structures, and attitudes towards international investment and outsourcing practices. It appears that, in Europe, the outsourcing market is growing relatively more quickly in the United Kingdom than in Germany or France, for example. Morgan Chambers (2001), in a study of outsourcing in the FTSE100 firms, found that 56% had engaged in the outsourcing of internal services.[13] The banking sector alone accounted for 22% of business processes (*e.g.* finance and procurement) and ICT outsourcing contracts, followed by aerospace and defence (16%), oil and gas (14%), and telecommunications (13%). ICT-only contracts account for almost 75% of total business processing and ICT outsourcing contracts (while business processes outsourcing will often also include an ICT component). For such contracts, aerospace and defence account for the largest share (21%), followed by banks (18%), telecommunications services (12%) and oil and gas (8%). The study also notes that while there are many ICT services providers among the FTSE100 firms, often with divisions offering outsourcing services for their clients, these firms do not tend to outsource activities themselves. The study also found that the average ICT outsourcing contract is for 5.3 years, against 6.4 years on average for business processes outsourcing contracts.

Finally, outsourcing practices may change over time (Millar 2002a, 2002b). In the late 1990s, in the presence of skills shortages and rising costs, outsourcing in Europe was mainly for low-value, low-skill work on fixed contracts. Firms that dominated this part of the outsourcing market at that time (India in particular) are believed to benefit now from first-mover advantages. Moreover, there appears to be a trend towards the outsourcing of high-value, high-skilled work to countries where the outsourcing market is relatively mature. Firms in these countries now require staff to have more diverse skills, *i.e.* to combine technical skills with communication, management and business skills. While the first type of outsourcing is mainly motivated by cost savings, higher-skill forms of outsourcing tend to be driven by quality improvement. The organisational structures themselves are also changing and display a tendency towards more co-operative agreements and alliances.

One consequence of increased and broader outsourcing practices should be greater efficiency, induced and enhanced by greater competitiveness. Indeed, given that both time and geography lose their importance as ICTs become ever more powerful and sophisticated, and with markets increasingly deregulated, skilled workers throughout the world compete with one another. This should lead everywhere to an increase in the quality of the workforce and in the efficiency of production, but it is also important to maintain good working conditions (OECD, 2000; ILO, 2002).

Migration

Allowing the inflow of migrants with sought-after skills is one way for countries to fill skills gaps. Most countries, such as New Zealand (see Annex Table C.6.14), have established skill shortage or occupational shortage lists which are advertised on the immigration office (or equivalent) Web site. These lists change over time, but tend to include at least certain types of ICT skills, which generally fall into the advanced user and/or ICT specialist categories.

Migration of highly skilled workers is often thought of in terms of brain drain/brain gain or even brain circulation (Saxenian, 1999a, 1999b; OECD, 2001), but in fact, little is known about its effects. The accumulation of the knowledge stock is an important concern in both developing and developed countries and is related to issues such as the degree of fungibility of skills and location decisions of firms engaging in foreign direct investment (FDI) and R&D. The international migration of highly skilled workers may have both positive and negative effects arising mainly from technological, knowledge and cultural spillovers, as well as migrant workers remittances (see Regets, 2001, for a detailed overview). However, there is little empirical evidence to shed light on such alleged effects.

Until recently, it was widely believed that shortages in the ICT-sector labour market created a climate favourable to the international migration of IT specialists and professionals. However, it appears that some countries are now starting to take a less favourable view of IT migration, in part as a result of the general slowdown that has taken place in the ICT sector, reduced skills shortages and/or an overestimation of skills needs. The United Kingdom removed IT occupations from the occupational shortage list in late 2002, Denmark took IT specialists out of the special immigration scheme in July 2003,[14] and Australia announced in November 2003 that the revised "Migration Occupations in Demand List" no longer contained any ICT specialisations, after having contained up to 26 in the past. Finally, the United States has announced the return to its lower former level of its H-1B visa quota,[15] which includes, but is not exclusively for, the immigration of IT specialists.[16]

Most European countries and developed Asian countries have not adopted special measures to recruit highly skilled workers but continue to rely on existing work permit schemes (McLaughlan and Salt, 2002; see also OECD, 2002). However, where special measures have been introduced, they tend to apply to IT and health (mainly nursing) occupations and intra-company transferees. The information on IT-related migration for selected OECD countries discussed below suggests that, for most countries, migration flows are influenced, among other factors, by historical (sometimes colonial) ties and/or the presence of a common language.

In the *United States*, IT firms have found it increasingly difficult to obtain visas for professionals from Indian consultancy firms, and India's largest IT service provider, Tata Consultancy Services (TCS), with some 5 000 staff in the United States, has encountered longer delays and refusals of visas (*The Economist*, 2003b). The US Department of Homeland Security's Citizenship and Immigration Services) has announced that the ceiling on H-1B visas, which many IT professionals use to work in the United States, will drop in 2004 from 195 000 to its former level of 65 000. Moreover, while computer-related occupations (defined as systems analysis and programming, data communications and networks, and computer systems technical support under the US Department of Labor's [DoL] coding system) accounted for 58% of H-1B approved petitions in FY 2000 and FY 2001,[17] they represented just over 38%

in FY 2002, but still remained the largest occupational group (US DoL, 2003; US Citizenship and Immigration Services, 2001 and 2000).

India accounted for over 48% of approved H-1B petitions in both 2000 and 2001, followed by China (over 8%) and Canada (over 3%), also in both years. However, for computer-related occupations, India was the main country of origin, accounting for 71% of total approvals in 2001 and 63% in 2002. Finally, the median annual compensation of H-1B beneficiaries in computer-related occupations in 2001 was USD 58 000 against a median of USD 55 000 for all occupations.

Australia announced in November 2003 that ICT specialisations no longer figure on the list of migration occupations in demand, as research had shown that Australia no longer had ICT skills shortages (*www.minister.immi.gov.au/media_releases/media03/v03007.htm*). Other government initiatives, such as suspending priority processing of ICT migrant applications and increasing the number of points required to meet the migration pass mark, also aim at reducing the inflow of ICT migrants. Table 6.6 shows arrivals and departures of IT managers and computing professionals in the period 1997/98-1999/2000. The largest flows were between Australia and the United Kingdom, Hong Kong (China) and the United States.

Box 6.4. **Survey of returning IT workers to Bangalore, India**

A survey of IT emigrants returning to Bangalore, India, was carried out in November 2002 (Khadria, 2004). The sample included 45 respondents in different types of software companies. Their mean age was 33 years, and nearly two-thirds were in the 25-35 years age bracket. They were mainly male (39 out of 45), married (35 out of 45), well educated (20 were graduates, 20 post-graduates and four held PhDs; one was educated abroad), and had stayed abroad for a relatively short period of time (17 out of 45 for less than 2 years, six for 2-4 years, ten for 4-6 years; the rest for longer periods of up to 16 years). Also, 35 respondents indicated they would like to emigrate again, although only if offered a lucrative overseas job, and 39 stated that if they emigrated again, they would not wish to remain abroad permanently.

Out of a total of 56 destinations (multiple answers were possible), the United States was the most favoured destination (36), followed by the United Kingdom (7) and Germany (4). Better professional infrastructure and favourable policies for granting visas to IT professionals were among the main reasons for the preference for the United States.

The main reasons for emigrating included: the opportunity to work on projects, mainly in the United States, made available through their employers in India (23 respondents); additional higher education in the host country (the main purpose of 13 respondents, although only nine succeeded); and work experience abroad which was felt to be of quite high value in India (eight respondents). Permanent settlement abroad was never given as an answer.

The respondents returned to India on their own initiative (29, for a variety of reasons, such as family or other personal reasons, but also increased opportunities in India) or were recalled by their employers (nine). Respondents were attracted to Bangalore in particular by abundant employment opportunities, relatively better infrastructure, better remuneration packages, and the availability of experts in the IT sector. The presence of family in Bangalore was also relatively important, as was the climate.

Even though the central and state governments have put in place incentive programmes and other policies aimed at encouraging expatriate professionals to return to India (mostly through tax rebates, housing facilities or financial assistance when setting up a business in Bangalore), only 11 respondents claimed to be aware of them (and very few managed to receive such help after their return). The remaining 34 claimed never to have heard of them, either before or after their return.

Job satisfaction in Bangalore is generally high (41 out of 45 respondents), mainly because of greater professional autonomy, world-class institutional infrastructure, favourable working environment, the cosmopolitan nature of Bangalore, and many opportunities for career advancement. Most respondents agreed that the knowledge and skills obtained overseas through higher education and on-the-job training were very important for their current job in Bangalore, as were the opportunities the stay abroad had given them to learn and familiarise themselves with new technologies. One-fifth of the respondents also mentioned benefiting from professional networks established while overseas.

Table 6.6. **Migration flows in and out of Australia, IT managers and computing professionals, 1997/98-1999/2000**

	Resident arriving	Resident leaving	Visitor arriving	Visitor leaving	Settler arriving
IT managers	746	1 300	1 089	324	334
Computing professionals	4 303	7 640	5 956	2 528	4 456

Source: Australian Department of Immigration and Multicultural and Indigenous Affairs (2003), revised 2004.

Canada has set up a pilot programme to facilitate the processing of IT workers in order to help employers fill critical shortages in the software industry. The programme is part of a government initiative to support the entry of skilled foreign workers (as temporary residents with an employment authorisation) when employers cannot fill vacancies through the domestic market as a result of labour shortages. A pilot software programme for alleviating short-term and temporary skills shortages with temporary residents was introduced in 1997 and became permanent in December 2001. Long-term strategies include re-examination of the educational system with a view to enabling the domestic labour force to meet employers' demands.

Table 6.7 shows the number of foreign IT workers who arrived under the software programme between 1997 and 2002 and some of the main source countries. The number increased steadily between 1997 and 2000, with the exception of 1999, but then declined. India was the largest supplier from the introduction of the programme, and its share increased from around 28% in 1997 to over 63% in 2002. Most of the other source countries have seen their shares diminish. Nevertheless, the sum of the shares of the countries reported in the table increased from over 56% in 1997 to over 80% in 2002.

Most arrivals locate in the main urban areas, and the three largest recipient cities account for around 60% of total arrivals. In 2002, Toronto received 39.9% of total inflows (total Ontario, 69.1%), Vancouver, 10.2% (total British Columbia, 11.9%), and Montreal 9.7% (total Quebec, 10.3%). This geographical pattern has been relatively constant from the start of the programme, although the relative importance of Toronto in total Ontario decreased substantially, from 70.7% in 1997 to 57.8% in 2002.

Since July 2003, *Denmark* no longer includes IT specialists in its job-card scheme, which facilitates the processing or work permits. In 2001 and 2002, specialists under the job-card scheme accounted for 7.6% and 5.5%, respectively, of total residence permits on immigration to Denmark and for 8% and 11.5%, respectively, in the first two quarters of 2003. Moreover, IT specialists accounted for 47% of residence permits given out under the job-card scheme in 2002 (applications after 1 July 2002), and for 43.7% and 41% in the first two quarters of 2003 (Danish Immigration Service, 2003).

In 1998, *France* introduced a fast-track system for IT specialists and highly skilled professionals in response to a shortage of IT professionals. The permits are valid for one year and are renewable and are limited to a specific region and a specific job. Table 6.8 shows the number of work permits issued to

Table 6.7. **Foreign workers entering Canada under the software programme by country of last permanent residence, 1997-2002 (flows)**

	1997		1998		1999		2000		2001		2002	
Total	**311**		**953**		**932**		**1 120**		**960**		**766**	
of which:		%		%		%		%		%		%
India	88	28.3	369	38.7	331	35.5	411	36.7	453	47.2	485	63.3
UK[1]	27	8.7	58	6.1	63	6.8	63	5.6	53	5.5	25	3.3
France	22	7.1	44	4.6	65	7.0	74	6.6	47	4.9	19	2.5
USA	20	6.4	58	6.1	52	5.6	97	8.7	83	8.6	47	6.1
Australia	15	4.8	32	3.4	35	3.8	45	4.0	27	2.8	16	2.1
Israel	3	1.0	18	1.9	16	1.7	0	0.0	16	1.7	23	3.0

1. United Kingdom and Channel Islands.
Source: OECD, based on data from Priorities, Planning and Research Branch, Strategic Research and Statistics, Citizenship and Immigration Canada (2003).

Table 6.8. **Number of work permits issued to permanent and temporary IT managers and engineers in France, 1996-2002**

	1996	1997	1998	1999	2000	2001	2002
Permanent total	4 267	4 582	4 149	5 326	5 990	8 811	7 469
Permanent IT managers/engineers	298	401	699	1 136	1 622	2 641	975
% of total	7.0	8.8	16.8	21.3	27.1	30.0	13.1
Temporary total	4 832	4 674	4 295	5 791	7 502	9 628	9 822
Temporary IT managers/engineers	285	564	796	1 033	986	1 368	792
% of total	5.9	12.1	18.5	17.8	13.1	14.2	8.1
Total IT manager/engineers	583	965	1 495	2 169	2 608	4 009	1 767
% permanent	51.1	41.6	46.8	52.4	62.2	65.9	55.2
% temporary	48.9	58.4	53.2	47.6	37.8	34.1	44.8

Note: The figures exclude immigrants from the EU15 and the European Economic Area (EEA).
Source: Service des statistiques, des études et de la communication, Office des Migrations Internationales (2003).

permanent and temporary IT engineers in France over the period 1996-2002. In 2000 and 2001 the demand for IT specialists was particularly strong with the passage to the year 2000 (Y2K-induced IT problems) and the adoption of the euro. Demand subsequently slumped, resulting in a sharp drop permits granted to IT specialists in 2002. There was a steady increase in both the absolute and relative number of permanent permits delivered to IT managers and engineers between 1996 and 2001, followed by a sharp drop in 2002. The number of temporary permits increased until 1999 and fluctuated thereafter, also with a sharp drop in 2002. Their relative number varied over most of the period, ranging from 5.9% in 1996 to 18.5% in 1998. Moreover, with the exception of 1997 and 1998, relatively more permanent than temporary permits were granted to IT engineers.

Table 6.9 and Figure 6.11 show the number and distribution of work permits granted to IT specialists by region of origin and the main source countries over the period 1999-2002. The sharp drop in permits in 2002 is observed for most regions and countries, except India. During the two years with particularly strong demand for IT specialists, Africa was by far the largest supplier. Moreover, while America's share decreased over the period 1999-2002, Asia's share increased considerably, as did non-EU15 Europe's, although to a lesser extent.

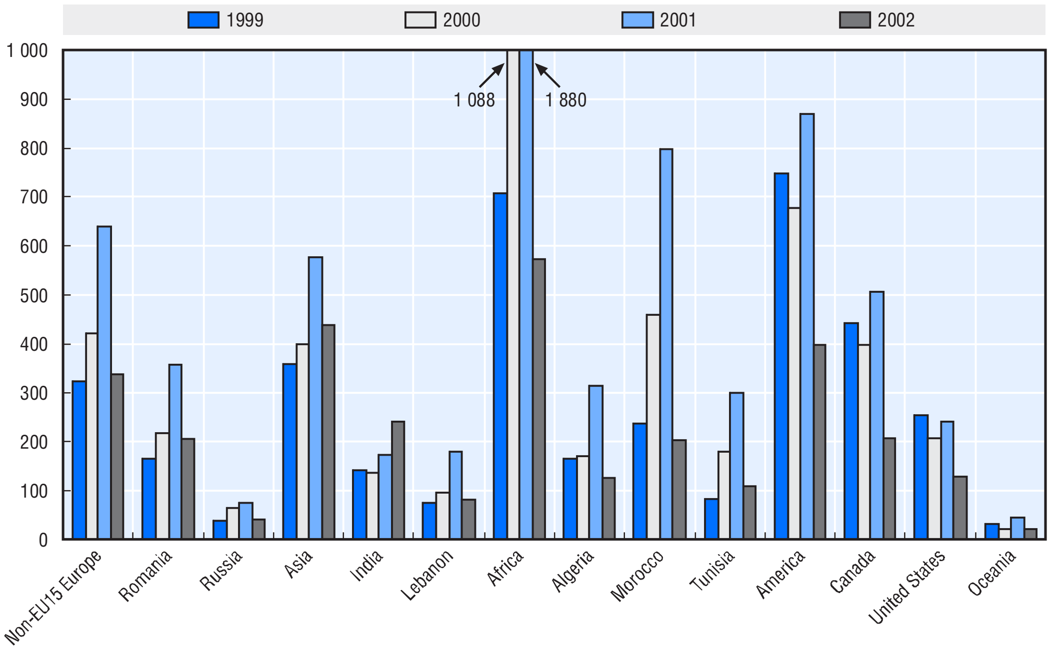
In August 2000, *Germany* introduced the IT specialist temporary relief programme, the Green Card, in order to allow IT specialists from non-EU15 countries to work in Germany for up to five years. Requirements are a good knowledge of either German or English and either a degree in the ICT field or a confirmed offer of a minimum annual salary of EUR 51 000. The initial quota was fixed at 10 000 cards and was subsequently raised to 20 000. However, as Figure 6.12 shows, by June 2003, fewer than three-quarters had been given out. For most countries of origin, between 78% and 98%, are men. Between around half and two-thirds of cardholders are employed in firms of up to 100 employees.

Table 6.9. **Regional shares of total work permits granted to IT specialists in France, 1999-2002**

	1999	2000	2001	2002
Africa	33	42	47	32
America	34	26	22	23
Asia	17	15	14	25
non-EU Europe	15	16	16	19
Oceania	1	1	1	1

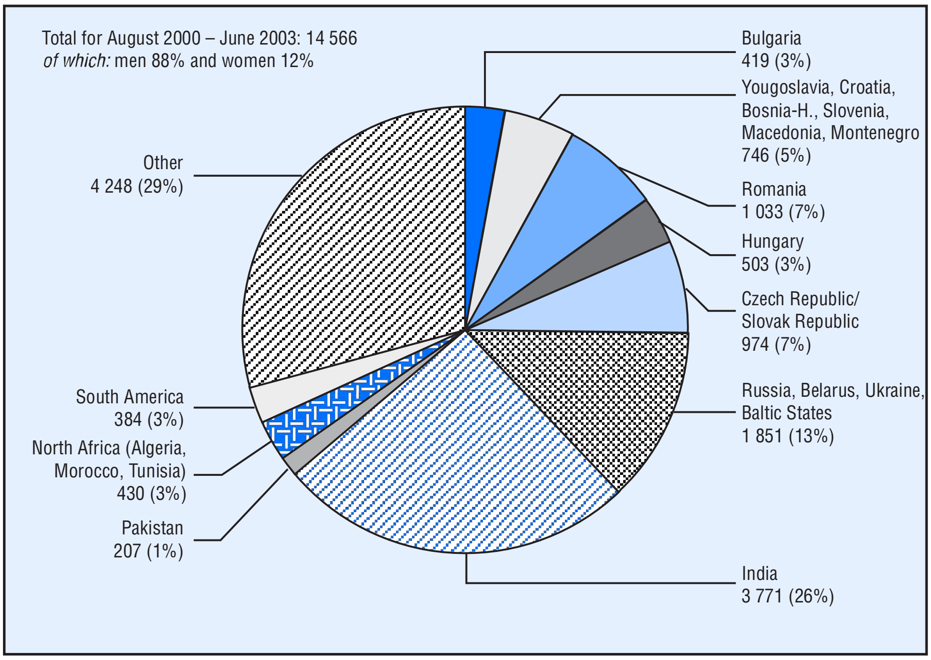
Note: Non-EU Europe refers to non EU15.
Source: Office des Migrations Internationales, 2003.

Figure 6.11. **Total work permits granted to IT specialists in France by region and country of origin, 1999-2002**



Note: Excludes immigrants from the EU15 and the EEA. Non-EU Europe refers to non-EU15.
Source: Office des Migrations Internationales, 2003.

Figure 6.12. **Permits for IT specialists (green cards) delivered in Germany, August 2000-June 2003**



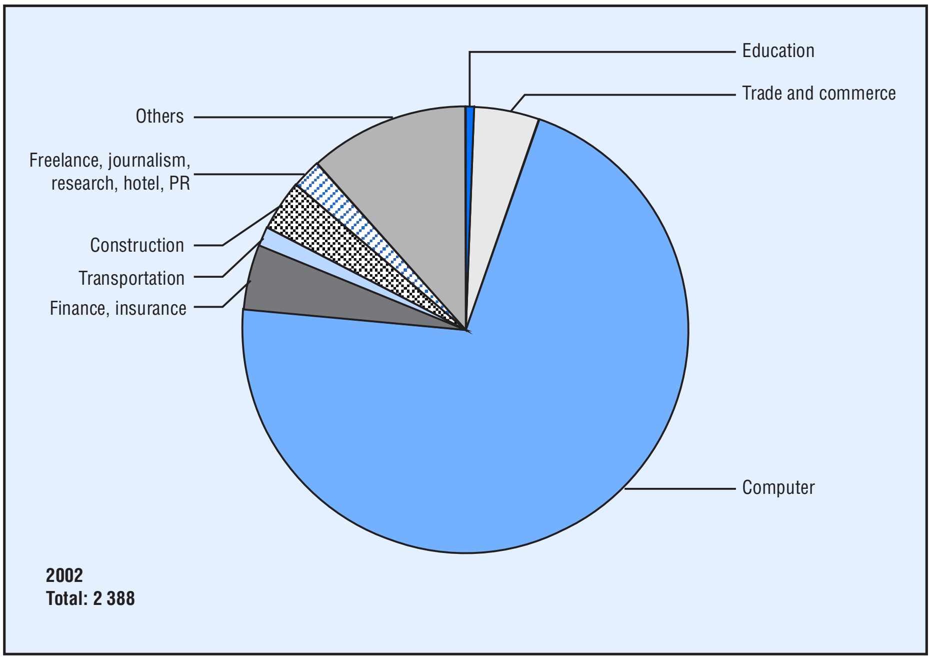
Source: ZAV IT-Sonderteam, Central Placement Office, Arbeitsamt (2003).

Ireland introduced the working visa and work authorisation scheme in June 2000. It is designed to aid sectors where skills shortages are particularly important, such as information and computing technologies. While the scheme does not eliminate the requirement of a work permit, it offers a faster alternative.

Japan records separately persons who enter Japan to work in a Japanese firm as technology specialists (including IT specialists). In 2002, four countries accounted for around 80% of total new foreign entrants under this scheme: 31.9% from China, 21.6% from Korea, 16.2% from the United States and 10% from India. For those who changed status by switching from a student visa, China accounted for 61.3%, Korea for 17.1%, followed by Malaysia and Indonesia with 3% and 2.1%, respectively. While the numbers do not allow for distinguishing between IT specialists and others, Figure 6.13, which shows the sectoral breakdown of visas issued for working in Japanese firms as technology specialists in 2002, indicates that computer-related immigration is relatively important in this group.

Korea's main emphasis has been on the education and training of domestic workers. It has recently loosened somewhat its relatively restrictive immigration policy for temporary employment, owing to labour shortages, particularly in the very high-technology area where it is relatively more difficult to satisfy the need for skilled personnel from the pool of domestic workers. The Korean Ministry of Information and Communication and the Korean Ministry of Justice therefore decided to allow the immigration of highly skilled IT workers through what has been called the IT CARD system. In December 2001, responsibility for this project was transferred to the Promising Information and Communication Companies Association (PICCA). The system operates through the issuance of E-7 visas, improvement of the Stay Permission System, and the issuance of a letter of recommendation. Companies that wish to hire IT immigrants undergo two official audits. Applicant immigrants must have at least five years of engineering experience in IT, e-business or related fields, or a bachelor's degree and two years' experience. If all conditions are satisfied, the Ministry of Information and Communication issues a letter of recommendation. Table 6.10 shows the total number of recommendations since 2000.

Figure 6.13. **Visas issued for working in Japanese firms as technology specialists by sector of activity, 2002**



Source: Japanese Ministry of Justice, Bureau of Immigration (2003).

Table 6.10. **Recommendations for IT CARDs by the Korean Ministry of Information and Communication, 2000-October 2003**

	2000	2001	2002	October 2003	Total
Recommendations	46	169	225	204	644

Source: Promising Information and Communication Companies Association (2003).

In *New Zealand*, IT specialists figure on the Occupational Shortage List (see Annex Table C.6.15 for details), and IT professionals – management and project management staff, policy planning and research staff, systems development staff, and technical advice and consultancy staff – are on the priority occupations list. However, between 11November 2002 and 30 June 2003, less than 2% of total approved work applications were for IT immigrants.

In *Norway*, the number of specialist permits awarded increased considerably in 2001 and 2002 as a result of changes and simplifications in the regulations and requirements governing these types of permits (Table 6.11).

The *United Kingdom* removed IT occupations from the shortage occupations list in late 2002, but the total number of IT work permits granted has changed little. This can be explained, in part, by the fact that a large share of approved work permits are extensions of permits for persons already in the United Kingdom. The evolution of the number of applications granted, by occupation, from April 2002 to September 2003 is shown in Figure 6.14.

Internet recruitment

This section examines online recruitment, a relatively new phenomenon which brings together the use of ICTs and ICT skills in the process of offering and finding employment. Job search and recruitment have moved onto the Internet with relative success, and Internet recruitment firms have been among the most successful dot.com companies. Their success can be explained by the role played by information, which is crucial both for jobseekers looking for job vacancies and information and employers who want to fill jobs and obtain information about jobseekers. Since the Internet offers a very low cost and speedy means[18] of transmitting information widely, on-line job search and recruitment has substantial advantages. As a consequence, more and more people (in a wide variety of occupations and sectors) are using the Internet for job searching, either through so-called job boards, which effectively have the same function as newspaper ads, or through Internet recruitment firms that often maintain job boards as well as databases of CVs. Moreover, many firms now post vacancies on their Web sites, and many also allow people to apply on line.

Advantages for jobseekers include the possibility to search among a very large pool of jobs, in general free of charge. Moreover, on-line recruitment firms offer jobseekers the possibility to search by keyword, job category, location, etc., to personalise and organise their searches, to receive e-mail notification of the progress of their application, as well as job search and career development advice.

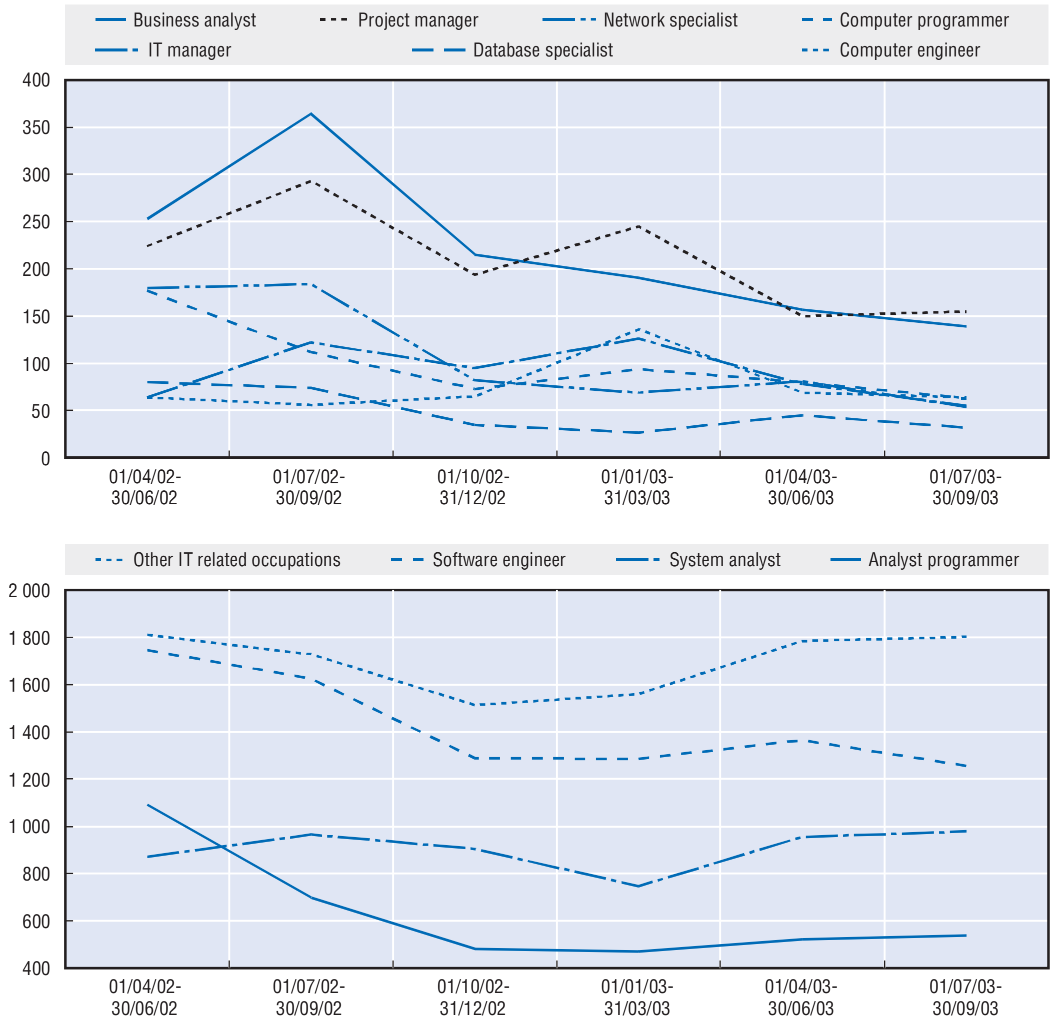
Firms seeking to recruit on line can do so either directly, through their Web site, or indirectly through the intermediary of online recruitment firms. The latter offer search possibilities similar to those for

Table 6.11. **Number of specialist permits issued in Norway, 1995-2002**

Year	1995	1996	1997	1998	1999	2000	2001	2002
Number of specialist permits	296	360	366	420	384	296	779	1 676

Source: Strategy and Documentation Department, Norwegian Directorate of Immigration, UDI (2003).

Figure 6.14. **Number of IT work permits approved in the United Kingdom, by occupation, April 2002-September 2003**



Source: Work Permits UK (2003).

jobseekers, pre-screening services, as well as advantages such as the ability to edit job advertisements, to post them in multiple locations, to track reactions, etc. Moreover, according to Monster, one of many Internet recruitment companies, cost savings are often cited as the main driver of on-line recruitment. Freeman (2002) reports that it has been estimated (by the Employment Management Association) that recruitment over the Internet costs a firm around one-fifth of what it would cost using print media. According to Monster UK, the gains are even more important. They claim that a typical recruitment ad in a national paper costs around GBP 10 000, whereas it costs only GBP 250 to post a vacancy on the Monster site for 60 days. At Careerbuilder.com, pricing for employers depends on the (customised) package purchased. An employer wanting to post a single vacancy in one location for 30 days will typically be charged around GBP 200, but the amount will vary depending on the number of postings and whether other services, such as the Resume Database Service, are also purchased.

Freeman (2002) points out that this type of on-line activity highlights the importance of network economies and of economies of scale, but that a balance is needed between the interests of jobseekers, who prefer sites with many firms and few applicants, and employers who prefer sites with many applicants and few firms. He also argues that, *a priori*, these developments should allow better and speedier matching of jobseekers and employers, speedier clearing of the labour market and reduced transactions costs, and that these gains should ultimately contribute to a more efficient economy. Nevertheless, Kuhn and Skuterud (2004) find some empirical evidence to the contrary, their results indicating that either Internet job searches are ineffective in reducing unemployment durations, or Internet job searchers are negatively selected on unobserved characteristics.

With the launch in September 2003 of EURES (European Employment Services), the European Job Mobility Portal Web site (*http://europa.eu.int/eures/index.jsp*),the European Union has also acknowledged the importance of the Internet as a recruitment tool. EURES is a co-operative network formed by public employment services with the participation of trade unions and employers' organisations. It aims to enhance labour mobility in participating countries (EU15 member states, as well as Iceland, Norway and Switzerland)by advertising vacancies for a wide range of sectors and skill levels from employers that wish to recruit internationally. It allows jobseekers who are interested in moving to another country to post their CVs on line and provides practical information about living and working in participating countries. The service is free of charge for both employers and jobseekers. The vacancy database, which at the outset contained around 11 000 vacancies, is updated daily. The Living and Working Conditions database, which contains details on issues such as finding accommodation and schools, taxes, cost of living, social security and comparability of qualifications, is updated at least twice a year.

- Some illustrations[19]

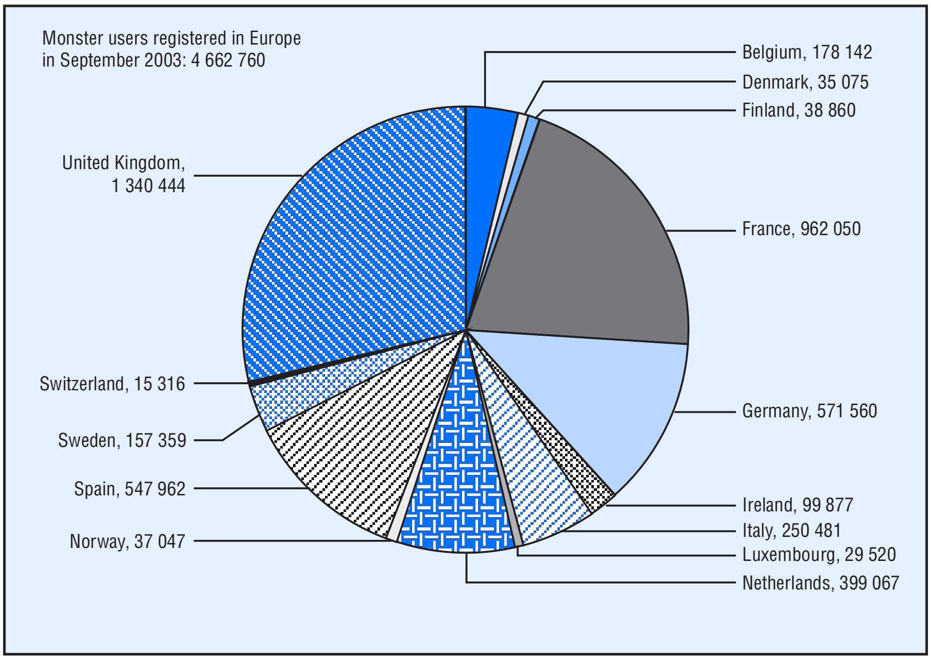
The Monster global network consists of local content and language sites in the United States, Canada, Australia, New Zealand, Singapore, Hong Kong (China), India, and in Europe in Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom. It has over 30 million resumes and a searchable database of over 300 000 employment opportunities. Monster offers company memberships that are scalable and customised to the individual level of service required. Thus, employers can purchase single job postings, or packages ranging from 15 to 6 000 postings. Moreover, job descriptions can be programmed to link to company profiles to give applicants a better understanding of the recruiting company. Figure 6.15 shows the geographical distribution of the over 4.6 million users that were registered in Europe in September 2003.

CareerBuilder.com has around 7 million different visitors each month and expects the number to (more than) double in early 2004 after the launch of the career sites of AOL and MSN, which it will power. It already powers the career sites for more than 350 US national, industry, local and niche sites. It offers more than 400 000 jobs from over 25 000 of the United States' top employers and covers most industries and fields. Companies can search over 7 million CVs.

HotJobs.com is fully integrated with Yahoo!, and when it features on the Yahoo! homepage, there is a 45% increase in traffic and a 49% increase in resume creation. It has recently been awarded leading industry and editorial awards (Weddle's and PC M*agazine*). Jobseekers voted it the best general purpose job board for jobseekers in both 2002 and 2003, and recruiters voted it the most recruiter-friendly general purpose site in 2003 in a survey carried out by Weddle's. It registered 6.6 million different visitors in March 2003 and recorded a total of 13.7 million jobseekers in April 2003. Over 3 million skilled workers are registered in fields such as construction, manufacturing and transportation. Some of the top 50 keywords entered into the HotJobs Mantle on Yahoo! include: driver (12), truck driver (15), electrician (21), construction (22), and part-time (29), a clear indication that on-line recruitment is an economy-wide phenomenon and is not just limited to the ICT sector and/or ICT specialists.

The market share of the top ten on-line recruitment sites in the United States and the United Kingdom in January 2004 is shown in Table 6.12. In the United States, these accounted for 50.7% of total usage of

Figure 6.15. **Geographical distribution of Monster users registered in Europe, September 2003**



Source: Monster (2003).

Table 6.12. **Top ten Internet recruitment sites in the United States and the United Kingdom, January 2004**

Rank	Site	Domain name	Market share
United States			
1	Monster.com	*www.monster.com*	18.4%
2	Yahoo! Hotjobs	*hotjobs.yahoo.com*	12.8%
3	Monster.com – My Monster	*my.monster.com*	5.8%
4	CareerBuilder	*www.careerbuilder.com*	3.8%
5	USAJOBS	*www.usajobs.opm.gov*	2.4%
6	America's Job Bank	*www.jobsearch.org*	2.3%
7	Dice IT Employment	*www.dice.com*	1.5%
8	MSN CareerBuilder Network	*msn.careerbuilder.com*	1.3%
9	Your Benefits Resources	*www.resources.hewitt.com*	1.2%
10	FlipDog.com	*www.flipdog.com*	1.2%
United Kingdom			
1	Jobcentre Plus	*www.jobcentreplus.gov.uk*	9.1%
2	Jobsite	*www.jobsite.co.uk*	5.7%
3	Fish4 Jobs	*fish4.co.uk/jobs*	5.4%
4	Total Jobs	*www.totaljobs.com*	4.8%
5	Reed.co.uk	*www.reed.co.uk*	3.5%
6	Monster.co.uk	*www.monster.co.uk*	2.7%
7	Jobserve	*www.jobserve.co.uk*	2.4%
8	TES Jobs	*www.tesjobs.co.uk*	1.7%
9	WorkThing	*www.workthing.com*	1.7%
10	Guardian Unlimited Jobs	*jobs.guardian.co.uk*	1.6%

Note: Market share refers to the company's share in the total on line recruitment market in the respective country.
Source: Hitwise (2004).

on-line recruitment sites, *versus* 38.5% in the United Kingdom. Monster is the only company that figures in the top ten in both the United States and United Kingdom.

In the United Kingdom, the National Online Recruitment Audience Survey (NORAS), carried out by Enhance Media Limited (2003), examined the demographic, work situation and Internet usage profiles of users of UK on-line recruitment sites (see Box 6.5).[20] Overall, there was little difference in terms of gender (51% male, 49% female for the sample as a whole), but most of the specialist sites show larger differences (see Annex Table C.6.16 for more detail). The average age in the total sample was 31.0 years (33.1 for the generic sites), and 86% of respondents were aged 15-44. More than half of all respondents (56%) were highly educated, having obtained either a degree or a professional qualification, compared to 48% for the generic sites. Just over a third of total and generic respondents (36% and 37%, respectively) were based in the southern part of the United Kingdom, but geographical concentration was fairly weak, with the Midlands accounting for 27% and 28% of total and generic users, respectively, and the north for 20% and 19%.

Box 6.5. Detailed profiles of UK users of on-line recruitment site

Most users were in full-time employment (at least 30 hours a week) on a permanent basis: 42% of total and 47% of generic users. However, the unemployed account for the second largest share: 25% and 28% of total and generic users, respectively. The average number of years of work experience was 10.6 years for the sample as a whole, and 11.7 years for generic users. The average salaries of those working were around GBP 22 500 for the total sample, and around GBP 23 700 for the generic users. Nearly 40% of all those working earned a pre-tax annual income of between GBP 10 000 and GBP 19 999, and a quarter between GBP 20 000 and GBP 29 999.

Nearly 80% of respondents use the Internet every day. Around a quarter visit the recruitment sites included in the survey daily. On average, they visit 5.5 recruitment sites. Over 40% visit from one to three sites to look for a job, and 14% visit more than ten. Both for total and generic users, search engines or links were the most important reason for visiting a particular site (31% and 39%, respectively), followed by recommendation of the site (over 20%). Advertising accounted for only 10% and 13%, respectively, of reported reasons for choosing a site.

Among reasons other than job hunting, recruitment sites are also cited as being used to find information about specific companies or potential employers (around 40%), to compare salaries (around 40%), to obtain information about the industry sector (around 30%), and to seek advice and tips on career management (nearly 30%). Around 70% of users have applied for a job found on the Internet (on line or *via* telephone, letter, etc.). However, fewer than 30% of those who have applied for jobs found on the Internet have obtained one. Other means of looking for a job included local newspapers (over 60%), national newspapers (over 50%), recruitment consultants and headhunters (over 40%). Nevertheless, both total and generic users chose the Internet as the preferred way to look for a job (43% and 39%, respectively), followed by local newspapers (nearly 20%) and recruitment consultants and headhunters (over 10%).

Source: NORAS, Enhance Media Limited, 2003.

The distribution by the employer's sector of activity and by the types of tasks performed by the respondent for the sample as a whole and for users of generic sites is shown in Table 6.13. The results show that most sectors of activity are involved, and that while the IT sector and those that carry out IT-related tasks are important users of Internet recruitment sites, they are not necessarily the main users.

Table 6.13. **NORAS results by sector of employer and type of activity**
Percentages of those working

Industry sector of the employer	Total	Generic	Type of tasks actually carried out	Total	Generic
Accountancy	1	1	Accountancy	4	5
Aviation	4	1	Admin/secretarial	14	15
Banking/finance	5	6	Aviation operations	1	0
Central government	1	1	Banking	1	2
Charity	2	2	Catering	2	2
Construction	5	3	Consulting/strategy/research	3	3
Consultancy	2	2	Creative/artistic/design	2	2
Defence/emergency	2	2	Customer service	6	5
Education	13	6	Domestic	0	0
Engineering	4	4	Editorial	0	1
Health	4	4	Engineering	7	6
Hospitality	3	3	Graduate	2	1
Insurance	1	1	HR/training	3	4
IT	6	10	IT	10	14
Law	1	1	Legal	1	1
Leisure	3	3	Management	6	7
Local government	7	3	Manual	2	3
Manufacturing	5	7	Marketing/PR	4	5
Marketing/advertising/PR	2	3	Medical/health	3	3
Media/entertainment	4	4	Other	4	4
New media	2	1	Public/general local government	5	2
Other	5	6	Retail operations	3	3
Pharmaceutical	1	2	Sales	5	6
Recruitment	2	2	Scientific	4	1
Retail	7	8	Skilled trade	3	3
Telecommunications	4	6	Teaching/lecturing	4	2
Transport	3	3			
Travel	2	2			
Utilities	1	1			

Source: Enhance Media Limited, 2003.

Conclusion

This chapter builds a picture of where people with ICT skills are employed in the economy, focusing both on those with specialist ICT skills as well as those with ICT user skills. The results show that ICT-skilled employment is spread throughout the economy, with certain services sectors having particularly high ratios of ICT-skilled employment to total employment, and the importance of ICT-skilled employment, at both the specialist and the user level, has increased over time. The distribution of skills throughout the economy is important for competitiveness, especially since the increased use of ICTs in production and business processes, which requires a pool of workers with appropriate skills, is expected of to be of crucial importance for countries' productivity and growth.

It is important to distinguish between different types of ICT skills. The general diffusion of ICTs throughout the economy is likely to ensure that at least the basic needs for ICT user skills will be broadly satisfied in future. Indeed, with the general diffusion of ICTs in households and at work, as well as the introduction of ICTs in schools, the pool of people with at least some familiarity with ICTs is likely to increase rapidly. The example of Internet recruitment suggests that these skills are in fact diffusing and are being used by quite a broad cross-section of the population. However, formal education does not appear to be the most effective means of satisfying needs for the skills of advanced users and certain types of specialist skills. These skills needs are likely to change rapidly as new technologies are developed and adopted. Sector-specific training and certification schemes may be more suitable for satisfying these particular skills needs. Chapter 8 outlines the various policies OECD countries are currently deploying in the field of ICT skills.

There is also a geographical dimension to the supply of ICT skills. If skills cannot be satisfied internally, firms can decide to outsource the activities for which they lack skilled labour, either domestically or internationally, or countries can allow the inflow of ICT-skilled migrants. While the latter method is on a downward trend since 2001, there are growing indications that the outsourcing of ICT-related and ICT-enabled activities is gaining momentum. This adds to the evidence that suggests that the ongoing development and diffusion of ICT products and processes, as well as the presence of an ICT-skilled pool of labour, will have an increasingly important impact on the spatial distribution of economic activities in the years ahead.

NOTES

1. This chapter builds on the 2002 OECD Information Technology Outlook, which addressed the evolution in the numbers and the characteristics of ICT workers, as well as concerns about possible skill mismatches in ICT-related jobs.
2. ICT-related occupations included in other OECD publications are: ISCO88 213, 312, 313 and 724. Further distinctions can be made between high-skilled (213, 312, 313), low-skilled (724) and computing occupations (213, 312).
3. Lemaître (2002) discusses two measures of skills that can be obtained from using labour force survey data: educational attainment and job requirements as built into the ISCO classification of occupations. He finds that the former measure, which has traditionally been used as a skills proxy, is a very partial one, and that the latter identifies another dimension of skills which is correlated with the educational measure, and holds up independently. This is the measure used here.
4. A survey of the ICT content of the standard ISCO occupations, which could be used to guide the choice of occupations to be included in such an exercise, would be helpful.
5. While it would be interesting to add educational attainment or wages as a third dimension, the current data set does not allow this. In particular, some detail would be lost in the other two dimensions (occupations and/or industries), as the labour force survey samples are not sufficiently large.
6. The choice of cut-off points was guided by examining industry distributions. The 30% and 10% cut-off points provided a relatively even distribution of industries in most countries.
7. As only 15 occupations were available, it is not possible to establish a list of occupations that closely matches any of the lists for other countries. The best approximation is as follows: the narrow definition includes technicians (agricultural technicians, fishery technicians, technicians in brewery, mechanical engineers, architects, programmers, data processing technicians), and the broad definition includes technicians (see above), as well as management (management staff in private companies, management staff in government sectors, members of parliament) and administration (secretary, clerk, collector for gas, electricity and water, station attendant, typist, stenographer, computer operator).
8. In Census Canada 2001, the experienced labour force excludes first-time jobseekers as well as those who were not in the labour force in 2000 and 2001.
9. For further analysis of the impact of ICTs on economic growth and productivity, see OECD, 2003a.
10. The survey examined whether the present provision was adequate for (self-) instruction but did not attempt to deal with the question of whether or not schools should provide computers for teachers and students. It explored several aspects of the use of ICTs by teachers and students in upper secondary schools. Upper secondary school principals were asked about the number of computers in their schools; the use of computers by teachers; the professional development of teachers and computer technology; the use of ICTs for educational purposes, more specifically in student assignments; the nature of ICT-related co-operation between schools and other institutions; and perceived teacher, software, hardware and organisation-related obstacles to attaining goals involving information technology.
11. Career-Space (http://www.career-space.com) is a consortium of nine major ICT companies: BT, Cisco Systems, IBM Europe, Intel, Microsoft Europe, Nokia, Philips Semiconductors, Siemens AG, Thales. Supported by the European Commission and together with EICTA (the European Information, Communication and Consumer Electronics Industry Technology Association) it has been exploring new ways of addressing skills shortages. The GENIUS consortium consists of nine universities located throughout the EU, four major IT companies (IBM, Intel, BT/Support IT and Philips) and e-Skills (the UK training organisation) and ICEL Ltd. Belgium.
12. Millar (2002a) defines these as R&D, design, editorial, multimedia and other forms of content generation.
13. The survey was carried out over a six-month period in 2001, and research for contracts was conducted for the five-year period from 30 March 1996 to 30 March 2001. Only contracts with a duration of at least two years and exceeding an annual GBP 1 million were included.

14. While IT specialists have been taken off the Danish job-card scheme, some IT specialists are still included indirectly through other categories (*e.g.* engineers, mathematicians, knowledge workers).
15. On the official US Citizenship and Immigration Services (CIS) Web site (*http://uscis.gov/graphics/index.htm*), the H-1B is defined as a non-immigrant classification used by an alien who will be employed temporarily in a specialty occupation or as a fashion model of distinguished merit and ability, and where a specialty occupation is defined as requiring theoretical and practical application of a body of specialised knowledge along with at least a bachelor's degree or its equivalent. A foreign worker can hold H-1B status for a maximum of six years at a time, three years initially followed by a renewal not exceeding three years, after which one year must be spent outside the United States before a subsequent application can be approved.
16. The United States temporarily raised the H-1B visa cap at the end of 1998 (with the American Competitiveness and Workforce Improvement Act in 1998 and subsequently the American Competitiveness in the Twenty-First Century Act in 2000). Because no legislative action was undertaken to prolong this measure beyond October 2003, the quota returned to its former level.
17. In FY 2000 257 640 applications were approved (86.1%), in FY 2001 331 206 (96.8%), and in FY 2002 197 537 (91.8%).
18. Monster UK, an Internet recruitment firm, reports that jobs advertised on line tend to be filled within 30 days, on average, compared to 90 days, on average, for jobs advertised in print. A recent survey of hiring managers by CareerBuilder.com found that 77% fill positions within one month and nearly 50% within two weeks. However, the duration of vacancies varies by industry.
19. The data in this section were provided by the relevant companies; Enhance Media provided the NORAS results.
20. It surveys both generic sites (*i.e.* sites that deal with many industry sectors) and specialist sites. The results are based on 10 000 questionnaires (1 000 for each of the generic sites, and the remaining 5 000 from six specialist sites) completed in October 2002. It is supported by the Association of Online Recruiters (AOLR), a division of the Recruitment and Employment Confederation in the United Kingdom.

REFERENCES

Alliance for Information Systems Skills and the Information Technology National Training Organisation (1999), "Skills 99: IT Skills Summary", University-Industry Interface, project funded by the UK Department for Trade and Industry, reference YAE/08/05/1205.

Arbeitsamt (2003), ZAV IT-Sonderteam, Central Placement Office (ZAV), Arbeitsamt Online, *www.arbeitsamt.de/zav/services/greencard/englisch*.

van Ark, B., R. Inklaar, and R. H. McGuckin (2002), ""Changing Gear' – Productivity, ICT and Service Industries: Europe and the United States,,, Research Memorandum GD-60, Groningen Growth and Development Centre, December.

Australian Bureau of Statistics (2002), "Education and Training Experience", Australia 2001, Cat. No. 6278.0 Survey of Education and Training, ABS, Canberra.

Australian Department of Immigration and Multicultural and Indigenous Affairs (2003), research and statistics available at: *www.immi.gov.au/research/index.htm*.

Borghans, L., and B. ter Weel (2002), "Do Older Workers Have More Trouble Using a Computer Than Younger Workers?", ROA-RM-2002/1E, Research Centre for Education and the Labour Market, Faculty of Economics and Business Administration, Maastricht University, February.

Borghans, L., and B. ter Weel (2003b), "Are Computer Skills the New Basic Skills? The Returns to Computer, Writing and Math Skills in Britain", The Institute for the Study of Labour, IZA Discussion Paper No. 751, April 2003; also published in *Labour Economics*, Vol. 11, Issue 1, p. 85-98.

Borghans, L., and B. ter Weel (2003a), "Do We Need Computer Skills to Use a Computer? Evidence from Britain", The Institute for the Study of Labour, IZA Discussion Paper No. 685, January.

Citizenship and Immigration Canada (2003), information available at *www.cic.gc.ca*.

Danish Immigration Service (2003), statistics available under "other figures on immigration", *www.udlst.dk/english/Statistics/figures_immigration.htm*.

Dickson, J., J. Hillage, K. McLoughlin, and J. Regan (2002), "Employers Skill Survey 2002", UK Department for Education and Skills, Research Report 372, September.

DiNardo, J. E., and J-S. Pischke (1997), "The Returns to Computer Use Revisited: Have Pencils Changed the Wage Structure too?", *The Quarterly Journal of Economics*, Vol. 112, No. 1, February, pp. 291-303.

The Economist (2003a), "America's Pain, India's Gain", 9 January.

The Economist (2003b), "Outsourcing to India – Growing Pains", 23 August.

Enhance Media Limited (2003), "National Online Recruitment Audience Survey", Results Winter 2003, *www.enhancemedia.co.uk*

European e-Skills Forum (2004), "Synthesis Report", forthcoming.

Eurostat (2003), NewCronos Database, *http://europa.eu.int/newcronos/*.

Felstead, A., D. Gallie, and F. Green (2002), "Work Skills in Britain 1986-2001", UK Department for Education and Skills, January.

Freeman, R. B. (2002), "The Labour Market in the New Information Economy", NBER Working Paper No. 9254, October.

Habtu, R. (2003), "Information Technology Workers", *Perspectives on Labour and Income (Online Edition)*, Vol. 4, No. 7.

Hitwise (2004), information available at *www.hitwise.com*.

Information Technology Association of America (2003a), 2003 Workforce Survey, presented at the National IT Workforce Convocation, 5 May, Arlington, VA; available at *www.itaa.org/workforce/*.

Information Technology Association of America (2003b), Report of the ITAA Blue Ribbon Panel on IT Diversity, presented at the National IT Workforce Convocation, 5 May, Arlington, VA; available at *www.itaa.org/workforce/docs/03divreport.pdf*.

International Labour Organisation (2002), "ILO Activities on the Social Dimension of Globalization: Synthesis Report", available at *www.ilo.org/public/english/wcsdg/globali/synthesis.pdf*.

Japanese Ministry of Education, Culture, Sports, Science and Technology (2003), *www.mext.go.jp/english/org/index.htm*.

Japanese Ministry of Justice (2003), Bureau of Immigration, information available at *www.moj.go.jp*/PRESS/030708-2/030708-2.*html*.

Japanese Ministry of Public Management, Home Affairs, Post and Telecommunications (2003), Statistics Bureau, Labour Force Survey, *www.stat.go.jp/english/index.htm*.

Khadria, B. (2004), STI Working Paper on Human Resources in Science and Technology in India and the International Mobility of Highly Skilled Indians, OECD, Paris, forthcoming.

Kuhn, P., and M. Skuterud (2004), "Internet Job Search and Unemployment Durations", *American Economic Review*, Vol. 94, No 1, pp. 218-232.

Lemaître, G. (2002), "Measures of Skill from Labour Force Studies – An Assessment", OECD, DSTI/EAS/IND/SWP(2002)13.

Mann, C. L. (2003), "Globalization of IT Services and White Collar Jobs: The Next Wave of Productivity Growth", Institute for International Economics Policy Brief 03-11, *www.iie.com/publications/pb/pb03-11.pdf*.

McLaughlan, G., and J. Salt (2002), "Migration Policies towards Highly Skilled Foreign Workers", Report for the UK Home Office, available at *www.homeoffice.gov.uk/rds/pdfs2/migrationpolicies.pdf*.

Millar, J. (2002a), "Outsourcing Practices in Europe", STAR Issue Report 27, *www.databank.it/star/list_issue/e.html*.

Millar, J. (2002b), "The Globalisation of Information Processing Services: The Implications of Outsourcing for Employment and Skills in Europe", STAR Issue Report 28, *www.databank.it/star/list_issue/e.html*.

Morgan Chambers (2001), "Outsourcing in the FTSE100: The definitive study – Episode 1: The UK plc", Morgan Chambers, London.

Norwegian Directorate of Immigration, UDI (2003), information available at *www.udi.no/default.asp*?MenuID=3234&intStrukturID=11244&PubID=2624.

OECD (2000), *International Trade and Core Labour Standards*, OECD, Paris.

OECD (2001), *International Mobility of the Highly Skilled*, OECD, Paris.

OECD (2002), *Information Technology Outlook – ICTs and the Information Economy*, OECD, Paris.

OECD (2003a), *ICT and Economic Growth – Evidence from OECD Countries, Industries and Firms*, OECD, Paris.

OECD (2003b), *Employment Outlook – Towards More and Better Jobs*, OECD, Paris.

OECD (2004), Completing the Foundation for Lifelong Learning: An OECD Survey of Upper Secondary Schools, OECD Directorate for Education, OECD, Paris.

Office des Migrations Internationales (2003), information available at: *www.omi.social.fr/*.

Pain, N., and D. van Welsum (2003), "Financial Liberalisation, Alliance Capitalism, and the Changing Structure of Financial Markets", in *Alliance Capitalism and Corporate Management – Entrepreneurial Cooperation in Knowledge Based Economies* (eds. J.H. Dunning and G. Boyd), Edward Elgar, Cheltenham.

Promising Information and Communication Companies Association (2003), "IT CARD System – The Current Status as of October 2003", presentation kindly provided upon request.

Regets, M. C. (2001), "Research and Policy Issues in High-skilled International Migration: A Perspective with Data from the United States", The Institute for the Study of Labour, IZA Discussion Paper No. 366, September.

Saxenian, A. (1999a), "Silicon Valley's Skilled Immigrants: Generating Jobs and Wealth for California", Research Brief Issue No. 21, Public Policy Institute of California, June.

Saxenian, A. (1999b), "The Bangalore Boom: From Brain Drain to Brain Circulation?", Revised paper prepared for *Working Group on Equity, Diversity, and Information Technology*, National Institute of Advanced Study, Bangalore, India, 3-4 December.

Statistics Denmark (2003), "Informationssamfundet Danmark 2003", available in Danish at: *www.dst.dk/Statistik/Publikationer/Informationssamfundet*%20*Danmark*%202003.*aspx*.

Statistisches Bundesamt (2002), Im Blickpunkt: Informationsgesellschaft, available at *www.destatis.de/allg/d/veroe/d_blickpkt.htm*.

US Citizenship and Immigration Services (2003), 2002 *Yearbook of Immigration Statistics*, Office of Immigration Statistics.

US Citizenship and Immigration Services, formerly US Immigration and Naturalization Service (2001, 2000), *Statistical Yearbook of the Immigration and Naturalization Service*: 2001 *and* 2000.

US Citizenship and Immigration Services, formerly US Immigration and Naturalization Service (2001, 2000, 1998-1999), *Report on characteristics of specialty occupation workers* (H1B): Fiscal years 2001, 2000, 1998-1999.

US Department of Commerce (1999), “The Digital Workforce: Building Infotech Skills at the Speed of Innovation”, Technology Administration, Office of Technology Policy, *www.technology.gov/reports/TechPolicy/digital.pdf*.

US Department of Commerce (2002), “Digital Economy 2002”, Economics and Statistics Administration, *www.esa.doc.gov/DigitalEconomy2002.cfm*.

US Department of Commerce (2003a), “Digital Economy 2003”, Economics and Statistics Administration, *www.esa.doc.gov/DigitalEconomy2003.cfm*.

US Department of Commerce (2003b), “Education and Training for the Information Technology Workforce”, Report to Congress from the Secretary of Commerce, *www.technology.gov/reports/ITWorkForce/ITWF2003.pdf*.

US Department of Education (2003a), “Internet Access in US Public Schools and Classrooms: 1994-2002”, National Center for Education Statistics, *http://nces.ed.gov/pubs2004/2004011.pdf*.

US Department of Education (2003b), “Computer and Internet Use by Children and Adolescents in 2001”, National Center for Education Statistics, *http://nces.ed.gov/pubs2004/2004014.pdf*.

US Department of Labor (2003), “Notice of Availability of Funds and Solicitation for Grant Applications (SGA) for Business-Led H-1B Technical Skills Training Grants”, Employment and Training Administration, Billing code: 4510-30, *http://wdsc.doleta.gov/sga/sga/H-1BFinal_SGA_03-114.doc*.

van Welsum, D., and G. Vickery (2004), “New Perspectives on ICT Skills and Employment”, Working Paper (forthcoming), OECD, Paris.

Work Permits UK (2003), information available at *www.workingintheuk.gov.uk/working_in_the_uk/en/homepage/work_permits.html*.

Table C.6.1. **Europe: Occupations included in the narrow and broad definitions of ICT-skilled employment**

121:	Directors and chief executives
122:	Production and operations managers
123:	Other specialist managers
211:	Physicists, chemists, and related professionals
212:	Mathematicians, statisticians and related professionals
213:	**Computing professionals**
214:	Architects, engineers, and related professionals
241:	Business professionals
242:	Legal professionals
243:	Archivists, librarians, and related information professionals
312:	**Computer associate professionals**
313:	**Optical and electronic equipment operators**
341:	Finance and sales associate professionals
342:	Business services agents and trade brokers
343:	Administrative associate professionals
411:	Secretaries and keyboard-operating clerks
412:	Numerical clerks
724:	**Electrical and electronic equipment mechanics and fitters**

***Narrow definition*:** similar to the IT specialists, or practitioners group, using the occupations previously used in OECD publications: ISCO88 categories.
***Broad definition*:** attempt to capture those classified as IT specialists, as well as those who can be considered as sector specific users and generic users: ISCO88 categories.
All occupations listed are in the broad definition, only occupations in bold are in the ***narrow definition***.
Source: OECD, based on EULFS (2003).

StatLink: http://dx.doi.org/10.1787/073073741347

Table C.6.2. **United States: Occupations included in the narrow and broad definitions of ICT-skilled employment**

Financial managers	7	Medical scientists	83
Personnel and labor relations managers	8	Librarians	164
Purchasing managers	9	Archivists and curators	165
Managers, marketing, advertising, and public relations	13	Economists	166
Accountants and auditors	23	Urban planners	173
Underwriters	24	Lawyers and Judges	178
Other financial officers	25	**Electrical and electronic technicians**	**213**
Management analysts	26	**Computer programmers**	**229**
Buyers, wholesale and retail trade except farm products	29	**Tool programmers, numerical control**	**233**
Architects	43	Supervisors and Proprietors, Sales Occupations	243
Aerospace engineer	44	Insurance sales occupations	253
Metallurgical and materials engineers	45	Real estate sales occupations	254
Mining engineers	46	Securities and financial services sales occupations	255
Petroleum engineers	47	Sales occupations, other business services	257
Chemical engineers	48	**Supervisors, computer equipment operators**	**304**
Nuclear engineers	49	Supervisors, financial records processing	305
Civil engineers	53	Chief communications operators	306
Agricultural engineers	54	**Computer operators**	**308**
Engineers, electrical and electronic	**55**	**Peripheral equipment operators**	**309**
Engineers, industrial	56	Secretaries	313
Engineers, mechanical	57	Typists	315
Mmarine and naval architects	58	Bookkeepers, accounting, and auditing clerks	337
Engineers, n.e.c.	59	Payroll and timekeeping clerks	338
Surveyors and mapping scientists	63	Billing clerks	339
Computer systems analysts and scientists	**64**	Cost and rate clerks	343
Operations and systems researchers and analysts	**65**	Billing, posting, and calculating machine operators	344
Actuaries	66	Bank tellers	383
Statisticians	67	Data-entry keyers	385
Mathematical scientists, n.e.c.	68	Statistical clerks	386
Physicists and astronomers	69	**Electronic repairers, communications and industrial equipment**	**523**
Chemists, except biochemists	73	**Data processing equipment repairers**	**525**
Atmospheric and space scientists	74	**Telephone line installers and repairers**	**527**
Geologists and geodesists	75	**Telephone installers and repairers**	**529**
Physical scientists, n.e.c.	76	Miscellaneous electrical and electronic equipment repairers	533
Agricultural and food scientists	77	Electrical power installers and repairers	577
Biological and life scientists	78	**Electrical/electronic equipment assemblers**	**683**
Forestry and conservation scientists	79	Numerical control machine operators	714

All occupations listed are in the broad definition, only occupations in bold are in the ***narrow definition***.
Source: OECD, based on CPS.

StatLink: http://dx.doi.org/10.1787/437401035185

Table C.6.3. **United States: classification of industries according to the intensity of broad ICT-skilled employment**

high-intensive (> 30%)				medium-intensive (10-30%)				low intensive (< 10%)			
	ind.	broad	rank		ind.	broad	rank		ind.	broad	rank
Accounting, auditing, and bookkeeping services	890	82.7	1	Real estate, including real estate-insurance offices	712	43.6	26	Furniture and home furnishings	501	35.7	51
Savings institutions, including credit unions	701	72.3	2	Scientific and controlling instruments	371	43.1	27	Electrical goods	512	35.5	52
Computer and data processing services	732	70.6	3	Not specified utilities	472	43.0	28	Miscellaneous wholesale, durable goods	532	35.3	53
Legal services	841	70.1	4	Food stores, n.e.c.	611	42.5	29	Screw machine products	290	35.3	54
Security, commodity brokerage, and investment companies	710	66.8	5	Public finance, taxation, and monetary policy	921	42.4	30	Electrical repair shops	752	35.3	55
Banking	700	61.3	6	Research, development, and testing services	891	41.6	31	Not specified machinery	332	35.3	56
Credit agencies, n.e.c.	702	60.5	7	Electrical machinery, equipment, and supplies, n.e.c.	342	41.1	32	Hardware stores	581	35.3	57
Engineering, architectural, and surveying services	882	60.3	8	Not specified wholesale trade	571	40.4	33	Gift, novelty, and souvenir shops	661	34.9	58
Insurance	711	58.4	9	Catalog and mail order houses	663	40.0	34	Music stores	640	34.8	59
Management and public relations services	892	57.0	10	Farm supplies	561	39.9	35	Economic programs administration	931	34.2	60
Telegraph and miscellaneous communications services	442	57.0	11	Misc wholesale, non-durable goods	562	39.7	36	Gasoline service stations	621	34.1	61
Radio, TV, and communication equipment	341	56.4	12	Variety stores	592	39.4	37	Stores, book and stationery	652	34.0	62
Telephone communications	441	54.9	13	Electric light and power	450	39.0	38	Petroleum refining	200	33.2	63
Computers and rel. equipment	322	53.0	14	Mobile home dealers	590	38.9	39	Aircraft and parts	352	32.5	64
Guided missiles, space vehicles, and parts	362	50.5	15	Metals and minerals, except petroleum	511	38.3	40	Lumber and building material retailing	580	32.2	65
Office and accounting machines	321	49.6	16	Motor vehcls and equipment	500	37.9	41	Apparel, fabrics, and notions	542	32.1	66
Not specified electrical machinery, equipment, and supplies	350	48.8	17	Stores, radio, TV, and computer	633	37.9	42	General government, n.e.c.	901	31.5	67
Photographic equipment and supplies	380	48.1	18	Stores, apparel and accessory, except shoe	623	37.9	43	Paper and paper products	540	30.5	68
Liquor stores	650	47.6	19	Petroleum products	552	37.8	44	Advertising	721	30.4	69
Miscellaneous vehicle dealers	622	47.5	20	Machinery, equipment, and supplies	530	37.7	45	Stores, furniture and home furnishings	631	30.3	70
Stores, dairy products	602	47.5	21	Jewelry stores	660	37.3	46	Stores, sporting goods, bicycles, and hobby	651	29.9	71
Fuel dealers	672	45.3	22	Professional and commercial equipment and supplies	510	36.9	47	Groceries and related products	550	29.7	72
Environmental quality and housing programs administratio	930	44.6	23	Not specified retail trade	691	35.9	48	Shoe stores	630	29.3	73
Stores, Retail nurseries and garden	582	44.2	24	Stores, Miscellaneous retail	682	35.9	49	Radio and television broadcasting and cable	440	29.1	74
Libraries	852	43.6	25	Scrap and waste materials	531	35.9	50	Stores, Auto and home supply	620	28.9	75

Table C.6.3. **United States: classification of industries according to the intensity of broad ICT-skilled employment** (*cont.*)

high-intensive (> 30%)				medium-intensive (10-30%)				low intensive (< 10%)			
	ind.	broad	rank		ind.	broad	rank		ind.	broad	rank
Hardware, plumbing and heating supplies	521	28.8	76	Retail florists	681	20.8	103	Motor vehicles and motor vehicle equipment	351	14.8	130
Lumber and construction materials	502	28.4	77	Video tape rental	801	20.5	104	Toys, amusement, and sporting goods	390	14.7	131
Gas and steam supply systems	451	28.4	78	Oil and gas extraction	42	20.5	105	Other rubber products, and plastics footwear and belting	211	14.6	132
Stores, misc general merchandise	600	28.4	79	Stores, household appliance	632	19.7	106	Leather products, except footwear	222	14.5	133
Drugs	181	28.3	80	Services incidental to transportation	432	19.4	107	Grain mill products	110	14.4	134
Electric and gas, and other combinations	452	28.0	81	Medical, dental, and optical instruments and supplies	372	19.4	108	Miscellaneous plastics products	212	14.0	135
Business services, n.e.c.	741	27.7	82	Human resources programs administratio	922	19.2	109	Chiropractors offices and clinics	821	13.7	136
Forestry	31	27.6	83	Drug stores	642	18.8	110	Physicians offices and clinics	812	13.6	137
Engines and turbines	310	27.6	84	Beverage industries	120	18.7	111	Miscellaneous petroleum and coal products	201	13.5	138
Motor vehicle dealers	612	27.5	85	Primary aluminum industries	272	18.4	112	Water supply and irrigation	470	13.3	139
Household appliances	340	27.0	86	Department stores	591	18.2	113	Pulp, paper, and paperboard mills	160	13.1	140
Ordnance	292	26.7	87	Nonmetallic mining and quarrying, except fuel	50	17.9	114	Executive and legislative offices	900	12.8	141
National security and international affairs	932	26.6	88	Printing, publishing, and allied industries, except newspapers	172	17.1	115	Misc fabricated metal products	300	12.7	142
Soaps and cosmetics	182	25.9	89	Colleges and universities	850	17.1	116	Blast furnaces, steelworks, rolling and finishing mills	270	12.0	143
Farm-product raw materials	551	25.7	90	Pipe lines, except natural gas	422	17.0	117	Labor unions	873	11.7	144
Industrial and miscellaneous chemicals	192	25.2	91	Religious organisations	880	17.0	118	Wood buildings and mobile homes	232	11.3	145
Drugs, chemicals and allied products	541	25.1	92	Construction and material handling machines	312	16.8	119	Metal forgings and stampings	291	10.9	146
Museums, art galleries, and zoos	872	24.5	93	Not spec manufacturing industries	392	16.8	120	Fishing, hunting, and trapping	32	10.9	147
Grocery stores	601	24.4	94	Metalworking machinery	320	16.7	121	Railroads	400	10.8	148
Agricultural chemicals	191	24.3	95	Farm machinery and equipment	311	15.7	122	Agricultural services, n.e.c.	30	10.6	149
Sewing, needlework and piece goods stores	662	23.9	96	Funeral service and crematories	781	15.7	123	Miscellaneous manufacturing industries	391	10.6	150
Misc personal services	791	23.4	97	Theaters and motion pictures	800	15.6	124	Justice, public order, and safety	910	10.5	151
Personnel supply services	731	23.2	98	Machinery, except electrical, n.e.c.	331	15.6	125	Health services, n.e.c.	840	10.4	152
Membership organisations, n.e.c.	881	22.5	99	Vending machine operators	670	15.6	126	Social services, n.e.c.	871	10.3	153
Sugar and confectionery products	112	22.0	100	Paints, varnishes, and rel. products	190	15.3	127	Canned, frozen and preserved fruits and vegetables	102	10.2	154
Alcoholic beverages	560	21.9	101	Retail bakeries	610	15.2	128	Newspaper publishing and printing	171	10.1	155
Automotive rental and leasing, w/ out drivers	742	21.7	102	Miscellaneous food preparations and kindred products	121	15.2	129	Dairy products	101	10.1	156

Table C.6.3. **United States: classification of industries according to the intensity of broad ICT-skilled employment** (*cont.*)

high-intensive (> 30%)				medium-intensive (10-30%)				low intensive (< 10%)			
	ind.	broad	rank		ind.	broad	rank		ind.	broad	rank
Tobacco manufactures	130	10.0	157	Fabricated structural metal products	282	7.2	184	Barber shops	780	3.1	211
Warehousing and storage	411	9.7	158	Miscellaneous entertainment and recreation services	810	7.1	185	Bakery products	111	3.1	212
Paperboard containers and boxes	162	9.6	159	Water transportation	420	7.0	186	Bowling centers	802	3.0	213
Cutlery, handtools, and general hardware	281	9.6	160	Trucking service	410	6.6	187	Coal mining	41	3.0	214
Hospitals	831	9.6	161	Yarn, thread, and fabric mills	142	6.5	188	Child day care services	862	2.7	215
Railroad locomotives and equipment	361	9.5	162	Cycles and miscellaneous transportation equipment	370	6.5	189	Taxicab service	402	2.5	216
Other primary metal industries	280	9.3	163	Detective and protective services	740	6.3	190	Automotive parking and carwashes	750	2.3	217
Hotels and motels	762	9.3	164	Automotive repair and rel. services	751	6.3	191	Nursing and personal care facilities	832	2.3	218
Tires and inner tubes	210	9.1	165	Miscellaneous wood products	241	6.3	192	Veterinary services	12	2.2	219
Air transportation	421	9.0	166	Elementary and secondary schools	842	6.1	193	Agricltrl production, livestock	11	2.1	220
Sanitary services	471	8.9	167	Metal mining	40	6.0	194	Lodging places, except hotels and motels	770	1.5	221
Misc repair services	760	8.7	168	Residential care facilities, w/out nursing	870	5.9	195	Eating and drinking places	641	1.2	222
Educational services, n.e.c.	860	8.6	169	Vocational schools	851	5.8	196	Private Households	761	1.1	223
Iron and steel foundries	271	8.6	170	Landscape and horticultural services	20	5.7	197	Logging	230	1.0	224
Miscellaneous paper and pulp products	161	8.1	171	Glass and glass products	250	5.5	198	Beauty shops	772	0.5	225
Apparel and accessories, except knit	151	7.9	172	Services to dwellings and other buildings	722	5.2	199	Not specified food industries	122	0.0	226
Laundry, cleaning, and garment services	771	7.9	173	Plastics, synthetics, and resins	180	5.0	200	Knitting mills	132	0.0	227
Carpets and rugs	141	7.9	174	Agricultural production, crops	10	5.0	201	Dyeing and finishing textiles, except wool and knit goods	140	0.0	228
Meat products	100	7.8	175	Dentists offices and clinics	820	4.7	202	Leather tanning and finishing	220	0.0	229
Miscellaneous fabricated textile products	152	7.8	176	US Postal Service	412	4.7	203	Structural clay products	252	0.0	230
Construction	60	7.6	177	Bus service and urban transit	401	4.2	204	Pottery and related products	261	0.0	231
Miscellaneous non-metallic mineral and stone products	262	7.6	178	Footwear, except rubber and plastic	221	4.1	205	Not specified metal industries	301	0.0	232
Miscellaneous professional and rel. services	893	7.5	179	Job training and vocational rehabilitation services	861	4.0	206	Watches, clocks, and clockwork operated devices	381	0.0	233
Optometrists offices and clinics	822	7.4	180	Miscellaneous textile mill products	150	4.0	207	Shoe repair shops	782	0.0	234
Ship and boat building and repairing	360	7.4	181	Health practitioners offices and clinics, n.e.c.	830	3.8	208	Dressmaking shops	790	0.0	235
Furniture and fixtures	242	7.4	182	Sawmills, planing mills, and millwork	231	3.1	209	Family child care homes	863	0.0	236
Cement, concrete, gypsum, and plaster products	251	7.2	183	Direct selling establishments	671	3.1	210				

Source: OECD, based on CPS (2003).

StatLink: http://dx.doi.org/10.1787/636043371585

Table C.6.4. **Japan: classification of industries according to the intensity of ICT-skilled employment**

	Broad definition	Intensity	Rank		Narrow definition	Intensity	Rank
46	Information and research services	**88.4**	1	46	Information and research services	**61.1**	1
50	Public services	**61.3**	2	45	Business services	**17.3**	2
37	Financial, insurance	**59.1**	3	18	Electronic machinery and instruments	**15.2**	3
24	Electricity, gas, heat provision, water	**58.8**	4	24	Electricity, gas, heat provision, water,	**11.8**	4
27	Communication	**57.6**	5	17	Machinery, precision machinery, arms	**10.3**	5
36	Financial, insurance, real estate	**53.1**	6	12	Chemical products , oil products, coal products	**9.5**	6
45	Business services	**51.9**	7	14	Metal machinery	**9.4**	7
38	Real estate	**40.0**	8	19	Machinery and instruments for transportation	**8.2**	8
30	Wholesale	**35.1**	9	43	Other services	**7.3**	9
12	Chemical products, oil products, coal products	**34.9**	10	39	Services	**6.3**	10
18	Electronic machinery and instruments	**34.8**	11	8	Construction	**5.8**	11
17	Machinery, precision machinery, arms	**32.2**	12	9	Manufaturing	**5.8**	12
23	Electricity, gas, heat provision, water, transportation, communications	**32.2**	13	15	Steel	**5.4**	13
43	Other services	**32.1**	14	11	Chemistry	**5.1**	14
25	Transportation, communication	**30.2**	15	40	Professional services	**5.0**	15
39	Services	**29.0**	16	27	Communication	**4.5**	16
14	Metal machinery	**28.9**	17	5	Non-agriculture nor forestry	**4.0**	17
5	Non-agriculture nor forestry	**27.3**	18	1	Industry total	**3.9**	18
1	Industry total	**26.2**	19	50	Public services	**2.8**	19
19	Machinery and instruments for transportation	**25.5**	20	13	Other chemical products	**2.6**	20
11	Chemistry	**25.3**	21	30	Wholesale	**1.9**	21
40	Professional services	**25.1**	22	23	Electricity, gas, heat provision, water, transportation, communications	**1.8**	22
26	Transportation	**24.7**	23	48	Other services	**1.7**	23
8	Construction	**24.6**	24	16	Steel products	**1.6**	24
9	Manufacturing	**24.5**	25	22	Other manufacturing	**1.5**	25
48	Other services	**24.4**	26	20	Other manufacturing	**1.4**	26
15	Steel	**24.3**	27	38	Real estate	**1.4**	27
28	Wholesale, retail, restaurants, financial, insurance, immobilier	**23.9**	28	21	Foods, drinks, cigaretts, feeds manufacturing	**1.3**	28
22	Other manufacturing	**22.2**	29	25	Transportation, communication	**1.2**	29
34	Other retails	**21.3**	30	36	Financial, insurance, real estate	**1.2**	30
7	Mining	**20.0**	31	37	Financial, insurance	**1.2**	31
13	Other chemical products	**20.0**	32	28	Wholesale, retail, restaurants, financial, insurance, immobilier	**0.6**	32
20	Other manufacturing	**19.4**	33	26	Transportation	**0.6**	33
29	Wholesale, retail, restaurants	**19.1**	34	29	Wholesale, retail, restaurants	**0.6**	34
16	Steel products	**19.0**	35	42	Education	**0.5**	35
41	Medical care	**17.6**	36	34	Other retails	**0.3**	36
47	Entertainment	**17.6**	37	31	Retail, restaurants	**0.1**	37
42	Education	**17.1**	38	2	Agriculture and forestry	**0.0**	38
4	Forestry	**16.7**	39	3	Agriculture	**0.0**	39
21	Foods, drinks, cigaretts, feeds manufacturing	**15.8**	40	4	Forestry	**0.0**	40
32	Cloths, furnitures, home appliances	**15.0**	41	6	Fishery	**0.0**	41
33	Retails on foods and drinks	**14.6**	42	7	Mining	**0.0**	42
31	Retail, restaurants	**13.6**	43	10	Fiber	**0.0**	43
10	Fiber	**13.5**	44	32	Cloths, furnitures, home appliances	**0.0**	44
44	Personal services	**13.5**	45	33	Retails on foods and drinks	**0.0**	45
49	Social insurance, social welfare	**12.0**	46	35	Restauratns	**0.0**	46

Table C.6.4. **Japan: classification of industries according to the intensity of ICT-skilled employment** (*cont.*)

	Broad definition	Intensity	Rank		Narrow definition	Intensity	Rank
51	Non-classified industry	**5.4**	47	41	Medical care	**0.0**	47
6	Fishery	**3.6**	48	44	Personal services	**0.0**	48
35	Restauratns	**3.1**	49	47	Entertainment	**0.0**	49
2	Agriculture and forestry	**1.5**	50	49	Social insurance, social welfare	**0.0**	50
3	Agriculture	**1.1**	51	51	Non-classified industry	**0.0**	51

Note: This classification includes both industry totals and sub-group totals.
Source: OECD, based on data provided by the Japanese Ministry of Public Management, Home Affairs, Post and Telecommunications; Statistics Bureau, Labour Force Survey.

StatLink: http://dx.doi.org/10.1787/172556327236

Table C.6.5. **Korea: Occupations included in the narrow and broad definitions of ICT-skilled employment**

Managers in financial intermediation service	Librarians and archivists
Other managers in business service	Web and multimedia designers
Managers in production	Draught persons (CAD)
Managers in information and communication	Multimedia directors (including web directors)
Managers in sales	Trader brokers
Human resource management and labor relation professionals	Real estate agents and brokers
Business consultant	Construction engineers
Certified public accountants	Civil engineers
Taxation accountants	Landscape engineers
Advertising and public relations professionals	Town planners
Marketing and market research professionals	Land surveying and mapping engineers
Other business and accounting professionals n.e.c.	Quantity surveyors
Accounting clerks	Mechanical engineer
Book keeping clerks	Factory automation and robot operators
Statistical survey clerks	Material engineers
Secretary	Chemical engineers
Clerks helper and word processor operators	**Electronic engineers**
Financial investment and credit analysts	Electric engineers
Financial fund managers	**Computer and office equipment fitters and mechanics**
Stock dealers	**Other electrical and electronical equipment fitters and mech**
Actuaries	**Computer engineers**
Other finance intermediation and insurance professionals n.e	**Telecommunication engineers**
Financial clerks	**Computer system analysts and designers**
Insurance clerks	**System software developers and programmers**
Bank tellers	**Application software developers and programmers**
Insurance agents and brokers	**Network system analysts and developers**
Insurance sales representatives	**Computer security engineers**
Natural science researchers	**Web developers and engineers**
Biological science researchers	**System administrators**
Judges	**Information technology consultants**
Attorney	**Telecommunication equipment fitters and mechanics**
Jurists	**Telecommunication line and cable installers**
Desk top publishers	Industrial Safety Engineer

All occupations listed are in the broad definition, only occupations in bold are in the ***narrow definition***.
Source: OECD, based on data provided by the Korean Work Information Center, Human Resource Development Service.

StatLink: http://dx.doi.org/10.1787/857706866853

Table C.6.6. **Korea: classification of industries according to the intensity of broad ICT-skilled employment**

Industry	Broad	Rank
Insurance and pension funding	88.9	1
Activities auxiliary to financial intermediation	86.4	2
Computer and related activities	84.0	3
Financial institutions, except insurance and pension funding	72.1	4
Research and development	66.7	5
Professional, scientific and technical services	60.0	6
Real estate activities	47.4	7
Electricity, gas, steam and hot water supply	36.6	8
Post and telecommunications	34.4	9
MF of computers and office machinery	32.5	10
MF of medical, precision and optical instruments, watches and clocks	25.8	11
MF of electronic components, radio, tv and communication equipment	23.7	12
MF of other machinery and equipment	22.2	13
MF of chemicals and chemical products	21.3	14
Collection, purification and distribution of water	18.7	15
Publishing, printing and reproduction of recorded media	18.6	16
MF of other transport equipment	17.9	17
General construction	17.7	18
MF of basic metal	17.6	19
MF of motor vehicles, trailers and semitrailers	14.9	20
Motion picture, broadcasting and performing arts industries	14.4	21
MF of coke, refined petroleum products and nuclear fuel	14.3	22
Membership organizations n.e.c.	13.9	23
Wholesale trade and commission trade, except of motor vehicles and motorcycles	13.8	24
MF of electrical machinery and apparatuseses	13.3	25
Sale of motor vehicles and motorcycles ; retail sale of auto	13.3	26
Sewage and refuse disposal, sanitation and similar activities	12.4	27
MF of fabricated metal products	12.2	28
MF of rubber and plastic products	12.0	29
Water transport	11.8	30
Manufacture of pulp, paper and paper products	11.5	31
MF of other non metalic mineral products	11.4	32
Public administration and defence ; compulsory social security	11.4	33
Extra territorial organizations and bodies	11.3	34
Maintenance and repair services	11.1	35
Manufacture of tabacco products	10.4	36
MF of furniture; manufacturing of articles n.e.c.	9.8	37
Air transport	9.7	38
Special trade construction	8.9	39
Supporting and auxiliary transport activities; activities of travel agencies	8.8	40
Manufacture of textiles, excepts sewn wearing apparel	8.3	41
Renting of machinery and equipment	7.4	42
Business support services	7.1	43
MF of wood and of products of wood and cork, except furniture; mf of articles of straw and plaiting materials	6.6	44
Manufacture of food products and beverages	6.5	45
Tanning and dressing of leather	6.4	46
Human health and veterinary activities	5.7	47
Manufacture of sewn wearing apparel and fur articles	5.3	48
Mining of coal, crude petroleum and natural gas, uranium ore	4.6	49
Education	4.5	50
Other recreational, cultural and sporting activities	4.1	51
Mining of other non ferrous metal ores	4.0	52
Retail trade, except motor vehicles and motorcycles	3.9	53
Social work activities	3.7	54
Land transport ; transport *via* pipelines	1.9	55
Fishing	1.1	56
Other services activities	0.6	57
Hotels and restaurants	0.4	58
Agriculture	0.1	59
Forestry	0.0	60
Recycling	0.0	61
Private households with employed persons	0.0	62

Source: OECD, based on data provided by the Korean Work Information Center, Human Resource Development Service.

StatLink: http://dx.doi.org/10.1787/363811807686

Table C.6.7. **Australia: Occupations included in the narrow and broad definitions of ICT-skilled employment**
ASCO 4-digit

1112	General managers	2293	Mathematicians, statisticians and actuaries
1211	Finance managers	2294	Business and organisation analysts
1212	Company secretaries	2299	Other business and information professionals
1213	Human resource managers	2521	Legal professionals
1221	Engineering managers	2522	Economists
1222	Production managers	2523	Urban and regional planners
1223	Supply and distribution managers	**3123**	**Electrical engineering associate professionals**
1224	**Information technology managers**	**3124**	**Electronic engineering associate professionals**
1231	Sales and marketing managers	3211	Branch accountants and managers (financial institution)
1291	Policy and planning managers	3212	Financial dealers and brokers
2111	Chemists	3213	Financial investment advisers
2112	Geologists and geophysicists	**3294**	**Computing support technicians**
2113	Life scientists	3399	Other managing supervisors (sales and service)
2114	Environmental and agricultural science professionals	**4314**	**Electronic instrument tradespersons**
2115	Medical scientists	**4315**	**Electronic and office equipment tradespersons**
2119	Other natural and physical science professionals	**4316**	**Communications tradespersons**
2121	Architects and landscape architects	5111	Secretaries and personal assistants
2122	Quantity surveyors	5911	Bookkeepers
2123	Cartographers and surveyors	5912	Credit and loans officers
2124	Civil engineers	5993	Insurance agents
2125	**Electrical and electronics engineers**	5995	Desktop publishing operators
2126	Mechanical, production and plant engineers	6121	Keyboard operators
2127	Mining and materials engineers	6141	Accounting clerks
2211	Accountants	6142	Payroll clerks
2212	Auditors	6143	Bank workers
2213	Corporate treasurers	6144	Insurance clerks
2221	Marketing and advertising professionals	6145	Money market and statistical clerks
2231	**Computing professionals**	**9918**	**Electrical and telecommunications trades assistants**
2292	Librarians		

All occupations listed are in the broad definition, only occupations in bold are in the ***narrow definition.***
Source: OECD, based on data provided by the Australian Bureau of Statistics.

StatLink: http://dx.doi.org/10.1787/824773353062

Table C.6.8. **Australia: classification of industries according to the intensity of broad ICT-skilled employment**

Industry		Broad	Rank
73	Finance	88.5	1
75	Services to finance and insurance	82.7	2
74	Insurance	70.9	3
78	Business services	52.0	4
82	Defence	51.6	5
15	Services to mining	41.4	6
36	Electricity and gas supply	41.3	7
71	Communication services	40.9	8
12	Oil and gas extraction	**37.1**	9
81	Government administration	35.1	10
37	Water supply, sewerage and drainage services	34.3	11
25	Petroleum, coal, chemical and associated product manufacturing	31.3	12
46	Machinery and motor vehicle wholesaling	31.1	13
91	Motion picture, radio and television services	31.1	14
65	Other transport	**30.6**	15
13	Metal ore mining	29.1	16
45	Basic material wholesaling	26.9	17
24	Printing, publishing and recorded media	26.6	18
62	Rail transport	26.5	19
66	Services to transport	26.1	20
47	Personal and household good wholesaling	24.4	21
03	Forestry and logging	**22.8**	22
77	Property services	22.2	23
28	Machinery and equipment manufacturing	20.7	24
92	Libraries, museums and the arts	18.7	25
63	Water transport	**18.6**	26
23	Wood and paper product manufacturing	16.7	27
96	Other services	16.6	28
21	Food, beverage and tobacco manufacturing	16.3	29
67	Storage	14.7	30
41	General construction	14.1	31
27	Metal product manufacturing	13.9	32
61	Road transport	13.5	33
26	Non metallic mineral product manufacturing	13.4	34
04	Commercial fishing	**12.7**	35
93	Sport and recreation	11.9	36
02	Services to agriculture; hunting and trapping	**11.5**	37
53	Motor vehicle retailing and services	11.4	38
84	Education	11.3	39
42	Construction trade services	11.2	40
11	Coal mining	**10.9**	41
22	Textile, clothing, footwear and leather manufacturing	10.8	42
64	Air and space transport	9.9	43
29	Other manufacturing	9.5	44
52	Personal and household good retailing	8.9	45
95	Personal services	8.4	46
86	Health services	7.9	47
14	Other mining	**7.6**	48
87	Community services	6.5	49
01	Agriculture	4.3	50
57	Accommodation, cafes and restaurants	3.6	51
51	Food retailing	3.0	52
97	Private households employing staff	0.0	53

Numbers in bold are based on estimates subject to sampling variability too high for most practical purposes.
Source: OECD, based on data provided by the Australian Bureau of Statistics.

StatLink: http://dx.doi.org/10.1787/702107484760

Table C.6.9. **List of IT occupations based on Census Canada, 2001**

IT occupations	Employment share of total IT occupations, 2001 (based on the experienced labour force), %	Unemployment rate (total for IT occupations: 4.7%)
Professional		
Computer engineers (except software engineers)	6.9	4.1
Information systems analysts and consultants	26.6	3.3
Database analysts and data administrators	3.5	4.0
Software engineers	6.7	3.9
Computer programmers and interactive media developers	24.9	5.4
Web designers and developers	5.7	8.4
Technical		
Computer and network operators and web technicians	11.8	4.9
User support technicians	12.1	5.2
Systems testing technicians	1.7	6.4

Source: Habtu, 2003.

StatLink: http://dx.doi.org/10.1787/107251607643

Table C.6.10. **Summary results from simple productivity regressions**

Dependent variable: gross value added per employee	ICT employment	P-value	Adjusted R^2	Number of observations
Austria	1.13	0.0006	0.32	31
Germany	0.61	0.0058	0.32	20
Spain	1.00	0.0155	0.12	40
Finland	0.61	0.0705	0.09	28
France	1.50	0.0000	0.38	37
Italy	1.57	0.0000	0.35	39
Netherlands	2.55	0.0072	0.37	16
Portugal	0.99	0.0117	0.30	18
Sweden	0.56	0.2378	0.02	28
United Kingdom	0.72	0.0452	0.09	36

Note: The productivity data refer to 2001 and the employment data to 2002. Some outliers have been removed.
Source: OECD, based on EULFS and NewCronos (2003).

StatLink: http://dx.doi.org/10.1787/776752115738

Table C.6.11. **Relative importance of computer training by country and by industry,[1] 1999**

	D Manufacturing	E Electricity, gas and water supply	F Construction	G Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	H Hotels and restaurants	J Financial intermediation	K Real estate, renting and business activities	O Other community, social, personal service activities
EU15	2 EMF	1 (COMP)	1 (COMP)	4 SAM	3 PSWL	2 SAM	1 (COMP)	2 SERV
Belgium	2 EMF	2 EMF	4 EMF	2 EMF	6 EPOSH	2 EMF	2 EMF	1 (COMP)
Denmark	1 (COMP)	2 EMF	2 EMF	4 EMF	3 LGE	1 (COMP)	1 (COMP)	4 SERV
Germany	2 EMF	1 (COMP)	2 PSWL	2 SAM	6 SERV	2 SAM	2 SERV	1 (COMP)
Greece	2 EMF	1 (COMP)	4 EMF	2 SAM	10 EPOHS	2 AFN	1 (COMP)	2 EMF
Spain	4 EMF	2 EMF	3 EPOHS	3 SAM	3 LGE	3 AFN	1 (COMP)	1 (COMP)
France	2 EMF	5 LGE	1 (COMP)	2 SAM	1 (COMP)	2 SAM	1 (COMP)	1 (COMP)
Ireland	2 OFFW	1 (COMP)	1 (COMP)	3 SAM	5 EPOHS	2 PSWL	1 (COMP)	2 SERV
Italy	4 EMF	3 EMF	5 EPOHS	3 PSWL	3 EPOHS/SERV	4 SAM	1 (COMP)	6 PSWL
Luxembourg	5 EMF			3 SAM		3 AFN	1 (COMP)	6 SERV
Netherlands	2 EMF	4 PSWL	4 EPOHS	3 SAM	6 SERV	2 AFN	1 (COMP)	2 EPOHS
Austria	2 EMF	1 (COMP)	3 EMF	2 SAM	4 MAD	2 SAM	1 (COMP)	3 MAD
Portugal	2 EMF	3 EMF	1 (COMP)	3 SAM	5 SERV	2 PSWL	1 (COMP)	4 EMF
Finland	3 EMF	2 EMF	2 PSWL	2 SAM	1 (COMP)	2 SAM	1 (COMP)	2 PSWL
Sweden	2 EMF	2 EMF	4 EMF	2 SAM	2 SERV	1 (COMP)	1 (COMP)	1 (COMP)
United Kingdom	2 EMF	1 (COMP)	1 (COMP)	6 MAD	2 PSWL	3 MAD	3 EMF	5 EPOHS

Table C.6.11. **Relative importance of computer training by country and by industry,[1] 1999** (*cont.*)

	D Manufacturing	E Electricity, gas and water supply	F Construction	G Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	H Hotels and restaurants	J Financial intermediation	K Real estate, renting and business activities	O Other community, social, personal service activities
Norway	2 EMF	1 (COMP)	3 EMF	2 SAM	5 SAM	2 SAM	1 (COMP)	1 (COMP)
Bulgaria	3 EMF	3 EMF	3 EMF	4 EMF	4 SERV	3 LGE	3 SERV	2 EMF
Czech Republic	6 EMF	2 EMF	4 EPOHS	3 LGE	5 LGE	1 (COMP)	1 (COMP)	2 LGE
Estonia	7 EMF	4 LGE	7 EMF	4 PSWL	6 LGE	3 AFN	7 AFN	2 EPOHS
Hungary	2 EMF	2 EMF	6 EMF	3 SAM	2 SERV	2 AFN	2 SAM	1 (COMP)
Lithuania	6 EMF	6 EMF	4 EMF	4 MAD	5 SERV	5 AFN	4 AFN	2 EMF
Latvia	8 SERV	2 EMF	5 EMF	3 SAM	7 SERV	2 AFN	3 SERV	4 AFN
Poland	5 EMF	4 EMF	4 EMF	2 SAM	5 EMF	6 PSWL	3 SERV	1 (COMP)
Romania	4 PSWL	3 PSWL	3 PSWL	7 SAM	7 SERV	2 AFN	2 PSWL	2 SERV
Slovenia	4 EMF	3 EMF	3 EMF	7 SAM	5 SERV	2 AFN	4 EMF	1 (COMP)

LGE = languages; SAM = Sales and marketing; AFN = Accounting and finance; MAD = Management (including human resource management and quality management) and administration; OFFW = Office work; PSWL = Personal skills/development, working life (including company knowledge and introduction courses); COMP = Computer science/computer use; EMF = Engineering and manufacturing (production techniques for goods and services including operations and maintenance of automated systems, quality control and development of new materials, products and services); EPOHS = Environmental protection, occupational health and safety; SERV = Services (personal, transport, security; *e.g.* including hotel and restaurant, travel and tourism). OTHER = Other field of training was excluded from the rankings.

1. The table summarises results from the second Eurostat survey on continuing vocational training, defined as training measures or activities that are fully or partly financed by the enterprise for their employees who have a working contract. It shows the rank of computer training (in terms of percentage of total hours of training) among all fields of training (except "Other"), by main NACE industry and by country. The second line indicates the most important field of training in each industry. While this makes it possible to obtain an indication of the relative importance of computer (vocational) training in each industry and in each country, it is not possible to make absolute comparisons. The relative importance of computer training in NACE K: Real estate, renting and business activities in EU countries was the most important type of training in this industry in 12 out of the 15 countries. Moreover, it appears that computer training is, overall, relatively more important in the EU and Norway. In the other countries, computer training tends to be relatively more important in NACE 0: Other community, social, personal service activities. Each cell in the table shows the rank of computer training among all fields of training (excluding "Other") by industry and by country, and the most important field of training (excluding "Other") by industry and by country.

Source: Eurostat, Newcronos, CVTS2, 2003.

StatLink: http://dx.doi.org/10.1787/050338451420

Table C.6.12. **Australia: relative importance of computer training, by industry, 2001**

Industry	Rank of computer training among all fields of training (12) by industry	Most important field of training by industry	Percentage of total computer training accounted for by each industry	Ranking[1]
Agriculture, forestry and fishing	6	Health and safety	0.5	18
Mining	6	Health and safety	1.0	17
Manufacturing	4	Health and safety	7.5	5
Electricity, gas and water supply	4	Health and safety	1.2	14
Construction	6	Health and safety	1.2	15
Wholesale trade	2	Management and professional	5.9	7
Retail trade	7	Sales and personal service	3.8	8
Accommodation, cafes and restaurants	7	Health and safety	1.2	16
Transport and storage	6	Health and safety	2.9	11
Communication services	5	Management and professional	3.4	9
Finance and insurance	2	Management and professional	8.4	4
Property and business services	2	Management and professional	17.2	2
Government administration and defence	2	Management and professional	14.3	3
Education	2	Management and professional	17.3	1
Health and community services	4	Technical and para professional	7.0	6
Cultural and recreational services	4	Management and professional	2.4	12
Personal and other services	5	Management and professional	3.3	10
Unknown	7	Management and professional	1.4	13
Total	4	Management and professional	100.0	

1. Industry rank is based on its share of total computer training.
Source: Australian Bureau of Statistics, 2002.

StatLink: http://dx.doi.org/10.1787/141114671151

Table C.6.13. **Australia: relative importance of computer training, by occupation, 2001**

Occupation	Rank of computer training among all fields of training (12) by occupation	Most important field of training by occupation	Percentage of total computer training accounted for by each occupation	Ranking[1]
Managers and administrators	2	Management and professional	8.0	4
Professionals	3	Management and professional	38.7	1
Associate professionals	4	Management and professional	14.1	3
Tradespersons and related workers	8	Trade and Craft	3.2	6
Advanced clerical and service workers	3	Management and professional	5.6	5
Intermediate clerical, sales and service workers	4	Management and professional	23.0	2
Intermediate production and transport workers	8	Health and safety	1.9	8
Elementary clerical, sales and service workers	6	Sales and personal service	3.2	7
Labourers and related workers	9	Health and safety	0.9	10
Unknown	7	Management and professional	1.4	9
Total	4	Management and professional	100.0	

1. The rank of the occupation is based on its share of total computer training.
Source: Australian Bureau of Statistics, 2002.

StatLink: http://dx.doi.org/10.1787/753758734425

Table C.6.14. **Information technology professionals on the Priority Occupations List in New Zealand, February 2004**

Groupings	Positions	Required IT skills*	Level(s)
Management and project management	Project director Research and development manager Chief information officer Project manager (large projects) Project manager (mid range projects)	Project managment	Manager Senior manager Director
Policy planning and research	Principal solutions architect Senior solutions architect Principal research engineer Senior research engineer	Java, SQL, OO, CCNE Oracle, C++, Cisco Developer 2000 Dreamweaver, Embedded C	Specialist practitioner Senior specialist Manager
Systems development	Senior software project manager Technical consultant – Applications development Senior systems analyst Senior systems programmer Principal design engineer Senior design engineer Web/multimedia architect e Business architect Senior e Business consultant	Java, SQL, OO, CCNE Oracle, C++, Cisco Developer 2000 Dreamweaver Embedded C	Specialist practitioner Senior specialist Manager
Technical advice and consultancy	Principal support consultant Senior support consultant Senior support specialist Senior principal consultant Principal consultant IT technical specialist	Java, SQL, OO, CCNE Oracle, C++, Cisco Developer 2000 Dreamweaver Embedded C	Experienced practitioner Supervisor Specialist practitioner Senior specialist Manager

Note: The Priority Occupations List also includes occupational groups other than IT professionals (mainly health/medical occupations).
* One or more required.
Source: New Zealand Immigration Service, 2004.

StatLink: http://dx.doi.org/10.1787/365217035886

Table C.6.15. **IT skills covered by New Zealand's Occupational Shortage List,[1] December 2003**

ActiveX	AS400	ASP (Active Server Pages)
ASP.net	Basic.net	BPR (Business Process Re-engineering)
C	C++	CCDPI
CCNA (Cisco Certified Network Admin)	CCNE (Cisco Cert Network Engineer) CGI	Cisco
CISSP (Security)	Citrix	Clipper
CNA (Certified Novell Administrator)	CNE (Certified Novell Engineer)	CNP
COM	Corba	CSSI
CTI (Computer Telephony Integration)	DCOM	Delphi
Developer 2000	Dreamweaver	DHTML
EJB (Enterprise Java Beans)	Embedded C	e-security
Firewall (security)	GIS (Geographical Information Systems)	HP UX
IVR (Interactive Voice Response)	JAD (Joint Application Development)	Jade
Java	JSP	J2EE
Knowledge Management	LINUX	Lisp
Master CNE	Maya	MCP – Microsoft Certified Professional
MCT	MCSE Msoft Cert Systems Engineer	MCSD – Solution Developer
MCDA – Database Administrator	MX Exchange	Netview
Network Design	Novell Netware	OO.net
Oracle	Oracle Case	Oracle Financials
OS400	Perl	PeopleSoft
PL/SQL	Power Builder	Pro *C
Progress (security)	Project management	RAD (Rapid Application Development)
Rational Rose	REXX	RF Engineers
RS6000	SAP	SAS
SMS Server	Solaris	SQL
SUN	SunOs	Sybase
TCP/IP	UML	Unix
Vignette	Visual Basic	Visual C++
Wireless Engineers	WML	XML

1. Applicants for visas or permits must have a minimum of three years full time work experience in at least one of the skills identified on the shortage list (Annex Table C.6.14) and have completed a recognised programme of formal training in that area.

Source: New Zealand Immigration Service, 2003.

StatLink: http://dx.doi.org/10.1787/455083255518

Table C.6.16. **Internet recruitment, detailed NORAS results**

Percentages

		Total	Generic	Generic sites					Specialist sites		
				Fish4Jobs	Peoplebank	PlanetRecruit	Total Jobs	Workthing	AndersElite	Jobs AC	Prospects
	Unique users			817 398	138 140	238 564	627 620	422 026	29 269	190 388	193 755
Gender (base: all)	Male	51	54	45	56	69	52	47	83	45	39
	Female	49	46	55	44	31	48	53	17	55	61
Age (base: all)	15-24	31	25	31	19	21	24	29	15	12	66
	25-34	35	38	33	33	43	39	40	39	44	26
	35-44	20	22	21	28	23	21	18	23	28	5
	45-54	11	12	12	16	10	13	10	16	13	2
	55-64	3	3	3	4	3	3	3	7	3	1
	65+	0	0	0	0	0	0	0	0	0	0
	Average age	31.9	33.1	32.4	35.1	32.9	33.2	31.8	36.2	34.9	24.5
Level of education (base: all)	GCSE/O level/CSE	12	15	23	15	9	14	12	5	1	1
	A/AS level/vocational training	28	32	37	33	28	31	30	29	5	15
	Degree/professional qualification	56	48	32	47	61	50	53	63	93	82
	No qualifications	4	5	8	5	3	5	5	2	1	2
Geography (base: all)	North	20	19	33	15	14	17	18	19	22	27
	Midlands	27	28	30	31	26	26	28	31	27	26
	South	36	37	25	38	43	41	40	28	30	30
	Scotland	6	6	6	6	5	7	6	7	10	9
	Wales	3	3	5	2	1	3	3	4	3	3
	Non-UK	6	6	2	7	11	6	4	11	8	4
Workingstatus (base: all)	FT perm	42	47	48	45	41	53	47	53	39	20
	FT temp	12	9	8	9	12	10	9	17	26	15
	PT perm	6	5	7	4	4	6	4	1	4	6
	PT temp	5	3	3	4	4	3	4	4	8	6
	Retired	0	1	1	1	0	0	1	0	0	0
	Unemployed	25	28	25	31	34	22	29	20	14	28
	FT education	8	4	4	4	2	3	4	2	7	23
	Other	3	3	3	3	3	3	3	3	2	3
Work experience since leaving FT education (base: all)	Still studying	10	5	6	6	4	5	6	3	8	24
	< 1 year	11	8	8	5	9	7	10	9	9	35
	1-3 years	15	13	12	11	13	13	17	10	18	23
	3-5 years	10	11	11	8	15	11	11	10	13	5
	5-10 years	14	16	15	14	16	17	18	15	17	5
	10 15 years	12	13	14	15	12	14	12	14	13	3
	15 20 years	10	12	13	14	12	11	9	11	8	1
	> 20 years	18	22	22	29	19	21	18	30	15	3
	Average years	10.6	11.7	11.9	13.8	10.9	11.6	10.3	13.1	9.7	3.3

Table C.6.16. **Internet recruitment, detailed NORAS results** (*cont.*)

Percentages

		Total	Generic	Generic sites					Specialist sites		
				Fish4Jobs	Peoplebank	PlanetRecruit	Total Jobs	Workthing	AndersElite	Jobs AC	Prospects
Pre-tax annual income (base: all working)	< £9 999	13	11	17	8	8	10	10	3	9	31
	£10 000-19 999	38	39	48	36	27	38	41	17	29	49
	£20 000-29 999	25	25	20	29	24	27	24	28	38	10
	£30 000-39 999	10	10	5	13	13	11	10	25	15	3
	£40 000-49 999	4	4	2	6	6	4	4	12	2	0
	£50 000-59 999	2	2	1	1	5	2	2	4	1	1
	Average	£22 494	£23 682	£18 265	£24 707	£31 778	£23 142	£22 441	£31 460	£23 040	£14 345

Notes: Unique users = the number of different people visiting a site over a specified period of time.
Because of space constraints, results for only three of the six specialist sites included in the survey are included. For the three specialist sites, as well as for PeopleBank, the number of unique users was measured in October 2002. The other three specialist sites surveyed were: AviationJobSearch, HotRecruit, and JobsGoPublic.
Salary bands over GBP 60 000 had very low percentages (0 3%) and are not shown.
Source: NORAS Winter 2003 results, Enhance Media Limited.

StatLink: http://dx.doi.org/10.1787/828020738440

Table C.6.17. **ICT occupations in the United Kingdom, based on Standard Occupational Classification 1990**

IT/computing	
126	Computer systems managers
214	Software engineers
320	Computer analysts, programmers (*incl. robot programmers*)
490	Computer operators (*incl. data processors*, VDU *operators, data entry clerks and database assistants*)
526	Computer engineers, installation and maintenance (Includes computer repairers)
Electronic/electrical	
212	Electrical engineers
213	Electronic engineers
302	Electrical, electronic technicians
520	Electrical production fitters
521	Electricians, electrical maintenance fitters
522	Electrical engineers (non professional)
529	Other electrical/electronic trades nec
850	Assemblers, etc. (electronic goods)
Telecommunications and broadcasting equipment related occupations (nes)	
386	Camera, sound equipment operators
462	Telegraph operators
463	Radio and telegraph operators
523	Telephone fitters
524	Cable jointers, lines repairers
525	Radio, TV and video engineers

ICT occupations are defined as including: *i)* ICT/computing occupations; *ii)* electronic/electrical occupations; and *iii)* telelecommunications and broadcasting occupations not elsewhere specified. The decision to include electrical occupations with electronic occupations throughout was guided by the fact that there are many occupational categories where the two types of occupation cannot be distinguished. Furthermore, this category also includes many higher level telecommunications occupations which cannot be separately identified.
Source: Mason *et al.*, 2002.

StatLink: http://dx.doi.org/10.1787/020645676022

Table C.6.18. **ICT occupations in the United States, based on the Occupational Classification from the 1980 Census**

IT/computing	
64	Computer systems analysts and scientists
65	Operations and systems researchers and analysts
229	Computer programmers
233	Tool programmers, numerical control
304	Supervisors, computer equipment operators
308	Computer operators
309	Peripheral equipment operators
385	Data entry keyers
525	Data processing equipment repairers
Electronic/electrical	
55	Engineers, electrical and electronic
213	Electrical and electronic technicians
523	Electronic repairers, communications and industrial equipment
533	Miscellaneous electrical and electronic equipment repairers
575	Electricians
576	Electrician apprentices
577	Electrical power installers and repairers
683	Electrical/electronic equipment assemblers
Telecommunications and broadcasting equipment related occupations (nes)	
228	Broadcast equipment operators
348	Telephone operators
353	Communications equipment operators nec
527	Telephone line installers and repairers
529	Telephone installers and repairers

ICT occupations are defined as including: *i)* ICT/computing occupations; *ii)* electronic/electrical occupations; and *iii)* telelecommunications and broadcasting occupations not elsewhere specified. The decision to include electrical occupations with electronic occupations throughout was guided by the fact that there are many occupational categories where the two types of occupation cannot be distinguished. Furthermore, this category also includes many higher level telecommunications occupations which cannot be separately identified.
Source: Mason *et al.*, 2002.

StatLink: http://dx.doi.org/10.1787/366240148246

Table C.6.19. **IT-related occupations: US Department of Commerce**

IT-related occupations	
High skill level	
Engineering managers	Computer and information systems managers
Computer and information scientists, research	Computer programmers
Computer software engineers, applications	Computer software engineers, systems software
Computer support specialists	Computer systems analysts
Database administrators	Network and computer systems administrators
Network systems and data communication analysts	Computer hardware engineers
Electrical engineers	
Electrical and electronic engineering technicians	Electronics engineers, except computer
Moderate skill level	
Computer, automated teller, and office machine repairers	Data entry keyers
Electromechanical equipment assemblers	Electrical power line installers and repairers
Electrical power line installers and repairers	Semiconductor processors
Telecommunications line installers and repairers	Telecommunications equipment installers and repairers, except line installers
Electrical and electronics repairers, commercial and industrial	
Low skill level	
Communications equipment operators	Computer operators
Billing and posting clerks and machine operators	Other office machine operators

Source: US Department of Commerce, 2003a.

StatLink: http://dx.doi.org/10.1787/722742184887

Table C.6.20. **Definition of ITEC (information technology, electronics, and communication technology) occupations**

UK SOC 90 Code	Occupational category	ISCO 88	Occupational category
126	Computer systems and data processing managers	213	Computing professionals
212	Electrical engineers	214	Architects, engineers and related professionals
213	Electronic engineers	311	Physical and engineering science technicians
214	Software engineers	312	Computer associated professionals
302	Electrical / electronic technicians	313	Optical and electronic equipment operators
320	Computer analysts, programmers	724	Electrical and electronic equipment mechanics and fitters
523	Telephone fitters		
524	Cable jointers, line repairers		
525	Radio, TV and video engineers		
526	Computer engineers		

Source: Millar, 2001a.

StatLink: http://dx.doi.org/10.1787/128033303007

Table C.6.21. **Classification of IT occupations**

	3-digit ISCO88
Knowledge workers Engineers and applied and social scientists	• Physical, mathematical and engineering science professionals (**211**, **212**, **214**) • Life science and health professionals (221, 222, 223) • Teaching professionals (231) • Other professionals (**241**, **242**, 244, 247) • Physical and engineering science associate professionals (311, **313**, 314, 315) • Life science and health associate professionals (321, 322, 323) • Other associate professionals (**341**, **342**)
Computer specialists	• Computing professionals (**213**) • Computer associate professionals (**312**)
Managerial workers	• Legislators and senior officials (111, 114) • Corporate managers (**121**, **122**, **123**) • Manager of small enterprises (131)
Data workers	• Teaching professionals (232, 233, 234, 235) • Other professional (**243**) • Teaching associate professionals (331, 332, 333, 334) • Other associate professionals (**343**, 344) • Office clerks (**411**, **412**, 413, 414, 419) • Customer service clerks (421, 422)
Service workers	• Other professionals (245, 246) • Other associate professionals (345, 346, 347, 348) • Personal and protective service workers (511, 512, 513, 514, 515, 516) • Models, sales persons and demonstrators (521, 522) • Sales and services elementary occupations (911, 912, 913, 914, 915, 916)
Goods producing workers	• Skilled agricultural and fishery workers (611, 612, 613, 614, 615) • Extraction and building trade workers (711, 712, 713, 714) • Metal, machinery and related trades workers (721, 722, 723, **724**) • Precision, handicraft, printing and related trades workers (731, 732, 733, 734) • Other craft and related trades workers (741, 742, 743, 744) • Stationary plant, and related operators (811, 812, 813, 814, 815, 816, 817) • Machine operators and assemblers (821, 822, 823, 824, 825, 826, 827, 828, 829) • Drivers and mobile plant operators (831, 832, 833, 834) • Agricultural, fishery and related labourers (921) • Labourers in mining, construction, manufacturing and transport (931, 932, 933)

Note: Occupations in bold are included in this chapter's broad definition of ICT-skilled employment; the main overlap occurs within the first three categories of workers.
Source: Arnal *et al.* (2001), based on Lavoie and Roy (1998).

StatLink: http://dx.doi.org/10.1787/523781745077