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Determining the future demand for ICT skills in Europe

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1. Background

The Information and Communications Technology (ICT) industry in Europe is experiencing a severe shortage of skilled personnel that is threatening to slow progress towards *e*Europe. With the support of the European Commission, a consortium of eleven major ICT companies, (BT, Cisco Systems, IBM Europe, Intel, Microsoft Europe, Nokia, Nortel Networks, Philips Semiconductors, Siemens AG, Telefonica S.A., Thales), and EICTA, the European Information and Communications Technology Industry Association have been exploring new ways of addressing this skills shortage. A project was set up, co-ordinated by International Co-operation Europe Ltd., to put in place a clear framework for students, education institutions and governments that describes the skills and competencies required by the ICT industry in Europe.

The first step was to develop core Generic Skills Profiles relevant to jobs in the consortium companies main activity areas, and to create a dedicated website to make this information widely available (www.career-space.com). The **Core Generic Skills Profiles** cover the main job areas for which the ICT industry is experiencing skills shortages**.** These core profiles describe the jobs, setting out the vision, role and lifestyle associated with them. The specific technology areas and tasks associated with each job are also outlined, as well as the level of behavioural and technical skills required to carry out the profiled jobs.

The second step was to invite a number of universities across Europe to join the ICT companies in a working group aimed at drafting **Curriculum Development Guidelines**. These guidelines, which will be published shortly and also made available on our website, are intended to assist universities in designing courses to match the skills profiles and needs of the ICT industry. This curricula work has been actively supported by CEN/ISSS - the European standardisation body for the information society, Eurel - the convention of national societies of electrical engineers of Europe and *eS*kills NTO – the UK national training organisation for ICT. Most importantly though, it has benefited from the direct involvement and support of over twenty universities and technical institutions across Europe. The resulting guidelines build on existing good curricula together with information and suggestions from the companies and associations. They provide a basis for universities and technical institutions to review and revise relevant courses.

The third step, the purpose of this report was to develop a **methodology**, which would lead to a better quantification of the resources required by the industry in Europe.

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2. Executive Summary

- There are presently about 6.5 million ICT jobs in Europe, 3.9 per cent of total employment.

- This number is likely to grow by 20 per cent to 7.8 million ICT jobs over the next four years.

- At present about 40 per cent are in ICT supplier industries and 60 per cent with end-users. These proportions are expected to change to 44 per cent and 56 per cent respectively by 2004.

- The largest concentration of ICT jobs is in the software and services industry.

- Fastest growing ICT occupations are software engineers, analysts and programmers.

- A clear message, which emerges from this study, is that there is an inadequacy of official data, both in terms of its range and timeliness, relating to New Economy skills. Indeed the method suggested in this study is a stopgap to fill the present vacuum.

- Given the highly innovative and dynamic nature of the ICT industries and the application of their products and services among end-users, a single point forecast is probably insufficient. Uncertainly and the impact of policies designed to meet these challenges suggest that alternative methods need to be evaluated. Analysing trends in ICT skills will require the application of a range of techniques including the use of scenarios as recommended in this report.

- The European Commission and the Member States should ensure the adequate provision of timely and comprehensive data on ICT skills.

  - This will entail an updating of ISCO 88(COM)

  - It may require co-ordination of national initiatives to ensure the harmonisation of statistical practices.

3. Introduction

Phase I of the Career space consortium's work described from an employer's perspective the key representative jobs in the ICT industry. These descriptions formed the thirteen Generic Job Profiles (see www.career-space.com for details).

From consortium members' own experience of difficulties in recruiting and retaining staff it was clear that there was a severe shortage of skills but what was less clear was the magnitude of this shortage and whether it was likely to persist and for how long. Related issues of a skills gap, that is a lack of appropriate skills or of a sufficient depth to meet a particular task, are dealt with in *'Curriculum Development Guidelines'* report recently prepared by the Career-Space consortium.

Task of the Supply & Demand Working Group

In Phase II a number of working groups were set up, one of which was the 'Supply and Demand' for ICT Skills working group. **It's task was to quantify the ICT skills in Europe, to determine their trends and to develop a methodology which would lead to a better quantification of the resources required by the industry**..

This work needed data but it was evident very early in the study that for most of Europe existing data was partial, fragmented, and often inconsistent. The United Kingdom and to a lesser degree the Nordic countries were notable exceptions. Their official data was sufficient to provide a reasonably good description of ICT skills. Combining all these data, with forecasts of sector employment by country suggested a way in which a first approximation of ICT skills for Western Europe could be derived.

The first step was to map the *Generic Job Profiles* on to the official occupational classification systems. A complete set of data on the corresponding ICT skills as a proportion of employment by industry sector could then be extracted from the British Labour Force Survey.

The word "skills" used in this context really means "jobs". Jobs have two dimensions, "skill specialisation" and "skill level" where the former "is defined as a field of knowledge required for competent, thorough and efficient conduct of tasks." (SOC2000). "Skill levels" reflect responsibility, experience, and any necessary formal training and qualifications. An occupation is a collection of skill attributes at a particular point in time. Illumination of this point is given in Table 3, Skills Framework for the Information Age developed by the *e*skills NTO. Over time, the combination of skill attributes and their level will evolve. This needs to be kept in mind when assessing the employment/occupation projections.

Next employment data by this industry segmentation for each European country was assembled and its growth projected to the year 2004. It was then assumed that the occupational structure of each industry in each country, subject to certain restrictions, was similar to that of the United Kingdom. This British occupational pattern by industry was then applied to the European employment levels to derive the likely level

and rate of growth of ICT skills in Europe as a whole. Clearly this is a first approximation. Further work will be needed to valid and refine the results.

This exercise provides a foundation for thinking about how skills' demand is likely to evolve and how demand can be related to potential supply. Given the highly innovative and dynamic nature of the ICT industries and the application of their products and services among end-users, a single point forecast is probably insufficient. Uncertainly and the impact of policies designed to meet these challenges suggest that alternative futures need to be evaluated. To that end a scenario approach is suggested.

Chapter 4 shows how the Generic Job Profiles map first on to British then on to European occupational classification systems. Advantages and disadvantages are discussed and a comparison is made with the most complete taxonomy of skills, the *Skills Framework for the Information Age.*

Chapter 5 segments the economy into ICT supplier and end-user sectors, with estimates of all employment, not just ICT skills, and provides projections of this employment over the next four years.

Chapter 6 begins with the segmentation by sector and then outlines the ICT skills content for this employment for each sector by an extension of UK data.

Chapter 7 combines both the European employment projections by sector with the ICT occupational element of employment to derive estimates of the number of ICT jobs by occupation for the year 2000 and provides growth rates out to 2004.

Chapter 8 examines how the estimates could be validated and extended to underpin scenario thinking about the future supply and demand for ICT skills in Europe.

4. Classifying the Generic Job Profiles

The first requirement of the Supply & Demand Working Group was to provide some measure of the overall magnitude of each of the thirteen job profiles as defined in Phase I of the consortium's work. Given that it had been decided to base these estimates on official statistics in the first instance, then it was clearly necessary to map these profiles on to official classificatory systems. This chapter describes this process. The strengths and weaknesses of this mapping are discussed. A comparison was made with the United Kingdom's *eS*kills NTO, *Skills Framework for the Information Age*. Finally data on the numbers for eleven SOC 90 occupations are given.

The Starting Point

Phase I identified thirteen job profiles, describing in detail what these jobs entailed and listed commonly used job titles for each.

Table 1 The Thirteen Job Profiles

Telecommunications
- Radio Frequency (RF) Engineering
- Digital Design
- Data Communications Engineering
- Digital Signal Processing Application Design
- Communications Network Design

Software and Services
- Software and Application Development
- Architecture and Design
- Multimedia Design
- IT Business Consultancy
- Technical Support

Product and Systems
- Product Design
- Integration and Test/Implementation
- Systems Specialist

For each of the Generic Skills Profiles the commonly used job titles are also listed as shown in the example below:

Job Profile	**Examples of Job Titles**
Software and Applications Development	Application Programmer Software Engineer System Developer Technical System Designer Software Architect Maintenance & Support Specialist

Occupational Classification Systems

As the European occupation classification system is insufficiently sophisticated to handle the fine distinctions of the *Generic Job Profiles*, see Eurostat (1999), it was decided to begin the mapping procedure with the United Kingdom's Standard Occupational Classification 2000. This system had the advantage that it was relatively newly defined and explicitly recognised the importance and newly acquired pre-eminence of the major ICT occupations. Examples of two ICT occupations are shown below.

Table 2 Standard Occupational Classification 2000 (SOC2000)

Minor Group	Unit Group	Group Title
213		Information and Communication Technology Professionals
	2131	IT strategy and planning professionals
	2132	Software Professionals

SOC2000 has only recently been adopted and data using this classification system is only just becoming available. For the purposes of this study therefore data coded under the previous version of the standard occupational classification, SOC90 was used. Fortunately the Office for National Statistics have published a direct mapping from the four digit unit groups of SOC2000 to the three digit unit groups of SOC90. Furthermore the ONS also provided a mapping from SOC90 on to the common standard of the Statistical Office of the European Communities (Eurostat) ISCO 88(COM).

Thirteen become Nine

Using the SOC2000/SOC90 systems, the thirteen *Generic Job Profiles* were mapped on to the nine occupations in Table 3 below. In addition there were two other occupations which did not fit well with this method. These were 381 Artists, graphic designers who include web designers and *430 Clerks not elsewhere classified* who include help desk operators Together these occupations account for 912,000 jobs but only a small proportion are relevant to this exercise. Clearly this biases downwards the estimate of the total of ICT skills. On the other hand not all *253 Management, business consultants* are specialists in ICT.

Table 3 ICT Skills in the United Kingdom in 2000

Occupations SOC90	Thousands Employed	Percentage of Total
126 Computer system managers	185	16.2
212 Electrical engineers	41	3.6
213 Electronic engineers	34	3.1
214 Software engineers	199	17.4
216 Design and development engineers	81	7.1
253 Management, business consultants	77	6.7
320 Computer analysts, programmers	315	27.6
490 Computer operators	150	13.1
526 Computer engineers	60	5.3
Total	1,142	100

Source Labour Market Survey

Data in the table shows that 1.142 million are currently employed in core ICT skills across the whole economy, both in supplier industries and end-users, and they account for nearly four per cent of the employment. Dominating these skills are computer analysts and programmers, software engineers, system managers, and computer operators. Electrical, electronic and design and development engineers are in the minority. This may reflect the UK's weakness in manufacturing and may not be representative of other European countries for example Germany or Finland.

Other definitions of ICT core skills often cast a wider net. For example *the Skills Framework for the Information Age*, which is probably the most fully developed taxonomy of ICT skills and which is summarised in Table 4, includes Sales and Marketing, Education and Training. These sectors would have added perhaps another 7 to 10 per cent to the 1.142 million given in this report but as emphasised throughout this report, the Working Group were aiming at a broad brush picture of ICT skills in Europe. Nine occupations by sector, by country looked and in practice turned out to be achievable.

The quantity, quality and range of data vary greatly by country. What this study was attempting was to establish a framework within which detailed country studies, both official and non-official, such as ad hoc market research and surveys, could be fitted.

The bald figures given above can be enhanced by segmenting them by suppliers, and their subdivisions, and end-users. The results raise interesting questions as to why there are concentrations of skills by country, industry, and occupation. These issues are addressed in the next chapter.

Table 4 Skills Framework for the Information Age (SFIA)

Category	Sub category	Skill mean value	Range of values
Strategy & planning	Information management	6.5	6 to 7
	Advice & guidance	5.5	5 to 7
	Business/IS strategy and planning	5.5	5 to 6
	Technical strategy and planning	5.0	3 to 6
Management & administration	Supply management	4.8	3 to 6
	Project management	5.0	2 to 7
	Quality management	4.9	3 to 7
	Resource management	6.3	5 to 7
Sales & marketing	Sales and marketing	4.0	1 to 6
Development & implementation	Systems development	4.0	2 to 6
	Human factors	4.2	2 to 6
	Installation & integration	3.3	2 to 5
Service delivery	Education and training	4.1	2 to 6
	Infrastructure	4.8	2 to 6
	Operation	3.6	1 to 6
	User support	3.0	1 to 5
Use	User	3.4	1 to 7

Source: *e*Skills NTO

SFIA provides details of actual skills as opposed to occupations. For each skill a level of responsibility is given. The mean values and ranges for each skill sub category are given in the table. The former provides a measure of the seniority of a category or collections of skills, while the range indicates level of responsibility at entry points to a job and how far advancement can be made for such a job.

5. Segmenting the ICT Labour market

The demand for ICT skills runs across the whole economy but there are concentrations in particular areas, most notably in the ICT supplier industries and particularly in the software and services industry. A commonly accepted definition of these industries has been given by the OECD who have also published data on employment for these supplier industries but not for the end-user industries. Moreover the OECD data is only for 1997. Using employment forecasts by country and industry prepared by the *European Economic Research and Advisory Consortium* (ERECO), the growth of employment in ICT supplier industries and end-users up to 2004 can be derived.

A commonly agreed definition of the ICT industry

Recently the OECD's Committee for Information, Computer and Communications Policy, acting on behalf of Member countries, agreed on a set of definitions of the supplier industries. These definitions, given in the table below, were used for the purposes of this report.

Table 5 OECD Definition in Terms of ISIC Classes

Manufacturing

- 3000 Office, accounting and computing machinery
- 3130 Insulated wire and cable
- 3210 Electronic valves and tubes and other electronic components
- 3220 Television and radio transmitters and apparatus for line telephony and line telegraphy
- 3230 Television and radio receivers, sound or video recording or reproducing apparatus, and associated goods
- 3312 Instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process equipment
- 3320 Industrial process control equipment

Services

- 5160 Wholesaling of machinery, equipment and supplies
- 7123 Renting of office machinery and equipment (including computers)
- 6420 Telecommunications
- 72 Computer and related activities

Other research exercises may use a wider definition. For example some include all or parts of the broadcast media.

Table 6 Employment by ICT Supplier industries and End-Users, Thousands 1997

Employment	Manufacturing ICT	Telecomms	Other ICT services	End-user	Total Employment
Austria	39	65	61	3,209	3,374
Belgium	23	30	78	3,612	3,742
Denmark	22	19	55	2,499	2,596
Finland	37	17	34	1,924	2,011
France	238	170	273	21,726	22,407
Germany	373	221	380	31,657	32,631
Greece	5	23	14	3,924	3,966
Ireland	34	12	10	1,370	1,426
Italy	186	180	306	21,496	22,167
Netherlands	78	41	80	5,442	5,641
Norway	10	18	45	1,997	2,071
Portugal	27	21	47	4,574	4,668
Spain	56	73	78	13,967	14,175
Sweden	56	36	79	3,868	4,040
Switzerland	50	29	93	3,527	3,699
United Kingdom	303	193	616	24,239	25,351
Europe	1,537	1,147	2,249	149,032	153,965

Source OECD, IBM

The above table shows employment by country broken down by three ICT supplier industries and by the rest of the economy, that is the end-users, in 1997. ICT jobs can be derived from these employment data. The method is outlined in the next chapter.

Figures for 1997 are a start but clearly what is needed are projections of growth over subsequent years. The method adopted here was to use employment growth rate projections produced by a European wide econometric model, the *E3ME model*, where E3ME stands for *Energy-Environment-Economy Model for Europe*. The appeal of this approach was that demand for ICT skills could be encompassed within a coherent forecast of growth and jobs, which reflected a comprehensive set of macro assumptions. For example, shocks to the European economy such as a downturn in world activity would reflect itself in the demand for ICT jobs.

The model forecasts used for the purposes of this report were published in September 2000 by the *European Economic Research Consortium*, ERECO (2000). This consortium consists of nine research organisation in as many countries. It includes *Cambridge Econometrics* who are based in the United Kingdom and who were the point of contact for the Supply & Demand for ICT Skills Working Group.

The model combines the features of an annual short and medium-term econometric model with those of an input-output model, providing a complete explanation of the demand for and supply of industry output at the sectoral level. There are 32 of these industry sectors. The model is designed to be estimated and solved for 19 regions of Europe (the EU15 member states plus Norway and Switzerland with Germany divided into east and west and Italy divided into north and south).

One of the attractive features of using such a model to underpin ICT employment is that alternate projections can be generated thus providing input to the development of scenarios.

Of the 32 sectors in the E3ME model, four were relevant to the *Supply and Demand Working Group*. These are shown below in Table 7.

Table 7 Relevant sectors in the E3ME model

E3ME Sector Ref	E3ME sector	3 digit NACE code
13	Office machines	230
14	Electrical goods	250
28	Communications	670
30	Other Market Services	710,730,750,770,790

ERECO's September 2000 report included two chapters, *Electronics*, and *Information Communications Technology Services*, which looked in some detail at these industries.

The former covered NACE80 codes 230 plus 250 and therefore coincided with the OECD's definition of ICT manufacturing, the latter included NACE80 code 670 plus 740 (part of). A drawback to this was that *Communications* included national post and courier services as well as telecommunications provision and maintenance of transmission equipment and services. To make allowance for these differences, the Working Group modified the ERECO growth rates drawing upon UK experience. These modified rates were then applied to the employment levels provided by the OECD, as described above, to give the projections of employment in 18 countries from 1998 to 2004. Employment estimates by sector for the year 2004 are given in Table 8 below.

The projections point to a significant expansion of about eight per cent in total employment with a corresponding tightening of the European labour market. This implies nearly a halving of the level of unemployment. The most labour intensive ICT sector, *Other ICT services*, which is largely the software and services industry, is projected to see employment increase by about 43 per cent. Part of this growth would be at the expense of the *Rest of the Economy* (end-users) as the process of ICT outsourcing sees the transfer of staff from end-users to this ICT services industry.

Table 8 Projected European employment by country and sector to the year 2004, Thousands

Country	Manufacturing ICT	Telecommunications	Other ICT Services	End-User	Total Employment
Austria	41	75	90	3,388	3,594
Belgium	24	38	108	3,869	4,039
Denmark	23	23	71	2,598	2,715
Finland	52	22	55	2,195	2,324
France	270	266	416	24,605	25,557
Germany	347	272	545	32,206	33,370
Greece	5	30	18	4,273	4,326
Ireland	57	17	19	1,718	1,811
Italy	202	236	387	22,379	23,204
Netherlands	90	57	126	6,282	6,555
Norway	11	22	70	2,217	2,320
Portugal	24	28	58	4,941	5,051
Spain	82	106	104	16,575	16,867
Sweden	67	47	115	4,207	4,436
Switzerland	50	34	122	3,662	3,868
United Kingdom	276	224	911	25,250	26,661
Europe	1,621	1,497	3,215	160,364	166,697

Source ERECO, IBM

Having determined the level of employment annually from 1997 to 2004, the next issue to be addressed was what proportion of these jobs are in ICT. This question addressed, in the next chapter.

6. ICT Occupations

Estimating the level and growth of employment in the ICT supplier industries and the rest of the economy (end-user) was a necessary first step to determining the likely demand for ICT skills. The proportion of these skills of total employment varies greatly by sector. For example ICT jobs account more than 60 per cent of employment in *Other ICT Services*. Among end-users this percentage can be quite small. Evidence for this comes from the United Kingdom. As comparable data is unavailable for many, if not most other countries in Europe, the expedient used here was to assume that the occupational structure of industry was for each of these countries similar to that in Britain. There are obvious drawbacks to this approach. For example some ICT skill intensive activities, such as research and development may be concentrated, in particular countries. Nevertheless the approach was thought to have sufficient validity to serve as a first approximation.

The table below shows the distribution of ICT skills by sector. Most are employed by end-users, mainly as managers, analysts and programmers, and computer operators.

Table 9 ICT skills as a percentage of employment by sector in the United Kingdom, year 2000

Occupations SOC90	**Manufacturing ICT**	**Telecommunications**	**Other ICT services**	**ICT skills employed by end-users**	**Total ICT skills[1]**
126 Computer systems managers	0.7	0.8	5.1	9.6	**16.2**
212 Electrical engineers	0.3	0.5	0.1	2.7	**3.6**
213 Electronic engineers	0.7	0.2	0.1	2.1	**3.1**
214 Software engineers	1.0	0.4	11.2	4.8	**17.4**
216 Design and development engineers	0.8	0.3	0.2	5.8	**7.1**
253 Management, business consultants	0.1	0.1	0.6	5.9	**6.7**
320 Analysts, ,programmers	1.2	0.7	9.6	16.1	**27.6**
490 Computer operators	0.4	0.4	1.6	10.8	**13.2**
526 Computer engineers	0.7	0.1	2.7	1.8	**5.3**
Total	**6.0[1]**	**3.4**	**31.2**	**59.4**	**100.0**

Source Labour Force Survey

The *Other ICT Services* sector, where total employment is quite small compared with *End-Users*, accounts for nearly a third of all ICT skills. As a proportion of total employment within this sector, these skills account for more than 60 per cent. This is therefore where the greatest concentration of ICT skills lies. As the process of outsourcing advances this sector could eventually come to have a near monopoly of such skills. This trend can be seen in the next table, which shows the annual compound growth rates of ICT skills, by sector.

Table 10 Annual average growth rates 1995 to 2000 in the UK

SOC90 Occupations	Manufacturing ICT	Telecommunications	Other ICT services	End-Users	Total ICT skill
126 Computer systems managers	-5.6	20.4	15.1	2.9	6.0
212+213 Electrical and Electronic engineers	-1.4	12.3	-8.3	1.9	1.8
214 Software engineers	5.2	16.4	17.2	23.5	17.8
216 Design & development engineers	-5.9	14.6	10.4	1.3	0.8
253 Management & business consultants	9.8	11.4	33.8	4.7	6.4
320 Computer analysts & programmers	-3.8	12.2	13.2	8.8	9.5
490 Computer operators	7.9	2.8	4.8	-1.9	-0.9
526 Computer engineersı	-5.6	-10	9.6	6.3	5.1
Total	-2.3	12.1	14.0	4.3	6.5

Source LFS survey

Over the five-year period from 1995 to 2000, the total number of ICT jobs was rising by 14 per cent in the software and services industry compared with 4.3 per cent with end-users. More recently these growth rates have slowed somewhat as the Y2K effect has waned. Nevertheless the direction the trend is taking is clear.

Combining the forecasts of employment by sector as shown in Chapter 3 with an extrapolation of the trends towards increasing shares of ICT skills within those employment totals, provided a consistent and coherent projection of the growth of ICT skills jobs over the next four years. The results are shown in the next chapter.

7. Distribution of ICT skills across Europe

A first approximation of the number and rate of growth of ICT skills in Western Europe was derived by projecting employment by sectors in each mainland European country, aggregating them, and then calculating the number and type of ICT occupation according to the characteristics of these sectors in the United Kingdom, subject to certain constraints. The derived figures for each of the 11 occupations by four sectors in Western Europe are shown in Table 11 below.

This method suggested that there were nearly 6.5 million ICT jobs in Western Europe in the year 2000, out of a total of nearly 167 million jobs, or just under four per cent of aggregate employment. Nearly 60 per cent of these ICT jobs were with end-users. Of the total ICT jobs, about 16 per cent were managers. Engineers, excluding those concerned with software, accounted for almost 1.4 millions. Software engineers, a comparatively new profession, accounted for just less than that number at 1.3 millions. Analysts and programmers were the largest group with nearly 1.9 millions jobs.

By sector, *Telecommunications* had the lowest concentration of ICT jobs at 18 per cent compared with *Other ICT Services* with over 60 per cent. Of *End-User* employment about 2.4 per cent were ICT jobs.

Using a similar technique to that described above, growth rates by occupation were calculated. Given the dynamic nature of the ICT industries, and the corresponding changing composition of skills associated with a particular occupation, a relatively short projection period has been chosen, that is up to 2004.

The results of this exercise are shown in Table 12. Total employment was forecast to expand by 0.8 per cent per annum while ICT skills were projected to increase by 4.7 per cent so that their share of total employment rose from under four per cent to 4.5 per cent. Most of these new jobs were concentrated in the software and services industry. Part of this growth was attributable to a transfer of staff under outsourcing deals from the end-users to the supplier industry.

Employment prospects varied greatly by sector. *Manufacturing* faced relatively slow growth. *Telecommunications* and *Other ICT services* were the most favoured. This together with changing occupational structure within a sector lead to the pattern shown.

Table 11 ICT skills by occupation in Western Europe, Thousands, 2000

SOC90 Occupation	Manufacturing ICT	Telecommunications	Other ICT services	Total ICT suppliers	End-users	Total ICT skills
126 Computer systems managers	51	59	331	441	578	1,019
212 Electrical engineers	24	35	4	63	140	203
213 Electronic engineers	45	13	4	62	134	196
214 Software engineers	61	28	707	796	510	1,306
216 Design and development engineers	55	19	13	87	312	399
253 Management, business consultants	7	10	42	59[1]	378	437
320 Computer analysts, programmers	92	65	588	745[1]	1,140	1,885
490 Computer operators	18	30	99	147	549	696
528 Computer engineers	45	12	159	216[1]	132	348
Total ICT skills	398	271	1,947	2,616	3,873	6489[1]
Total Employment	**1,621**	**1,497**	**3,215**	**6,333**	**160,363**	**166,696**

Source IBM

Table 12 Western Europe Annual average growth rates 2000 to 2004

SOC90 Occupation	Manufacturing ICT	Telecommunications	Other ICT services	Total ICT suppliers	End-users	Total ICT skills
126 Computer systems managers	4.0	1	9.7	8	1.8	4.1
212 Electrical engineers	2.7	0	5.9	1.4	-1.2	-0.5
213 Electronic engineers	0.9	3.4	3.2	1.6	3.3	3
214 Software engineers	0.7	1.5	9.1	8.3	13.8	10
216 Design & development engineers	1.9	0	7.6	2.4	-0.4	0.2
253 Management & business consultants	3.1	2.1	10.1	8.1	3.1	3.7
320 Computer analysts & programmers	5.3	6.3	8.4	7.9	5.1	6.1
490 Computer operators	-5.6	2.9	9.1	6.4	-1.7	-0.5
528 Computer engineers	0.9	19.1	8	7.9	6.1	6.5
Total ICT skills	2.1	2.9	8.9	7.4	3.3	4.7
Total employment	0.7	3.8	4.7	3.5	0.7	0.8

Source IBM

These projections were a first approximation, the next chapter considers how the numbers could be validated and how this work could form the foundation for thinking about future directions.

8. Future Directions

The basic framework

Outlined in this report is a method to derive a first approximation of ICT employment for Europe. ICT jobs were segmented by supplier industries and end-users at country level. This approach brought together official data and as such provided a coherent set of data by cross section and over time. History and projections could be updated as new data are published and projections could be adjusted to reflect changing assessments of the European economic outlook.

These estimates of ICT employment and how it was thought to be changing over time provide a broad framework within which disparate individual country studies, market research, and ad hoc surveys can be encompassed. Also since the estimates were based on official definitions and data they could be related to potential supply of industry entrants for example from higher education institutions. Having laid the foundations, work can now begin in earnest to determine the magnitude of the skills shortage and then develop policy prescriptions to address this problem.

Given that the methods, and the derived estimates of ICT employment, rely heavily on UK experience, one of the next tasks would be to collect individual country data, compare these with the estimates, and make amendments where necessary. Next country level official data would be collected on ICT vacancies, hard to recruit skills, salary levels and rates of growth, new ICT occupational entrants, both newly qualified graduates, and from other occupations. The third task would be to collect non-official data, that is from market research, industry analysis, and skills surveys with the aim of deepening understanding of the nature of the skills shortage and to provide timely indicators of its intensity. Fourth task would be to extend the coverage of the estimates to include the newly defined Generic Job Profiles. Finally from time to time the employment projections would need refreshing using the E3ME model.

Scenarios and indicative planning

Collecting and synthesising data was a necessary first step to determining the magnitude of the ICT skills shortage. The next step is to think of ways of solving it. A difficulty is that the rapid and, at times, discontinuous pace of innovation of ICT technologies, can mean that point projections of skills demands could quickly become obsolete. In these circumstances conditional alternative views of the future are more appropriate. These alternative views can be generated as competing scenarios and employed in the process of indicative planning.

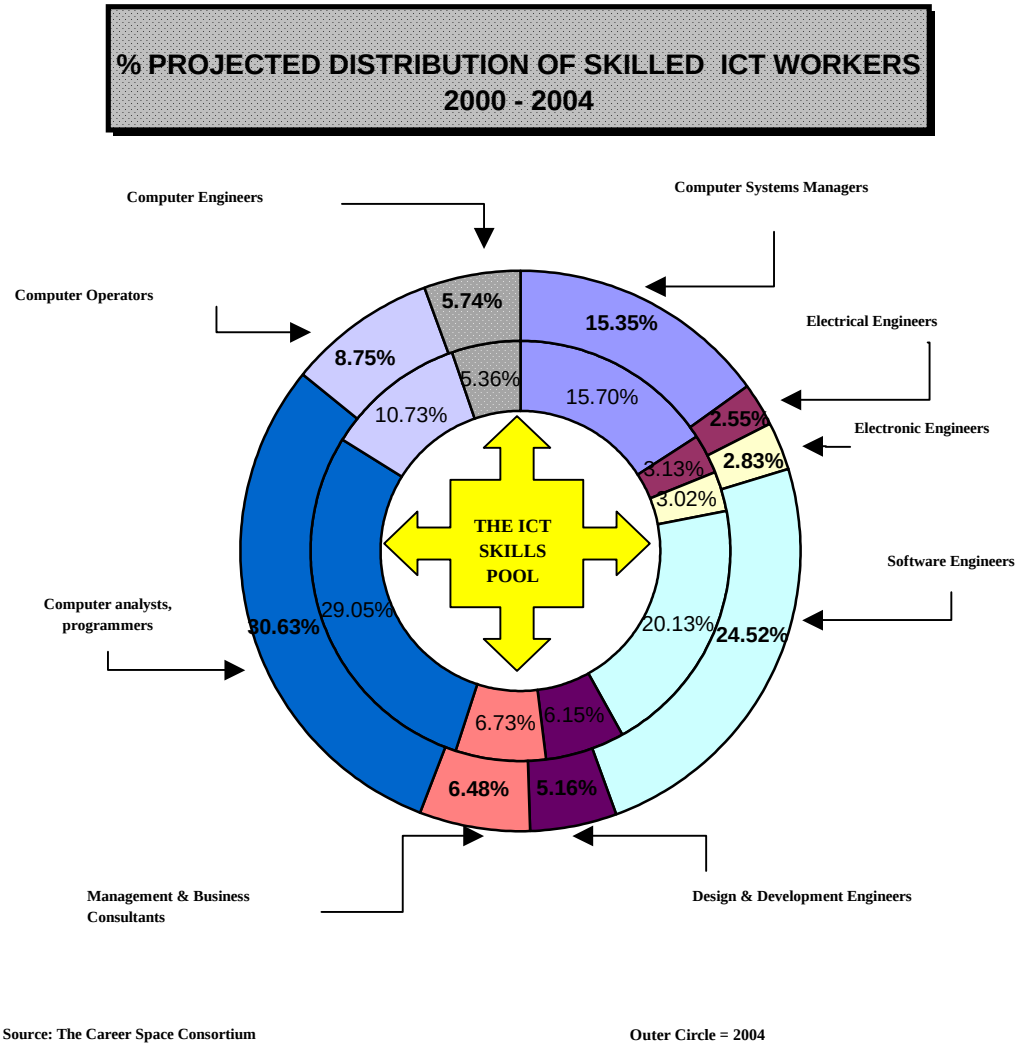
Such an approach is currently being used in Finland (see study by the Federation of Finnish Electrical & Electronics Industries in Annex I).

In their study '*ICT Employment Scenarios 2010'* the authors have developed a formula to forecast ICT employment in a "Boom" situation i.e. when the overall economic development is favourable and in a "US-led recession" i.e. when the US economy tumbles into a deep recession and pulls the whole world economy with it. The essence of the exercise is to define current status, describe a range of alternative futures, decide on the basis of a range of criteria including society, markets, and technology, which is or are the most preferred futures, and then determine the necessary steps to make it happen.

9. Conclusion

This report has outlined a method to give a broad-brush picture of ICT jobs in Europe and has suggested how this work could be advanced

A clear message, which emerges from this study, is that there is an inadequacy of official data, both in terms of its range and timeliness, relating to New Economy skills. Indeed the method suggested here is a stopgap to fill the present vacuum. Specific recommendations are made relating to this paucity of data. Some of these recommendations have already been highlighted in EICTA's recently published position paper on *"Skills Shortage in ICT"*.


% PROJECTED DISTRIBUTION OF SKILLED ICT WORKERS
2000 - 2004
Computer Engineers
Computer Systems Managers
Computer Operators
Electrical Engineers
Electronic Engineers
Software Engineers
Computer analysts, programmers
Management & Business Consultants
Design & Development Engineers
THE ICT SKILLS POOL
5.74%
15.35%
8.75%
5.36%
15.70%
10.73%
2.55%
3.13%
2.83%
3.02%
30.63%
29.05%
20.13%
24.52%
6.73%
6.15%
6.48%
5.16%
Source: The Career Space Consortium
Outer Circle = 2004

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Volume 1 Structure and descriptions of unit groups
Volume 2 The coding index

Annex I – ICT Employment Scenarios 2010

The Future Scenarios of the Employment in the European ICT Sector

Federation of Finnish Electrical and Electronics Industry