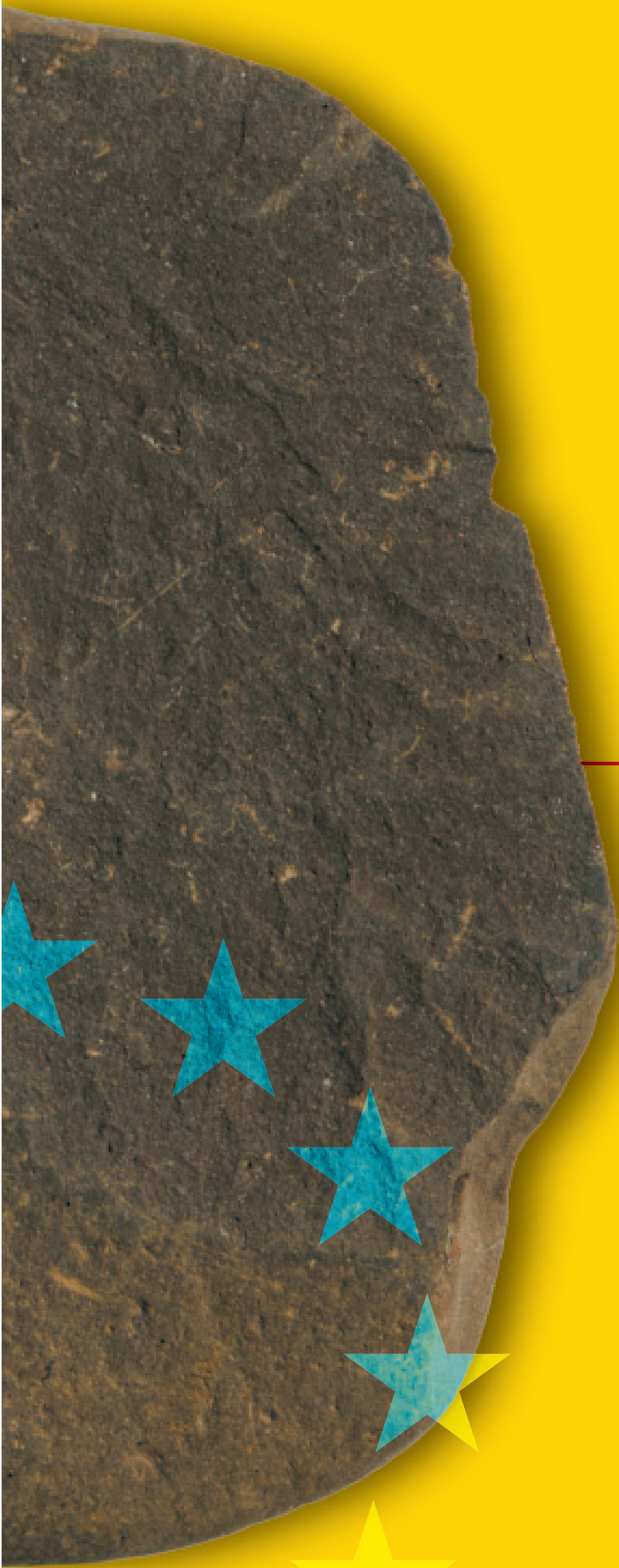

Information Technology Practitioner Skills in Europe

Study of the
Labour Market position,
in particular for Germany,
Ireland, Sweden, and the
United Kingdom

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... the attractive texture and pleasing

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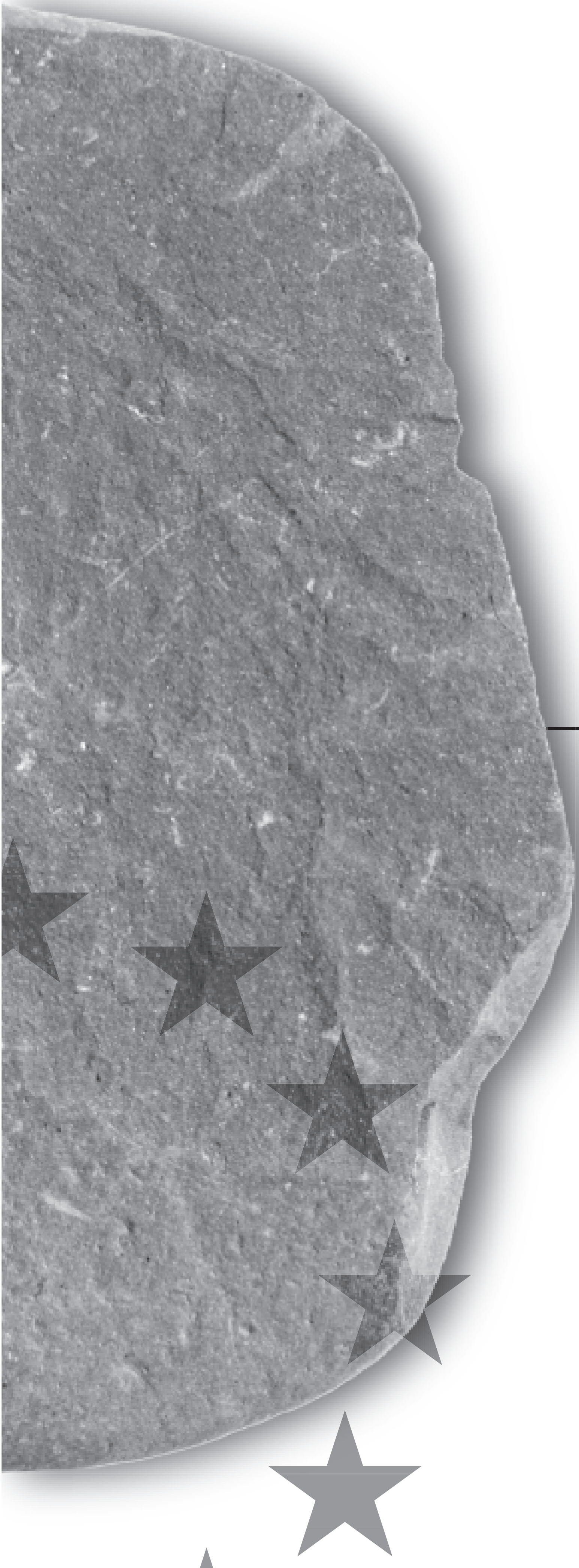
Informatics...



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May, 2002

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Preface

In spite of an extended period of discussions in various bodies about the IT "skills gap" in Europe, there remain many questions about the exact nature of the problem, and how to tackle it, whether from the political or economic perspective. Attempts at policy measures to effectively improve the situation for the benefit of European employment and the economy are still in their early stages in a number of countries. Since the IT profession needs to contribute to effective policy development as one of the strong drivers of national competitiveness, CEPIS Member Societies agreed through their Council to commission a serious study from an acknowledged expert.

This CEPIS report surveys the current state of IT practitioner skills within the European Union. It presents an overview of the IT practitioner labour market und summarises recent trends on employment in four different countries (Germany, Ireland, Sweden, and the United Kingdom). The future development of the size of the IT practitioner workforce is then explored by using different plausible employment growth scenarios, with annual increases of 2% to 15%, following an initial downturn.

This work forms part of a CEPIS initiative to help improve IT practitioner skills within European countries. The labour market study was initiated by the former CEPIS president Peter Morrogh in Spring 2001. It presents a comprehensive perspective of the field, together with a significant amount of new statistical information, and makes recommendations for follow-through to provide a sound basis for the future work of decision makers in policy, education and business. Due to the limited coverage of the report in its current preliminary version, it is planned to extend and update the quantitative data, in particular to encompass the position of IT Practitioners in all Member States. The initial cross-comparisons between the situations in four Member States can then be extended for the European Union as a whole. In particular, details on education, training and certification programs are to be addressed, in order to clarify the most effective approaches to tackling the expected future IT skills shortages.

One of the key objectives of this study is to provide a sound factual basis on which plans can be developed by CEPIS for strengthening education and training of IT professionals by means of certified training programmes recognised at the European level. The Council of European Professional Informatics Societies is funded by subscriptions from 32 member societies in 28 European countries and by the European Computer Driving Licence (ECDL) Foundation, which was founded by CEPIS in 1996. The ECDL has reached over 1.5 million graduates and has gained considerable recognition by the European Commission. The Council is currently engaged in an EU-funded project developing ***European Certification for Informatics Professionals*** (EUCIP). This will become an important contribution to meeting the challenges of the future IT Practitioner labour market.

CEPIS is hopeful that this report and its other work will contribute to establishing a strong learning and skill development context for IT professionals intended to complement conventional education in order to help bridge the growing skills gap in Europe and create employment. Readers are invited to send us their thoughts on how best to accomplish this aspiration. The author would particularly appreciate any comments or suggestions you may have on the report, in order to improve the quality of the follow-on work.

We thank Dr. Matthew Dixon who carried out this CEPIS study for his excellent work.

Frankfurt, May 2002

Wolffried Stucky
CEPIS President

Peter Morrogh
CEPIS Past President

Disclaimer

Any opinions expressed in this report are those of the author, and do not of themselves constitute a statement of approved CEPIS policy or the position of any of its Member Societies. The sources used for the data presented in the document are generally indicated: their validity is as described, and the figures have not been cross-checked by the Council of European Professional Informatics Societies. In spite of its full confidence in the author and his approach, CEPIS recognises the resulting preliminary nature of some of the conclusions. It views the report as an important contribution to the clarification of the position of the IT Practitioner labour market within the European Union, and seeks to support future work to further strengthen the scope and value of this approach.

Frankfurt
May, 2002

Acknowledgements

The author has been lucky enough to draw on the understanding and expertise of a number of people knowledgeable in this area in several countries, and is pleased to be able to acknowledge the particular contribution of:

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Wolffried Stucky	President CEPIS and University of Karlsruhe, Germany
Keith Telford	Senior Economist, IBM United Kingdom

Special thanks belong to the CEPIS Past President, who initiated the project by inviting the author to carry out the study and whose idea it was that a serious study be undertaken to clarify the position of IT professional skills in Europe.

Executive Summary

Executive Summary

The current state of the IT Practitioner* workforce within the European Union is assessed, with the position in four Member States being studied in some detail, in particular through review of the most recent national analyses and examination of levels of employment of the core technical communities from official statistics over a five year period.

The report examines:

- the scale of the IT Practitioner ("ITP") labour market;
- the economic and policy contexts;
- the nature and structure of this labour market, and its quantitative position and recent trends in more detail in Germany, Ireland, Sweden and the United Kingdom;
- initial comparisons between Member States of certain aspects of this labour force, and the role of migration;
- the challenges of estimating skill shortages, in particular into the future; and
- four employment growth scenarios, to provide insights into future supply challenges.

The two other significant analyses of the European level position are reviewed in some depth, and an analysis and forecasting approach was adopted for the study that overcomes certain of their limitations.

Levels of employment in the four countries selected are presented from Eurostat holdings of national Labour Force Survey official statistics in two occupational areas ("Computing Professionals" and "Computer Associate Professionals") over a five year period. While these figures are generally noticeably below the "headline" figures assumed within recent national employer surveys (which have often covered - all occupations in - the supply sector), they are more meaningful in representing the scale of the core technical communities requiring the hard technical skill needs on which public policy development in relation to IT Practitioner skills must primarily focus.

Levels and recent trends of a number of aspects of this workforce are reported, and the official figures suggest noticeable differences between the four Member States examined, in relation to, for example:

- the level of female employment in this work;
- the age profile of the ITP workforce;
- the amount of self-employment within the workforce, and
- the share of employment within the supply (IS Industry) sector.

While this data suffers from certain differences of classification – in particular concerning the IT Practitioner occupations – between countries, and the findings need further verification, the trends and certain ratios remain meaningful, and significant national differences suggest the need for further exploration.

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* In this study, ***IT Practitioners*** include both IT ("Informatics") Professionals and non-professional dedicated IT workers. They do not include either electronic engineers or Telecommunications workers (the study is not of I**C**T Practitioners) or IT *End-Users* who make use of IT in their own work.

The likely future development of the size of the ITP workforce is explored using four employment growth rate scenarios (annual increases of 2%, 5%, 10% and 15%), all of which start with an initial fall in the numbers in employment resulting from the downturn in ICT activity that started during 2001. The numbers of "new IT Practitioners" needed over the coming years – both in each country examined and for Europe as a whole – are calculated, taking into account the reality of replacement demand that was not considered in the other analyses.

Although it is clear (under e.g. the 5% and 10% growth scenarios) that several hundred thousand "new entrants" will be needed annually in the European Union as a whole as the growth picks up (a level that will require considerably more than the flows of graduates emerging from tertiary education courses in Information Technology) the EU totals are probably not worthy of detailed scrutiny, since action will be needed at the national level, and policy responses are most meaningful and effective within Member States.

The differences in certain key characteristics of the ITP workforce between (even) the four Member States examined suggest that a more detailed review should be undertaken, to verify (or otherwise) these differences, and distil, both from these and from successful policy measures in different Member States, recommendations for constructive policy measures.

The main finding of the study is that it is possible to gather more detailed, meaningful and broadly comparable information about the IT Practitioner labour market in Europe than has been done before, with relatively modest resources. The comparative success of such a study suggests there would be value to policymakers (both national and at the European level) in following through – preferably in collaboration – for CEPIS to:

- review with the European Commission the key issues in this area for which better understanding is required;
- examine the position and trends in all Member States in relation to other perspectives;
- extend the data coverage into a number of other important areas, and
- refine the forecasts, in particular in the light of national economic cycle phasing and efforts towards strengthening the cross-comparability of official national occupational statistics in this area.

The report concludes with a series of recommendations for this.

Table of Contents

Section 1

Introduction

1. Introduction

This Study was initiated by the CEPIS President in Spring, 2001, in response to concern within the Council – not least in relation to the potential market for *European Certification for Informatics Professionals* (EUCIP) – about the lack of adequate understanding of the nature, size and likely development of the labour market for those with IT Practitioner skills within Europe. Such figures as were available had arisen largely from the work of the International Data Corporation (IDC), and the estimates, both for present levels of employment and for future development, were felt by some within the CEPIS community to be implausibly large.

The work on the IT Practitioners' labour market in the United Kingdom that had been reported in ***Skills99*** (ITNTO/AISS, 1999) was recognised to be a relatively comprehensive and robust analysis of the position there, and the CEPIS Executive Committee felt it would be desirable to explore the feasibility of extending that approach to an attempt to develop a summary of the position of this labour market within other Member States, and so within Europe as a whole.

The work was therefore commissioned as a feasibility study with a modest budget, and CEPIS proposed that it should explore in some detail the labour market in four Member States (Germany, Ireland, Sweden and the United Kingdom), with a view to extending the work – should feasibility be proved – to all other Member States, preferably with EU Commission funding.

The strategic importance of ICT skills at the European level was recognized in March 2002, by Erkki Liikanen, European Commissioner for Enterprise and the Information Society, in his Foreword to the 2002 edition of the *European Information Technology Observatory* (EITO):

> *"Despite the current consolidation phase within the ICT sector, one of the biggest concerns of European enterprises remains that of finding employees with ICT and e-business skills. To address this challenge, the Enterprise Directorate-General of the Commission has established in September 2001 an "ICT Skills Monitoring Group", composed of representatives of all Member States, to analyse demand for ICT and e-business skills in the EU and to monitor the policies and the actions designed to match demand with supply. EITO has strongly contributed to this debate, as the figures published in the EITO Yearbook 2001 became a point of reference for the discussion on the ICT skills shortage".*

The CEPIS leadership shares the challenging aspiration of Commissioner Liikanen that measures need to be taken to ensure that Europe will gain a leading position in the development and use of the strategic Information and Communication Technologies, and its valuable development work for EUCIP is already a significant step in that direction. However, as indicated in the Preface, CEPIS believes that future policy-making on IT Practitioner skills in Europe must be developed on a more objective and sound factual basis about the labour market than has been possible before.

This study was carried out largely over the same period as the *ICT Skills Monitoring Group*'s initial phase of work, and will enable CEPIS to make a valuable input into the work of that *Group*.

Usage of Terms

The following terms are used, within the report, with the following broad meanings. See the Glossary (part 2) for details of types of education and training in EU languages.

Skills: The set of requirements needed by employers from those who are capable of satisfactorily carrying out each relevant occupation. In the context of labour market work, the word is generally used to refer to the overall market parameters.

Occupations: The set of separate broad roles carried out within a particular working area. There are many occupational frameworks in IT, and these are discussed in Section 4 and Annex A.

Competencies: The set of capabilities that people in a particular occupation need to have, in order to reliably and consistently perform that role to an adequate level of performance (the term is therefore close to, and often used in this context interchangeably with, ***Skills***)

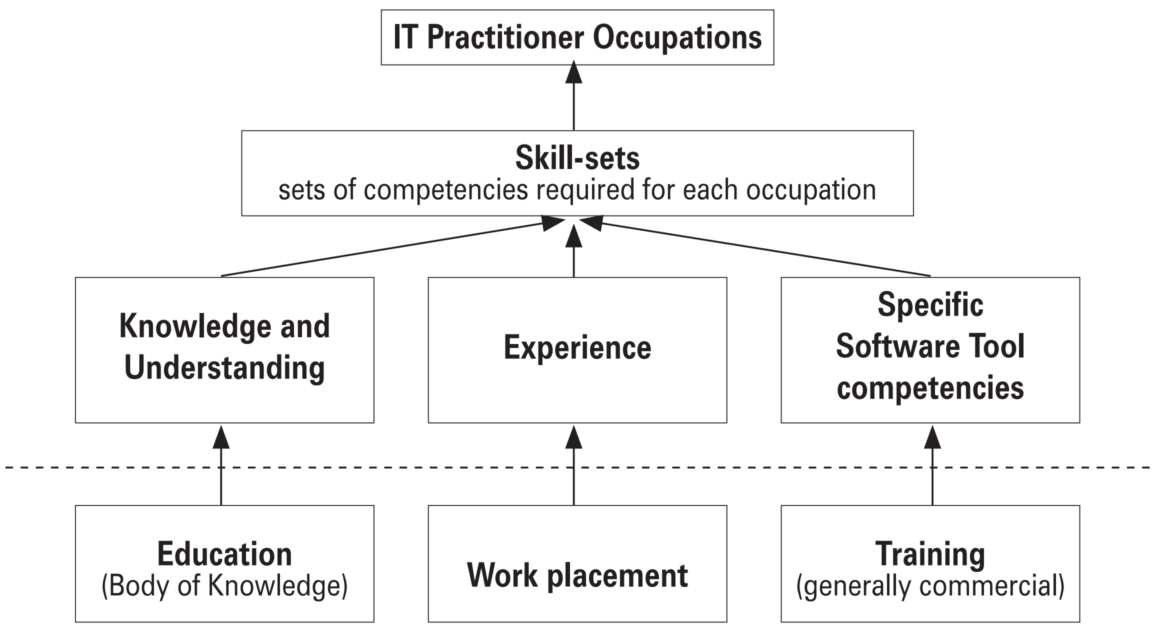
Education: The instilling of the underlying principles that are taught (generally to young people) in broad preparation for life, including working life. Publicly-funded education in most EU Member States consists of three broad levels: 1) Primary, 2) Secondary, and 3) Tertiary (generally in universities). Generally, education provides the underpinning knowledge and understanding required for achieving workplace competencies.

Training: Focused learning directly related to capabilities required in specific jobs. Much (although not all) of training for IT Practitioners is in the use of specific software tools: it is largely commercially delivered, and often *certified* by the supplier of this software.

Continuing Professional Development (often referred to generally as *Lifelong Learning*):
The often-regular learning required to maintain employability and effective performance as occupational requirements change over a career.

Schematically:

Figure 1: Relationships between Occupations, Skills and components of Skill Development



In its quantitative work, this study focuses particularly on the size, profiles and trends of *numbers in IT Practitioner occupations*, as a starting point for estimating the scale of future supply needs.

As will be seen, overall the study aims to improve understanding of a relatively complex world through clarification, in particular, of one or two key distinctions:

- the fundamental difference between the ***occupational*** and ***sectoral*** (or "industry") views of employment, and
- the distinction between the "***headline total***" of all those who work in some way as IT Practitioners (as opposed to End-Users of the technology) and the smaller "***technical core of IT Practitioner occupations***" whose need for "advanced" technical skills produce the most serious skill shortages, and which should be the main focus of major policy responses.

Information Technology Practitioner Skills in Europe

Section 2

Economic Context

2. Economic Context

2.1 Scale and Importance

While the significant loss of confidence – and resultant downturn - in the Information and Communications Technology (ICT) sectors have, during 2001, resulted in substantial levels of personnel lay-offs by high-tech companies, this does not reduce the fundamental importance of these sectors of the economy to future development, and the continuing need for large numbers of people with relevant skills in the coming years. It is hardly surprising that the growing recognition of the realities of the new-technology market-place (that – as in all other markets – not every enterprise would succeed and make the initiators rich) produced a hesitation in the strong growth that arose as the Internet take-up really began at the end of the twentieth century.

The strategic importance of the new global information infrastructure remains, and further technological developments will continue to enable speed, functionality and operational business effectiveness – and so further value – to be added. But the marketplace has behaved – as all marketplaces – as a laboratory and learning environment, where clever, innovative, business ideas and models will be tested and will succeed or not.

Unfortunately, the "shake-out" of early e-business models coincided, in early 2001, with a serious downturn in the United States economy, and this trend was compounded by reactions to the events of 11 September in New York and Washington. All of this has produced a significant and discouraging loss of business confidence, and a sombre economic context and prospect for Information and Communications Technologies at this time (early 2002). The impact of a steady stream of layoffs from companies in the ICT sectors does, however, have the effect of reducing (if not eliminating) the serious shortages of ICT skills that have faced employers over recent years within EU Member States and beyond. That reality will allow policy-makers and others interested in this area a modest respite - an opportunity to reflect seriously on labour market behaviour, and to consider more thoroughly how future shortages might be reduced, not least by steps taken in advance of the next phase of growth.

It is important that the lack of labour market pressure does not allow the issue to disappear altogether at the bottom of the political agendas of national Education, Skills and Industry ministries, for two reasons: a) because of the strategic importance of the area, and b) because action in advance of the next strong growth phase could help reduce the severity of the likely skill shortages when the pick-up starts.

Indications of the importance of ICT to national economies within Europe can be shown from both the economic activity (production volumes) and employment within ICT. OECD and Eurostat estimates for these are shown in Tables 1a and 1b.

Table 1a: ICT Production & Employment in EU Member States
(Source OECD, 2000 - no figures for Luxembourg)

Country	ICT Production in 1997 (units: US$M)	Employment* in the ICT Sector in 1997 (see clarification on occupations and sectors in Annex A)	Share of ICT employment in total business Sector
Austria (A)	29,052	165,000	4.9%
Belgium (B)	34,863	130,000	4.3%
Denmark (DK)	20,867	96,000	5.1%
Finland (FIN)	19,156	88,000	5.6%
France (F)	100,075	681,000	4.0%
Germany (D)	96,626**	974,000	3.1%
Greece (EL)	3,865***	N/A	N/A
Ireland (IRL)	16,059	56,000	4.6%
Italy (I)	136,431	671,000	3.5%
Netherlands (NL)	29,657	199,000	3.8%
Portugal (P)	16,925	94,000	2.7%
Spain (E)	27,792**	N/A	N/A
Sweden (S)	37,541	174,000	6.3%
United Kingdom (UK)	230,224	1,112,000	4.8%
European Union	over 800,000	4,441,000	3.6%

* OECD Figures for employment included as a general indication: see clarifications in Annex A.
** does not include Production of "Other ICT Services"
*** does not include ICT Manufacturing or "Other ICT Services"

The European Statistical Office (Eurostat) gathered a series of key statistics for the "Information Society" in September 2001 (Deiss, 2001), which confirmed that there were over 4 million persons employed in the ICT sector in the EU. Key figures over the late 1990s are shown in Table 1b.

Table 1b: ICT Enterprise & Employment numbers in EU Member States

	Number of Enterprises					**Employment** (thousands)			
	95	**96**	**97**	**98**		**95**	**96**	**97**	**98**
B					B	93.4	95.8	95.9	101.9
DK	2,863			2,463	DK	56.0			62.1
D		40,324	43,555	47,998	D	444.0	408.3	400.8	392.0
EL					EL				
E				20,250	E				257.0
F		42,925	44,812	47,390	F		697.3	546.6	580.7
IRL	1,115	1,454	1,654		IRL		52.5	62.7	
I	63,540	65,703	69,830		I	514.7	522.9	514.6	
L	591	645	729	838	L				
NL	14,110	11,950	13,875	15,580	NL		172.0	182.1	200.1
A	4,641	6,344	6,275	7,771	A	126.1		136.7	101.7
P		3,925	3,682	3,746	P		64.5	67.1	71.1
FIN	4,334	4,677	4,831	5,489	FIN	71.4	73.2	79.8	89.4
S		16,732	20,214	22,403	S			150.2	170.1
UK		75,063	100,241	120,506	UK			1,111.6	
EU-15		319,000	343,000	389,000	EU-15			4,170.0	4,300.0
US			172,809		US			4,521.1	
JP			44,422		JP			2,060.0	

(Source: The European Statistical Office (Eurostat)/Structural Business Statistics)

Both sets of figures clearly confirm the scale and importance of ICT activity within Europe. However, the numbers are for employment in all occupations within the sector, and there are many IT Practitioners who work in (IT departments in) organizations in many other ("User") sectors. As is explained in section 4 and Annex A, this report examines only ITP ***occupations***, so that ***the numbers above are not directly relevant*** for a study of IT Practitioner skills.

2.2 Market Performance

Labour markets operate in principle in the same way as free markets generally: i.e. they are broadly self-regulating through the use of the price mechanism. When the availability of labour rises while demand remains steady, the price of that labour (normally expressed in terms of wages, salaries or – for self-employed contractors – day rates) falls*. Likewise when demand for particular skills rises and other things remain the same, the price of that labour rises. In principle, as the price rises, the supply of labour will increase, since it becomes increasingly attractive to gain work in an area of rising labour prices (workers can earn more than in their present job by moving to such work). Thus shortage of skills should, in principle, be resolved by price increases that result in strong incentives for supply increase in response, in particular by employers' training or recruiting more. However, as with all markets, there are ***imperfections*** in the behaviour of the IT skills labour market. In particular, an individual can only become "available" to bid for work in a particular area if s/he has an adequate level of relevant skills (or competencies). Acquisition of the relevant skills requires time, and the delay involved can be significant in relation to the ("time-constant" of the) market's own dynamics.

The big debate around IT Practitioner skills is to do with precisely what education, training, qualifications, competencies, and thus "skills", Practitioners actually need to perform cost-effectively in each occupational role. Unlike most "professions", the majority of graduates working in the field, at least within the UK, do not hold degrees in Computer Science (or other IT-related field). Furthermore, there are many without degrees who make important contributions to the Industry, in areas where a degree would often have been expected. This situation arises very largely from the fact that economic activity in the industry has shown very strong sustained growth ever since the early days, and the demand for labour has outpaced – sometimes by a long way – the delivery capabilities (volumes) of public sector education institutions that have developed in response to the growth. In this situation, while the "supply channels" from education still have a most important role to play, the "supply model" into these occupations is not a simple "linear" one (with a straightforward career path from IT specialisation within education, an IT degree and a career as an IT professional).

Thus the market realities continue to involve very significant *inflows* into IT practitioner occupations both with those from non-IT degrees and from more mature people in other occupations. A typical progression is via the "expert user" phase, where the individual becomes steadily "more competent" in the use of IT and understanding of systems and development approaches, and through a combination of experience and specific training, becomes sufficiently attractive within a generally tight labour market supply situation to make the crucial step to a job where the work involves being part of the IT team that supports the organisation's users.

Given this reality of the dynamics of IT Practitioner markets, it is important for public policy development to take the unusual structure of this labour market into account in developing policy responses.

One of the areas of growing importance in skills policy in many countries is the strengthening of opportunities for ***Lifelong Learning***. Growth of public investment in such provision is generally triggered by a combination of:

- industrial structural change (with demand for employment in certain sectors falling, and major re-training programmes therefore needed for skills for which demand is growing),

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* in the labour market as a whole – i.e. for recruitment, rather than individual salary levels

- the introduction of new technologies and tools in the workplace, and
- the growing competitive pressure on businesses of most kinds arising from the slow but steady movement towards the globalisation of markets.

Increasingly such pressures produce a shift of employment realities that result in the need for people to recognize that they cannot rely on earning their living in a particular occupation throughout their life, and must increasingly take responsibility for acquiring updated, and often quite different, skills as their career progresses. Governments have increasingly urged and supported individuals taking responsibility for their continued employability via an accepted commitment to Lifelong Learning.

2.3 National Characteristics

The general characteristics of labour markets in different countries form a key factor in understanding the economic context within which national governments can respond to skill shortages, whether in IT or other areas. Across the EU there is certain variation of the economic and social environment within which labour markets operate, and these can have an impact on business responsiveness and ultimately national competitiveness. Each national employment environment will inevitably influence both the particular elements of labour market imperfection and the kinds of policy measures than can – and/or would – be tried in tackling skill shortages. With the relentless trend towards globalisation of markets generally (and ICT markets in particular), pressures on the survival of certain traditional national differences are likely to grow.

Among the differences within EU Member States in this area are:

- Employment legislation provisions of various kinds (e.g. on employment contractual arrangements, minimum employee rights, etc.);
- The national labour market dynamic characteristics – e.g. how long – if left to itself – each national ITP Labour Market would take to "clear"*;
- Prevailing labour reimbursement rates (salaries) and differentials;
- Existence or otherwise of a *training levy* (where employers are required to train, or – if they don't – to pay a small percentage of their payroll cost into a common training fund from which their employees may benefit);
- Various aspects of the "supply infrastructure" – e.g. secondary education structure, arrangements for vocational education and training, apprenticeships, etc; and
- Actual experience with recent and current public policy measures (e.g. publicly-funded training schemes for the unemployed).

* i.e. for supply and demand to come into equilibrium

2.4 Employers' and Individuals' Roles

It is perfectly possible to view skill shortages as something that a free/flexible labour market will resolve itself. With salary levels of IT practitioners often some 50% higher than the national average wage or higher, there is - in principle - considerable incentive for individuals to try to acquire the necessary skills to enter this labour market and thereby increase their income significantly. Clearly there are various potential barriers to this taking place:

- Inadequate funds for the individual to cover the cost of the relevant training (effectively a "capital failure");
- Inadequate time for him/her to devote to such training given current work (and other) commitments;
- Lack of sufficient underlying understanding (education) on which to base such "further learning".

In principle, the greater earning power available when such skills have been acquired could cover (retroactively) the "capital" cost of the training. For example, if an IT training course costing 5,000 would enable an individual to get a job at a salary level, say, 2,000 per annum higher than their current one, then – if the new job were found straight after the course was completed – the cost of the training investment could in principle be comfortably paid off after three years, and thereafter the individual would have lifted his/her future income level and possibly achieved more future employment security in a growing sector.

However, there is never an absolute guarantee that the individual would get the new, highly-paid, job automatically; and, even if this did happen, the individual might not be able to afford to finance the course in cash-flow terms. The "Career Development Loan" initiative by the United Kingdom government (which provides guaranteed loans for this purpose at comparatively low interest rates and with "repayment holidays") has helped tackle this "capital failure" problem, and over 100,000 people have benefited from its provision to "give their careers a lift" since its introduction in 1988, in many cases in acquiring new IT skills.

From the employer's point of view, there is always a risk of loss of the "return" on investment made in the training of an employee, since the "newly-trained" employee – with extra value in the marketplace arising from the newly-acquired skills – may decide to leave to go to a higher paid job. This produces what economists refer to as the "poaching externality", the fear of which can cause employers to hold back from providing such training. In philosophical terms, there are two ways of viewing this:

- The first is that such "poaching" is fundamentally wrong, and that government should try to stop it. Clearly if the result is a (probably significant) under-investment in employee training, there is a case for exploring policy initiatives that might reduce it*.
- That "all's fair in love and business" – i.e. that competition between enterprises is not just for sales or market share, but also for the best "talent". In order to attract the most valuable workers, an employer has to make itself as attractive as possible to new recruits, by offering an attractive overall "package", including generous amounts of training for its employees…

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* The "Transferable Training Loan" policy initiative currently being piloted in the United Kingdom is one such approach. This attempts, through a government-mediated (but not subsidized) agreement, involving all the major employers in a sector, to "pick-up" (the residue of) any loan made by the employer from whom a worker is recruited for training enjoyed by that worker.

While the "all's fair.." approach has attractions (including the possibility that successful enterprises that invest in their people will, over time, "drive up" employment standards and training levels), there are clearly various constraints under which employers operate, including, in many cases, limits to agreed staffing budgets. Perhaps the greatest thrust of public policy in recent years has been the encouragement of individuals to recognize their responsibility for "ownership of their career". This has led to an accompanying strengthening of commitment to the provision of lifelong learning provision of various kinds, as well as strengthened career guidance arrangements and mechanisms to support more effective career-management by individuals.

Increasingly, the emphasis of government (in particular in the UK) is to encourage the effective working of the labour market, and to limit its role to ***tackling problems arising from cases of real "market failure"***. This increases the importance of a sounder, deeper understanding of the market operations. Booth and Snower (1996) describe the underlying economic mechanisms.

Section 3

Policy Context

3. Policy Context

3.1 Academic and Vocational Education and Training Infrastructures

Education arrangements in EU Member States have long been recognised as forming fundamental elements of the national culture and identity, and for this reason have been relatively immune to pressures towards standardisation at the European level. They are an area where "subsidiarity" should apply, reflecting the richness of the European cultural heritage.

There are considerable differences between education systems within Member States, both within ***academic*** and ***vocational*** "streams". These differences do not disappear at the secondary and tertiary levels, and during the early employment years. The approach to the "formation" of professionals – especially in respect of the amount of practical experience required before the professional qualification is achieved - shows these differences up, in particular between the "Anglo Saxon" (British and Irish) and continental models for the "initial formation" of professional engineers. In terms of vocational education and training, there has been extended comparative review of arrangements in (in particular) the UK and Germany documented by Wagner and Mason et al.*. The studies suggest that both the highly developed and highly-regarded German apprenticeship "dual-system", and the more market-oriented approach in the UK (drawing in recent years on clarifying the explicit specification of detailed occupational competence), have both strengths and weaknesses.

These different traditions also have an impact on the approach to (and perceptions of) *occupational frameworks* within new and emerging career fields, and, as will be seen in Section 4 and Annex A, such frameworks are fundamental to a meaningful understanding of IT practitioner (and other) labour markets.

3.2 Approaches to Labour Market Policies

There are various ways public policy might influence skills supply and labour market operation more generally, and these include:

- Employment legislation (which might influence employer behaviour in relation to recruitment, remuneration, etc.);
- Public sector education provision – primary, secondary, and tertiary (of both academic and vocational kinds);
- Provision of subsidies (up to 100%) for vocational training (for the unemployed and sometimes also for those in employment);
- Provision of tax incentives to employers in relation to investment in employee training;
- Introduction of training levies; and
- Exploration of "market-catalytic" measures (e.g. the UK *Career-Development Loan*).

In addition, the significant growth of jobs in these occupations are natural "targets" for governments looking to help find work for those not in employment. Perhaps the most basic issue around public

* see e.g. Mason & Wagner (1994) and Steedman, Mason and Wagner (1991)

investment in the supply side of skills lies around a government's attitude to the boundaries between *education* and *training*. While there are in different Member States subtle differences in the concepts involved (see Glossary), in the United Kingdom these two notions are generally assumed to be fundamentally different and their contribution to workplace skills must be separately recognised, the assumption often made that ***education*** should be paid for by tax-payers and ***training*** (only) by employers is not always a helpful one.

3.3 Policy responses to Skill Shortages

As indicated above, in times of strong economic growth, in particular when this involves fast growth in areas of new technology deployment where technical skills of considerable depth are required, employers often suffer from *hard-to-fill-vacancies* when they try to recruit. Where this problem is particularly acute, and growth is threatened, employers look – often via their national trade bodies – to government to help by improving the relevance of educational provision and other possible policy responses.

The amount of effort applied to policy development and measures in this area needs to be "proportionate" to the evidence of (negative) impact of such shortages. Among the consequences of serious skill shortages generally assumed are constraints on:

- business growth,
- ability to bid for new contracts,
- quality of delivery.

As indicated, employers will always benefit from "ample supply" - the availability of large numbers of candidates for recruitment with the right skill sets. It is therefore not always easy for governments (in the face of strident calls for action) to clarify how serious shortages really are, and so how urgent is the need for a policy response of some kind. At the European level, some broad-brush indications of "economic impact" were presented in 2000 by Datamonitor, but evidence in support of estimates is not easy to find. Recent research in the United Kingdom on the "Extent, Consequences and Impact of Skills Deficiencies" (e.g. econometric analysis of a major Employer Skills Survey - DfES, 2001) has provided more evidence in support of the proposition and clarification of the degree of the problem.

In many cases, policy responses have assumed the "linear" supply flow into IT occupations referred to above*. The urgency of the demand in this labour market, especially in times of growth, means that generally the supply from this source is not adequate, and indeed sometimes dramatically below what is needed. Nevertheless, this "supply channel" remains an important one, and one where apparently public policy has the greatest opportunity of influencing a response to skill shortages.

One response is to try to tackle the serious under-representation within the IT Practitioner workforce of women. As will be seen in Section 4, there are generally 3-5 times as many men as women in IT Practitioner occupations in EU Member States. If this work were to become significantly more attractive to women, then the increased in-flows could make a real difference. Unfortunately, while general promotional activity may help, improvements on this front are not likely to make significant impact in the short term.

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* that is to say that the (only/main) source of supply is from education, and particularly technical (vocational) tertiary education, in particular university courses in IT-related disciplines

Probably the greatest challenge in this area arises from the widely-observed, growing, perceived unattractiveness to young people of both genders of work as an IT Practitioner, as evidenced in particular by the significant fall in applications from the most academically-able young people to study engineering and IT courses in higher education. A recent study by Bruniaux, Hansen, Steedman, Vignoles and Wagner (2000) reviews this situation in a number of countries, and confirms the problems with student applicants in terms of quantity and/or "quality".

Debate continues as to whether the technical aspects of IT Practitioner work require formal learning through public education channels (in particular in tertiary education in Information Technology related courses), or whether employers prefer (not least in the light of their higher average prior academic achievement!) to recruit "good" graduates from *non-technical* degree subjects, who are subsequently trained in some depth on the technical aspects of the work over their early months of employment.

However, whether the supply of new IT Practitioners is to come from university IT courses or from any other education source, where the supply of young people is considered, certain realities of the education -> working life transition need to be understood, and this transition has different characteristics in different Member States. The European Centre for the Development of Vocational Learning (CEDEFOP) has recently published the results of an extended study on this matter (CEDEFOP 2001), which, drawing on a common conceptual framework, covers the institutional characteristics of national education systems, the beginning of the transition process, labour market entrants, and the integration of young people into working life & community policies.

3.4 Experience with Relevant Initiatives

As will be seen, many national governments have introduced initiatives over recent years in response to perceived shortages of ICT skills. A preliminary "inventory" of these is provided in an interim review by the World Information Technology and Services Alliance (WITSA), based on returns from its members in 16 countries (+EU as a whole), which is available on their website (www.witsa.org). These public policy interventions have undoubtedly had an impact, but this has often turned out relatively small in relation to the effects of market behaviour. Two rather significant national programmes have been the "SwIT" initiative in Sweden and the "Bug-buster" training project within the UK, both of which have achieved a level of useful IT training for tens of thousands of people within relatively short timeframes (see Annex F).

3.5 Roles of National and European Policy-Makers

The European Commission reviews Europe's strategic position in relation to the rest of the world, and initiates programmes to support the development of world class capabilities in the economic and other domains, in particular to strengthen Europe's competitiveness in relation to growing globalisation. The budget for this is relatively modest, and thus it is important for the Commission to identify, with Member States' help, areas where national development work can contribute to achieving these world-class standards, through upgrading the national supply of skills.

However, there are a number of important roles that European policy-makers can contribute in the overall response to skill shortages. These include:

- Coordinating the clarification of skills issues;
- Seeking, identifying and disseminating examples of successful policy responses;
- Exploring "critical mass" issues (e.g. enabling and supporting developments towards ensuring European enterprises of world class scale);
- Supporting (both politically and occasionally with funding) work in Member States that helps tackle shortages; and
- Exploring the impact of increased labour market mobility between Member States, and tackling barriers where these exist;
- Supporting the development of EU-wide standards (e.g. ECDL, EUCIP).

It is interesting that the strong growth in mobility of skilled workers in recent years has led to both serious scrutiny of the issue of the mobility of IT Practitioners within the OECD (see, for example, *OECD Employment Outlook, 2001*), and the establishment in the summer of 2001 by the Commission of a "High Level Task Force" to explore the issues of skills and mobility together (The Task Force reported in December 2001 - see section 4.9).

Both *Career-Space* (a consortium of major European ICT industry leaders), and the *European Information and Communications Technology Industry Association* (EICTA) – the grouping of national ICT trade bodies - have made recommendations to the European Commission on the skills issue (see their respective websites: www.career-space.com, www.eicta.org), and the Commission has reflected the challenge, *inter alia* through its "e-Learning Summit declaration" in June 2001.

Section 4

The IT Practitioner Labour Market in Europe

4. The IT Practitioner Labour Market in Europe

This section:

- introduces the definitions and data sources for Information Technology Practitioner ("ITP") employment used in the study,
- gives an overview of the development of the ITP workforce in Member States over recent years,
- examines in more detail the position in Germany, Ireland, Sweden and the UK, (the details are not all directly comparable between countries – more details on a comparable basis are available in Annexes B, C, D and E, concluding with preliminary scenarios for the development of the ITP workforce in the coming years based on official (Eurostat) figures),
- illustrates certain *differences* between this workforce in the four countries apparent from the LFS data,
- indicates the relative scale and importance of the ITP workforce in the Member States, and
- introduces the growing role of migration of IT Practitioners between Member States.

4.1 IT Practitioners: Definitions and Data Sources

Scope

This study assumes a clear distinction between ***IT Practitioners*** and ***IT "End-Users"***. Its scope is limited to the former, and it makes no attempt to address the position of computer user skills. While it is recognised (and crucially important to the supply of practitioners) that many *end-users* become increasingly capable in understanding IT tools and techniques and make a career-choice to become a practitioner, until they switch to a role where they are working for others they are not practitioners.

The study also addresses the labour market for ***Information Technology*** (IT) practitioners rather than the ***Information and Communications Technology*** (ICT) occupations, and does **not** include in its detailed quantitative analysis the hardware skills needs (e.g.) by electronic engineers. This area could be included in a fuller analysis.

The definition assumed for IT practitioner for this study is:

> An IT practitioner is viewed as ***someone who designs, develops, operates, maintains, supports, services, and/or improves IT systems, in support of End-Users of such systems****.

IT Practitioners consist of ***IT (Informatics) Professionals*** plus ***non-professional IT occupations***.

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* Managers of IT systems, services and/or companies are not included in the "core" technical occupations covered

The ISCO classification used for Eurostat Labour Force Survey (LFS) data includes two categories:

- ***Computing Professionals*** (corresponding to IT (Informatics) Professionals, and
- ***Computer Associate Professionals*** (corresponding to non-professional IT occupations)

The work of ***IT Practitioners*** covers a range of IT functions. These can broadly be considered and understood in relation to an Information System "life cycle". The broad categories of:

- Strategy & planning
- Management & administration
- Development
- Implementation, and
- Service delivery

that form the core of the UK's *Skills Framework for the Information Age* (SFIA – see Annex A), are reflected in most if not all classification systems.

IT Practitioners work within both ***IT (supplier) companies*** and the many ***(IT) "User" organisations*** in other sectors. Table 2 shows the estimates of numbers of people employed as "Computing Professionals" (those in employment in occupations categorised by Eurostat as ISCO 213 – see below) or "Computer Associate Professionals" (occupations characterised as ISCO 312) within the two kinds of employer for the European Union as a whole (in 2000), based on the Eurostat holdings of figures from Member States' national "Labour Force Surveys" (LFS - see below).

Table 2: Split of IT Practitioners between Supply and User organizations
(Figures for all EU Member States, as of early 2000, estimates rounded)

Sectors / *Occupations*	(employed by all) IT (Supply) Companies: (NACE 72)	(employed by all) IT User Organisations	Total employed by all employers
IT Practitioner Occupations ("Computing Professionals" and "Computer Associate Professionals")	1,021,000	1,422,000	2,443,000
(All) Other Occupations	936,000	155,022,000	155,958,000
Total of all Occupations	1,957,000	156,444,000	158,401,000

While the two occupational groupings tracked by the Eurostat data are recognised to be only a subset of the total of all workers involved in Information Technology systems (they do not include IT Managers, Computer Operators or Engineering support staff – or indeed those involved in selling or marketing IT products and services, who not need the advanced technical – software - skills – see Annex A), the table illustrates the fundamental difference between a ***Sectoral*** perspective on skills and an ***Occupational*** one. Labour markets, skill considerations and educational & training provision all operate at the *occupational* perspective ("horizontal" slices through the "matrix" as shown), and thus this Study will primarily focus on this view of the world.

A fuller description of the Sector <-> Occupational relationship, and of occupational frameworks for the study is given in Annex A, and study of this is recommended if the reader is not clear about this fundamental distinction from the above introduction.

Data Sources:

The two main data sources used for this study are:

- The most recent national studies covering IT Practitioner skills in the four countries examined in more detail (these are listed in Section 4 and Annex F), and
- Holdings of EU Member State *Labour Force Survey* statistics held at the European Statistical Office ("Eurostat") in Luxembourg. These datasets are submitted to Eurostat either quarterly or annually, and trends in the data are examined by reference to datasets submitted since 1995. The "inventory" of the quarters for which this data was provided to Eurostat is shown in Annex A.

Official classifications for sectoral and occupational data

Official statistics within EU Member States use different classification frameworks for data on sectors and occupations, but these are mapped on to two accepted frameworks for data held at the European level: these are:

- **NACE** (*Nomenclature generale des Activites economiques dans la Communaute Europeenne*) for specification of *sectoral* scope and coverage (this is essentially identical with the *International Standard Industrial Classification* (ISIC) e.g. 30.02 and 72, and
- **ISCO** (the International Occupational Classification System) for specifying *occupational* scope and coverage. The two codes relevant to IT Practitioners are ISCO 213 ("Computing Professionals") and ISCO 312* ("Computer Associate Professionals").

The basic structure of these classification systems is shown in Annex A.

Specifically, the essence of the defined occupations of the two key ISCO categories is that:

Computing Professionals (ISCO 213) "conduct research, plan, develop and improve computer based information systems, software and related concepts, develop principles and operational methods as well as to maintain .. systems .. ensuring integrity and security of data".

Computer Associate Professionals (ISCO 312) "provide assistance to users …., control and operate computers and peripheral equipment and carry out limited programming tasks connected with the installation and maintenance of computer hardware and software".

* For reasons explained in Annex A (Footnote A-4), IT Practitioner occupations in the United Kingdom and Ireland are coded (allocated) to ISCO 213 – there is therefore no data for ISCO 312 from either Member State.

4.2 Recent development of the IT Practitioner workforce in Member States

All EU Member States have considerable IT activity, and most governments see ICT as an area of strategic growth. Figures 2 and 3 show the development of this activity over recent years as measured by growth of employment of *Computing Professionals* (ISCO 213) and *Computer Associate Professionals* (ISCO 312) as reported by Member State statistical offices to Eurostat.

As is explained in Annex A, these figures do not include all workers that are sometimes viewed as being IT Practitioners. In particular, they do not include:

- IT Managers
- Computer Operators
- Computer Engineers
- Computer Sales Staff
- Teachers/Lecturers in IT working within education
- Some IT staff within the defence industry

Nor, as already indicated, do they include:

- Telecomms practitioners
- Electronics Engineers

They are, thus, predominantly *software engineers* and *technicians*, *systems analysts* and *software development specialists*. These occupations represent the “core” of IT technical staff, and as such their populations represent more meaningfully than the large “headline” totals sometimes used, the community that needs to be the focus of technical skill requirements analyses.

The most recent (rounded) totals for Member States are as follows:

Member State	**ISCO 213 Total "Computing Professionals"** (date)	**ISCO 312 Total "Computer Associate Professionals"** (date)	ISCO 213+312 (total IT occupations**)
Austria	13,900 (2000 Qtr. 2)	45,100 (2000 Qtr. 2)	59,000
Belgium	67,700 (2000 Qtr. 4)	5,900 (2000 Qtr. 3)	73,600
Denmark	47,900 (2000 Qtr. 4)	15,900 (2000 Qtr. 4)	63,800
Finland	44,800 (2000 Qtr. 4)	12,200 (2000 Qtr. 4)	57,000
France	245,200 (2000 Qtr. 1)	129,100 (2000 Qtr. 1)	374,300
Germany	295,500 (2000 Qtr. 2)	256,600 (2000 Qtr. 2)	552,100
Greece	7,200 (2000 Qtr. 3)	7,400 (2000 Qtr. 3)	14,600
Ireland	20,800 (2000 Qtr. 2)	-*	20,800
Italy	13,200 (2000 Qtr. 4)	188,300 (2000 Qtr. 4)	201,500
Luxembourg	1,700 (2000 Qtr. 2)	1,000 (2000 Qtr. 2)	2,700
Netherlands	125,600 (2000 Qtr. 2)	123,300 (2000 Qtr. 2)	248,900
Portugal	6,000 (2000 Qtr. 3)	29,600 (2000 Qtr. 3)	35,600
Spain	82,500 (2000 Qtr. 4)	68,100 (2000 Qtr. 4)	150,600
Sweden	92,900 (2000 Qtr. 2)	42,300 (2000 Qtr. 2)	135,200
United Kingdom	540,800 (2000 Qtr. 4)	-*	540,800

(Source: Eurostat holdings of Member State *Labour Force Survey* data)

* No returns from the United Kingdom or Ireland for ISCO 312 (see Annex A)
** most meaningful for overall cross-comparisons between Member States

Figure 2
National Employment of *Computing Professionals*

(Source: Eurostat Holdings of Member State LFS Data : Check for Statistical Reliability!)

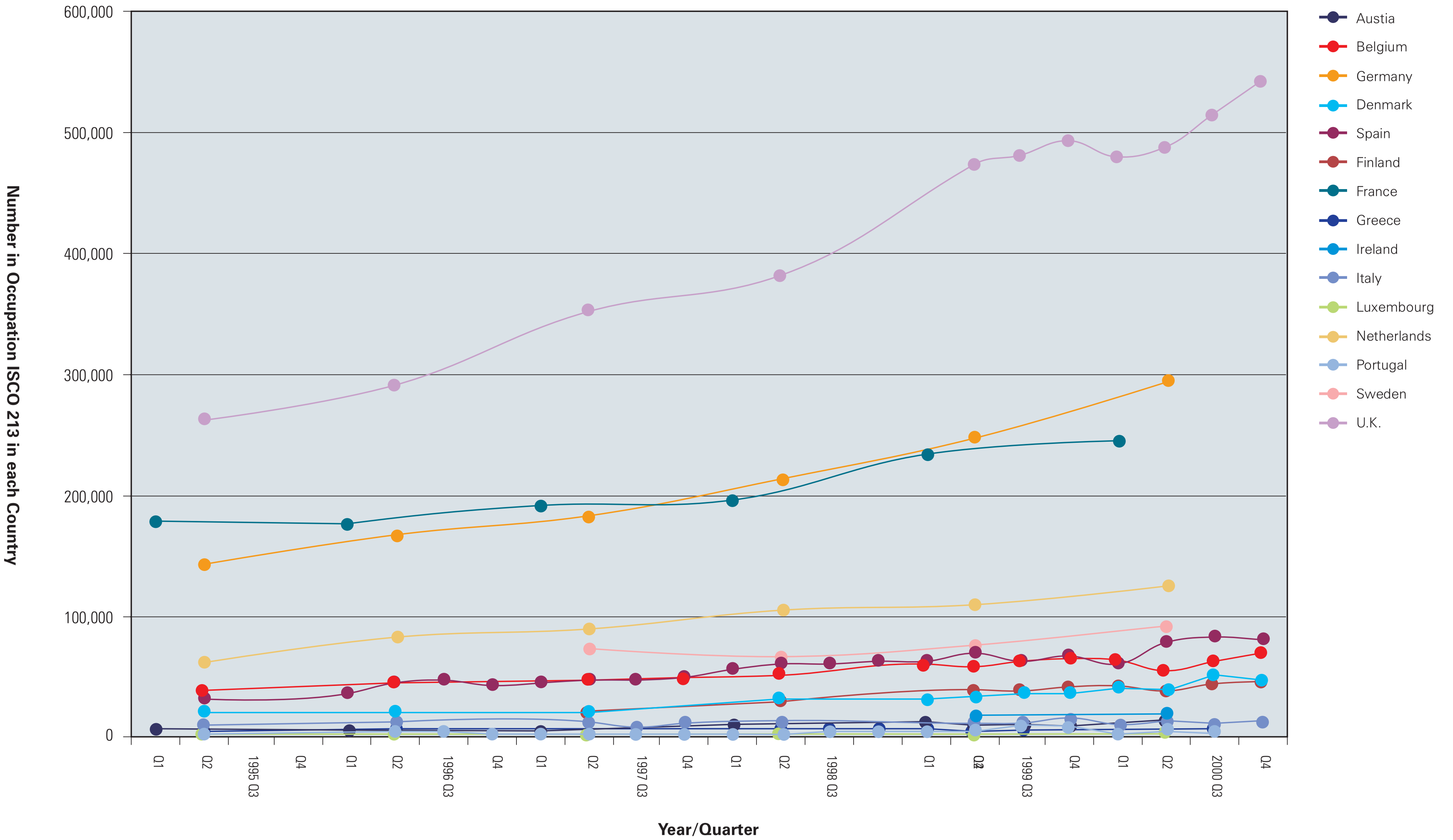
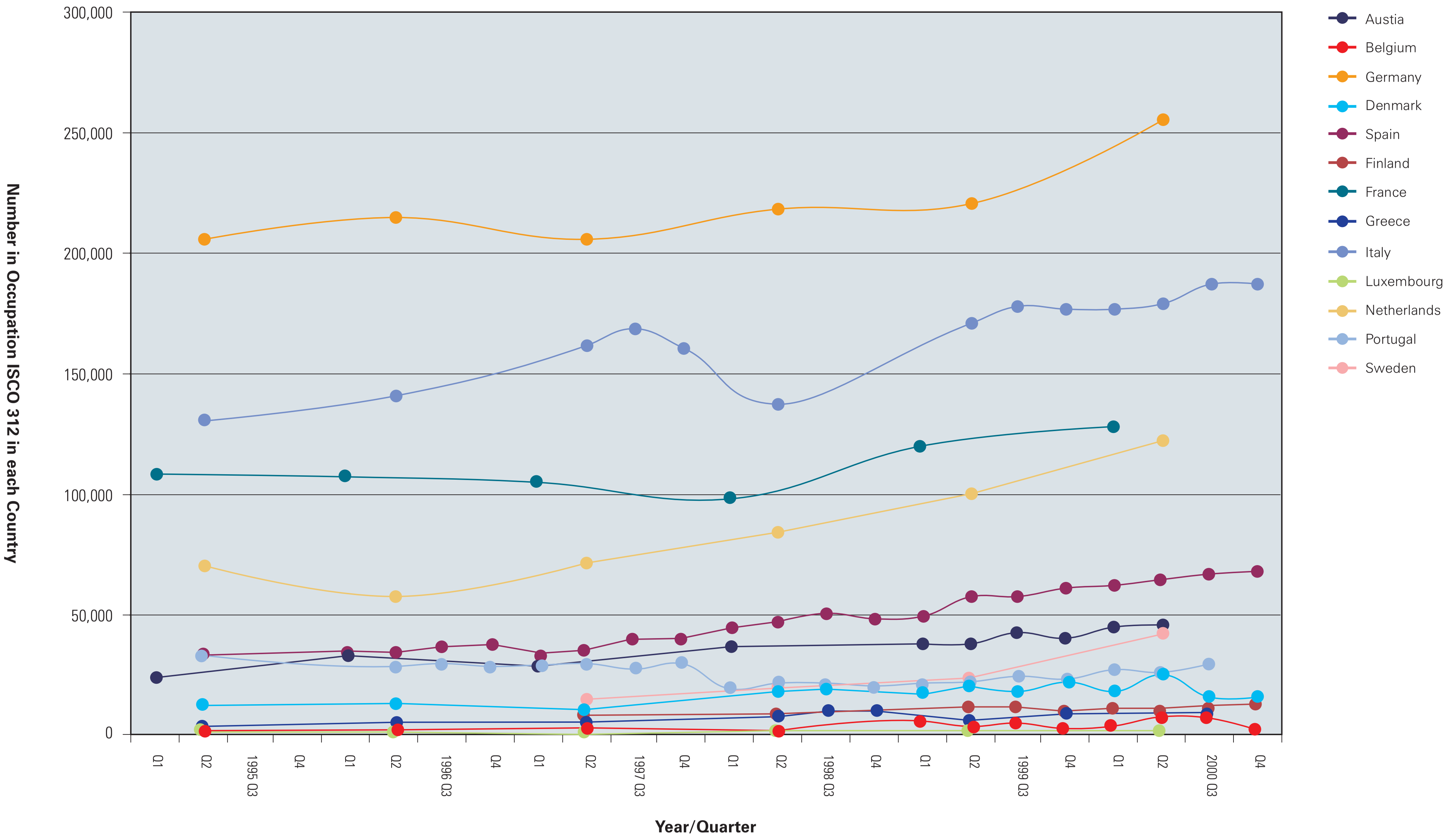


Figure 3

National Employment of *Computer Associate Professionals*

(Source: Eurostat Holdings of Member State LFS Data: Check for Statistical reliability)



4.3 IT Practitioners in Germany

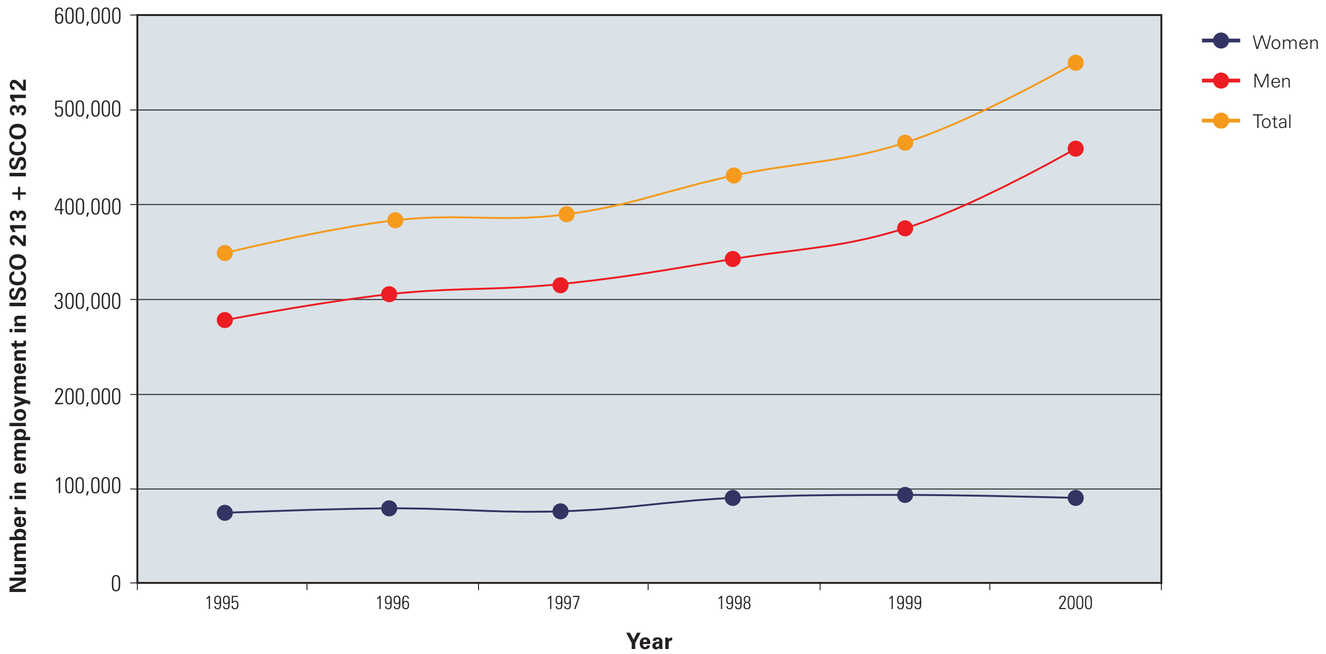
The most significant recent national analysis of the ICT skills position in Germany is provided in *"Monitoring Informationswirtschaft"* (Monitoring the Information Economy) published in 2001 by the Institute for Information Economics (IIE) together with the market research company *Infratest Burke* for the German Federal Ministry for Economics and Technology. The "Core report" (*Band 1: 2. Kernbericht*) is a broad, comprehensive analysis of the current international technology/market position, covering - from a German perspective - the overall market for the Information Economy (IE), Infrastructure basics, and Applications. The analysis of the "ICT and Information Economy Labour Market" covers

- Employee numbers in ICT,
- Salaries in the IT field,
- "Green Card" arrangements,
- Education and Training, and
- Call Centre requirements.

The study reports a number of figures, based on a survey of experts in the field, associated with estimated numbers of workers and shortages.

Figure 4 shows the development over the second half of the 1990s of the estimated IT Practitioner workforce in Germany, based on official German Labour Force Survey (LFS) data (for the two IT Practitioner occupations - i.e. total of figures for ISCO's 213 and 312).

Figure 4
Total IT Practitioners in Germany
from national LFS Statistics



The numbers employed in the "ICT Sector", based on information from the Federal Statistical Office and the *German Association for Information Technology, Telecommunications and New Media* "BITKOM" (as reported in their "Core Report") are:

1998: 734,000
1999: 761,000
2000: 794,000

The Eurostat Labour Force Survey (LFS) data from Germany for (Quarter 2 of) these years is as follows:

1998

	IT Industry	Total – all industries
Computing Professionals (ISCO 213)	67,216	215,182
Computer Associate Professionals (312)	67,454	219,062
Total IT Practitioners	134,670	434,244
Total all occupations	261,480	35,537,000

1999

	IT Industry	Total – all industries
Computing Professionals (ISCO 213)	86,499	247,702
Computer Associate Professionals (312)	76,071	220,947
Total IT Practitioners	162,570	468,649
Total all occupations	302,271	36,089,000

2000

	IT Industry	Total – all industries
Computing Professionals (ISCO 213)	111,195	295,529
Computer Associate Professionals (312)	97,945	256,558
Total IT Practitioners	209,140	552,087
Total all occupations	388,566	36,324,000

Thus the Eurostat (official LFS data from the Federal Statistical Office, Germany) figures for employment within the IT industry (NACE 72) are some 36-49% of those quoted in the IIE Infratest Burke report. The difference is attributable to the employment within the non-computing occupations and "other sectors" encompassed within ICT, and in particular within manufacturing and telecommunications, Internet, multimedia sectors, etc, as well as the fact that the report figures are likely to have been as of the end of the year in question rather than in the Spring. It is likely that the growth in the share of the total figure represented by the IT services sector (NACE 72) over the three years arises partly from acquisitions and re-classifications (manufacturing and telecommunications companies "becoming" IT services companies).

In terms of flows of Tertiary education provision, Siemens reports* that there were some 5,000 Computer Science graduates in 2000, with forecasts for the flow in 2004 and 2006 currently estimated at 10,000 and 18,000. As elsewhere, not all of these will necessarily go into IT Practitioner work.

* (Menzel, private communication)

The *"Monitoring Informationswirtschaft" Kernbericht* quotes a number of estimates emerging from other studies about the labour market position in Germany. These include:

- Breakdown of employment within ICT (in 2000);
  - Manufacturing of Communications equipment: 12%
  - Manufacturing of office machinery and Data Processing equipment: 14%
  - Communications Services: 32%
  - Software and IT services: 42%

- Fraction of ICT and Telecomms jobs not filled in early 2001: 13%;
- Number of (young?) people emerging from the "Dual" (apprenticeship) system into IT occupations in 2000: 7,000;
- Percentage of employment in Computing occupations represented by immigrant workers from other EU Member States: 1.8%;
- Percentage of employment in Computing occupations represented by immigrant workers from outside the EU: 2.2%;
- 79% of immigrants entering ICT practitioner work between 1998 and 1999 had tertiary education, as against only 37% of "domestic" entrants;
- Remuneration of senior IT staff in 2000 was estimated as follows:
  - IT Director: 210,000DM
  - IT Manager: 174,000DM
  - Applications Development Manager: 152,000DM
  - Network Manager: 148,000DM
  - IT Operations Manager: 147,000DM
  - Information Systems Manager: 143,000DM
  - Database Manager: 142,000DM
  - Office Communications Manager: 138,000DM
  - Data Preparations Manager: 135,000DM
- Within Europe, salary levels for IT management were felt to be highest in Germany and Switzerland;
- Monthly Issue of "Green Cards" (predominantly to incoming ICT workers) was running, in the Autumn of 2000, at 1,364 (August), 776 (September), 702 (October), and 600 (November);
- The number of Informatics students more than doubled in the Winter semester of 2000, from 10,000 to some 24,000;
- Over 50% of all IT management positions are held by those with secondary education, whereas this is not true for those in technical positions.

The overall structure of educational qualifications held by IT Professionals in 2000 was as follows:

Qualifications	Management	Technical Specialists
University Higher Degree	3%	2%
University Degree	26%	15%
Technical University (business)	16%	13%
Technical University (technical)	12%	8%
Secondary Education ("Abitur")	14%	23%
Vocational Secondary Education*	19%	26%
Basic Education ("Hauptschule")	6%	10%
Other education	3%	4%

* ("Realschule")

From the data gathered for this study, based on official German LFS statistics, as compared with the situation in some other EU Member States, the *Computing Professional* (ISCO 213) community in Germany appears, over the second half of the 1990s, to have the following characteristics (see Section 4.6 and Annex B for detailed charts):

- a relatively low fraction of women in this employment (Figures 9 and B-1);
- a comparatively low fraction of younger workers (Figures 10 and B-2);
- a rather low percentage of Self-employed professionals (Figures 11 and B-5);
- a comparatively low share of employment within the IS Industry (i.e. IT supply companies) (Figures 12 and B-4); and
- an apparently low percentage of *Computing Professionals* in training (Figures 16 and B- 8).

Overall, in terms of the fraction of the national employed population working in one of the two ISCO IT Practitioner occupations (ISCO 213 and ISCO 312), the position in Germany appears to be a little below the European Union average for *Computing Professionals*, and a little above average for *Computer Associate Professionals*. However, both – and in particular the *Computing Professional* community – have grown steadily over recent years.

Detailed analyses of the German *Computing Professional* workforce are provided in Annex B, together with employment level scenarios relating to the four growth rates developed in Section 5.

4.4 IT Practitioners in Ireland

The Irish economy saw remarkable growth over the late 1990s, and part of this undoubtedly arose from the notable success of high-tech industries. This emerged in part from the establishment in Ireland of European bases of a number of growing IT companies from North America (in particular the United States). This was quickly augmented by the flowering of an "indigenous" industry within the new Technologies, including what is viewed as the e-Business ("Born-on-the-web" e-commerce- and Internet Data Centre- enterprises) and Digital Media (incorporating Commercial/ Corporate Digital Media-, Education and Training media- and Entertainment Digital media- companies) sectors.

The very strong growth in demand for IT (and other) skills arising from this economic growth caused the Irish government to set up in 1998 an "Expert Group on Future Skills Needs", which presented three reports, the third of which, in 2001, drawing on the earlier primary research, and on expert opinion elicited through a series of workshops, included a significant review of the position and set of policy recommendations, based in particular on the findings of three commissioned reports ("Third Report of Expert Group..", March 2001), that focused on:

a) the skill needs of the Software Industry, demand for software skills across the economy and the emerging areas of e-Business, digital media and multi-media (from McIver Consulting)

b) the changing skills requirements and overall demand for skills in the hardware sector (from Eirlink), and

c) labour market projections and forecasts for the supply of "third-level" graduates in IT (from ESRI)

The main policy response focused on estimating the likely number of "third-level" skills provision up to the year 2005. The forecasts were driven by assumptions about the growth in total employment for the industry sectors involved – with each (supply) sub-sector considered in some detail as well as the expected demand within user industry ("wider economy") sectors. The initial estimates produced for the *First Report* led in 1999 to additional public investment in a) 5,400 IT-related third level places, b) 1,100 IT places on the "Accelerated Technician" programme, and 1,500 places on post-graduate IT-conversion courses.

The Expert Group continued to monitor the situation, and on the basis of a deeper analysis and in the light of developments, the *Third Report* proposed an adjustment in the provision as between IT Professionals and Technicians, with a small shift of funding resource from technicians to those with degrees.

The analysis on which the forecasts were prepared was based on secondary research, looking in particular employment trends in Ireland and other countries, and on a new survey of employment within web development companies. Early estimates were reviewed in workshops with the relevant industry bodies and agencies. The forecasts themselves assumed annual growth in the indigenous software industry of 25% between 2001 and 2005, and took a figure of an annual increase of employment in "overseas owned" software companies of 2,300 over the same period. Increases assumed for the other sectors considered (Digital Media and e-Business) were also relatively high, although from a significantly smaller base, and it was assumed that employment (in IT departments of) User Organisations (the "wider economy") would grow at some 1,600 per annum. It was felt that significant growth in this employment would occur "even in the event of a severe slowdown".

As a result of these assumptions, it was estimated that the average annual demand for "third level skills" would be as follows:

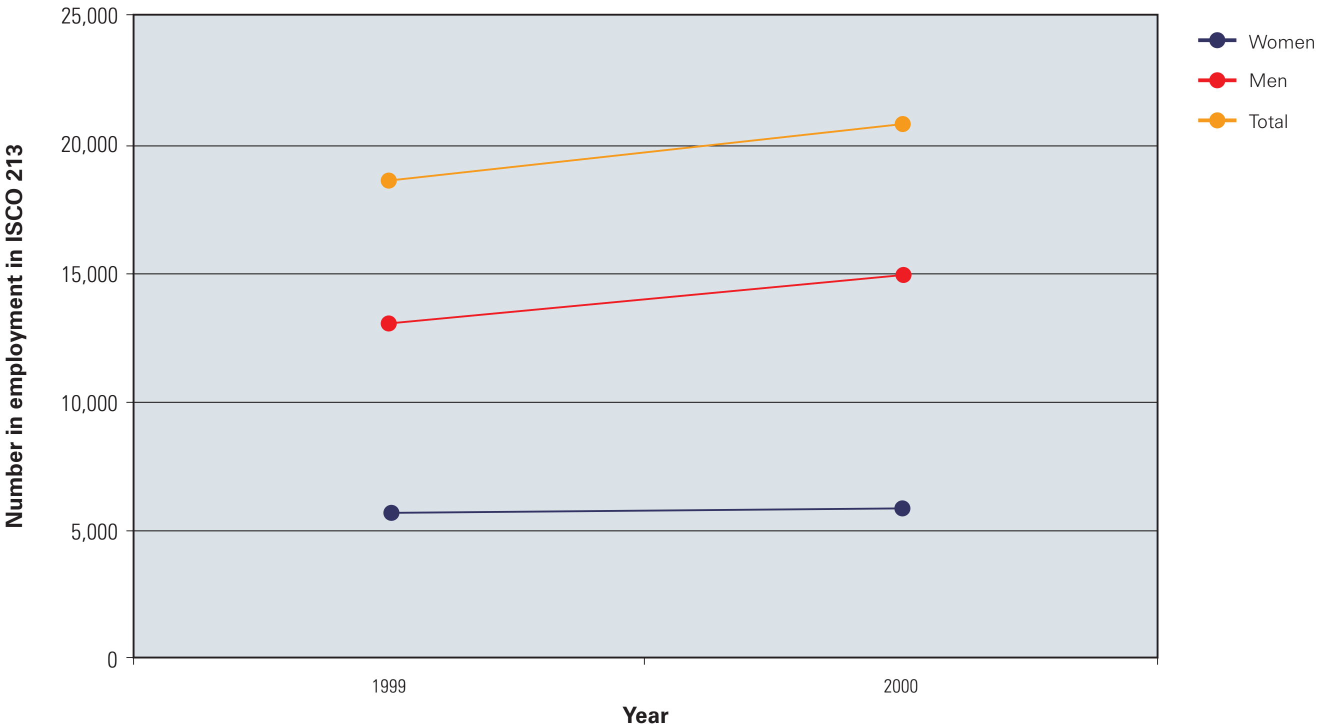
Types of skill	**Estimated Average Annual Demand** (rounded)
Professionals:	
Computing (for software)	4,380
Engineering (for hardware)	2,460
Total Professionals	6,840
Technicians:	
Computing (for software)	1,620
Engineering (for hardware)	840
Total Technicians	2,460
Grand Total	**9,300**

Forecast estimates for supply from the education sector were significantly below this, resulting in the forecast of substantial shortages.

The policy response strategy allowed for a fair degree of responsiveness to labour market conditions, which in turn made it feasible to plan on the basis of a fairly optimistic view of the future, in the knowledge that a less positive outcome would have only limited negative implications.

Figure 5 shows the estimates of the IT Practitioner workforce in Ireland available from Eurostat based on official Irish LFS data (all ITPs allocated to ISCO 312 – see footnote on page 97).

Figure 5
Total IT Practitioners in Ireland
from national LFS Statistics



As part of its work, the *Expert Group* also carried out a study into *e-Business skills* which reported early in 2000. It identified four main e-Business occupational areas:

1. Managers and Management Advisers
2. Designers ("creatives", multimedia developers)
3. Technical (programmers, software engineers, systems specialists), and
4. "IT Literates" (the many occupations where basic IT skills are required).

In terms of demand for these skills, it identified the following:

- need for existing Managers and Management Advisers to understand the business implications of e-Business;
- major increase in demand for designers to work on web design, and for people with a strong mix of design and technical skills; and
- as available bandwidth increases, the requirement for people to produce "content" (including "live action" and animation) will increase.

The report includes a number of recommendations, in particular for educational provision around the area of including more IT content within Business courses.
From the data gathered for this study (while there was less historical data for Ireland than for most of the other countries), as compared with the situation in some other EU Member States, the *Computing Professional* (ISCO 213) community in Ireland appears to have the following characteristics (see Section 4.6 and Annex C for detailed charts):

- a relatively high fraction of women in this employment (Figures 9 and C-1);
- a comparatively high fraction of younger workers (Figures 10 and C-2);
- an apparently fast-changing percentage of Self-employed professionals (Figures 11 and C-4) (although this probably arises from the fact that the source figures here are below the threshold of statistical reliability); and
- a comparatively high share of employment within the IS Industry (i.e. IT supply companies) (Figures 12 and C-3).

Overall, in terms of the fraction of the national employed population working in the *Computing Professional* occupation (ISCO 213 - there are no returns to Eurostat from Ireland in the ISCO 312 category*), the position in Ireland appears to be around the European Union average.

Detailed analyses of the Irish *Computing Professional* workforce are provided in Annex C, together with employment level scenarios relating to the four growth rates developed in Section 5.

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* This is because it was not possible to split the core technical occupations in the UK (SOC90) classification into those with degrees and those without (see Annex A). The same situation applied in Ireland.

4.5 IT Practitioners in Sweden

The two main current sources for data on the IT Practitioner labour market within Sweden are the "Teldok Yearbook 2001: *Sweden in the Information Society*", and the *IT-Företagens program för kompetensfrågor för 2001* (The IT Enterprise Programme for Skills – 2001) report produced by the national IT Industry body.

The *IT-Företagens* report is broad in scope, analyzing the problem as a whole, and presents a wide ranging qualitative assessment of the IT skills position within Sweden from the perspective of the IT (Supply) industry, with broad conclusions and recommendations for government, education and employers. It covers most of the same areas of possible policy response as appear in such studies in other countries, pleading in particular for stronger collaboration between (Higher) Education and Industry.

The Teldok Yearbook does include some quantitative analysis including, from ITPS (the Industry ministry), a useful table of employment (in all occupations) between sectors and sub-sectors for Quarter 1 2001 showing the distribution between employers of different size (see Table 3).

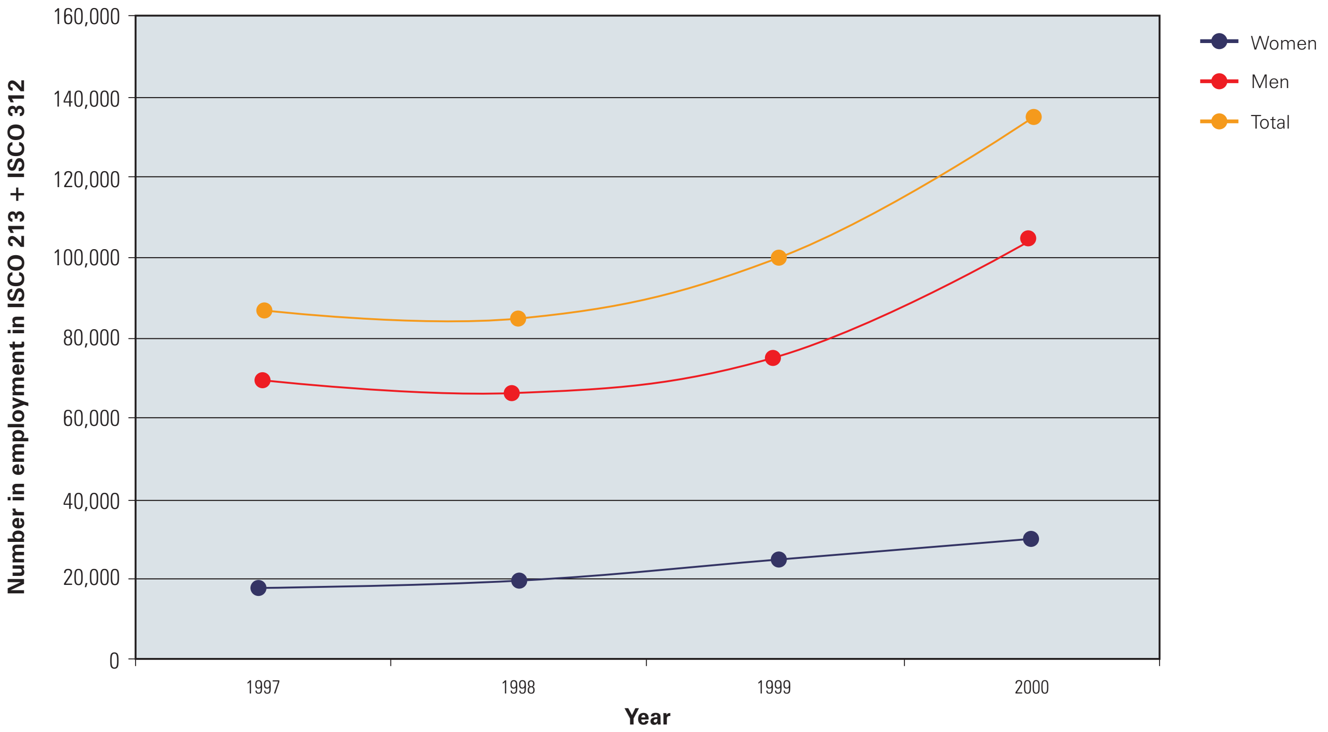
Table 3: Sub-sectoral structure of the Swedish ICT Industry: Numbers of enterprises and employees by NACE code

	NACE	Total	Total	enterprise size-bands (in no. employees)			
		No. of enter-prises	No. of emplo-yees	1->49	50->199	200->499	500+
					Number of Employees		
Total (Manufacturing)		3,849	60,849	6,372	7,145	9,170	38,162
Manufacture of office Machinery	30.01	2,054	1,500	156	521	322	501
Manufacture of computers and other Information Processing machinery	30.02	367	2,872	999	377	1,496	0
Manufacture of insulated wire and cable	31.3	78	4,180	589	849	1,648	1,094
Manufacture of electronic valves, tubes and other electr. components	32.1	362	5,343	1,242	980	770	2,351
Manufacture of TV and Radio Transmitters and apparatus for line telegraphy and telephony	32.2	134	28,443	720	660	1,447	25,616
Manufacture of TV and Radio Receivers and Sound and Video reprodustion appilancec	32.3	171	4,774	490	956	1,630	1,698
Manufacture of instruments of measuring	33.2	487	11,676	1,682	2,536	1,567	5,891
Manufacture of industrial process control equit	33.3	196	2,061	494	266	290	1,011
(Total: Services)		32,988	164,221	66,889	28,556	20,325	48,451
Wholesale of electrical household appliances and Radio & TV goods	51.43	1,571	10,534	4,383	1,722	1,395	3,034
Wholesale of Office Machinery and equipment	51.64	2,850	21,360	9,946	4,865	3,513	3,036
Wholesale of other machinery for use in industry, trade, …	51.65	5,827	27,427	18,595	5,355	2,164	1,313
Telecommunications	64.2	407	25,170	1,321	1,906	896	21,047
Renting of office machinery & equipment inc. Computers	71.33	207	298	208	90	0	0
Hardware Consultancy	72.1	1,033	3,089	1,120	64	0	1,905
S/W consulting and supply	72.2	19,446	63,973	28,134	12,594	10,567	12,678
Data processing	72.3	697	8,128	1,457	1,341	825	4,505
Data activities	72,4	186	1,509	449	500	560	0
Maintenance & repair of office accounting and computing machinery	72.5	364	1,978	583	57	405	933
Other computer-related activities	72.6	400	755	693	62	0	0
		22,333	79,432				
Total of IT in Manufacturing and Services		36,837	225,070	73,261	35,701	29,495	86,613
All industries		814,733	3,589,364	1,019,991	405,435	279,616	1,884,322

The figure for total employment within the IT services sector (NACE 72) is 79,400, which compares reasonably with the 92,100 given from Eurostat (official Swedish LFS) sources for the same NACE sector.

In terms of the *IT Practitioner* workforce across *all* sectors, the official Swedish LFS figures held by Eurostat for the relevant ***occupations*** show a strong growth at the end of the 1990s.

Figure 6
Total IT Practitioners in Sweden
from national LFS Statistics



The latest Teldok Yearbook (2001) also provides estimates (from Statistics Sweden and NUTEK*) for the numbers of employees in the largest IT and electronics companies in Sweden for 1996 and 1997. The figures for the IT companies are:

Employer	No. employees in 1996	No. employees in 1997
LM Ericsson	28,500	35,500
Telia	26,500	26,000
Samhall	3,200	3,000
ABB Norden holding	3,100	3,750
Enator	3,000	2,750
WM-data	2,800	3,250
IBM Nordic	2,600	2,500
Cap Gemini	2,100	2,250
Celsius	2,000	2,000
SEMA/Investor	1,800	2,000

N.B. This is total employment – of ***all*** occupations! (only a fraction of these would be *IT Practitioners*)

* The Swedish National Board for Industrial and Technical Development

From the data gathered for this study, as compared with the situation in some other EU Member States, the *Computing Professional* (ISCO 213) community in Sweden appears, over the last few years, to have had the following characteristics (see Section 4.6 and Annex D for detailed charts):

- a relatively encouraging (in comparison with other Member States!) fraction of women in this employment (Figures 9 and D-1);
- a modest fraction of younger workers (Figures 10 and D-2);
- a rather changeable percentage of Self-employed professionals (Figures 11 and D-5) (although this probably arises from the fact that the source figures here are below the threshold of statistical reliability);
- a comparatively high share of employment within the IS Industry (i.e. IT supply companies) (Figures 12 and D-4); and
- an apparently relatively high percentage of *Computing Professionals* in training (Figures 16 and D-7).

Overall, in terms of the fraction of the national employed population working in one of the two ISCO IT Practitioner occupations, the position in Sweden for *Computing Professionals*, is intriguing – both fast recent growth since 1998 and the highest %age workforce within the EU! As far as *Computer Associate Professionals* is concerned, although there was apparently a significant fall in 1998, the subsequent growth has been remarkable, and employment in this occupation, too, represents the highest fraction of the total national workforce of any Member State.

Detailed analyses of the Swedish *Computing Professional* workforce are provided in Annex D, together with employment level scenarios relating to the four growth rates developed in Section 5.

4.6 IT Practitioners in the United Kingdom

The position of IT Practitioner skills in the UK from 1995 was laid out rather fully in "*Skills99*". ***The workforce*** was characterized (as of 1999) as:

- Large: over 850,000, ***including*** Managers, Operators and Computer Engineers, but ***not including*** some of those working in Sales & Marketing, Education (e.g. university lecturers), or Defence;
- Split between the five categories within the "SOC90" occupational classification:
  - Computer Analysts/Programmers (some 34%),
  - Computer Systems Managers (some 20%),
  - Computer Operators (some 19% - share falling steadily),
  - Software Engineers (some 19% - share rising steadily), and
  - Computer Engineers (8%)
- The majority working in IT User organizations (70%), although the share of employment in IT supplier companies was growing fast;
- Largely male, and steadily becoming more so (75% in 1999, from 71% in 1995);
- Mostly employed by large organizations (75% are employed by organizations with more than 50 staff);
- Relatively young (2/3 aged between 25 and 44); and
- Mostly full time (92%), and mostly employed (93%, although the numbers of self-employed contractors grew steadily over the second half of the 1990s)

In terms of the ***demand*** for IT Practitioners, all "proxy" indicators examined confirmed at that time real shortages in the labour market, including:

- Staff turnover (typically 15-20%)
- Employers' survey assessments (mostly of *hard-to-fill vacancies*) with 15% to 35% of employers reporting heavy demand for specific skills, and high percentages in the public sector;
- Price inflation: both salaries and contractor dates rates both increasing well above rates of inflation and average earnings;
- Apparent Recruitment Demand, with IT job advertisement volumes running at record levels (up to 1999).

The available ***supply***, measured in terms of the qualification levels and flows from the different branches of the education systems, was well below those required to sustain the remarkable growth levels. In particular:

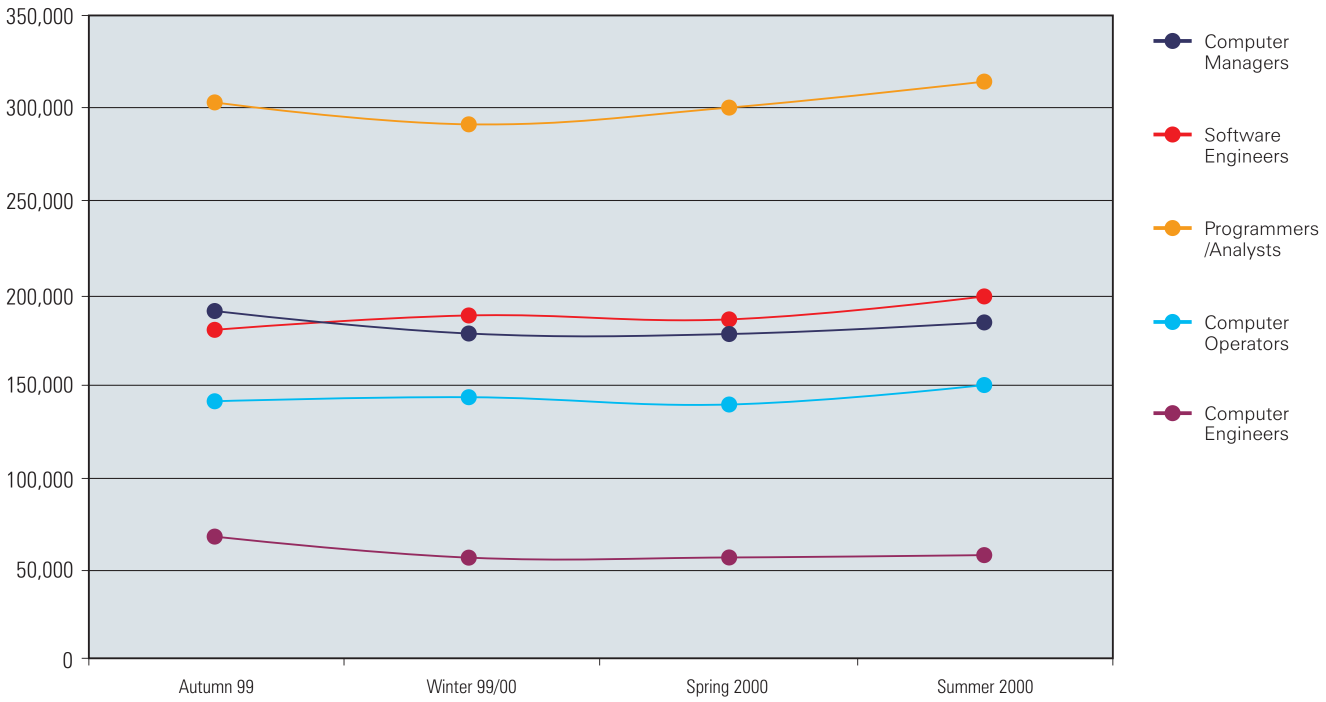
- 28% of current IT Practitioners had a first degree as their highest academic qualification (of whom 37% have a single, major, or balanced-subject IT degree)
- A third of graduates from IT-related courses worked as IT Practitioners, while 2/3 did not;
- Employers of IT Practitioners who recruit them from "fresh" graduates were increasingly inclined (and forced!) to recruit those who did not study IT (see Section 2.2);
- Although numbers on IT Degree courses continue to grow, the academic achievement levels of

applicants to such courses (as measured by “A” Level points) remained poor;

- While levels of formal professionals qualifications (in particular corporate members of the *British Computer Society* and the *Institution of Electrical Engineers*) remained largely static, the acquisition of proprietary (e.g. Microsoft, Cisco) qualifications was growing fast – generally exponentially!).

Since that report, the UK Labour Force Survey has confirmed that there was a definite fall in employment in IT Practitioner occupations following 1 January 2000, although employment levels recovered as the year 2000 wore on. Figure 7 shows how numbers in employment in the five SOC90 categories developed over the “Millennium change”.

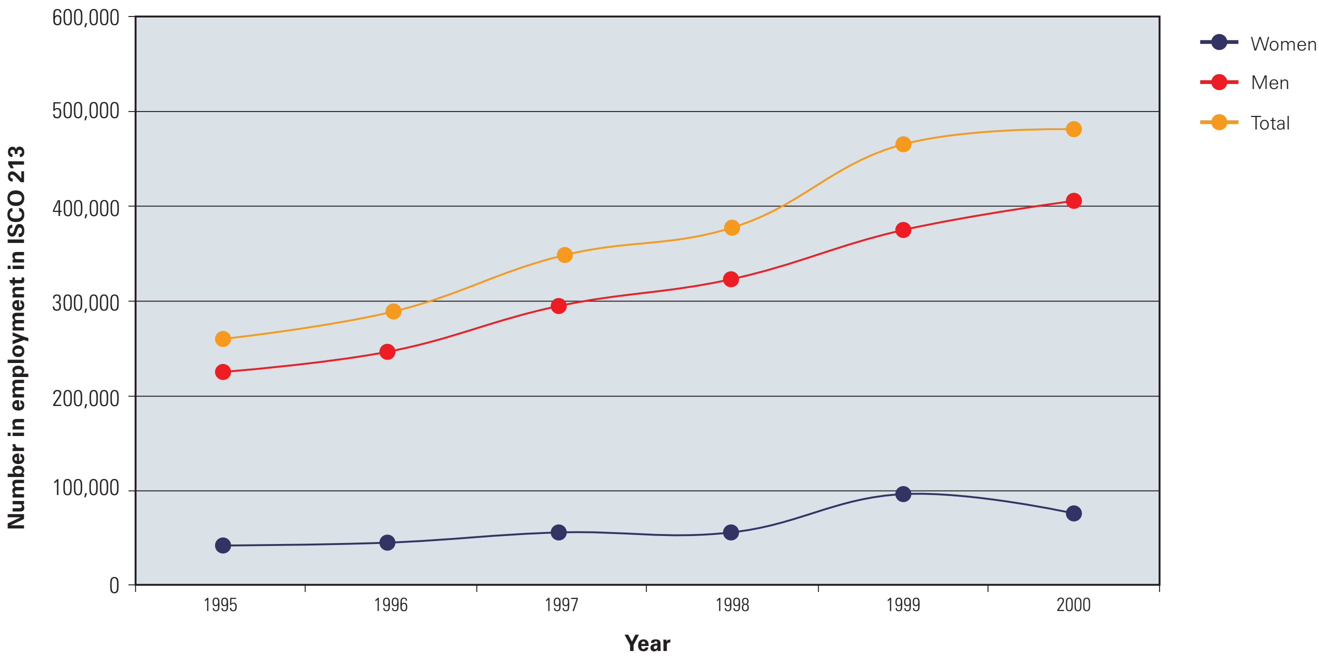
Figure 7
Development of IT Practitioner workforce in the UK between 1999 and 2000



The mapping of the SOC90 categories to the ISCO codes is straightforward: the ISCO 213 figures combine the “Software Engineers” and the “Computer Analysts and Programmers”, and so do not include Computer -Managers, -Operators and -Engineers.

This mapping produces the figures for the total number of (core, technical) IT Practitioners in the U.K. over the second half of the 1990s, as held by Eurostat from UK LFS data, shown in Figure 8.

Figure 8
Total IT Practitioners in the UK
from national LFS Statistics



The UK *e-skills NTO* managed a significant employer survey of the "ICT Professional" labour market carried out by NOP Research at the beginning of 2001, and its conclusions (based in particular on telephone interviews with nearly 4,000 employers of more than 5 employees) were reported in early 2002 as "e-skills 21: IT and Communications Professional in the UK". The most significant findings were:

- An estimate of more than 900,000 ICT professionals working within some 160,000 establishments in the UK (early 2001) (this figure includes both Telecomms. practitioners and – as indicated below – several occupations beyond the core technical ones);
- These broke down into six main categories considered (a new occupational classification, indicated to be drawn from the *Skills Framework for the Information Age* (SFIA)), with approximate numbers as follows:
  - "Internal Operations Professionals" (340,000)
  - "Development Professionals" (236,000)
  - "External Customer Services Professionals" (110,000)
  - "ICT Sales and Marketing Professionals" (100,000)
  - "Strategy and Planning Professionals" (68,000)
  - "Other Professionals" (54,000)
- Over ¾ of ICT Professionals were found to have 3 or more years experience in their current roles;
- Generic skills and experience appeared to be of significant importance to employers, particularly problem-solving-, oral communication-, general IT user- and team-working- skills;

- Around one in ten establishments thought that fewer than half the ICT professionals working for them were fully proficient in their current role, although few were able to specify exactly which skills were missing;
- A lack of experience of new technologies was given as the principal reason for shortfalls in proficiency, and was cited by 2/3 of establishments suffering "skills gaps";
- Over a quarter of establishments in the ICT supply sector had vacancies at the time of interview;
- Just over half of vacancies for ICT Professionals were believed to require 2 or more years' experience;
- Some 9,000 establishments (6% of all larger than 5 employees) reported hard-to-fill vacancies at the time of the survey, and nearly four out of five of these viewed this as arising from either low numbers of applicants with the required skills, lack of work experienced required or a lack of qualifications demanded by the employer;
- Just under half of all establishments employing ICT professionals had no formal training budget or plan;
- On-the-job training was the most commonly cited method of training provision, with just over one third of all establishments providing this;
- Of the 908,000 ICT professionals identified, it was estimated that some 480,000 (53%) had not taken any off-the-job training over the previous year, and 58% had none planned for the coming year;
- Just over a quarter of establishments reported they had increased the number of directly employed ICT Professionals during the 12 months prior to the survey;
- It was estimated that, for the UK as a whole over the following year, the following (additional) workers would be needed:
  - 85,000 "Development Professionals"
  - 55,000 "Internal Operations Professionals"
  - 32,000 "External Customer Services Professionals"
  - 19,000 "ICT Sales and Marketing Professionals"
  - 16,000 "Strategy and Planning Professionals";
- Local newspapers were reported as being the most commonly used medium for recruiting (used by 45% of establishments);
- Three quarters of establishments needing additional ICT Professionals over the following year would be looking for those trained/experienced in the skills required.

The findings of the NOP survey were also fed into a significant review of secondary research, carried out by the Institute of Employment Studies at the University of Sussex (also in the first half of 2001) that is written up as "An assessment of Skill Needs in Information and Communication Technology" (this is the report of the UK Government's "Skills Dialogue" work for these sectors). The five main conclusions to emerge from this work were:

- **Demand for professional ICT skills continues to expand** (for both fundamental operating systems and programming languages, as well as new Internet-related skills)
- **Supply is starting to respond**, as university output increases and other channels open up;
- **Skill deficits still persist**, through external recruitment shortages and internal skill gaps;
- **However the worst of the recent skill shortage crisis appears to have passed**, as demand slows down and supply catches up; and
- **Concern is switching from inadequacies in the quantity to the *quality* of skills supply.**

From the data gathered for this study, as compared with the situation in some other EU Member States, the *Computing Professional* (ISCO 213) community in the United Kingdom appears, over the second half of the 1990s, to have had the following characteristics (see Section 4.6 and Annex E for detailed charts):

- a comparatively low fraction of women in this employment (Figures 9 and E-1);
- above average in terms of the fraction of younger workers (Figures 10 and E-2);
- a relatively high percentage of Self-employed *Computing Professionals* (Figures 11 and E-5);
- below average in terms of share of employment within the IS Industry (i.e. IT supply companies) (Figures 12 and E-4); and
- a relatively high %age of *Computing Professionals* in training (Figures 16 and E-8).

Overall, in terms of the fraction of the national employed population working in the ISCO 213 occupation (there were no UK returns for ISCO 312), the position in the UK is understandably relatively strong in the *Computing Professional* community – significant growth over recent years, and positioned second overall behind Sweden.

Detailed analyses of the British *Computing Professional* workforce are provided in Annex E, together with employment level scenarios relating to the four growth rates developed in Section 5.

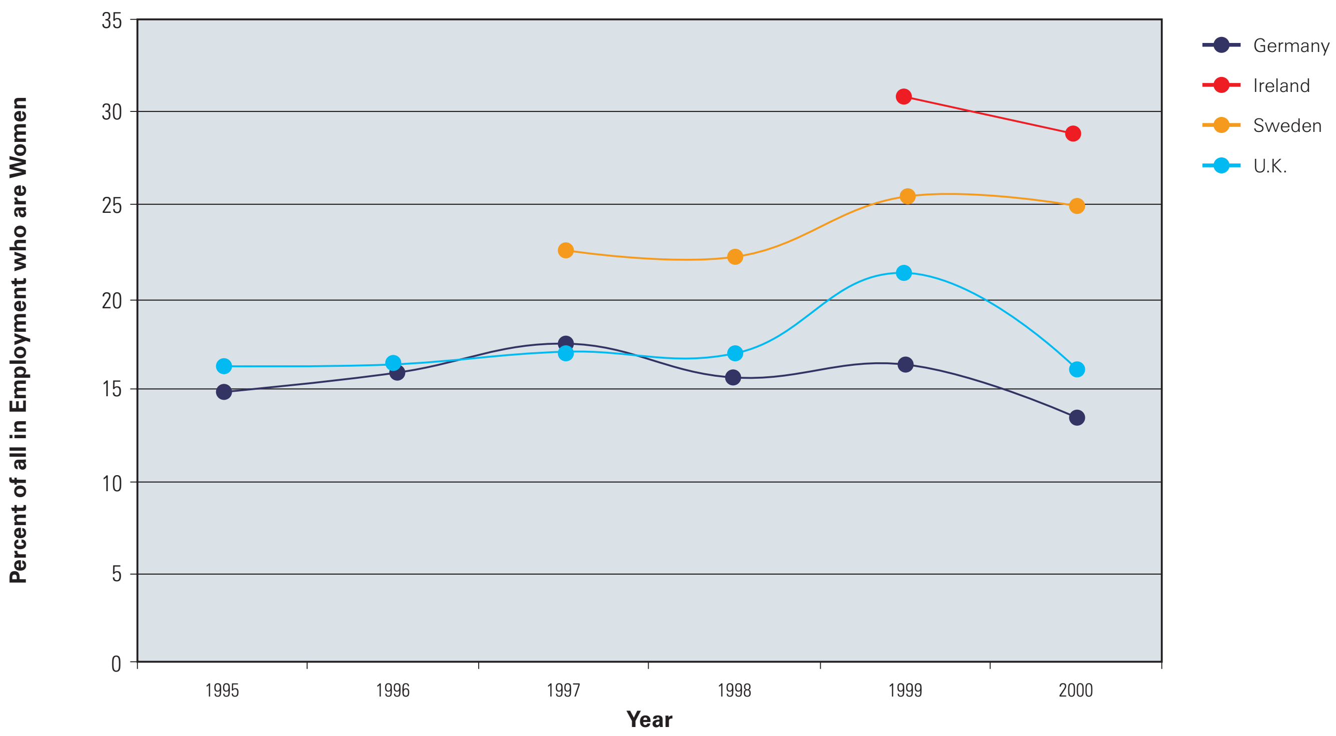
4.7 Some comparisons between the four Member States examined

As has been seen, the Eurostat holdings of Member State Labour Force Survey data provide a considerable amount of interesting data. However, not all of this is available for all variables and all Quarters over the five-year period under scrutiny (See Annex A – Table A-5 for details). This section examines those areas of IT Practitioner employment as tracked by the Labour Force Survey data where comparison is meaningfully possible. (N.B. These percentages are based in some cases on source figures of questionable statistical reliability. They should therefore be recognized to be tentative and in need of validation from other sources)

Gender split:

The first comparison of interest is that concerning the Male-Female split among Computing Professionals in the four countries. Figure 9 shows how this split has developed in recent years in the four countries examined, in terms of the percentage of all in employment who are female.

Figure 9
Female Employment as *Computing Professionals*
(Source: Eurostat Holdings of Member State LFS Quarter 2 Data)



As can be seen, Ireland boasts the highest fraction of female Computing Professionals, with nearly twice as high a proportion as is found in the UK and Germany. Sweden, where around ¼ of Computing Professionals are women, lies in between, but the trend in all four countries, following an apparent rise in 98/99, is negative in terms of women's participation.

Age Distribution:

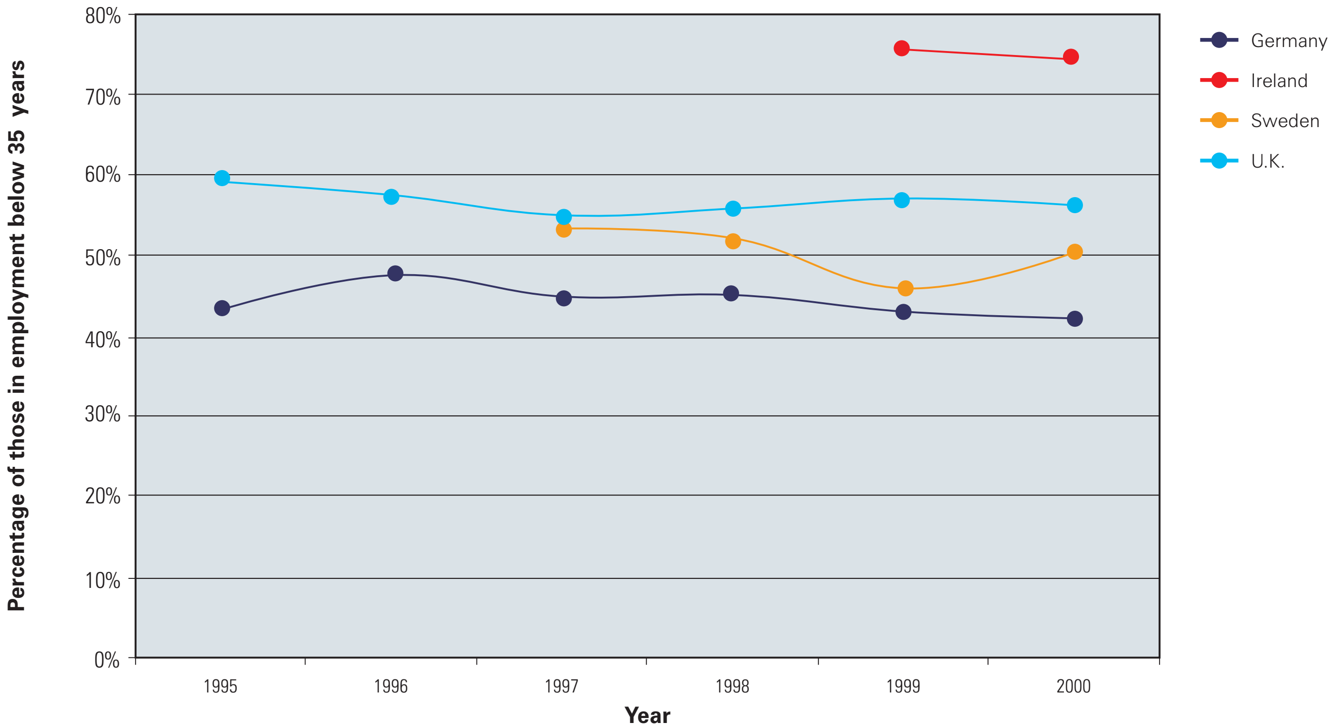
Numbers of Computing Professionals in all four countries tend to be higher in the younger age-bands. Figure 10 shows the percentage in this occupation below the age of 35.

Figure 10

Age Distribution of *Computing Professionals*

Share of *Computing Professional* employment by those younger than 35

(Source: Eurostat Holdings of Member State LFS Quarter 2 Data)

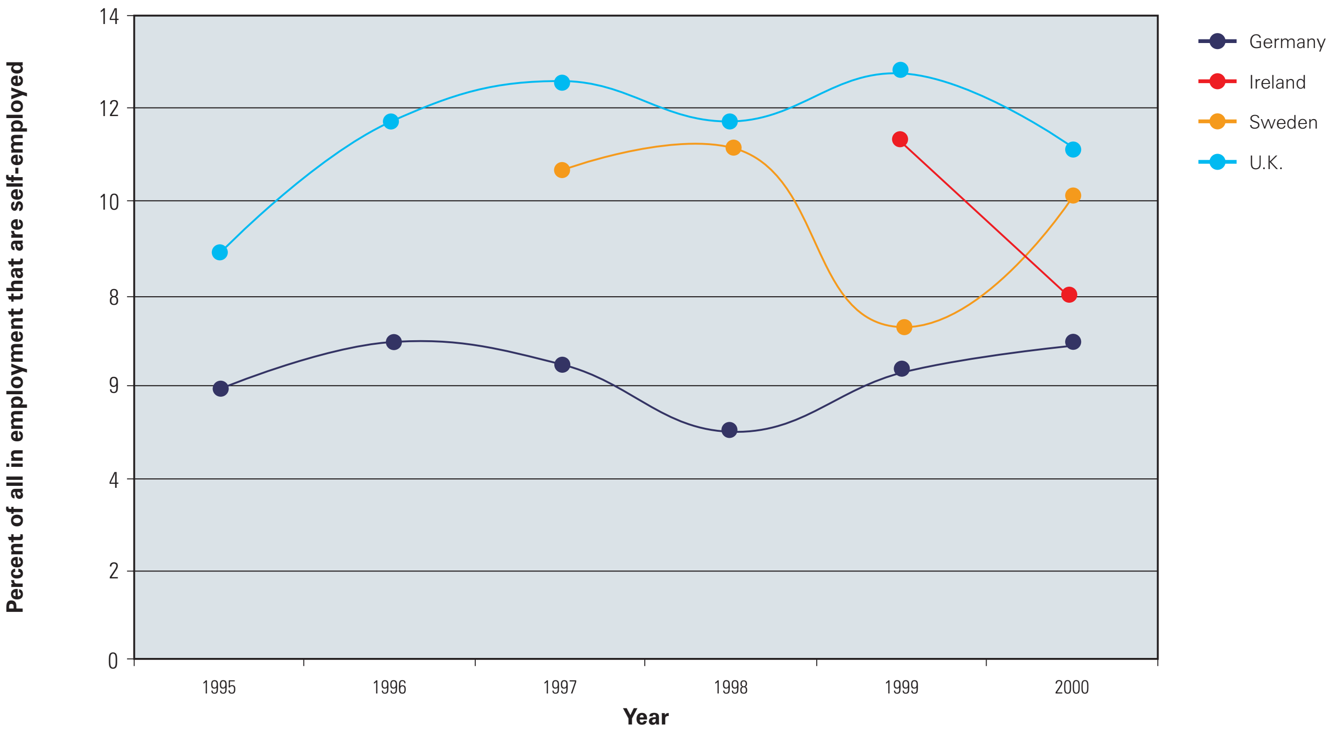


As can be seen, Ireland's *Computing Professionals* have the youngest profile of the four countries, with Germany's workforce the only one with those younger than 35 continuing to represent less than half of the total.

Employment Status:

Probably the most interesting characteristic of Employment *status* is the split between those employed and those self-employed. Figure 11 shows the fraction of *Computing Professionals* in employment represented by those self-employed (with or without employees).

Figure 11
Self-employment of *Computing Professionals*
(Source: Eurostat Holdings of Member State LFS Quarter 2 data)
(Source figures for Sweden and Ireland lie below the statistical reliability threshold)

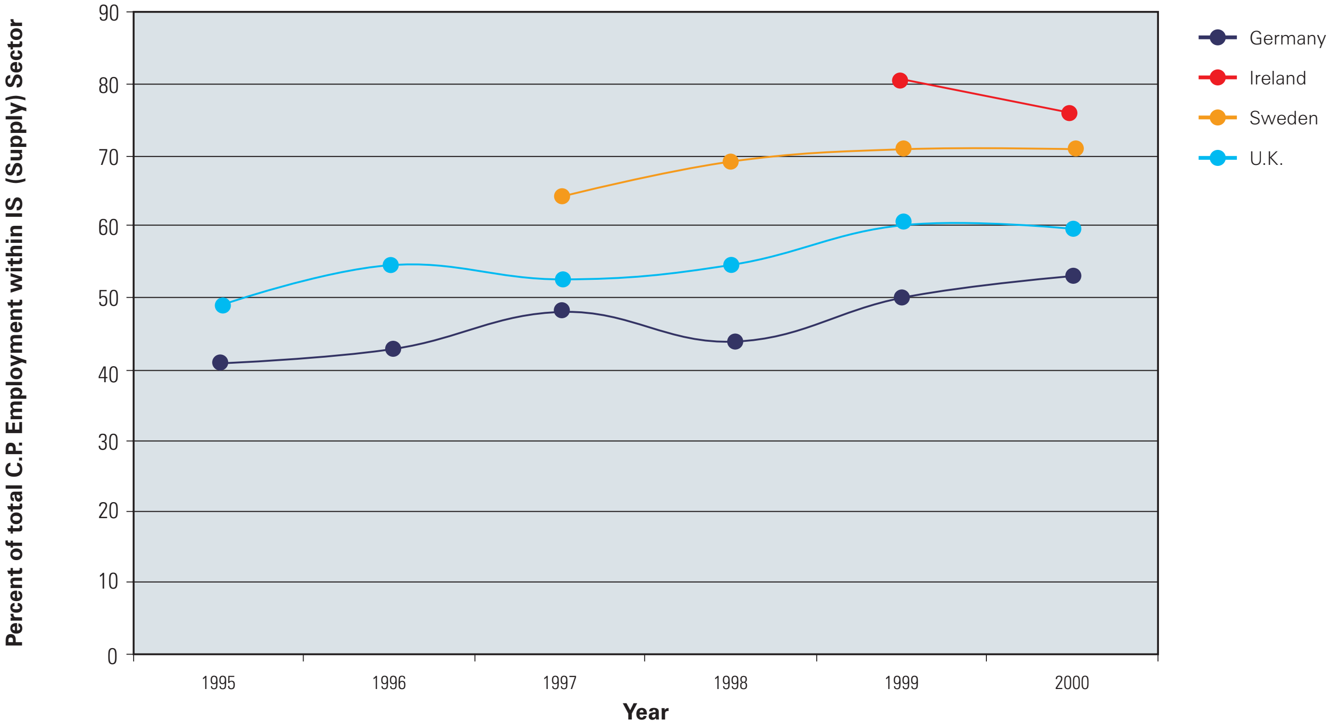


As can be seen, the fraction of self-employed "independent contractors" is largest in the United Kingdom, with getting on for twice as many (in proportion) as in Germany. The figures in Sweden seem to have changed rather dramatically in 1999, but the variations over time in Germany and in the UK seem broadly "in phase". Interestingly, there are clear *falls* in the percentage in Britain and Ireland between 1999 and 2000 (assumed to be influenced by *Y2K date-change* activity), whereas the fraction of contractors *rose* over that period in Sweden and Germany.

Split between Supply and User Industries:

As discussed, *Computing Professionals* work for employers in both supplier (IS Industry) and user organisations. However this split varies between countries.

Figure 12
IS Industry Share of *Computing Professional* Employment
(Source: Eurostat Holdings of Member State LFS Quarter 2 data)



As can be seen, the supply sector in all four countries now holds more than half the employment of Computing Professionals, with Ireland and Sweden holding over 70%. (Where *IT Managers*, *Computer Operators* and *Installation and Maintenance Engineers* are included in the UK, the fraction is lower, but the trend has been for steady growth, influenced considerably by "acquisition" of these occupations arising from increases in outsourcing contracts. Thus the recent percentage fall in Ireland and the UK is perhaps surprising).

Highest Academic Achievement of Computing Professionals:

Each country's Labour Force Survey involves a question asking the respondent what was the "highest level of education (or training) successfully completed". Responses are given in terms of the relevant national qualification framework, and these are "translated" to the corresponding level of the classification used for Eurostat. The International Standard Classification of Education (ISCED) system attempts to identify levels of academic qualification or achievement internationally. The ISCED level definitions are shown below.

L	Description
0	Education preceding the first level (pre-primary)
1	Education at the first level (primary)
2	Education at the lower secondary level
3	Education at the upper secondary level
5	Education at the tertiary level, first stage
6	Education at the tertiary level, first stage, leading to first degree
7	Education at the tertiary level, second stage, leading to a post-graduate degree

The LFS data held by Eurostat is allocated to *three* broad groupings:

- ISCED Levels 0-2: *General education*
- ISCED Level 3: *Upper Secondary Education*
- ISCED Levels 5-7: *Tertiary education*

Generally it is assumed that work as a *Computing Professional* requires a university education (minimum ISCED L5). However, such has been the growth of demand for people that those with many other backgrounds have become involved in this work. Figures 13, 14 and 15 show the fractions of the *Computing Professional* labour forces in Germany, Sweden and the U.K. that have achieved ISCED Levels corresponding to General, Secondary and Tertiary education respectively. Note that a new version of ISCED ("ISCED97") began to be used in Member States in 1998, introduced to supersede "ISCED76" (LFS time-series with ISCED-related data that span 1998 therefore need to be carefully interpreted).

Figure 13: *Computing Professionals* with "only General Education"
Fraction of *Computing Professional* with Highest Education ISCED Levels 0-2
(Source: Eurostat holdings of Member State LFS Quarter 2 data)
(generally based on relatively low responses, and the percentages are not statistically robust)

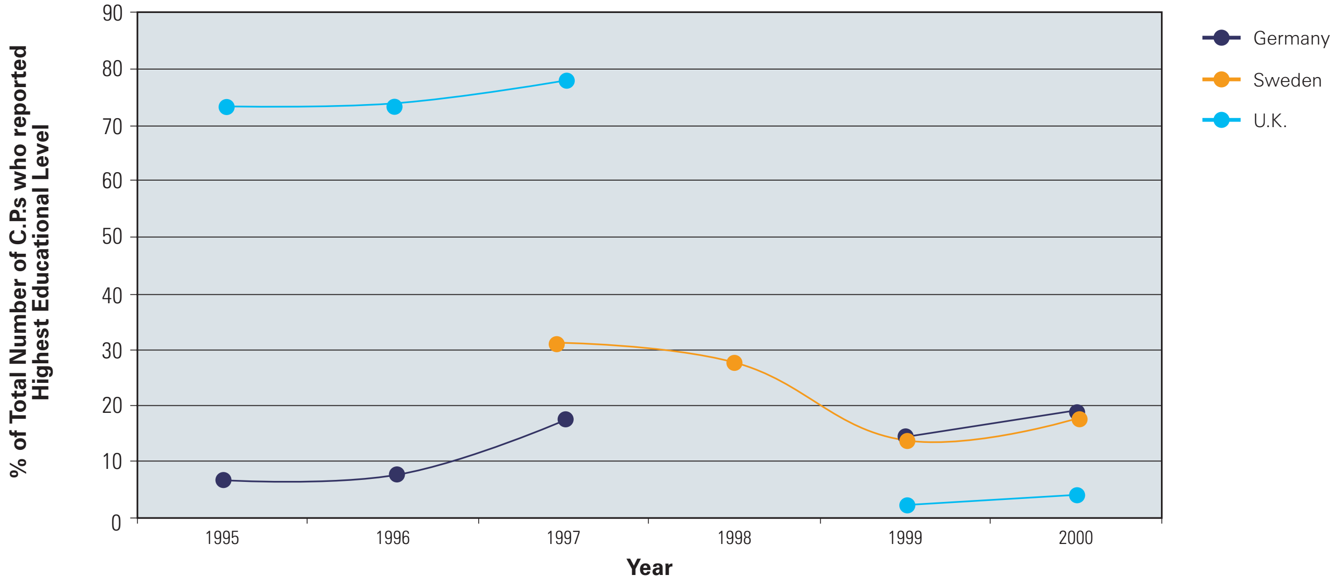


Figure 14
Computing Professionals **with Upper Secondary Education**
Fraction of *Computing Professionals* with Highest Education ISCED Level 3
(Source: Eurostat Holdings of Member State LFS Quarter 2 data)

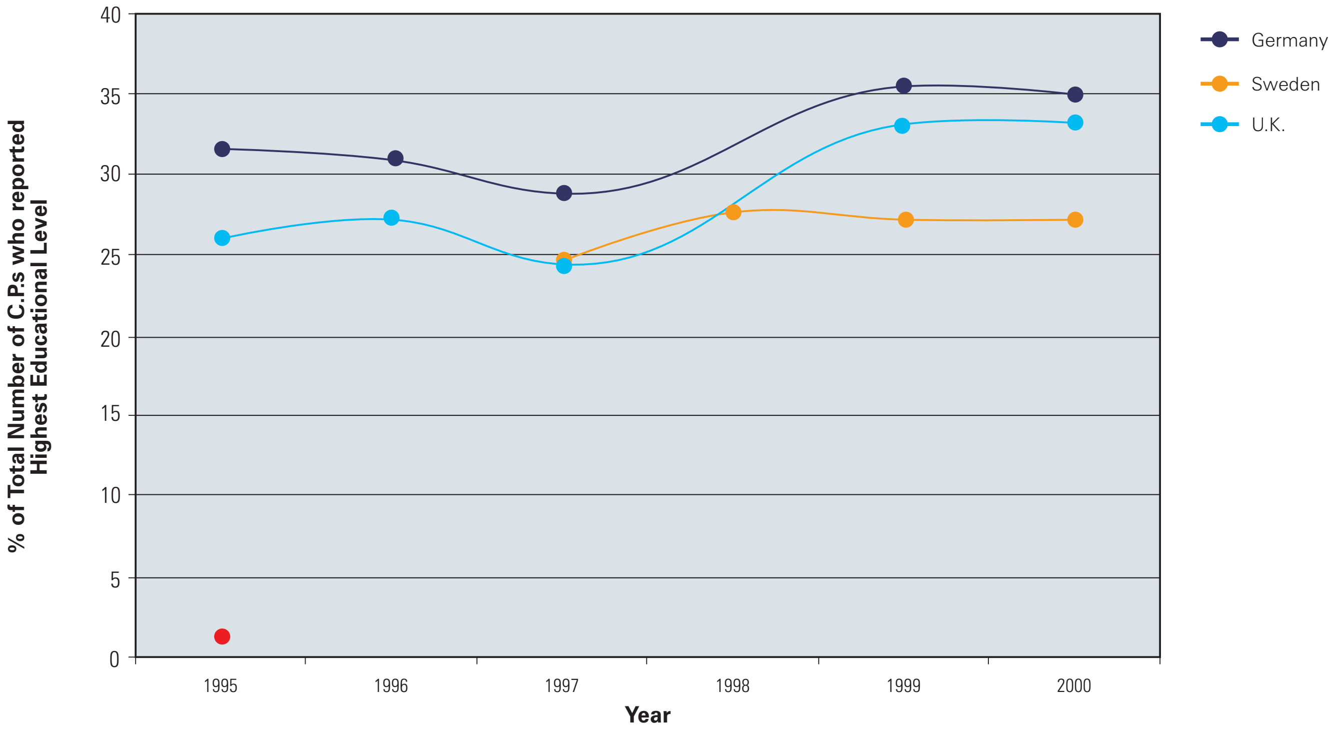
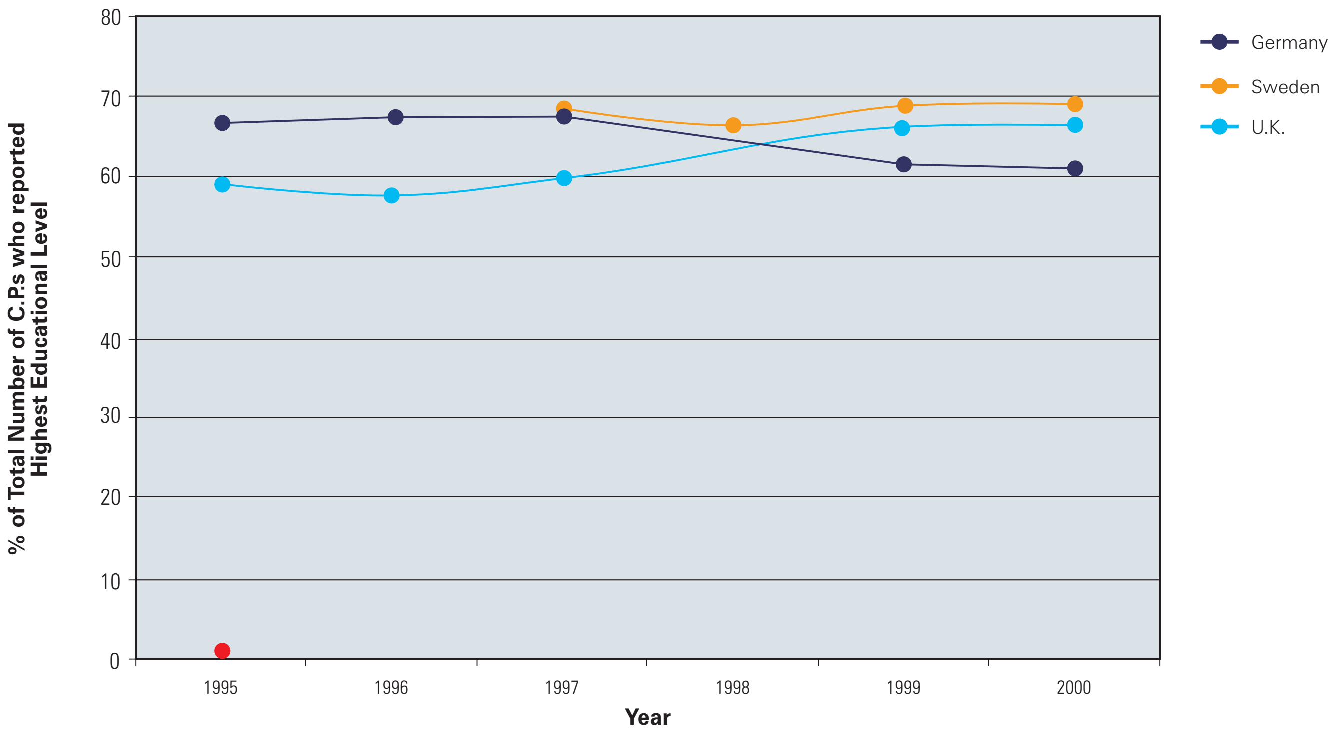


Figure 15
Computing Professionals **with Tertiary Education**
Fraction of *Computing Professionals* with Highest Education ISCED Levels 5-7
(Source: Eurostat Holdings of Member State LFS Quarter 2 data)



ISCED Levels 0-2: *General Education*

Figure 13 shows the development of the share of those with (only) General Education (levels 0-2 of the ISCED classification): the figures for the UK are suspect (the gap for 1998 and the dramatic difference of the figures before and after that gap relate to the change (update) of ISCED standard over that period), but there is a noticeable growth in the Levels 0-2 share in Germany against an apparently decreasing share in Sweden.

ISCED Level 3: *Upper Secondary Education*

The situation here (Figure 14) is relatively uniform, with the workforces in the UK and Germany showing rather close development over time and about one third of the *Computing Professionals* holding ISCED Level 3 as their highest academic achievement. Sweden's share is a little lower, at just over one quarter.

ISCED Levels 5-7: *Tertiary Education*

Here, too (Figure 15) there is rather strong similarity between the situation in the three countries, except that the fraction of *Computing Professionals* with ISCED Levels 5-7 has enjoyed a modest increase in the UK and Sweden, but fallen by a comparable amount in Germany.

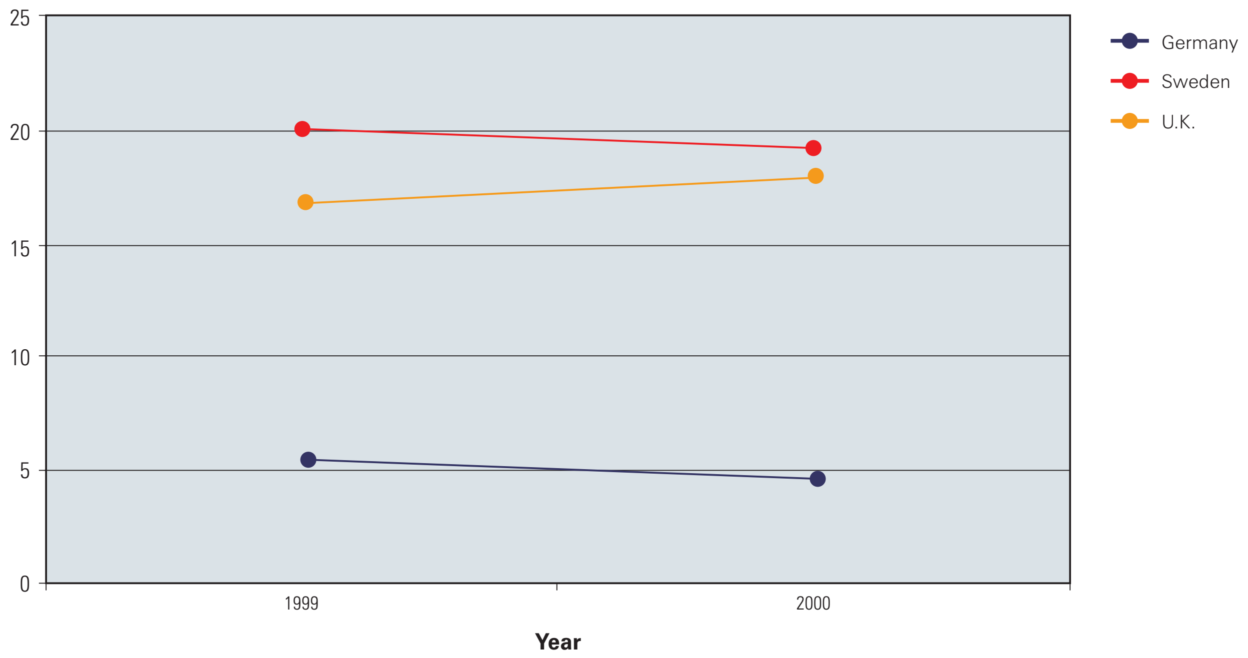
……….

In very broad terms, some 2/3 of *Computing Professionals* (those allocated to ISCO 213) are graduates, and nearly 1/3 have upper secondary education. Note that this distribution would not be expected from the *Computer Associate Professional* (ISCO 312) community.

Training Received by Computing Professionals:

Labour Force Surveys ask respondents whether they have received training during the four weeks leading up to the survey. While there is less data in the Eurostat holdings on this aspect than for many other variables, Figure 16 does show some interesting differences between the position of three of the four countries.

Figure 16
Training of *Computing Professionals*
Percentage of all C.P.s who received Training in four weeks before Survey
(Source: Eurostat Holdings of Member State LFS Quarter 2 data)



This data suggests that there is significantly less training undertaken in Germany than in Sweden and the United Kingdom. This difference (around 5% of all *Computing Professionals* as opposed to nearly 20% in Sweden and the UK) is sufficient to raise questions about the question formulation and interpretation.

4.8 IT Practitioners in other Member States

Perhaps the most interesting overall indicator of the significance (relative level) of IT Practitioner activity within EU Member States is provided by the fraction of the national workforce involved in these occupations. Figures 17 and 18 show the development of this percentage between 1995 and 2000, for the *Computing Professional* (ISCO 213) and *Computer Associate Professional* (ISCO 312) occupations.

The comparative data shown is "normalized" by dividing the estimated total numbers in each occupational category by the estimated total national employment of that Member State at the time of each survey (Eurostat LFS data in each case). This provides an indication of the relative amount of activity within these occupations in each Member State.

In spite of the general limitations of this data, therefore, the comparative data provides useful broad indications, in particular of growth (or decline) of occupational activity, and of comparative levels of employment in these occupations within Member States.

It should be borne in mind that "percentage of national workforce" is an indicator of "input" resource, and can only be related to (real or perceived) normalized national "output" of such occupations (still less, *industries*) through overall productivity values.

Noteworthy characteristics are:

Computing Professionals (ISCO 213):

- Relatively high workforce numbers in Belgium, Denmark, Finland, Sweden, and the United Kingdom (all showing more than 1.5% of total workforce by 2000);
- Comparatively low *Computing Professional* communities in Austria, Greece, Italy and Portugal (all with less than .5% of working population);
- Particularly strong growth in recent years in Denmark, Germany and the UK;
- Noticeable falls in employment levels in the year 2000 (probably arising from the disappearance of work related to the "Y2K date change" problem), particularly notable in Belgium and Finland.

Computer Associate Professionals (ISCO 312):
(Zero returns from the UK and Ireland)

- Relatively high workforce numbers in Austria, Italy, the Netherlands and Sweden (all showing more than .8% of total workforce by 2000);
- Comparatively low *Computer Associate Professional* communities in Belgium and Greece (with less than .2% of working population) (and in Ireland and the U.K!);
- Particularly strong growth in recent years in Austria and Sweden;
- Significant changes in Denmark between 1999 and 2000, also possibly arising from the final stages of "Y2K" work

Figure 17
Numbers of *Computing Professionals* as a fraction of the national workforce

(Source: Eurostat holdings of EU Member State Labour Force Surveys: data for ISCO 213)

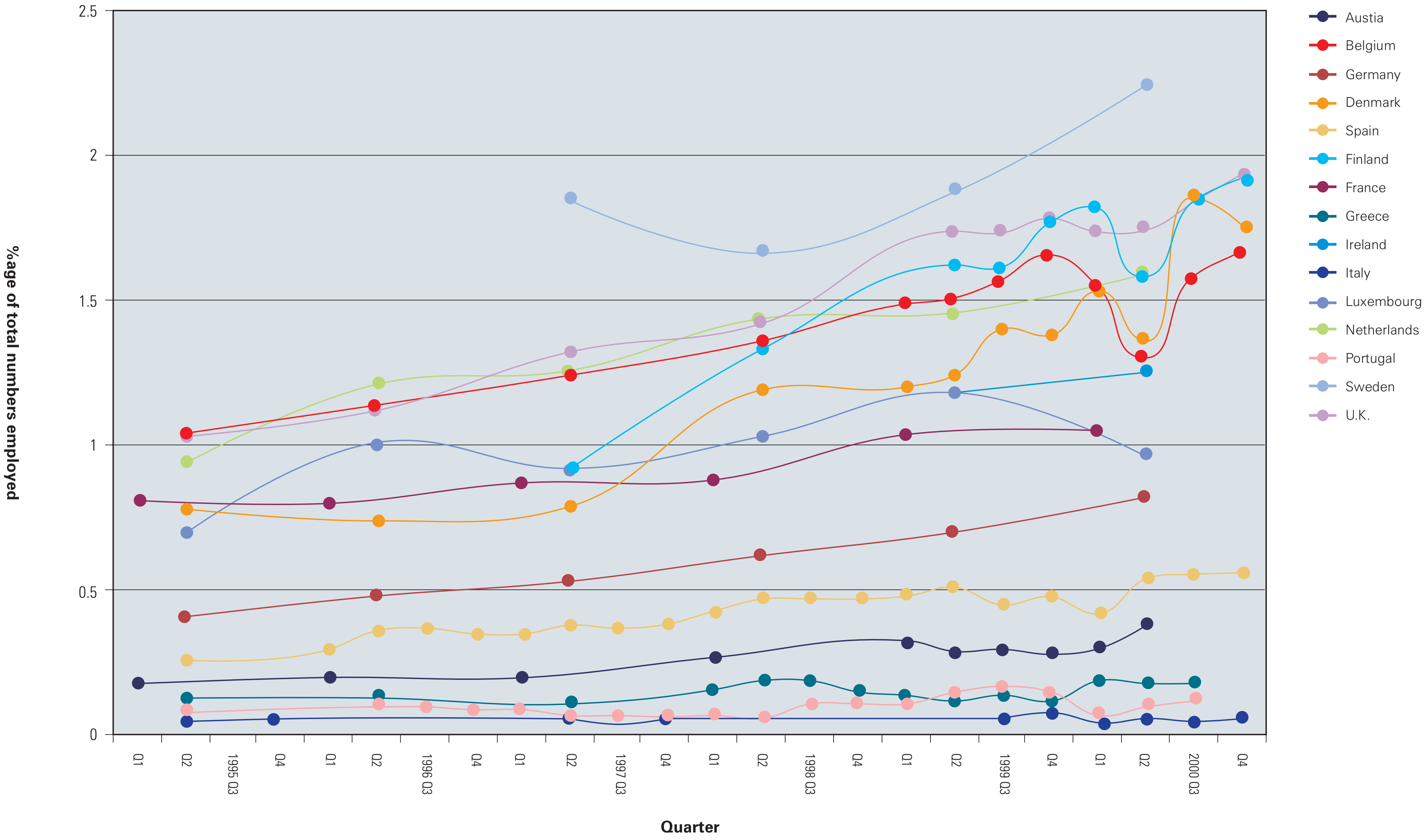
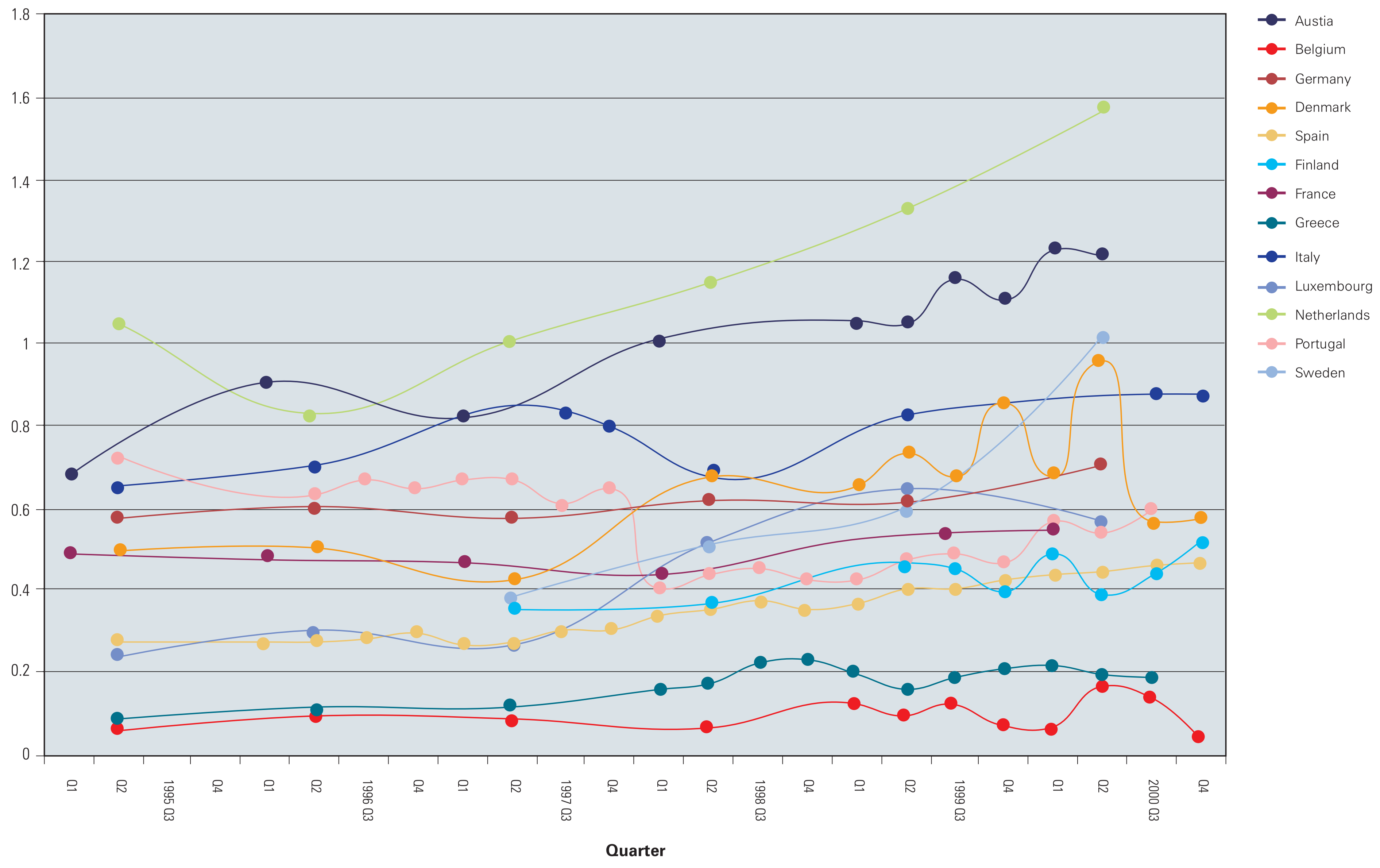


Figure 18

Numbers of *Computer Associate Professionals* as a fraction of the national workforce

(Source: Eurostat holdings of EU Member State Labour Force Surveys: data for ISCO 312)



4.9 The Role of Migration

Economic migration has occurred for centuries. However, growth of income differentials between countries and the reduction in the costs of travel and in barriers to entry in many countries (and particularly within trading blocks), has resulted in strong growth in migration generally, and movement between the EU/EEA* countries in particular.

Although it has kept a watching brief in this area for some time**, in response to growing interest by Member Governments, the Organisation for Economic Cooperation and Development (OECD) initiated in June 2001, a study on the migration of ICT workers. In addition, the European Commission established a *High Level Task Force on Skills and Mobility* in the Spring of 2001 to review the position of skills needs and migration together, with the following mandate:

- to identify the main drivers and characteristics of the new European labour market;
- to identify the main barriers to further development of these markets (in particular in skills and mobility); and
- to report with a set of policy initiative recommendations for implementation at European and national levels.

The Task Force reported in December 01, and presented a number of recommendations in three areas:

- expanding *occupational mobility*, based on *relevant and adaptable skills*;
- increasing *geographical mobility*, and
- proposals for a *transparent and integrated labour market information system*

OECD confirmed in 2001 that in the context of economic growth in its Member Countries, the demand for skilled and highly-skilled labour had been increasing. Labour shortages were particularly marked in Information and Communications Technologies.

Most OECD Member countries have amended their legislation in order to facilitate the admission of foreign specialists, in particular in high technology fields. Such measures are composed of one or more of five principle elements:

- relaxing any quantitative constraints that apply;
- setting up special programmes for shortage occupations;
- facilitating recruitment conditions or procedures and relaxing criteria for issuing employment visas for highly skilled workers;
- increasing non-wage incentives for skilled foreign workers; and
- allowing foreign students to change status at the end of their course and thereby enter the labour market.

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* European Economic Area (EU + Iceland, Liechtenstein and Norway)
** see e.g. OECD Employment Outlook, 2001

Recent policy responses to skill shortages in ICT in Ireland, Germany and the UK have included arrangements to accelerate work permit applications for overseas (beyond the EEA) applicants with ICT skills. France has been operating a simplified admission system for computer specialists since 1998.
Migration within the European Union has been increasing steadily over recent years, and is now of growing significance to a number of Member State labour markets. Table 4 (from OECD Employment Outlook, 2001) shows the overall position of Intra-European mobility of EU citizens (for all occupations) in 1997, and gives a feel for the flows between countries. This migration is growing, and will undoubtedly continue to grow.

OECD held a seminar in June 2001 on International Mobility of Highly Skilled Workers ("Human Resources in Science and Technology" (HRST)). The proceedings of the meeting, published early in 2002 (OECD 2002), reported on the work. The seminar had three main objectives:

- to provide data on the scale and characteristics of flows and stocks of skilled and highly skilled foreign workers in OECD Member countries and certain non-member countries, to assess the quality of the available data and concepts used and to help improve their comparability;
- to analyse the mobility of skilled workers and "HRST" and their impact on the economy through case studies covering most of the major regions that send and receive these workers;
- to examine appropriate migration policies for facilitating the mobility of skilled workers in ways that are beneficial both to "receiving" and "sending" countries.

The studies showed that, while it is difficult to measure the international mobility of skilled workers, there is every reason to believe that these flows rose substantially during the 1990s. This being the case, mobility of "HRST" has a major impact on countries' performance in the field of science and technology and therefore on growth. However, these effects remain unequally distributed, especially between sending countries (mostly developing countries) and receiving countries. As a result, policies aimed at facilitating the recruitment and mobility of highly skilled workers, in particular migration policies, must endeavour to ensure a fairer distribution of benefits.

Mobility between Member States – and different countries in general - in certain occupational areas (in particular in professions which involve elements of safety risks for Society) is often constrained by the fact that certain governments regulate both the use of professional "title" and in some cases, the *practice* of the profession. Thus, for example, most countries regulate the practice of various medical professions, and most countries regulate certain safety-related aspects of engineering (e.g. design of dams, aircraft, gas installations, etc.). This inevitably involves specific education, training and experience requirements that pose barriers to mobility for professionals from other countries who have not "gone through that system". The EU Commission has striven to tackle these barriers, and there exist certain *Directives* that require "receiving" Member States to minimize barriers to access to practice for experienced professionals from other Member States, where they have been practising in essentially the same area. The current set of Directives (some of which apply to specific professions while some involve a "general systems" coverage of a range of others), are currently undergoing review, and a new set of arrangements is expected to come into force within a year or so which will specify the migration processes for professionals between Member States in a consistent way.

IT Professionals are generally not subject to these barriers. This is probably because the IT profession is relatively young, and there has not been a history of regulation of practice that creates such barriers in the first place. However, in view of the increasing importance of IT systems to many (most) areas of life and work, including the emergence of a growing number of software systems governing "safety-critical" operations, it is possible that this may become an issue in the future. In view of the differences between national education and training systems for IT Professionals, there could indeed be challenges of rationalisation, and it may be that the significant take-up of *proprietary* qualifications internationally will result in the emergence of international standards (even, perhaps, passports?) drawing on these.

These considerations are also on the agenda of the World Trade Organisation, whose working group on professional services is addressing barriers to mobility between countries beyond the EU.

Receiving Country / **Nationality**	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Luxembourg	Netherlands	Portugal	Spain	Sweden	U.K.
Austria	-	0.9	1.8	1.4	1.3	7.0	3.2	4.0	1.7	0.7	1.6	1.1	1.2
Belgium	1.2	-	1.7	1.1	6.4	1.3	3.0	16.7	9.6	4.6	6.5	0.9	0.8
Denmark	1.5	1.6	-	4.9	1.4	1.7	4.0	2.0	1.9	1.2	1.7	14.3	2.0
Finland	2.1	1.5	5.0	-	0.9	2.1	3.0	1.5	2.1	1.0	2.5	39.7	4.6
France	5.6	25.5	9.6	6.4	-	9.5	11.6	23.4	9.4	12.2	13.6	5.0	33.9
Germany	51.1	11.3	20.4	10.4	9.9	-	26.4	9.5	25.6	23.0	29.1	13.3	12.7
Greece	4.2	2.2	1.1	1.9	1.2	11.0	-	1.1	3.5	0.1	0.2	2.8	14.7
Ireland	1.0	1.2	1.9	0.9	2.1	2.6	1.0	1.1	3.2	1.3	0.8	1.6	2.3
Italy	11.0	10.0	6.7	4.2	13.8	26.2	8.7	6.9	6.6	6.1	10.1	2.8	4.3
Luxembourg	0.1	0.8	-	0.0	0.2	0.4	0.1	-	0.1	0.1	0.1	0.1	-
Netherlands	4.4	22.8	8.0	3.8	3.4	4.7	7.0	3.6	-	10.8	5.5	3.8	7.7
Portugal	4.5	5.9	1.0	0.3	36.4	17.7	0.4	25.9	3.4	-	6.9	0.7	3.5
Spain	2.3	4.2	6.2	3.6	8.1	4.9	0.9	1.8	5.6	17.1	-	2.2	5.3
Sweden	3.5	2.3	18.9	48.3	2.2	2.4	5.8	1.9	2.8	2.2	2.3	-	7.1
United Kingdom	7.5	9.8	17.6	12.8	12.7	8.5	24.9	4.2	24.4	19.7	19.1	11.7	-
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100
In percent of total inflows of foreigners	20.2	56.0	27.6	17.0	9.7	24.5	17.5	78.3	25.0	59.0	39.1	21.4	32.3
Share of EU citizens in total population	1.1	4.7	0.8	0.2	2.0	2.3	0.2	30.0	1.4	0.3	0.3	2.1	1.4

Table 4
Immigration Flows (all occupations) by nationality in per cent of total inflows of EU citizens (1997)
Source: Eurostat, New Cronos database (no data available for arrivals in Italy or Ireland)

Section 5

Estimating Skill Shortages

5. Estimating Skill Shortages

Even where industrial structure is only changing slowly, employers of IT Practitioners rarely find it easy to articulate their current and (particularly) future skill needs very precisely. These needs can in principle be fulfilled from within their own staff (the shortfall of skills *within* employers' existing staff is termed – in the UK - "skills *gaps*"), or by recruiting new people (buying in people from the available supply in the external labour market – generally problems in finding the "right" people in this way are referred to as skill *shortages*).

Furthermore, employers may not be able – or may choose not – to afford the necessary action to reduce their problems in this area. Trying to measure such shortages of supply in a labour market has a number of difficulties, and trying to predict how such shortages will develop in the future is increasingly hard, particularly in a time of continuing change of work practices. There are thus fundamental limitations in both identifying skill shortages in existing labour markets and in forecasting their development in the future. These need to be considered separately.

5.1 Possible Approaches

a) Estimating skill shortages in relation to labour stock levels (numbers in employment) is not easy. Generally, researchers view estimates of grossed up samples of Employers' reported "Hard-to-fill vacancies" as the least unsatisfactory indicator of recruitment difficulties – i.e. shortages of supply in the market-place. However, labour markets contain a number of additional complexities beyond the operation of product or service markets, including the problem of "churn"*.

b) Estimating skill shortages from the growth of economic/business activity that produces a growing demand for labour is a risky business. In essence, very few forecasts can be shown to have been fulfilled, and indeed general macro economic modelling is often now not to be used directly in forecasting (Smith, 1998).

A helpful review from the European Science and Technology Observatory of the different aspects of forecasting in relation to high technology skills more broadly is given in Ekeland and Tomlinson (2001): the study examines the relevant labour markets in terms of stock/flow indicators for both relevant sectors (NACE) and occupation (ISCO).

The prevailing approach is generally to ***estimate skills demand levels from a productivity factor applied to business activity levels arising from assumed economic growth in a sector***.

5.2 Existing Estimates for the European Union

The two significant sets of estimated levels and forecasts for IT practitioners within Europe recently carried out are those by IDC (in particular through the 2001 European IT Observatory – EITO - Report) and an analysis carried out for the *Career-Space* industry consortium (drawing in particular on work carried out within IBM United Kingdom).

* where – at a time of very high shortage – employees frequently leave their current employer to earn more at another.

The IDC approach is based on estimates of IT system development and service delivery activity and an assumed human resource requirement (in terms of "full-time equivalents") to staff this activity. As is inevitable in such an approach, the occupational classification assumed is in reality more of a *functional* classification. It uses a unique, *apparently forward-looking*, classification, involving 3 broad categories of skill:

- ICT skills,
- e-Business skills, and
- Call Centre skills.

The *ICT skills* category is split into (those required for) five different types of computing ("technology environment"):

- "Internetworking" (Internet protocol environments; networking infrastructures)
- "Applications" (application software development and delivery)
- "Distributed" (centred on client-server infrastructures)
- "Technology-neutral" (IT business consultancy: work to align clients' IT and business processes)
- "Host-based" (centred on large server environments)

And *e-Business skills* are deemed to consist of:

- "Internet strategists"
- "Internet-dependent" activities

While the approach to composition of demand is interesting and the categories chosen are useful in relation to the way IT business is categorized, they are not a particularly valid split of skill requirements, and they suffer from their uniqueness. As a result, there is no way of relating them to, testing them against, or above all *reconciling them with* more *robust* estimates based on widely accepted classifications of distinct occupational skill requirements. Specifically, IDC have made no attempt to relate the "full-time-equivalent" estimates they provide for current and recent years with the realities of the numbers known to be in employment. For example, the figures given in the EITO 2001 for the ***supply*** of ICT skills in the United Kingdom in 1999 and 2000 are seriously unrealistic in relation to what is known of employment levels in the UK ICT Practitioner labour market (see Annex A). This inevitably raises real doubt as to the validity (indeed meaning) of the estimates for the future, especially at the European level, and knowledgeable industry and labour market commentators in different European countries remain sceptical about the excessive magnitude of these figures. For example, the total number of IT Practitioners in the UK (as specified by the sum of the figures for the five SOC-90 codes that cover all direct IT roles – see Annex A) were, in 1999 and 2000, ***a little over ½*** of the IDC estimated ***supply*** total for just their "ICT skills" categories*.

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* IDC acknowledges that its approach is based on making "technology forecasts relating to product shipments, and then attaching work-rates to the shipment of IT products"… the estimates are asserted to be "based on the 'real' amount of work (in person-hours) necessary to make IT products work effectively". "This means that IT work undertaken by, for example, an office manager would be included in the numbers and that office manager might be .3 of an IT professional" (quoted in Mason, 2000). While even this approach would be unlikely to result in anywhere near the effective doubling of the workforce that the discrepancy in the figures would require, the view taken in this study is that the requirements for IT Practitioner skills are fundamentally different from those of IT End-Users (see Annex A), so that the office manager given in IDC's example would not need higher education, or technical training/ experience of an IT Practitioner to perform the functions carried out in the .3 of his/her job indicated.

The European Union figures were assembled from estimates in six country sub-groups:

- Germany
- France
- Italy
- Spain
- UK and
- "Other Western Europe"

for which the forecasting proceeded by assuming growth rates (separately) for each year to 2003.

The IDC figures for *supply* also suffer from the fundamental lack of realism in assuming that supply largely arises from those graduating from ICT-related Higher Education courses. As Mason (2000) confirms, "this approach places too much weight on the supply of new entrants from the full-time education system and too little on alternative sources of new IT skills".

A more meaningful and "relate-able" analysis was carried out for the *Career-Space* consortium in early 2001 by the labour market expert within IBM United Kingdom (*Career-Space*, 2001). This study used:

- OECD estimates of total employment in the ICT supply sectors
- forecasts of overall economic activity within most Member States from the E3M3 model of ERECO, and
- estimates of employment of ICT occupations from total employment in the supply sectors based on the occupational structure within the U.K, using 9 SOC90 categories that were deemed to cover all the 13 "generic job profiles" defined by the *Career-Space* initiative.

This approach produced significantly lower estimates of both current & recent and forecast future employment of ICT Practitioners in Europe. However, it suffers from errors arising from assumptions associated with:

- estimating the structure of occupation <-> sector employment levels within the UK, and
- estimating the total European level based on the assumption that the occupation <-> sector structure in other EU countries is identical with that in the UK

The EU total was made up from figures for 14 Member States (Luxembourg was not treated separately within the E3M3 economic model), and the forecasting to 2004 proceeded by assuming annual average growth rates, separately, for each sector-occupation cell defined for the study.

The report concluded with proposals for follow-on work: it forecast only employment levels, and did not attempt to estimate shortage figures.

The mappings between the occupational classifications used in these two analyses and that used for this report are shown in Annex A.

5.3 Improving Validity of Estimates and Forecasts

a) The IDC study asserted shortfalls for each country and "skill category" as the difference between the estimated *demand* and *supply* for that skill area. These are reported to be calculated as follows:

- "*Demand* for ICT workers is estimated through a detailed analysis of numbers of IS departments, ICT-intensive business units, and numbers of companies in demand for IS support in the European economy, their size and evolution over time as a result of changing IS needs. Changing ICT skills needs and gap evaluation are also developed through close monitoring of ICT job-search sites, and unfilled positions over time"

- "*Supply* of ICT workers is estimated through the assessment of two major important segments:

  - the number of current ICT workers available in the market (less average attrition rates);

  - the number of new ICT workers becoming available from university/college graduation, through re-training from other industry sectors or from other business units in the same company, as part-time workers from third party labour providers, as skilled and top-management workers from other industries."

According to these definitions, it should be possible to reconcile the IDC figures for *supply* for past years with the actual employment levels. As indicated, the employment levels in the case of the UK are around 50% of the asserted IDC figures for ICT workers. It is true that the UK figures used do not include non-IT occupations of any kind, and do not include engineers or technicians of a kind that would be employed in Telecommunications work (they do not cover the "C" of ICT). However, the non-technical occupations are not relevant to a study aimed at understanding possible skill shortages of IT occupations, and the (hardware) engineers and technicians are known to constitute a comparatively minor workforce (less than 10% of the IT occupation working population).

b) Ideally skill shortages would be estimated directly, from reported *hard-to-fill vacancies* from a pan-EU survey of employers with the same questions and adequate samples conducted at the same time. In the absence of such evidence, it is almost impossible to make meaningful cross-country comparisons in terms of more detailed occupational categories. However, what is known about labour markets measured in a consistent way over a period is their growth. Thus, if a labour market for a particular occupation grows over a year by, say, 10,000, then the number of people required in that year with the relevant skillset is 10,000 + the number who withdraw from that occupation during the year (the *replacement demand* arising from "attrition"). The additional supply each year in the future can therefore be estimated from the best forecasts of growth, together with an assumption about the *replacement demand* rate (normally expressed as a percentage of the total - "stock" - level). Since Eurostat holdings of Member State Labour Force Survey data enable a relatively consistent measure of national levels of employment in each occupation, this provides a significantly more consistent and valid way of estimating future demand, against which policy responses can be considered. This approach inevitably depends fundamentally on the validity of forecasts, but the accuracy of the growth rates used in the IDC and *Career-Space* forecasts depend likewise on the reality of economic growth, in relation to that assumed.

c) The approach taken in this study is therefore to investigate future demand by exploring scenarios of the development of employment levels from the most recent figures available from official statistics. This will be done making certain very broad assumptions about the development of overall economic activity, but will also ***explore several scenarios***, in recognition that a single projection produces unmerited implicit confidence in a particular future that is not supported by any evidence. There is a considerable body of knowledge surrounding scenario analysis. Often forecasting analyses draw on two or three scenarios. This study uses four scenarios, since two scenarios can misleadingly give the impression that the future will definitely lie somewhere between the two, and three scenarios generally produce the instinctive response of selecting the "middle" course, which is thereby given undue credibility as a "compromise". With four scenarios, the reader recognizes that there could be more and thus none of the scenarios will actually come to pass, and the absence of "one in the middle" strengthens the recognition of many possibilities (technically, these are ***employment growth possibilities***, rather than "real" scenarios).

d) The scenario developments adopted for this study are shown in Figure 19. As can be seen, there is an initial dip in the development reflecting the recent fall in confidence in the relevant economies generally and IT activity in particular, including a series of lay-offs of high tech staff*. The four scenarios involve annual employment growth rates of 2%, 5% 10% and 15% respectively, superimposed on a "trough" characteristic represented by a 'sinusoidal' waveform. This has been chosen as a relatively good way of achieving a smooth dip, and fulfils the following constraints:

- There is an initial peak (to enable a smooth "point of inflection" transition to a fall)
- The trough "hits its lowest point" around the end of 2002
- The "trough" component disappears once the curve has returned to the initial peak level (since this cyclical component is too "short" - for a "real business cycle" - for it to produce further influence once a real pick-up has been achieved)

As can be seen from Figure 19, the combination of the steady growth and the trough component produces troughs of different intensity and lowest-point-timing depending on the underlying growth rate.

The choice of the four employment growth rates (while essentially arbitrary) is broadly consistent – in terms of a range – with the growth rates experienced over recent years: taking the four countries examined in depth and the total of all Member States, the figures are as follows:

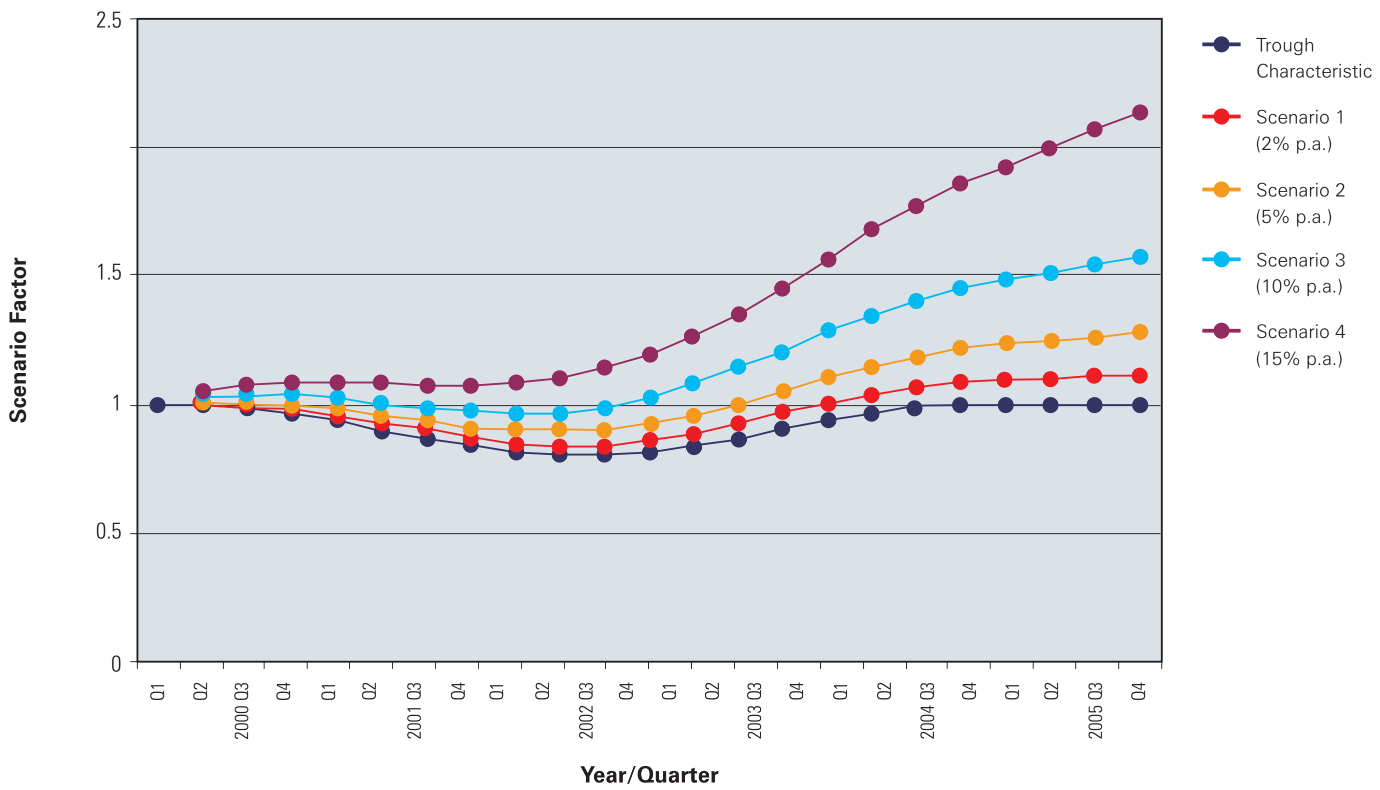
	Average annual employment growth over five years	Percentage increase in the latest year for which there is data
Germany	9.5%	17.8%
Ireland	(unavailable)	11.2%
Sweden	15.6% (over 3 years)	34.7%
United Kingdom	12.9%	2.5%
EU as a whole	11.6%	10.5%

* The latest informed commentaries continue to confirm serious concern for the IT sector

Perhaps the most valuable test is of "smoothness" of continuation of the trend from the actual figures in recent years, as detected by the eye**.

While, overall, this model is by no means perfect, it is nevertheless believed to a be a robust enough basis for considering futures up to the year 2005, and can be updated as new data appears. It is undoubtedly true that "employment development" curves can in principle change dramatically. However, in practice the "overall inertia in the system" means this is very unlikely, so that "smoothness" of the growth curves is in reality a very powerful consideration.

Figure 19
Growth Scenarios



The fact that the most recent figures available at the time of writing for all Member States are for Quarter 2 of 2000 is inevitably a problem (since there has been significant change in the employment growth since then): however, since the figures for subsequent Quarters of 2001 will be appearing over the coming months, it will be possible as they arrive to clarify which scenario has been closest to the actual development, and, on a country-by-country basis the discrepancies will be used to influence the refining of the scenarios.

** it is recognized that these are scenarios only in the sense of possible future trajectories of employment growth. Full scenario analysis would normally involve a series of explicit assumptions about development of a series of "drivers" (e.g. Political, Economic, Social and Technological)

5.4 Robustness of Estimates

As can be seen from the above, the approach using four scenarios involves an important degree of robustness as compared with the IDC and *Career-Space* approaches, and the presentations have been designed to minimize risk of unwarranted confidence in the reader in any one future. However, as with all forecasting work, it is crucial to recognize that "future-gazing" is a risky business, and perceptions based on this model must continue to be questioned and tested, in particular by updating the model as new data becomes available, and errors between the new data and forecasts for it should be thoroughly analysed for lessons to be learned.
In summary, the limitations to the analyses and forecasts in this study include the following:

- Limited "granularity" of analysis resulting from having to work with only two occupational categories;
- Likely imperfections of consistency in use of the ISCO classification by statistical offices in different Member States in relating to national occupational classification frameworks;
- Inconsistencies arising from other differences between the LFS data-gathering processes in different Member States, including variation in degree of use of *proxy interviews* (reported by Eurostat to be - e.g. - significantly higher in Spain than in Nordic countries)
- Limitations to various analyses of specific characteristics of the occupational labour markets investigated (different "cross-tabulations" arising from statistical reliability limitations where sample size for the sub-sets fell below the relative level – confidence threshold generally shown in chart);
- Limitations associated with the assumptions within the scenario model – in particular the shape of the "initial trough" curve.

5.5 Preliminary Scenarios

The "initial trough with varying underlying growth rate" forecasting model has been applied to the latest (2000Q2) figures for all ITPs (ISCO 213 and – where non-zero – ISCO312) both in the four Member States examined in more detail (see Annexes B, C, D and E) and the total for the EU as a whole – see Figure 20.

The corresponding estimates for new demand each year until 2005 are given in Table 5. Replacement demand is assumed, as a preliminary rough estimate, to be 3% of initial stock.

This leads to a set of cumulative (*net*, *new*) demand figures for the European Union for the four years 2001–>2005 of:

2% underlying growth:	583,000,
5% underlying growth:	912,000,
10% underlying growth:	1,505,000, and
15% underlying growth:	2,592,000.

(all figures rounded to the nearest 1,000)

Figure 20
Development Scenarios for the IT Practitioner workforce in the European Union

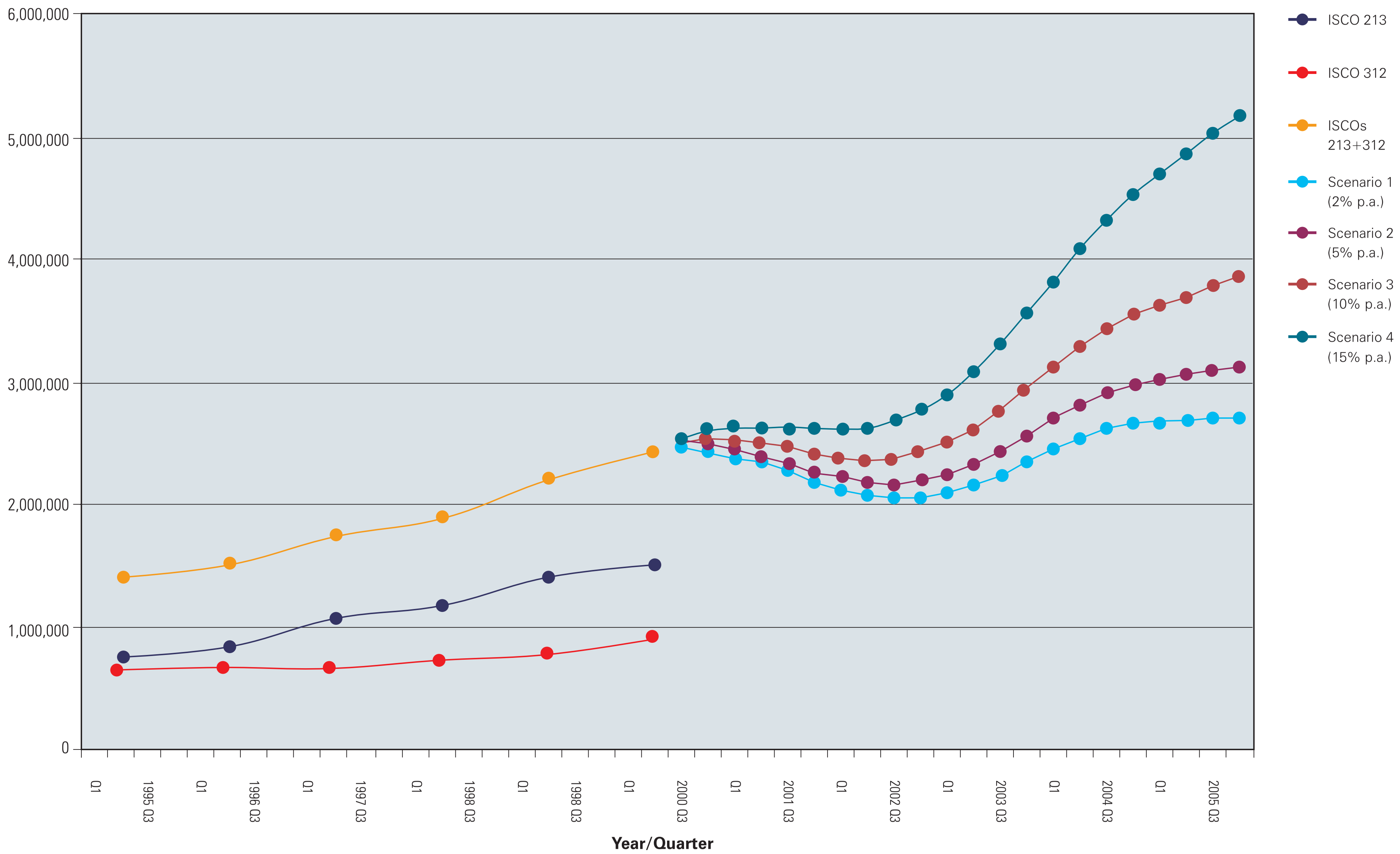


Table 5: Scenarios for Development of IT Practitioner workforce in the European Union
Annual New Supply Requirements (figures not rounded)

	Year/ Quarter	Scenario 1: initial trough +2%		Scenario 2: initial trough +5%		Scenario 3: initial trough +10%		Scenario 4: initial trough +15%	
		Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment
Scenario Starying Point:	2002 Q2	2,442,564		2,442,564		2,442,564		2,442,564	
2000-2001:	2001 Q2	2,340,572		2,401,157		2,495,405		2,635,114	
Growth Demand			-101,992		-41,407		52,841		192,550
Replacement Demand			58,514		60,029		62,385		65,878
Total (Net) Demand			-43,478		18,622		115,226		258,428
2001-2002	2002 Q2	2,074,523		2,183,311		2,358,068		2,629,500	
Growth Demand			-266,049		-217,846		-137,337		-5,614
Replacement Demand			51863		54,583		58,952		65,738
Total (Net) Demand			-214,186		-163,263		-78,385		60,124
2002-2003	2003 Q2	2,161,500		2,333,733		2,619,463		3,084,520	
Growth Demand			86,977		150,422		261,395		445,020
Replacement Demand			54,038		58,343		65,487		77,113
Total (Net) Demand			141,015		208,765		326,882		532,133
2003-2004	2004 Q2	2,542,640		2,816,304		3,285,194		4,085,026	
Growth Demand			381,140		482,571		665,731		1,000,506
Replacement Demand			63,566		70,408		82,130		102,126
Total (Net) Demand			444,706		552,979		747,861		1,102,632
2004-2005	2002 Q2	2,686,987		3,053,226		3,701,355		4,860,187	
Growth Demand			144,347		236,922		416,161		775,161
Replacement Demand			67,175		76,331		92,534		121,505
Total (Net) Demand			211,522		313,253		508,695		896,666

Information Technology Practitioner Skills in Europe

Section 6

Conclusions and Recommendations

6. Conclusions and Recommendations

6.1 General Conclusions

This work started out as a *feasibility* study. The objective was to clarify how much of the coverage of the UK "***Skills 99"*** study could be achieved for the European Union within the resources available from a relatively small budget, plus input from experts in one or two countries. In short, how feasible would it be to try to produce a ***Skills 99*** for the European union as a whole?

The focus of the study has been on achieving:

- the basic parameters of the IT Practitioner workforce over recent years;
- some comparisons between aspects of the IT Practitioner workforce in a subset of Member States;
- a critical analysis of the two major European IT labour market studies thus far, and
- some more meaningful and robust forecasts than previously available.

This constitutes only a part of the ***Skills99*** coverage (with detail analysis for only four out of 15 Member States) but considerable clarification of the position has been achieved, and this bodes well for possible follow-on work.

Thus feasibility has been proved, and the report can therefore justifiably be termed an "Initial Study". The main contribution of this work in terms of new data is undoubtedly that derived from the official national statistics that relate to the two broad categories of IT Practitioners within the ISCO occupational classification: *Computing Professionals* and *Computer Associate Professionals*.

These figures have certain limitations. However, it is not possible to ignore them, since official statistics form a significant part of the basis on which public policy must be formulated. And while the estimates of employment levels are likely to be viewed as generally well below the "headline" figures being used to confirm the significance of this activity to the national economy, they almost certainly provide more valid figures for planning for requirements of the core technical occupations in Information Technology work for which substantial technical understanding is required.

Even if all the less heavily-technical occupational areas are included in the estimation of total employment levels, consensus levels remain significantly below those suggested in IDC analyses. For example in the UK the most recent employer survey findings (e-skills NTO, 2002) confirm an overall level only *slightly over ½* of the asserted IDC levels for 1999 and 2000. This observation weakens the case for using IDC figures directly in policy-making.

This Study therefore lays the groundwork in the area of IT Practitioners for more rigorous cross-comparisons of the position in different Member States, and for clarification of employment growth prospects for the future.

6.2 The Need for, and Value of, More Realistic Forecasting

Manpower Planning – the paradigm of estimating future skill needs and then taking measures that should help assure that supply – is a particularly risky business. Within the United Kingdom, the “Manpower Planning” approach to public policy on skills was tried and found wanting in the 1970s, since when it has been somewhat discredited.

The problems arise from a combination of pitfalls:

a) Forecasting future skill needs is difficult to get right. This is true even in industries where occupational structure is relatively stable, but in IT, where this is not the case, it is particularly susceptible to errors and flaws, and

b) The “pure time delay” – or “pipeline” associated with the supply of people from specialist Tertiary Education provision makes policy responses based (only) on such provision particularly inflexible, resulting in supply-demand mismatches reminiscent of the major errors that sometimes occurred in planned economies.

However, lack of past success does not necessarily mean the approach is fundamentally flawed, and current thinking is that a combination of *efforts to improve the “look-ahead”* while *speeding up the response programme duration* ought to give the possibility of improved policy measure effectiveness. In the case of the fast-moving IT world, there may be an effective solution involving a highly concentrated, high quality “occupation-transition” programme of around, say, *three months*, providing the participants’ start with an adequate level of analytical and learning capability, open-mindedness and motivation. One of the really interesting questions facing policy-making in this area is around the *content* of such a scheme, and programme design is likely to benefit, as well as from the initial development programmes of large IT (supplier/services) employers, from some of the best practice developed for post-graduate Higher Education “conversion courses” in IT. In addition, the more involvement of employers in such arrangements the better, and in tight labour market conditions this ought to be possible in the context of employers’ own recruitment interests.

Whatever the measures under consideration, good figures for the labour market position achieve two important additional benefits:

- a sound picture of the scale of the problem and the likelihood that the market might, on its own, provide; and
- a cross-check for planners and investors (in the private sector) on the soundness of plans for investment or development in the sector.

In addition, resource availability may well constrain business and therefore economic growth, so that valid supply data can provide an important cross-check on the plausibility of forecasts of sectoral growth.

And in policy terms, the effectiveness of policy response (and thus the return on public investment) will always improve with the validity of labour market understanding on which policy development is based.

6.3 Issues needing Further Clarification

The data gathered for this study, together with experience in the United Kingdom, suggests that there are a number of key issues in relation to the IT Practitioner labour market and the future supply of such skills for the EU as a whole. If the leading position in the development and use of the strategic Information and Communication Technologies aspired to for Europe by Commissioner Erkki Liikanen and others is to be realized, it is likely that measures in relation to the following key issues must be given serious consideration. Clarification is needed in particular in relation to:

- the ***importance of the IT Practitioner community active within User organisations***, in addition to that within the ICT (Supply) Industry (e.g. improved understanding of the needs of employers and practitioners beyond the ICT sector). Possible European level measures might include: improved measuring of this community and of labour market interactions between supply and user employers, identification of effective arrangements for ensuring adequate representation of User employer needs;
- the scale, scope, and importance of, and possible effective measures to prepare, ***those without IT tertiary education working as IT Practitioners***. Measures might include improved public-private partnerships tailored to providing high quality high intensity transition learning and assessment of those currently working in other occupations. EU level measures need to consider both successful experience (good practice) in those Member States with experience and a European wide relevant assessment standard (e.g. EUCIP). Possible European level measures might include: strengthened support for EUCIP-like initiatives in addition to Tertiary IT curriculum development (e.g. drawing on *Career-Space* developments);
- opportunities for ***improving the validity and consistency of national data-gathering*** in relation to understanding the IT Practitioner labour market Possible European level measures might include: analysis of current constraints to refinement of official classification and survey arrangements; agreement on occupational classifications that could be used for new primary research across all Member States, etc.

In nearly every case, improved understanding of the exact position in relation to these issues through the assembling of further objective data, and the following section lists the areas where the data gathered for this study could be usefully extended.

6.4 Proposed Full Study for all EU Member States

This Preliminary Study has produced certain baseline understanding of the overall position of the European labour market for IT Practitioners, with the situation in four Member States being examined in more depth. However, the available resources have limited the depth to which certain aspects of the analysis could proceed, and, in the light of CEPIS Member Society interests and priorities, considerably more light could be shed on particular aspects of the analysis.

Among the areas that are candidates for further data-gathering and analysis are (in order of consultant's initial thoughts on relative importance/priority):

a) Extension of the detailed coverage to the remainder of the EU Member States and to the *Computer Associate Professional* (ISCO 312) occupation;

b) Comparison of the "actual" figures for Quarter 2 of 2001 (and beyond) when these become available – with the scenario forecasts, and careful review of what can be learned from the divergence(s);

c) Investigations of the relationship between more detailed occupational frameworks and the skillsets and competencies needed for effective performance of these occupations (*knowledge and understanding*, *experience* and *specific software tool competencies* – see Figure 1)

d) Gathering of (official) data on Higher Education provision in IT (including trend data), in particular:
   - i. Flows through IT courses;
   - ii. Prior academic achievement (and volumes) of applicants;
   - iii. "First destinations" of graduates (IT graduates and non-IT graduates into IT Practitioner and other work as the first (real) job).

e) Data on penetration of *proprietary qualifications* (at least for Microsoft and Cisco) within European countries (including trend data);

f) Data on the (commercial) training market – including trends of best estimates of both turnover and volumes in Member States;

g) Exploration of the dynamics of the national ITP labour market, in particular the ("phasing") correlation of labour force levels in relation to business activity in IT;

h) Review of other data sources (e.g. OECD work – e.g. on migration of ITPs);

i) Extension of the analysis, where possible, to cover the Telecommunications sector and hardware-oriented occupations (e.g. electronic engineers);

j) More detail on comparative review of impact of national policy responses, including documenting and dissemination of successful initiatives.

6.5 Specific Recommendations

These considerations lead to a number of natural recommendations:

a. That CEPIS review the issues flagged in section ***6.3*** with the EU Commission's *ICT Skills Monitoring Group* to clarify the degree of importance they justify and the priorities for possible future CEPIS contributions to policy development at the European level;

b. That, in the light of the outcomes of these discussions, CEPIS explore with the European Commission ways on which this preliminary work can be extended, possibly in partnership (e.g. with *Career-Space, EICTA,* and/or *EISA*), in order to improve the validity of the evidence available on key issues for future policymaking in relation to IT Practitioner skills at the European level;

c. That this exploration explicitly consider the relative importance of the different possible extensions of coverage listed in ***6.4***;

d. That, as part of the follow-on work, CEPIS Member Societies convene within their own countries, in partnership with key representatives of national ICT employers and government, reviews of the national skills position that could serve to improve the validity of each national component of the overall EU-level analysis;

e. That relevant Eurostat officials, as well as representatives of national statistical offices, take part in these reviews, in order to explore ways of improving the comparability of national occupational statistics in this area, and of contributing to the development of increasingly harmonized occupational frameworks for IT Practitioner occupations within Europe.

Information Technology Practitioner Skills in Europe

Glossary

Glossary

(i) Abbreviations

Assintel	Association of Information and Telecommunications Cos. (Italy)
BCS	British Computer Society
BITKOM	German Association for Information Technology, Telecommunications and New Media
CEDEFOP	European Centre for the Development of Vocational Training
CEPIS	Council of European Professional Informatics Societies
CAP	*Computer Associate Professional* (ISCO 312)
CP	*Computing Professional* (ISCO 213)
CPD	Continuing Professional Development
E3M3	Economic Model of Europe (produced by ERECO)
ECDL	European Computer Driving Licence
EEA	European Economic Area
EICTA	European ICT industry Association
EISA	European Information Technology Services Association
EITO	European Information Technology Observatory
EMTA	Engineering and Marine Training Authority (UK)
ERECO	European Economic Research and Advisory Consortium (eeig)
ESRI	Economic and Social Research Institute (Ireland)
EU	European Union
EUCIP	European Certification for Informatics Professionals
FEANI	European Federation of National Engineering Associations
FEEI	Association of Austrian Electrical & Electronics Industries
FENIT	Netherlands IT Federation
GIIT	(EU) Inter-institutional Terminology and Documentation Group
ICT	Information and Communications Technologies
IDC	International Data Corporation
IIE	Institute for Information Economics (Germany)
INSEA	Information Services Association (Belgium)
IS	Information Systems
ISCED	International Standard Classification of Education
ISCO	International Standard Occupational Classification
ISIC	International Standard Industry Classification
IT	Information Technology
ITP	Information Technology Practitioner
LFS	Labour Force Survey
NACE	*Nomenclature generale des Activites economiques dans laCommunaute Europeenne* (c.f. ISIC)
NIESR	(UK) National Institute for Economic and Social Research
OECD	Organisation for Economic Cooperation and Development
SFIA	Skills Framework for the Information Age (UK)
SIC	Standard Industrial Classification
SOC	Standard Occupational Classification (SOC90, SOC2000) (U.K.)
V-ICTN	ICT Association of the Netherlands
VIW	Association for e-Business in Austria
WIFO	Austrian Institute for Economic Research
WITSA	World Information Technology and Services Alliance
Y2K	Year 2000 (computer date change problem)

(ii) Education and Training terms in different European languages (from GIIT-CEDEFOP ***Glossarium***)
(diacritics excepted)

ES	DA	DE	EN	FR	IT	NL	PT
educacion	uddannelse	Bildung	Education	Education	educazione	vorming	educacao
cultura general	Almen dannelse	Allgemeinbildung	General education	Culture generale	Cultura generale	Algemene vorming	Cultura geral
Formacion profesional	Erhvervs-uddannelse; Erhvervsmaessig uddannelse	Berufsbildung; Berufliche Bildung	Vocational training	Formation profess-ionnelle	Formazione professionale	Beroepsvorming; beroepspleiding	Formacao profissional
Educacion continua; Formacion continua	videreuddannelse	Weiterbildung	Continuing education	Formation continue	Formazione continua	Voortgezette vorming	Formacao continua
Ensenanza profesional	Erhvervs-uddannelse; Erhvervsmaessig uddannelse	Berufsausbildung; berufliche Ausbildung	Vocational education	Enseignement professionnel; (L): Regime professionnel	Istruzione professionale	beroepsonderwijs	Ensino profissional
Formacion profesional inicial	1. erhvervsmaessig grunduddannelse 2. erhvervfaglig grunduddannelse;	Berufliche Erstausbildung	Initial training (initial professional development)	Formation professionelle initiale	Formazione iniziale	(B): Initiele beroepsvorming (NL): Primair beroepsop-leidende educatie	Formcao profissional inicial
Aprendizaje	Laerlinge-uddannelse	Lehre; Lehrlings-ausbildung	apprenticeship	Apprentissage (stage?)	apprendistato	(B): Leerlingwezen; (NL): leerlingstelsel	Aprendizagem

Annexes

Annex A

Definitions, Datastructures and Limitations

Annex A

Definitions, Datastructures and Limitations

Definitions: What are IT Practitioners and where do they work?

There are probably as many views as to what IT Practitioners are and do as there are people who take an interest in this area. It is inevitable that readers of this report from different EU Member States will have a range of particular perspectives. The different kind of work in (and around) labour markets, including the work of those considering and developing:

- careers material,
- education and training approaches and programmes,
- professional formation and career development requirements, and
- salary surveys,

all require the assumption of a set of occupational definitions (with a greater or lesser detail of skill/competence requirements) in the broad area of interest. These different focuses inevitably have different requirements as to the amount of detail of skill requirements and the "granularity" of the classification. For example, Salary surveys generally require information about a comparatively large number of occupational categories, so that individual employers will learn about market conditions for the categories they happen to use – this can result in *many dozens* of "job titles" being used for different kinds of IT practitioners. On the other hand, careers material needs to paint a "broad brush" picture of general areas of activity in an attractive way – here the number of types of IT practitioner would generally be much lower – generally *less than 10*.

In addition to the range of application areas for occupational classifications, the speed of development of the technology, of the tools, systems and methodologies arising from this and their penetration into the marketplace have also played a role. As IT management and occupational analysts in different organizations, contexts and countries have tried – over the last few decades - to distil structure from the fast-changing picture, it is understandable that a number of different occupational frameworks have emerged.

But from the point of view of sound analysis of the IT Practitioner labour market – of tracking developments and understanding the labour market well enough that sensible decisions can be made, both at the enterprise and at the public policy levels – the most important set of occupational frameworks are those for which *surveys* (whether of employers or of individuals) have been carried out. Even within a single country (e.g. the United Kingdom) a range of different frameworks have been used for surveys (these are shown in ***Skills99***). While there are broad similarities, the fact that the frameworks used are not the same means that data gathered from the different surveys cannot generally be usefully compared, and thus contribute to building up an overall picture enriched by evidence from all the different surveys.

The great desirability of the use of a single ("unifying") framework for all surveys (and ideally, for as many other applications as possible) led to an initiative over the late 1990s within the UK to win wide support for such a framework, built largely from the BCS's *Industry Structure Model*. The resulting framework

- “Skills Framework for the Information Age” (SFIA) - developed with active steer from industry, has considerable merit, but needs even greater buy-in. Details can be found at www.e-skillsnto.org.uk/sfia/. The only framework of an international character developed thus far arose from an initiative by a number of large European ICT companies, which led to the development of the “*career-space*” framework. Since this is intended first and foremost for careers promotion purposes, it is a relatively “coarse-grained” framework (with thirteen generic job profiles, including Communications specialisms), and it is only 1-dimensional – i.e. it does not directly reflect the fact that different occupations exist at different levels of technical complexity and responsibility. More details can be found at www.career-space.com.

It is important to recognize that – for a fast moving set of industrial sectors and occupations – the task of tracking development in a robust quantitative way will always be very difficult. All occupational frameworks in such an environment need to have review and updating built in. Even more difficult in that situation is the task of forecasting future skill needs, both in terms of “competence-content” and of development of numbers required in the labour market as a whole, since trend data is lost if a single occupational framework cannot be sustained.

Probably the most important principle to be understood when trying to develop a sound view of IT Practitioner skills is to recognize the *fundamental distinction between the **sector** and **occupational** perspective*. IT (supplier) companies arise from, and are strongly influenced by, the abilities of the “technical people”. But such companies generally also employ people with a range of other skills, in support operations of various kinds (e.g. accounts people, admin. people, marketing and sales people, personnel staff, general managers, office cleaners, etc.). In addition, organizations in most other parts of the economy – e.g. banks, manufacturing companies, local authorities, hospitals (and other health care operations), airlines, retail businesses, government departments, etc. - all make considerable use of Information Technology, and in doing so, generally have “IT departments” that employ teams of IT Practitioners. In many countries, the number of IT practitioners employed in these “IT user organizations” is greater than the numbers employed in IT (supplier) companies. Table A-1 shows the structure in its simplest form: a 2 x 2 matrix. The numbers of people employed in the 4 boxes show the basic profile of a country’s IT practitioner community.

Note that this report makes no attempt to describe the skills position of “IT End-Users” – the (millions) whose main job is not IT, but who use IT - often very considerably - in their work. While many “End-Users” are extremely capable “drivers” of powerful software tools, they are not IT practitioners until they shift over (as many hundreds of thousands undoubtedly do within Europe each year) into employing these skills essentially for the benefit of others.

Telecommunications and Electronics sectors and occupations and Convergence

Recent developments in digital technology have accelerated the convergence of a series of related technologies and markets. This convergence is very important and will further increase the impact of these technologies on most aspects of our lives. It is also introducing further complexity into attempts to clarify the labour markets involved.

The approach of this study is, while recognizing these realities, to emphasise the ***occupational*** view of the world, since, while new products and services will continue to spawn fast-growing new sectors which will need a range of different technical skills, the key underlying occupational differences – e.g. between software development and electronics design and technical skills - will remain.

The scope of this feasibility study was not intended to include coverage of (tele) commun-ications or electronics occupations (or these supply sectors). Where data is readily available for these, it has been mentioned, and it would in principle be possible in principle to extend the scope of this approach to cover these at a later date.

Table A-1

	IT (Supply) Companies	IT User Organisations
IT Practitioner Occupations		
Other Occupations		

This simple 2x2 table can be expanded to show the different types of IT Practitioner occupation and of IT Supply Companies. As indicated, there are many possible ways of doing this (depending on the purpose for which the framework is needed), but Table A-2 gives an example, showing some of the different types of "high-tech" sectors emerging.

Table A-2

One "Forward-Looking" Classification (including Electronics and Communications)

	Electronic Hardware System and Component Manufacturing companies	"Digital Media" companies, inc. • education s/w • web devel't • entertainment content	Companies primarily engaged in e-commerce	Telecomm-unications companies	S/W Development & IT Ops activities of IT user organizations
IT Managers					
Team Leaders/ Supervisors					
Business Analysts					
Designers/ Architects					
Software Developers					
Software QA specialists					
Systems Admin people					
Database Admin people					
Technical Support specialists					
Content Designers/ Developers					
Electronics Engineers					
Radio Freq'cy Engineers					
Electronics Technicians					
(All other occupations)					

Occupational Frameworks for this Study

This study has two important characteristics:

- It is exploring the aspiration of tracking IT Practitioner developments within a number of different European countries (in a common "language"), and
- It is desired that its findings (or at least those conclusions arising from it) can be taken seriously enough by policy makers (both in national governments and at the European Union level) to get them used in public policy measures in relation to feared skill shortages.

In addition, the desire to explore forecasts of future numbers means that trend data in figures would bring additional information about recent market movements: thus datasets for which there are time series would be of particular value.
These three considerations inevitably lead to the selection of official national Labour Force Survey (LFS) data for the core common datasets. The national statistical data on EU Member State labour forces is held by the official EU statistics office "Eurostat". While the national household surveys are generally carried out on a quarterly basis, the Eurostat Member State LFS will not receive full quarterly data from all Member States till 2005. However, the Eurostat holdings do now have quarterly returns for over half the countries (see below).

The occupational and sectoral classification systems used by Eurostat are *ISCO-88 COM* and *NACE* (this is essentially the same as the "International Standard Industry Classification" – ISIC), where the corresponding UK national classifications are the Standard Occupational Classification (SOC) and Standard Industry Classification (SIC)*.

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* The UK occupational classification (SOC90) has two core technical occupations: *Computer Analyst/Programmer* and *Software Engineer*. The latter includes both those with university degrees and those without. It was not possible (when considering the mapping from SOC90 to ISCO-88, to split these two categories, as a result of which a decision was made to allocate all to ISCO 213. The Irish statistical office chose to follow this process, and this means that comparisons involving the UK and Ireland are really only possible for ISCO 213 ("Computing Professionals"). This is a significant inconsistency that means that any serious cross-Member State comparisons must be carried out using the ***sum*** of the figures for the two ISCO codes.

Table A-3 shows a third Occupational <-> Sectoral matrix, this time showing the relevant groupings that are used for official LFS statistics at the European level.

Table A-3

Current relevant Official Classifications at European Level

(including Electronics and Communications)

	<--------------------------------- ICT supply --------------------------------->				
	Hardware Manufacture (NACE 30-33)	**Hardware & Software Wholesale & Retail (some NACE 51)**	**Tele-communications (NACE 64.2)**	**Consultancy, Software, Other Computer-related Business (NACE 72)**	**User Organisations (can be split into different broad groups) (The rest)**
Computing Professionals (ISCO 213)					
Professional Engineers and Architects (ISCO 214)					
Computer Associate Professionals (ISCO 312)					
Physical and Engineering Science Technicians (ISCO 311)					

As indicated, the scope of this feasibility study does not include Electronics or Communications sectors or occupations, and thus the core common datasets focus on the Computer-related occupations, covering both IT supply (NACE 72) and User Organisation groupings.

The top level structures of the NACE and ISCO frameworks are as shown on the following pages.

NACE

Nomenclature generale des Activites economiques dans la Communaute Europeenne
(c.f. ISIC, SIC in the UK)

Statistical Classification of Economic Activities
(NACE Rev.1 : used in LFS for "main business activity of employer")
(Top level – 2-digit – structure)

Section A: Agriculture, hunting and forestry

01 Agriculture, hunting and related service activities

02 Forestry, logging and related service activities

Section B: Fishing

05 Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing

Section C: Mining and quarrying

10 Mining of coal and lignite; extraction of peat

11 Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying

12 Mining of uranium and thorium ores

13 Mining of metal ores

14 Other mining and quarrying

Section D: Manufacturing

15 Manufacture of food products and beverages

16 Manufacture of tobacco products

17 Manufacture of textiles

18 Manufacture of wearing apparel; dressing and dyeing of fur

19 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear

20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials

21 Manufacture of pulp, paper and paper products

22 Publishing, printing and reproduction of recorded media

23 Manufacture of coke, refined petroleum products and nuclear fuel

24 Manufacture of chemicals and chemical products

25 Manufacture of rubber and plastic products

26 Manufacture of other non-metallic mineral products

27 Manufacture of basic metals

28 Manufacture of fabricated metal products, except machinery and equipment

29 Manufacture of machinery and equipment n.e.c.

30 ***Manufacture of office machinery and computers***

31 Manufacture of electrical machinery and apparatus n.e.c.

32 Manufacture of radio, television and communication equipment and apparatus

33 Manufacture of medical, precision and optical instruments, watches and clocks

34 Manufacture of motor vehicles, trailers and semi-trailers

35 Manufacture of other transport equipment

36 Manufacture of furniture; manufacturing n.e.c.

37 Recycling

Section E: Electricity, gas and water supply

40 Electricity, gas, steam and hot water supply

41 Collection, purification and distribution of water

Section F: Construction

45 Construction

Section G: Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods

50 Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel

51 Wholesale trade and commission trade, except of motor vehicles and motorcycles

52 Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods

Section H Hotels and restaurants

55 Hotels and restaurants

Section I: Transport, storage and communication

60 Land transport; transport via pipelines

61 Water transport

62 Air transport

63 Supporting and auxiliary transport activities; activities of travel agencies

64 Post and ***telecommunications***

Section J: Financial intermediation

65 Financial intermediation, except insurance and pension funding

66 Insurance and pension funding, except compulsory social security

67 Activities auxiliary to financial intermediation

Section K: Real estate, renting and business activities

70 Real estate activities

71 Renting of machinery and equipment without operator and of personal and household goods

72 ***Computer and related activities***

73 Research and development

74 Other business activities

Section L: Public administration and defence; compulsory social security

75 Public administration and defence; compulsory social security

Section M: Education

80 Education

Section N: Health and social work

85 Health and social work

Section O: Other community, social and personal service activities

90 Sewage and refuse disposal, sanitation and similar activities

91 Activities of membership organization n.e.c.

92 Recreational, cultural and sporting activities

93 Other service activities

Section P: Private households with employed persons

95 Private households with employed persons

Section Q: Extra-territorial organizations and bodies

99 Extra-territorial organizations and bodies

NACE Groupings used for *Employer Sector employment distribution* for each Member State ITP Labour Market examined in detail (Annexes B, C, D and E):

Manufacturing & Construction:
NACE 15-36 inclusive, 45

Transport & Distribution:
NACE 50,51,52,60,61,62,63

Financial and other Business Services:
NACE 65,66,67,70,71,74

Government:
NACE 75,80,85,90

IS Industry:
NACE 72

"The Rest":
NACE 1,02,05,10,11,12,13,14,37,40,41,55, 64, 73, 91, 92, 93, 95, 99

ISCO

International Standard Occupational Classification
(ISCO-88 (COM))
(Top level – 2-digit – structure)

100 Legislators, senior officials and managers

110 Legislators, senior officials and managers

120 Corporate managers

130 Managers of small enterprises

200 Professionals

210 Physical, mathematical and engineering science professionals

213 ***Computing Professionals***

220 Life science and health professionals

230 Teaching professionals

240 Other professionals

300 Technicians and associate professionals

310 Physical and engineering science associate professionals

312 ***Computer Associate Professionals***

320 Life science and health associate professionals

330 Teaching associate professionals

340 Other associate professionals

400 Clerks

410 Office clerks

420 Customer services clerks

500 Service workers and shop and market sales workers

510 Personal and protective services workers

520 Models, sales persons and demonstrators

600 Skilled agricultural and fishery workers

610 Skilled agricultural and fishery workers

700 Craft and related trades workers

710 Extraction and building trades workers

720 Metal, machinery and related trades workers

730 Precision, handicraft, craft printing and related trades workers

740 Other craft and related trades workers

800 Plant and machine operators and assemblers

810 Stationary-plant and related operators

820 Machine operators and assemblers

830 Drivers and mobile plant operators

900 Elementary occupations

910 Sales and services elementary occupations

920 Agricultural, fishery and related labourers

930 Labourers in mining, construction, manufacturing and transport

000 Armed forces

010 Armed forces

National Occupational Classifications against which data is cross-coded to ISCO-88 (COM):

Germany: ***KldBB-92 Rev*** Ireland: (as for UK) Sweden: ***SSYK-95*** United Kingdom: ***SOC90***

Limitations: Eurostat Holdings of Member State Labour Force Survey data

Much of the analysis within this report draws on data from the official statistical unit of the European Union. The ***Eurostat*** service is an impressive data source, and enables considerable comparative analysis to be carried out across Member States. However, as can be guessed from the above, caution must be exercised in this process, since the traditions for gathering official statistics in different Member States inevitably involve differences.

Labour Force Surveys are "household" surveys. That is to say a large number of *individuals* are interviewed at home (in this case) about a significant number of aspects of their working lives, and the figures produced from the response sample (e.g. some 120,000 responses in the UK for a working population of some 30 million) are "grossed-up" to provide estimates of the characteristics for these different aspects for the working population as a whole.

Probably the most significant variation between the national LFS data surveys concerns the size of the sample. These vary between country, and the sample size affects the threshold below which grossed up figures can be considered statistically meaningful, reliable or robust. Table A-4 shows these thresholds for this data, and they are indicated on each Figure where this caveat is relevant.

Table A-4

Member State	Code	Reliability Threshold (of grossed-up estimates)
Austria	AT	2,000
Belgium	BE	2,500
Denmark	DK	2,500
Finland	FI	2,500
France	FR	3,500
Germany	DE	8,000
Greece	GR	2,500
Ireland	IE	2,500
Italy	IT	3,500
Luxembourg	LU	500
Netherlands	NL	4,500
Portugal	PT	7,500
Spain	ES	2,500
Sweden	SE	9,000
United Kingdom	UK	10,000

This means that any data involving values lower than these thresholds cannot be relied upon. Since the size of the IT Practitioner labour market in EU Member States is now very significant, the total grossed-up estimates arising from these Labour Force Surveys are generally well above the reliability limits. However, as cross-tabulations are carried out to clarify certain *detailed* characteristics of the IT Practitioner working population (for example breaking down the total numbers into age-bands), the resulting totals for some categories are often small enough to result in risk of statistical unreliability. For this reasons the thresholds in the charts need to be checked (the relevant threshold is indicated in each chart title).

In addition to the occupational classifications and sample sizes, other potential variations between the national surveys include:

- The nature of the questions (and interpretation of the responses);
- Industry (sector) classification systems;
- Definitions of employment status;
- Classifications of educational achievement (the ISCED system – see below - is discussed in Steedman and McIntosh (2001))

Eurostat LFS Data availability over recent years

As indicated, while it has been agreed that all EU Member States should, by 2005, provide comparable LFS data on a regular quarterly basis, not all national statistical offices have yet been able to implement this. The availability for each quarter since the beginning of 1995 in the Eurostat holdings of national LFS data related to ISCO 213 and ISCO 312* is shown in Table A-5.

Table A-5

	AT	BE	DE	DK	ES	FI	FR	GR	IE	IT	LU	NL	PT	SE	UK
1995Q1	✓						✓								
1995Q2		✓	✓	✓	✓			✓		✓	✓	✓	✓		✓
1995Q3															
1995Q4															
1996Q1	✓				✓		✓								
1996Q2		✓	✓	✓	✓			✓		✓	✓	✓	✓		✓
1996Q3					✓								✓		
1996Q4					✓								✓		
1997Q1	✓				✓		✓						✓		
1997Q2		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
1997Q3					✓					✓			✓		
1997Q4					✓					✓			✓		
1998Q1	✓				✓		✓	✓					✓		
1998Q2		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
1998Q3					✓			✓					✓		
1998Q4					✓			✓					✓		
1999Q1	✓	✓		✓	✓		✓	✓					✓		
1999Q2	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
1999Q3	✓	✓		✓	✓	✓		✓		✓			✓		✓
1999Q4	✓	✓		✓	✓	✓		✓		✓			✓		✓
2000Q1	✓	✓		✓	✓	✓	✓	✓		✓			✓		✓
2000Q2	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
2000Q3		✓		✓	✓	✓		✓		✓			✓		✓
2000Q4		✓		✓	✓	✓				✓					✓

* except for Ireland and the UK

The occupational classification approaches of IDC and Career-Space

In considering the forecasting scenarios assumed in this Study in relation to the two main existing approaches, it is necessary to understand the reason behind what are major differences on the figures involved. Most of the differences arise from the different occupational classifications used, and the following tables attempt to "cross-map" between these:

IDC Classification:

ISCO-88 Codes / IDC "skills" Categories	123 "Other Specialist Managers"	213 "Computing Professio-nals"	214 "Architects, Engineers and related professio-nals"	311 "Physical and Engineering Science technicians"	320 "Computer associate Professio-nals"	313 "Optical & Electronic equipment operators"
ICT Skills:						
"Internetworking"		Some			Some	
"Applications"		Some			Some	
"Distributed"		Some			Some	
"Technology-Neutral"		Some			Some	
"Host-based"		Some			Some	
e-Business Skills:						
"Internet strategies"		Some			Some	
"Internet-dependent"		Some?			Some	
Call-centre skills:						

The IDC estimates for 1999 and 2000 in the UK can be compared with the "actual" employment in these years (figures rounded).

	1999	**2000**	scope
ISCO-88 213 *Computing Professionals*, comprising: SOC-90 214 Software Engineer + SOC-90 320 Analysts & Programmers	482,000	505,000	***Actual*** (core technical) in UK
SOC-90 totals 126 Computer Systems Manager 214 Software Engineer 320 Analysts & Programmers 490 Computer Operators 526 Computer Engineers	870,000	886,000	***Actual*** (all IT-related occupations) in UK
IDC EITO "ICT Skills" (Figures for "Supply" of skills for:) Internetworking Applications Distributed Technology Neutral Host-based	1,608,000	1,687,000	***IDC-Asserted*** for UK
SOC-90 totals for all ITPs as %age of IDC ICT Skill totals	54.1%	52.5%	

This – and comparable comparisons in the other countries examined - suggests that existing scepticism about the high levels of IDC figures among ICT labour market specialists is well-founded.

Career-Space Classification:

The initial work of the *Career-Space* consortium was to develop a number of "Generic Job Profiles" in Information and Communications Technologies:

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 the analysis carried out for the *Career-Space* employment level forecasting*, however, the thirteen *Generic Job Profiles* were mapped on to the nine (SOC90) occupations that are shown below, together with their correspondence against the ISCO classification.

* "Determining the future demand for ICT skills in Europe" (See Annexe F)

ISCO-88 Codes / SOC-90 Categories	123 "Other Specialist Managers"	213 "Computing Professio-nals"	214 "Architects, Engineers and related professio-nals"	311 "Physical and Engineering Science technicians"	312 "Computer associate Professio-nals"	313 "Optical & Electronic equipment operators"
126 Computer Systems Managers	some				Some	
212 Electrical Engineers			Some			
213 Electronic Engineers			Some			
214 Software Engineers		All				
216 Design and Development Engineers			Some			
253 Management, Business Consultants	some					
320 Computer Analysts, Programmers		All				
490 Computer Operators					Some	Some
520 Computer Engineers				Some		

Annex B

Analyses of Eurostat Data: Germany

Annex B

Analyses of Eurostat Data: Germany

The detailed profiles of the *Computing Professional* working community in Germany, on which the summary in section 4.3 is based, are shown in the following charts, drawing on official German LFS statistics as reported to Eurostat. The corresponding analyses for the *Computer Associate Professional* occupation are available, and can be presented as part of the fuller study it is hoped to carry out, if additional funding can be procured. As with equivalent figures in the following 3 Annexes, this data is subject to the limitations explained in Annex A.

Figure B-1
Numbers of *Computing Professionals* in Germany
(Source: Eurostat Holdings of Member State LFS Quarter 2 Data: values below 8,000 are not statistically reliable)

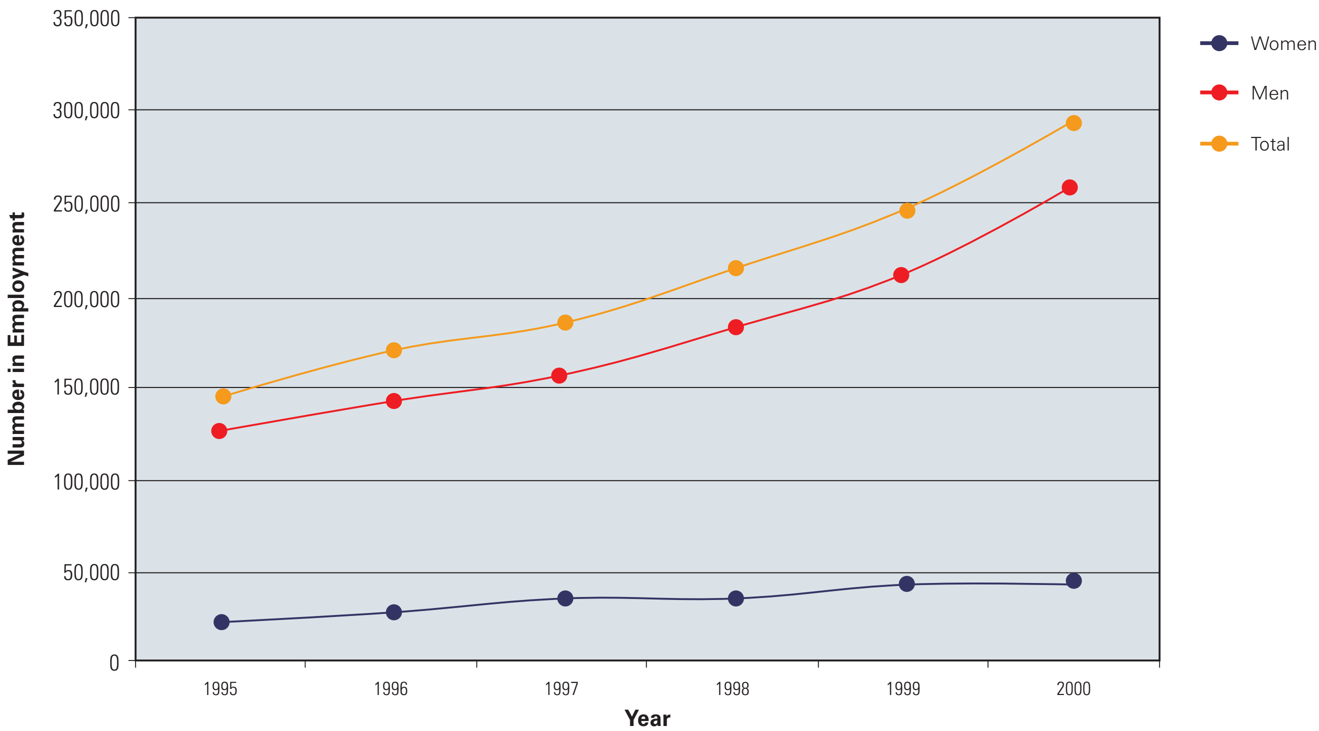


Figure B-2
Age Profiles of *Computing Professionals* in Germany

(Source: Eurostat holdings of Member State LFS Quarter 2 Data:
values below 8,000 - inc. some data in agebands below 25 and above 55 - are not statistically reliable)

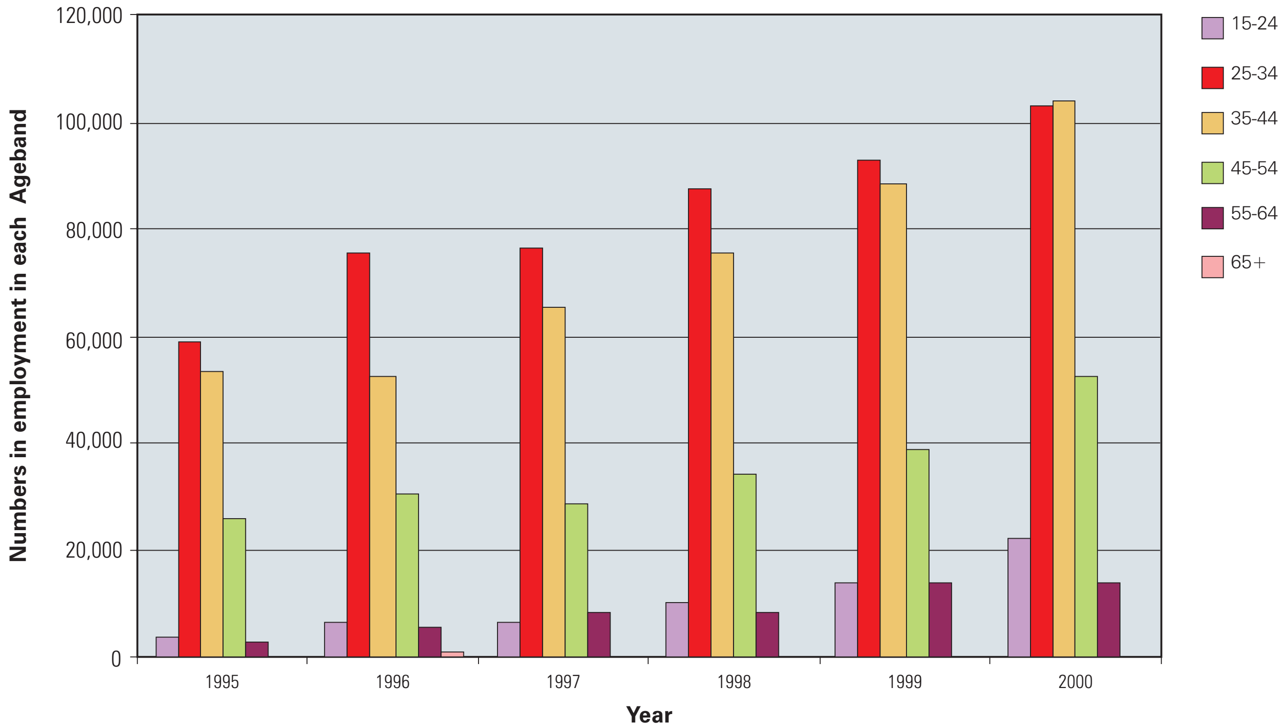


Figure B-3
***Computing Professionals* Employer Size Distribution in Germany**

(Source: Eurostat holdings of Member State LFS Quarter 2 Data
values below 8,000 are not statistically reliable)

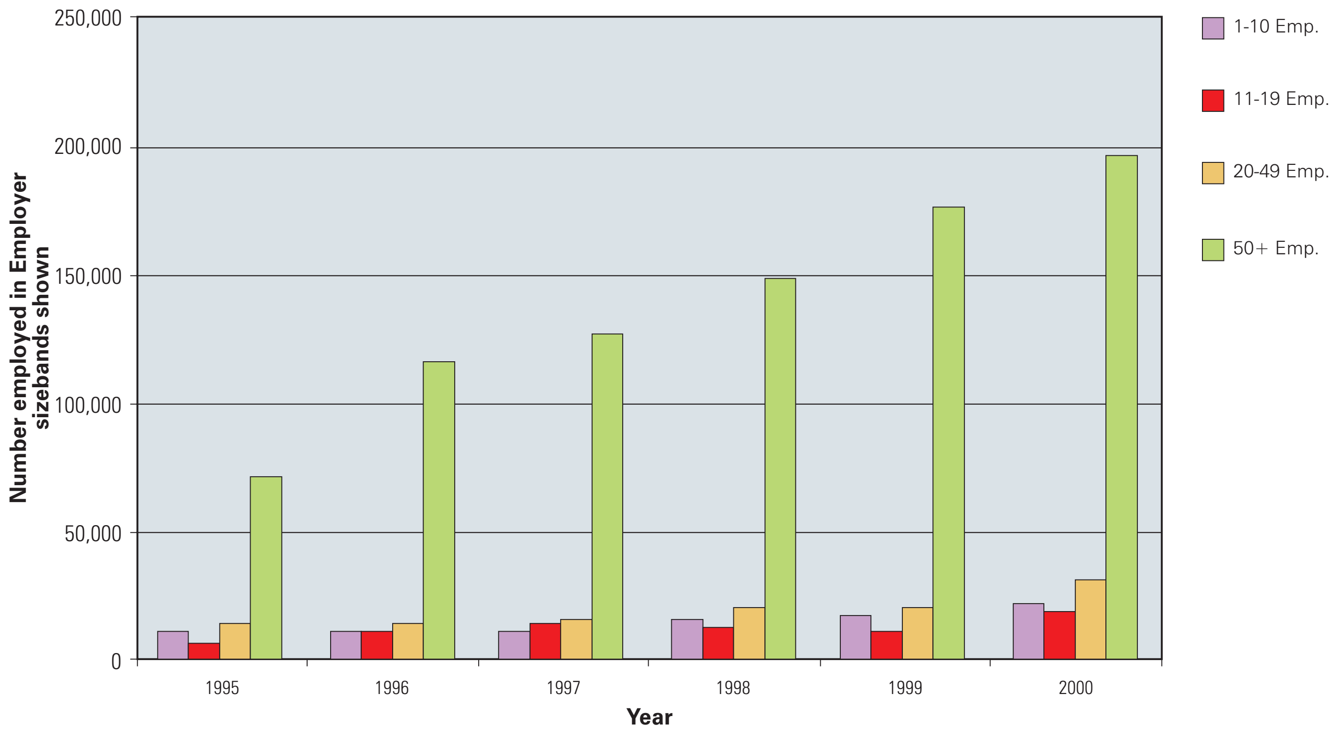


Figure B-4
Employment of *Computing Professionals* between Employer Sectors in Germany

(Source: Eurostat holdings of Member State LFS Quarter 2 Data
values below 8,000 - inc. figures for Government sector before 1998 - are not statistically reliable)

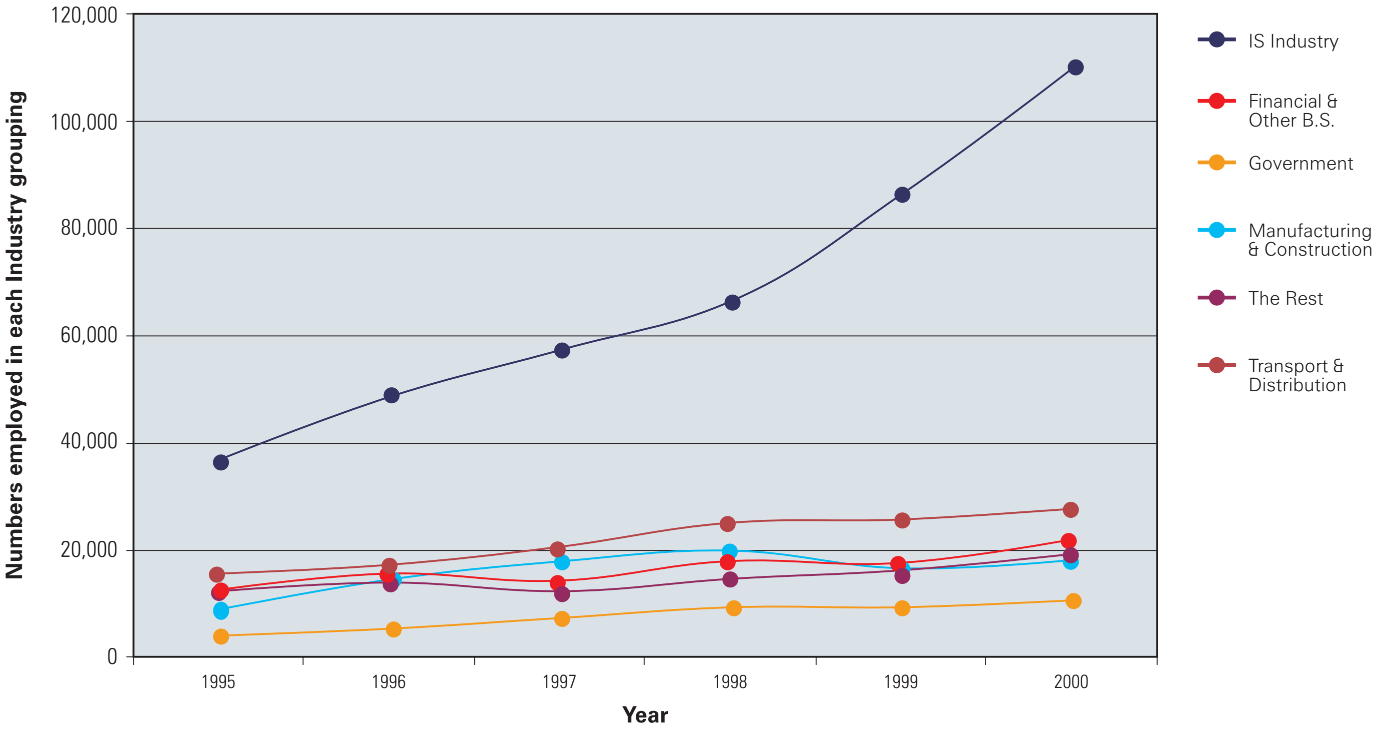


Figure B-5
Numbers of *Computing Professionals* in Germany by Employment Status

(Source: Eurostat holdings of Member State LFS Quarter 2 Data: values below 8,000 are not statistically reliable)

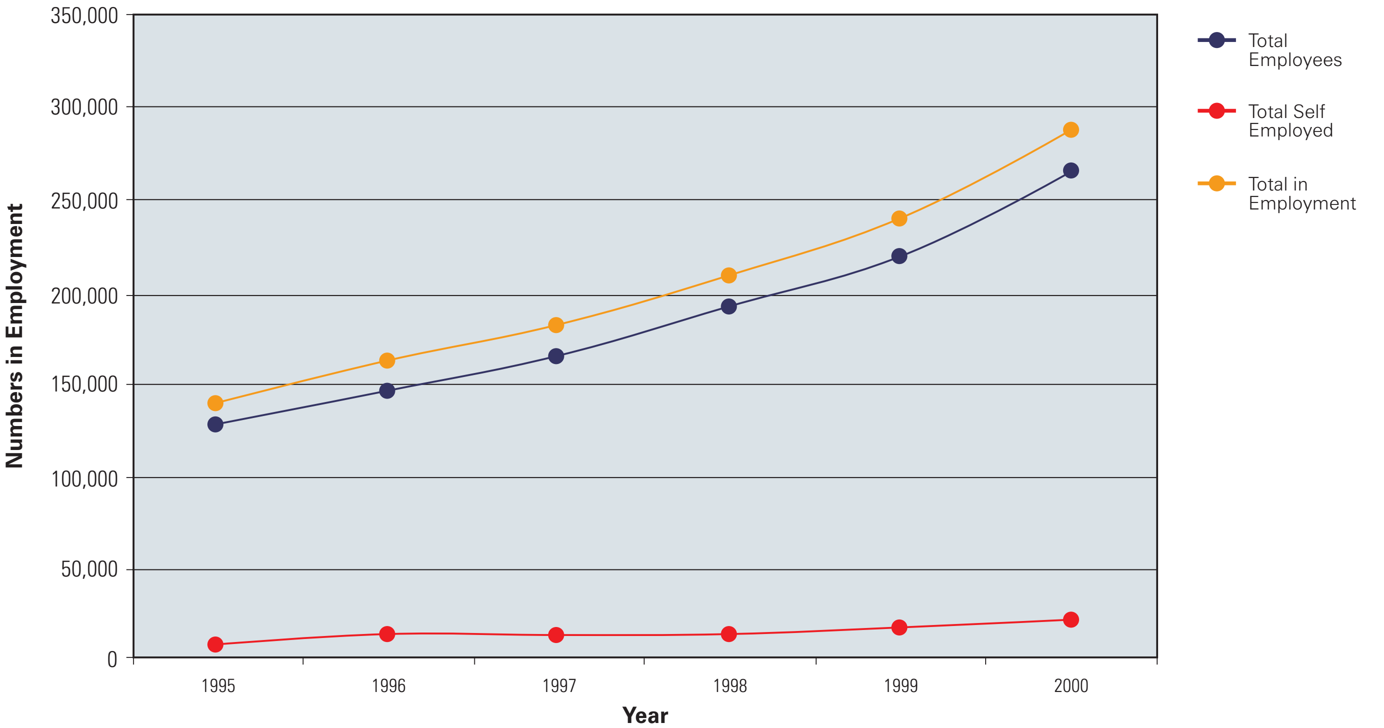


Figure B-6
Highest Education Level of *Computing Professionals* in Germany

(Source: Eurostat Holdings of Member State LFS Quarter 2 Data:
values below 8,000 - inc. most data for ISCED 0-2 - are not statistically reliable)

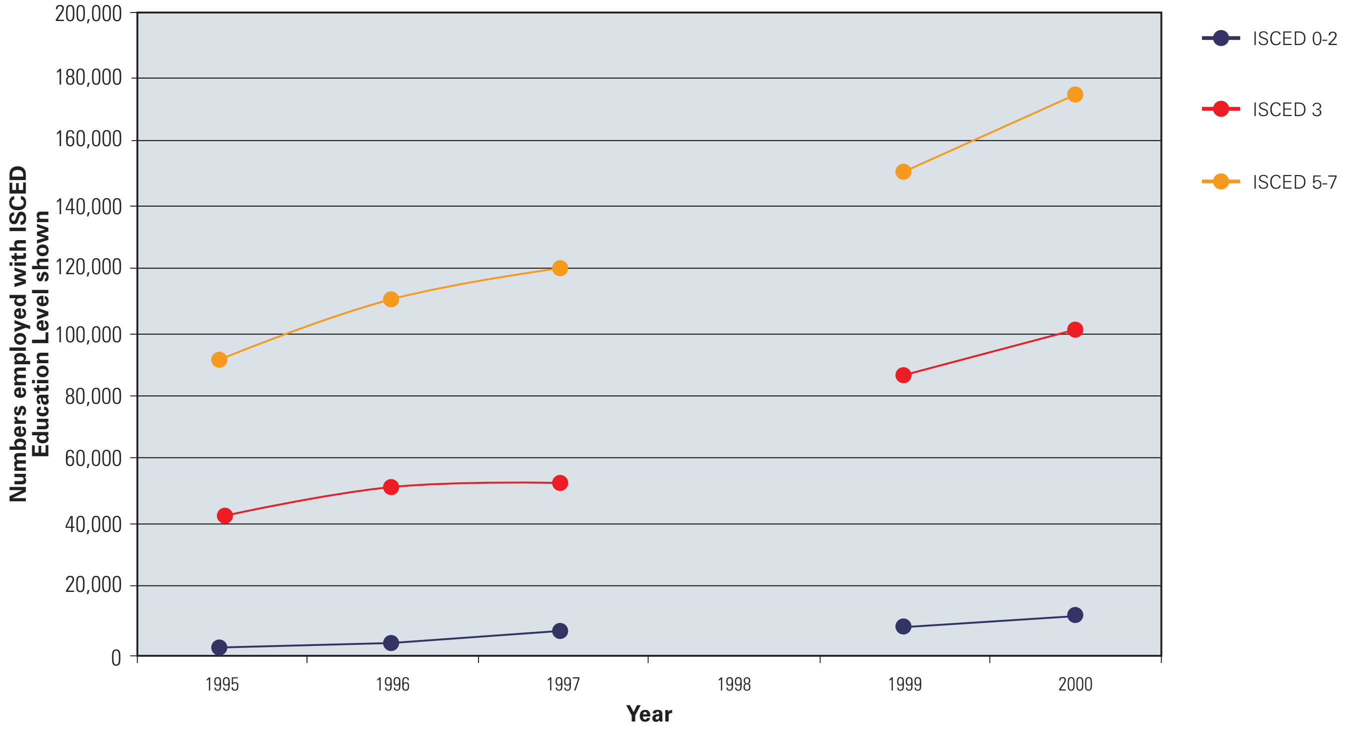


Figure B-7
Status of *Computing Professionals* in Germany one year before

(Source: Eurostat holdings of Member State LFS Quarter 2 data: Values below 8,000 - inc. all data for unemployed status - are not statistically reliable)

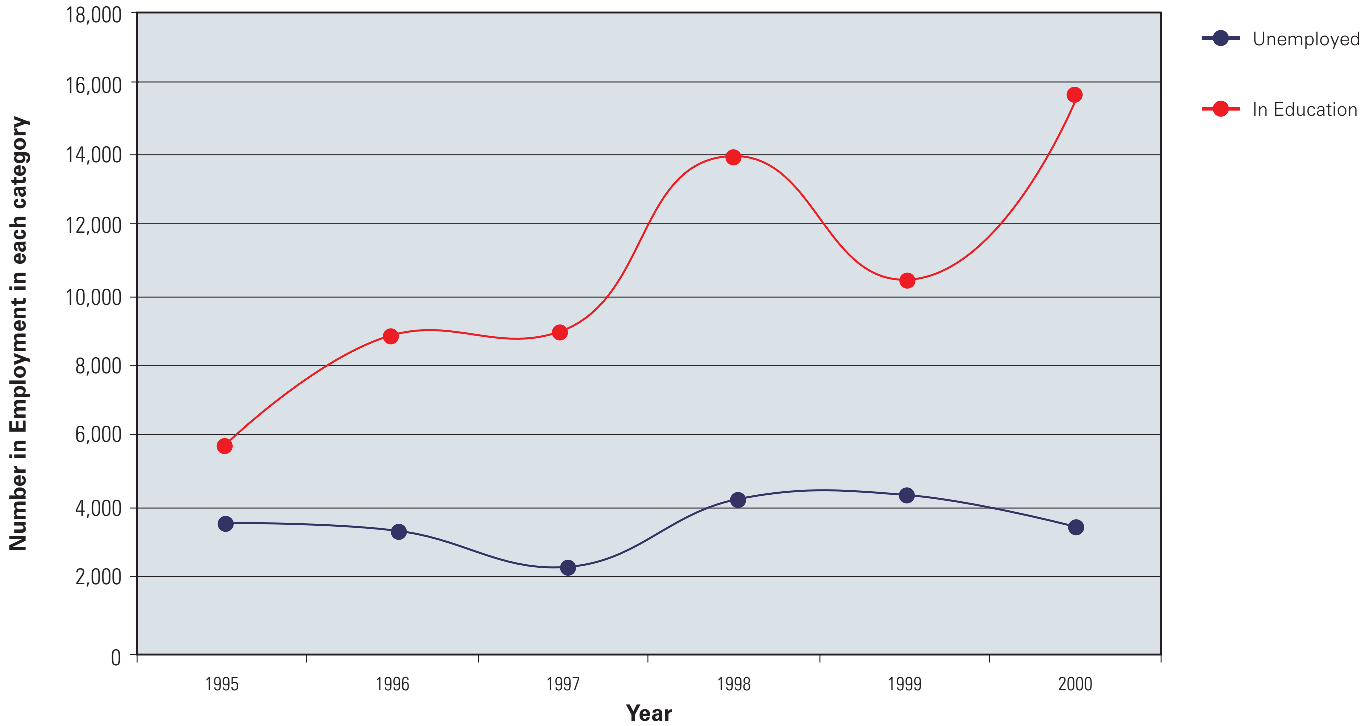
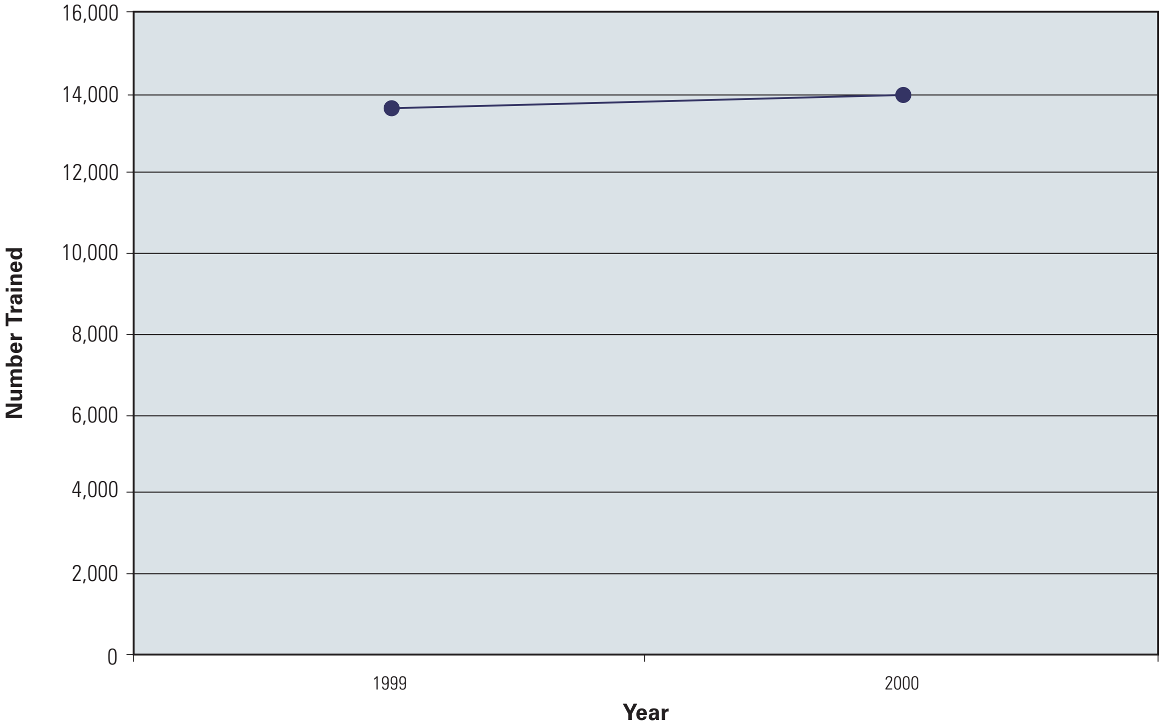


Figure B-8
Number of *Computing Professionals* in Germany who had received training in Four Weeks before Survey

(Source: Eurostat holdings of Member State LFS Quarter 2 data values below 8,000 are not statistically reliable)

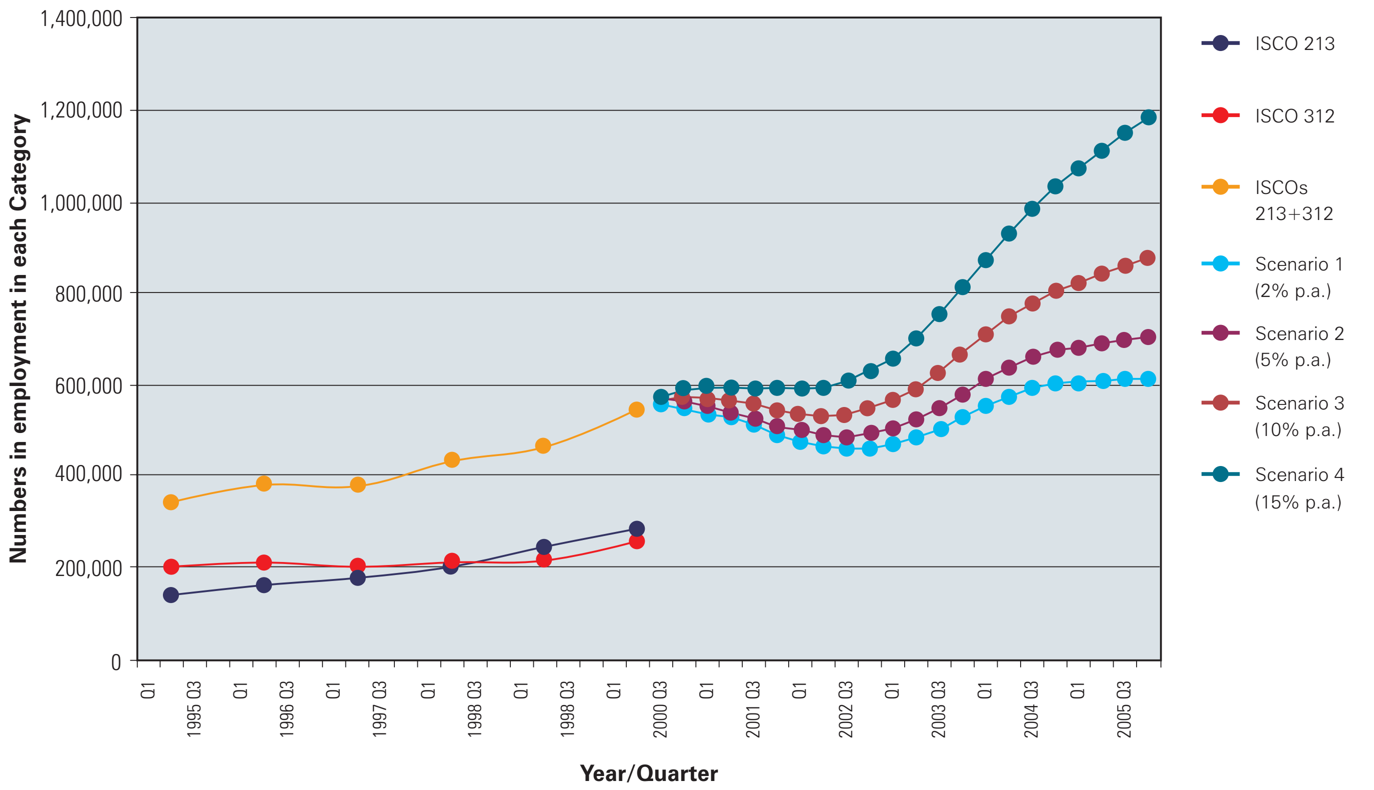


Possible Futures of IT Practitioner employment in Germany

Figure B-9 shows four scenarios for the development of the size of the IT Practitioner workforce in Germany, based on the Eurostat totals for *Computing Professionals* (ISCO 213) and *Computer Associate Professionals* (ISCO 312), based on assumptions of employment growth at 2% p.a., 5% p.a., 10% p.a. and 15% p.a., subject to an initial trough arising from the 2000->2001 loss of confidence in the ICT sector, which led to significant job losses internationally in 2001. The details of the scenario model and the reasons for its choice are given in Section 5.

Table B-1 shows, for the four scenarios given, the ***Total (net) new supply*** of skilled manpower that would be required to sustain that level of employment growth. It is recognized that the validity of the assumptions – in particular about the shape of the initial "trough", the "phasing" in relation to the relevant national business cycle, and the level of replacement demand - would be refined as the first step in deeper review analysis at the national level.

Figure B-9
Recent development of German ITP workforce total and Forecast Scenarios



N.B. Average employment growth over previous 5 years was 9.5%; employment growth in the previous year was 17.8%

Table B-1
Development Scenarios for IT Practitioners in Germany
Net supply estimation for each Scenario
(estimates have not been rounded)

	Year/ Quarter	Scenario 1: initial trough +2%		Scenario 2: initial trough +5%		Scenario 3: initial trough +10%		Scenario 4: initial trough +15%	
		Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment
Scenario Starying Point:	2002 Q2	552,087		552,087		552,087		552,087	
2000-2001:	2001 Q2	529,034		542,728		564,031		595,069	
Growth Demand			-23,053		-9,359		11,943		43,522
Replacement Demand			13,226		13,568		14,101		14,890
Total (Net) Demand			-9,827		4,209		26,044		58,412
2001-2002	2002 Q2	468,900		493,489		532,989		594,340	
Growth Demand			-60,134		-49,239		-31,042		-1,269
Replacement Demand			11,722		12,337		13,325		14,858
Total (Net) Demand			-48,412		-36,902		-17,717		-13,589
2002-2003	2003 Q2	488,559		527,489		592,071		697,187	
Growth Demand			19,659		34,000		59,083		102,847
Replacement Demand			12,214		13,187		14,802		17,430
Total (Net) Demand			31,873		47,187		73,885		120,277
2003-2004	2004 Q2	574,707		636,563		742,545		923,329	
Growth Demand			86,148		109,074		150,474		226,142
Replacement Demand			14,368		15,914		18,564		23,083
Total (Net) Demand			100,516		124,989		169,037		249,225
2004-2005	2002 Q2	607,334		690,114		836,609		1,098,537	
Growth Demand			32,626		53,551		94,064		175,208
Replacement Demand			15,183		17,253		20,915		27,463
Total (Net) Demand			47,810		70,804		114,979		202,671

Annex C

Analyses of Eurostat Data: Ireland

Annex C

Analyses of Eurostat Data: Ireland

The detailed profiles of the *Computing Professional* working community in Ireland, on which the summary in section 4.4 is based, are shown in the following charts (as for the UK IT Practitioner community, there is no corresponding data for the *Computer Associate Professional* occupation). As indicated, this is official Irish data.

Figure C-1
Number of *Computing Professionals* in Ireland

(Source: Eurostat holdings of Member State LFS Quarter 2 data: values below 2,500 are not statistically reliable)

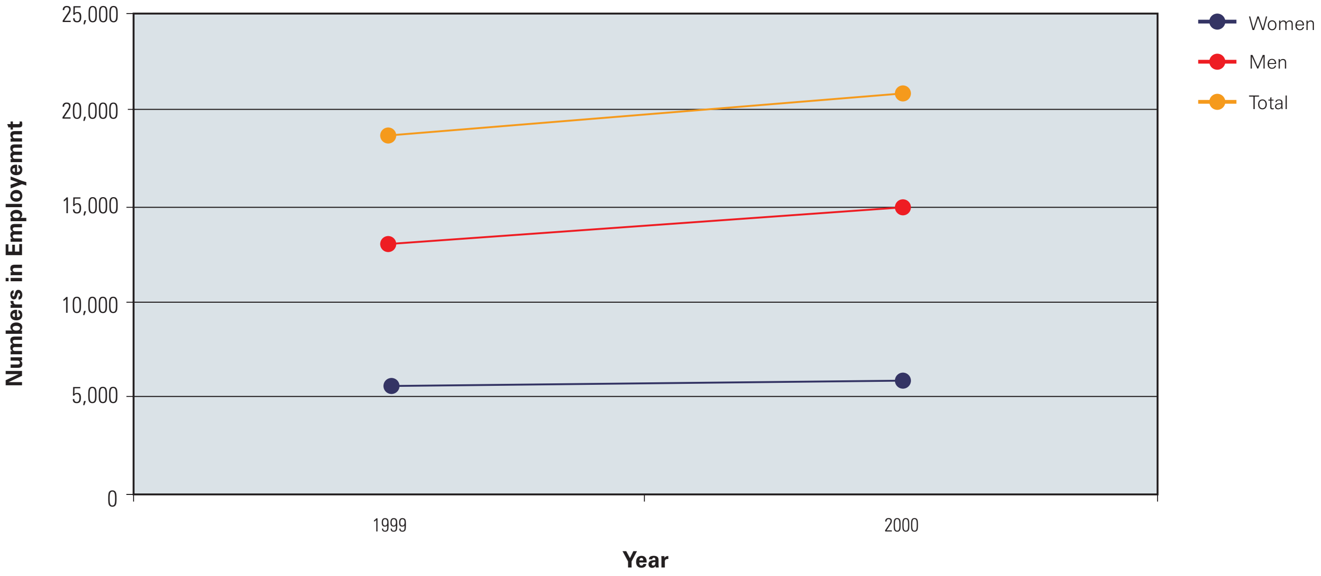
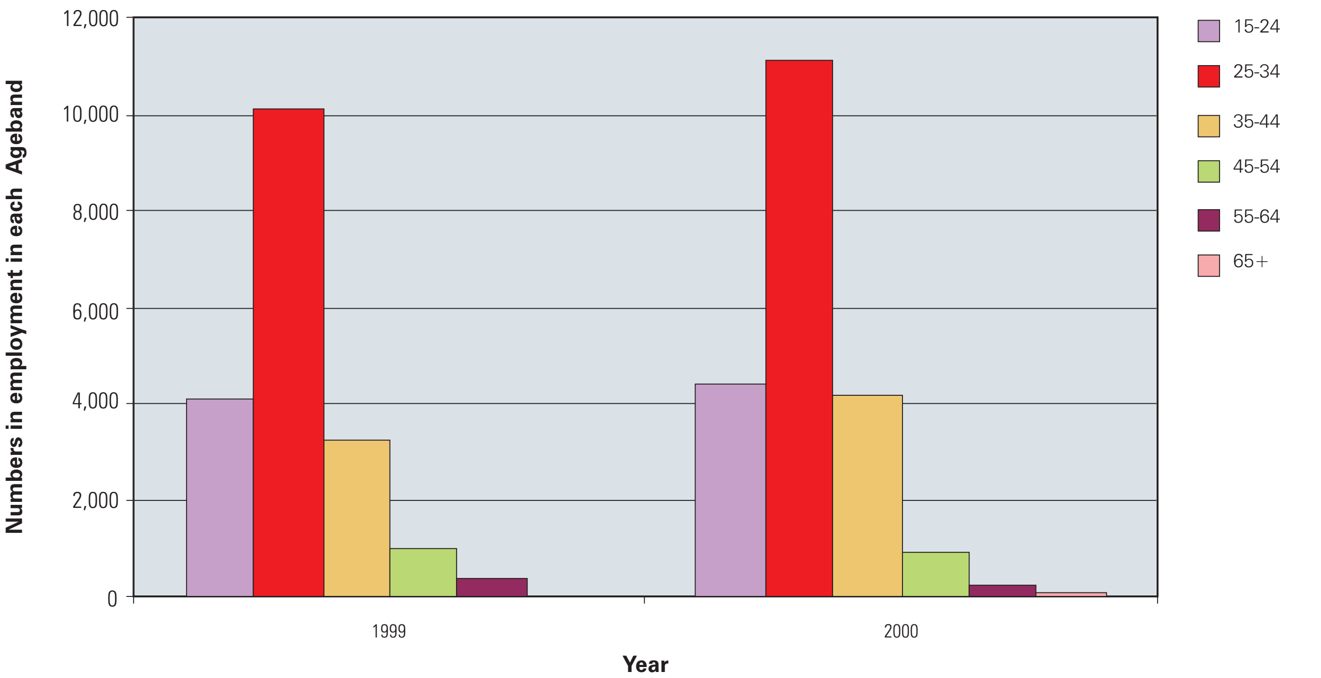


Figure C-2
Age Profiles of *Computing Professionals* in Ireland

(Source: Eurostat holdings of Member State LFS Quarter 2 data:
values below 2,500 - inc. figures for agebands above 45 - are not statistically reliable)



Employer Size Distribution of Computing Professionals in Ireland
No meaningful data available

Figure C-3
Employment of *Computing Professionals* between Employer Sectors in Ireland

(Source: Eurostat holdings of Member State LFS Quarter 2 data:
values below 2,500 - i.e. for all sectors except IS Industry - are not statistically reliable)

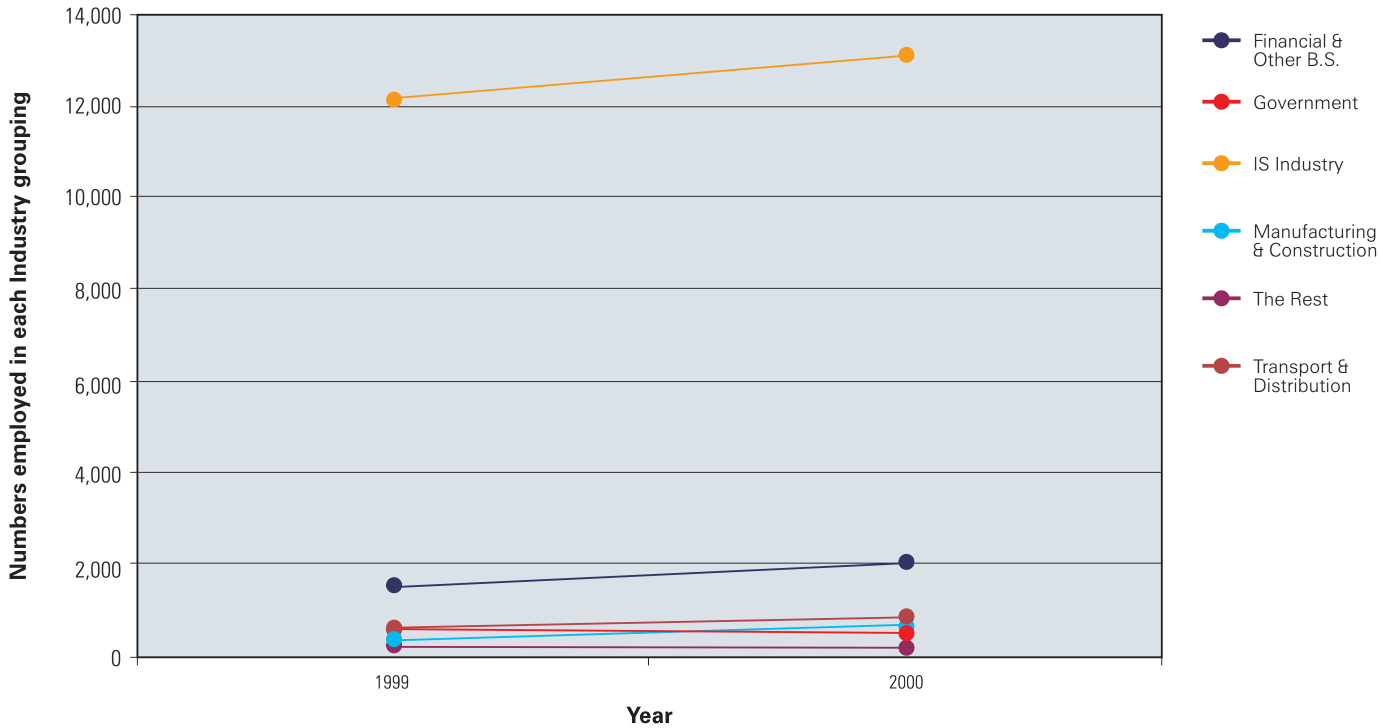
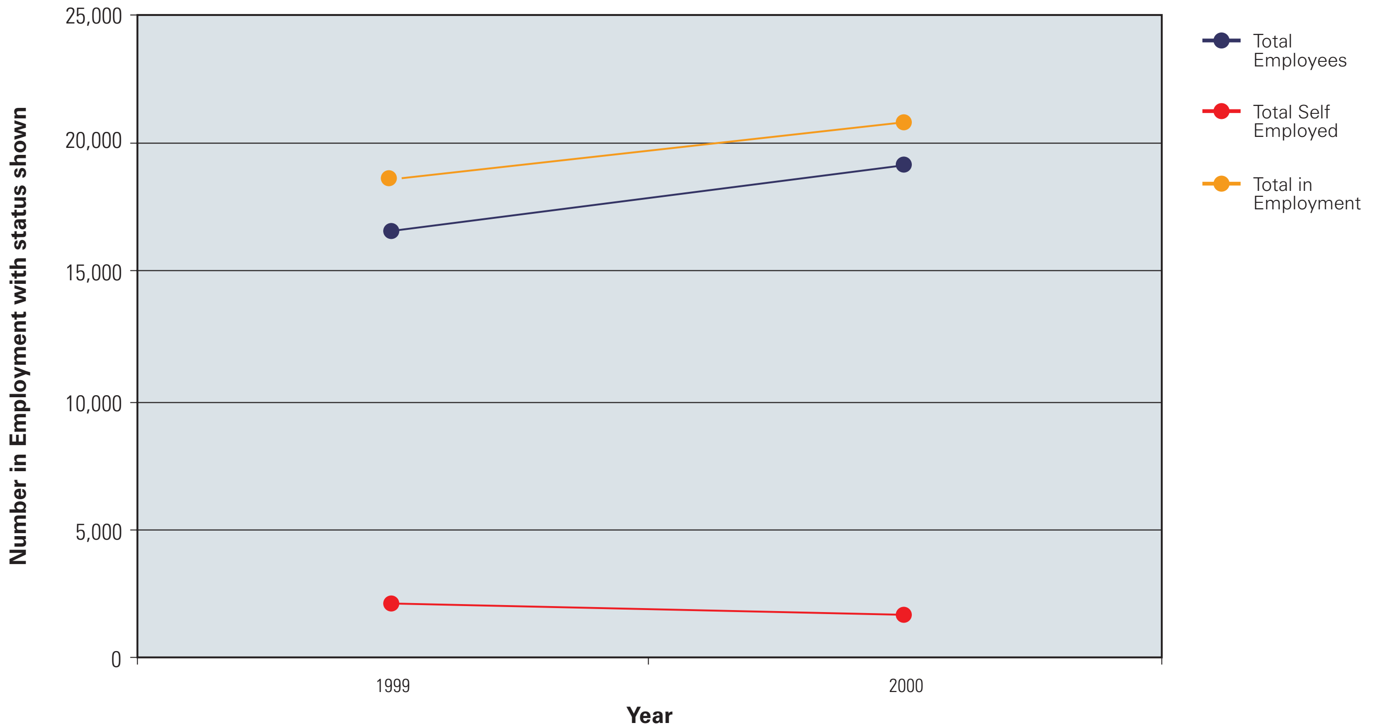


Figure C-4
Numbers of *Computing Professionals* in Ireland by Employment Status

(Source: Eurostat holdings of Member State LFS Quarter 2 data:
values below 2,500 - i.e. data for Self-Employed - are not statistically reliable)



Highest Education Level of *Computing Professionals* in Ireland:
No meaningful data available from Eurostat

Status of *Computing Professionals* in Ireland one year before Survey:
No meaningful data available from Eurostat

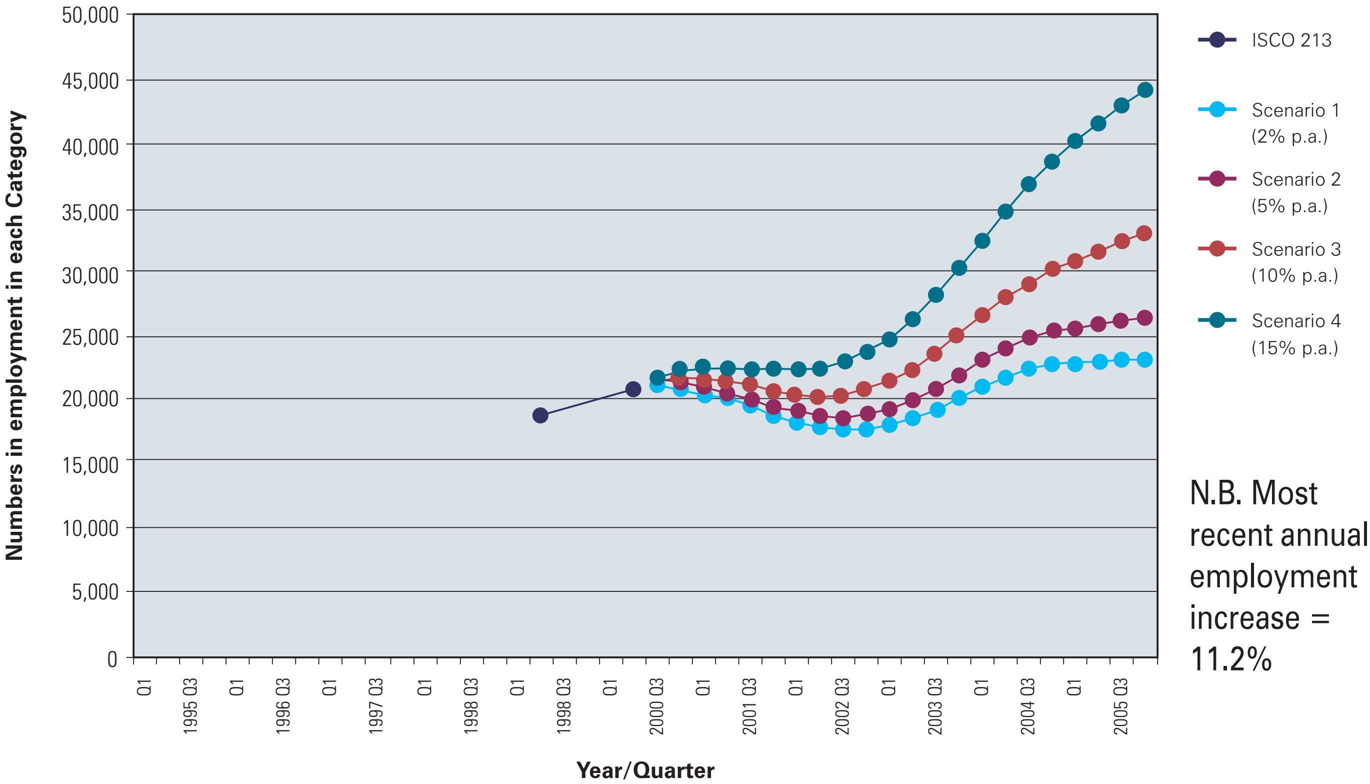
Number of *Computing Professionals* in Ireland who had received Training in Four Weeks fore Survey:
No meaningful data available from Eurostat

Possible Futures of IT Practitioner employment in Ireland

As for Germany, Figure C-5 shows four scenarios for the development of the size of the IT Practitioner workforce in ***Ireland***, based on the Eurostat totals for *Computing Professionals* (ISCO 213) (Ireland has submitted no data for *Computer Associate Professionals* (ISCO 312*)), based on assumptions of employment growth at 2% p.a., 5% p.a., 10% p.a. and 15% p.a., subject to an initial trough. The scenario model is described in Section 5.

Again, Table C-1 shows, for the four scenarios given, the ***Total (net) new supply*** of skilled manpower that would be required to sustain that level of employment growth. It is recognized that the validity of the assumptions – in particular about the shape of the initial "trough", the "phasing" in relation to the relevant national business cycle, and the level of replacement demand - would be refined as the first step in deeper review analysis at the national level.

Figure C-5
Recent development of Irish ITP workforce total and Forecast Scenarios



* because, as for the United Kingdom, the main national IT Practitioner category included workers both with and without degrees (see Annex A)

Table C-1
Development Scenarios for IT Practitioners in Ireland
Net supply estimation for each Scenario
(estimates have not been rounded)

	Year/ Quarter	Scenario 1: initial trough +2%		Scenario 2: initial trough +5%		Scenario 3: initial trough +10%		Scenario 4: initial trough +15%	
		Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment
Scenario Starying Point:	2002 Q2	20,845		20,845		20,845		20,845	
2000-2001:	2001 Q2	19,975		20,492		21,296		22,488	
Growth Demand			-870		-353		451		1,643
Replacement Demand			499		512		532		562
Total (Net) Demand			-371		159		983		2,205
2001-2002	2002 Q2	17,704		18,633		20,124		22,440	
Growth Demand			-2,271		-1,859		-1,172		-48
Replacement Demand			443		466		503		561
Total (Net) Demand			-1,828		-1,393		-669		513
2002-2003	2003 Q2	18,446		19,916		22,355		26,323	
Growth Demand			742		1,283		2,231		3,883
Replacement Demand			461		498		559		658
Total (Net) Demand			1,203		1,781		2,790		4,541
2003-2004	2004 Q2	21,699		24,035		28,036		34,862	
Growth Demand			3,253		4,119		5,681		8,539
Replacement Demand			542		601		701		872
Total (Net) Demand			3,795		4,720		6,382		9,411
2004-2005	2002 Q2	22,931		26,056		31,588		41,477	
Growth Demand			1,232		2,021		3,552		6,615
Replacement Demand			573		651		790		1,037
Total (Net) Demand			1,805		2,672		4,342		7,652

Annex D

Analyses of Eurostat Data: Sweden

Annex D

Analyses of Eurostat Data: Sweden

The detailed profiles of the *Computing Professional* working community in Sweden, on which the summary in section 4.5 is based, are shown in the following chart, drawing on official Swedish data. The corresponding analyses for the *Computer Associate Professional* occupation are available, and will be presented as part of the fuller study it is hoped to carry out, if additional funding can be procured.

Figure D-1
Numbers of *Computing Professionals* in Sweden

(Source: Eurostat holdings of Member State LFS Quarter 2 data: values below 9,000 are not statistically reliable)

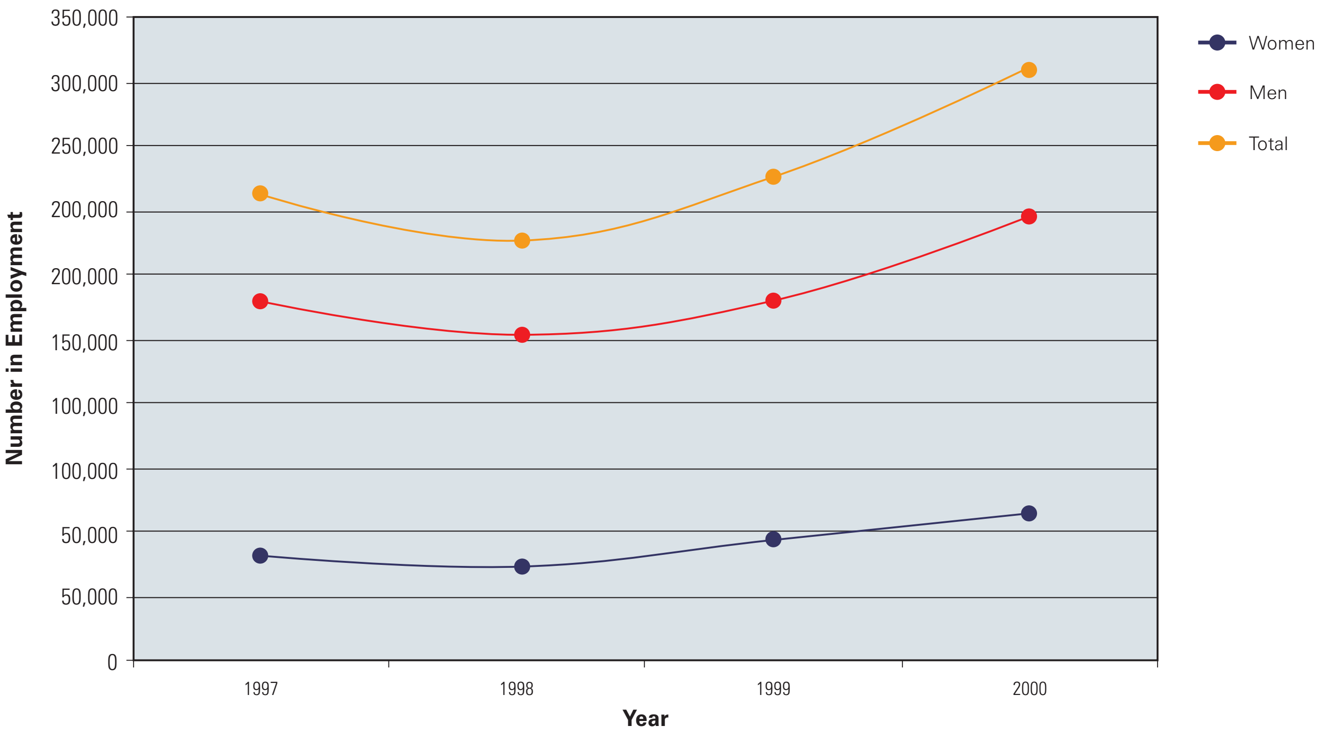


Figure D-2
Age Profiles of *Computing Professionals* in Sweden

(Source: Eurostat holdings of Member State LFS Quarter 2 data:
values below 9,000 - inc. data in agebands below 25 and over 55 - are not statistically reliable)

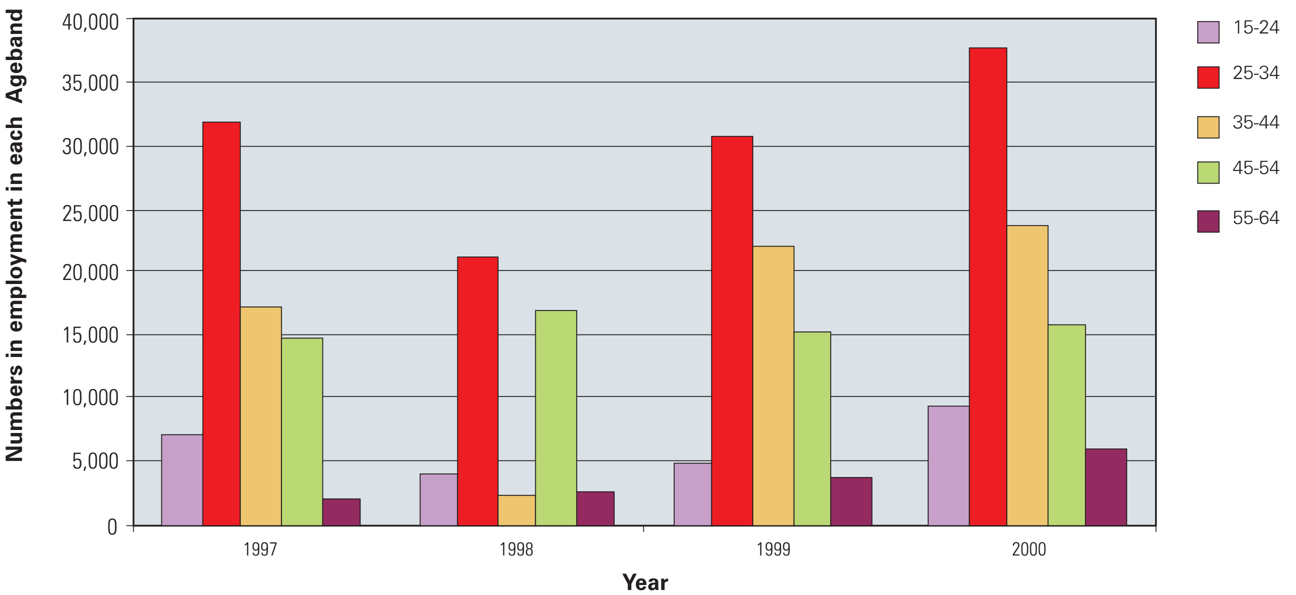


Figure D-3
Computing Professionals' Employer Size Distribution in Sweden

(Source: Eurostat holdings of Member State LFS Quarter 2 data:
values below 9,000 - inc. all data for organisations with between 11 and 19 employees - are not statistically reliable)

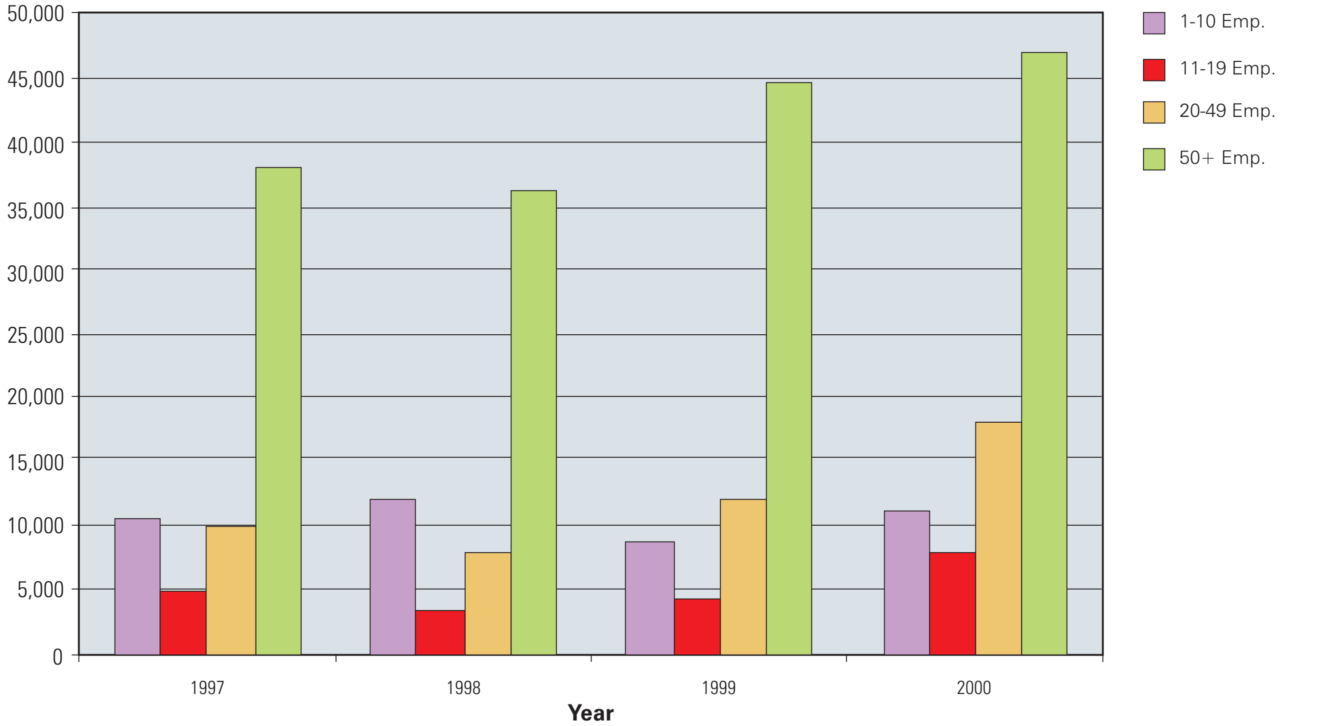


Figure D-4
Employment of *Computing Professionals* between Employer Sectors in Sweden

Source: Eurostat holdings of Member State LFS Quarter 2 data:
values below 9,000 - I.e. data for all sectors except IS Industry - are not statistically reliable)

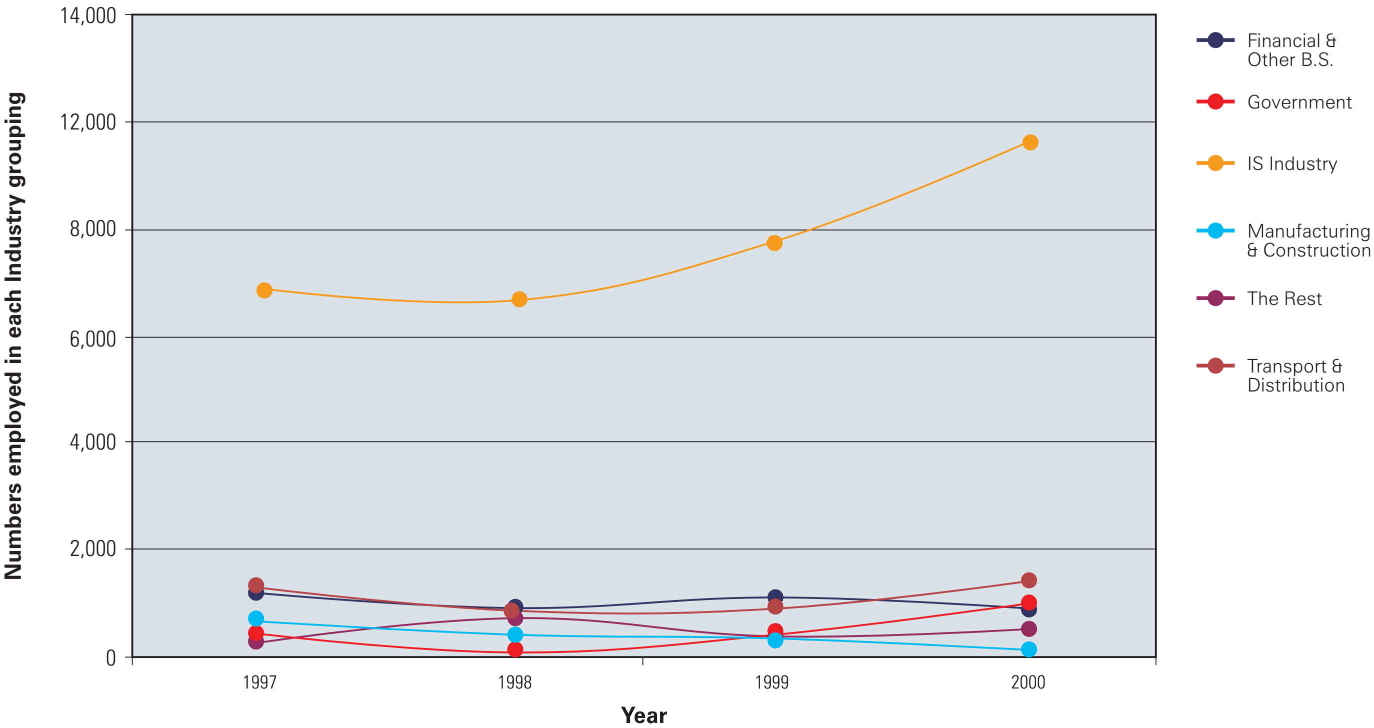


Figure D-5
Numbers of *Computing Professionals* in Sweden by Employment Status

(Source: Eurostat Holdings of Member State LFS Quarter 2 data:
Figures below 9,000 - i.e. data for Self-Employed - are not statistically reliable)

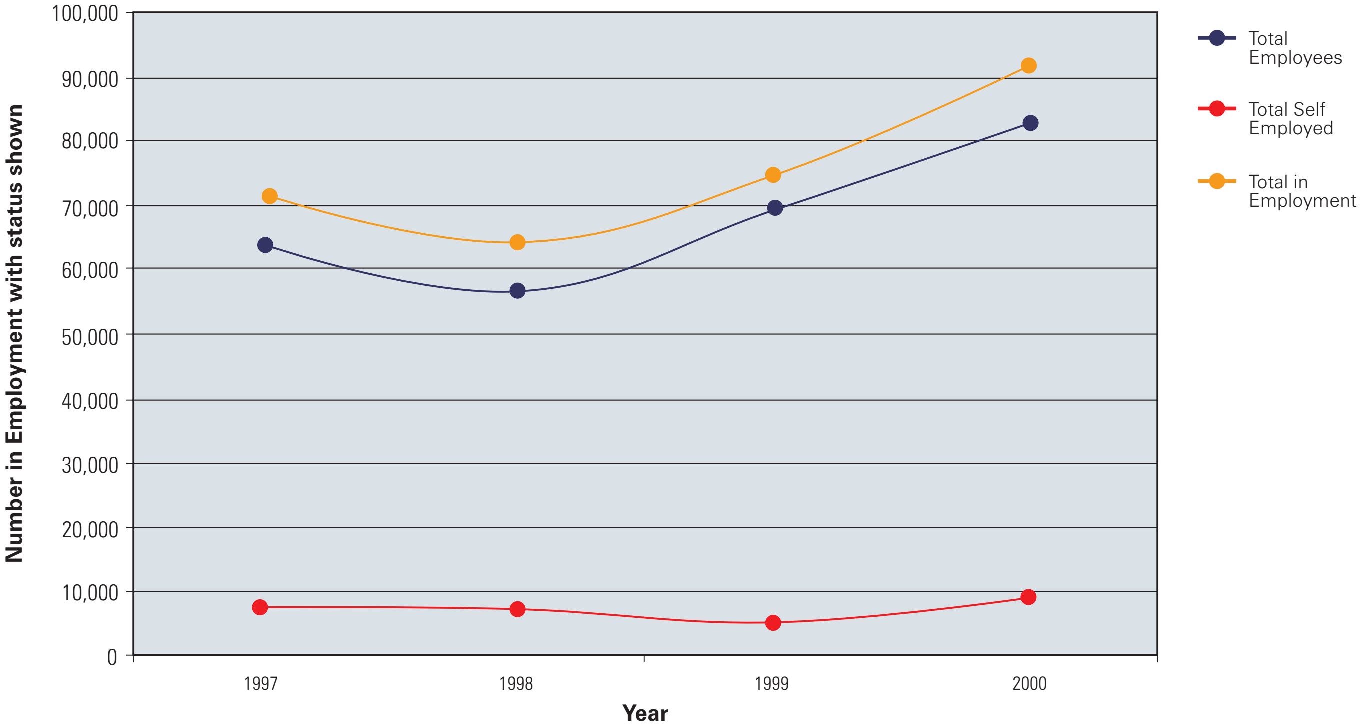
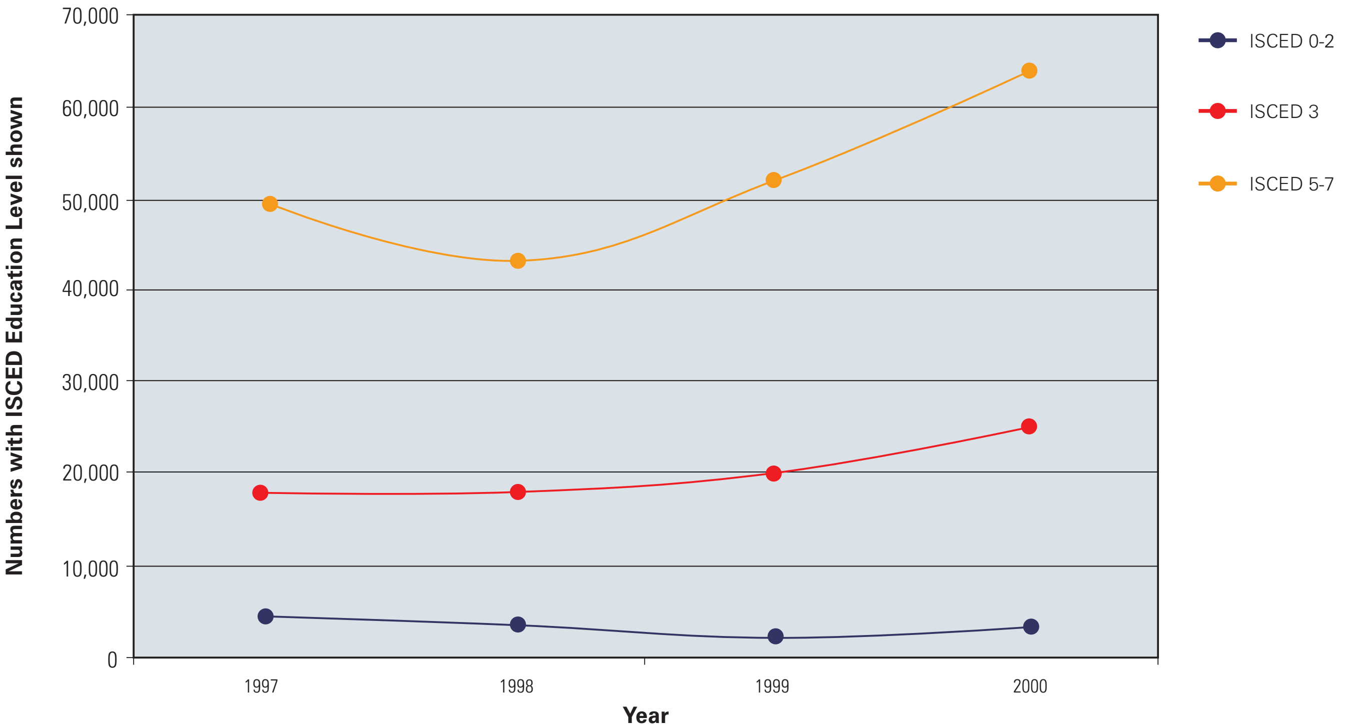


Figure D-6
Highest Education Level of *Computing Professionals* in Sweden

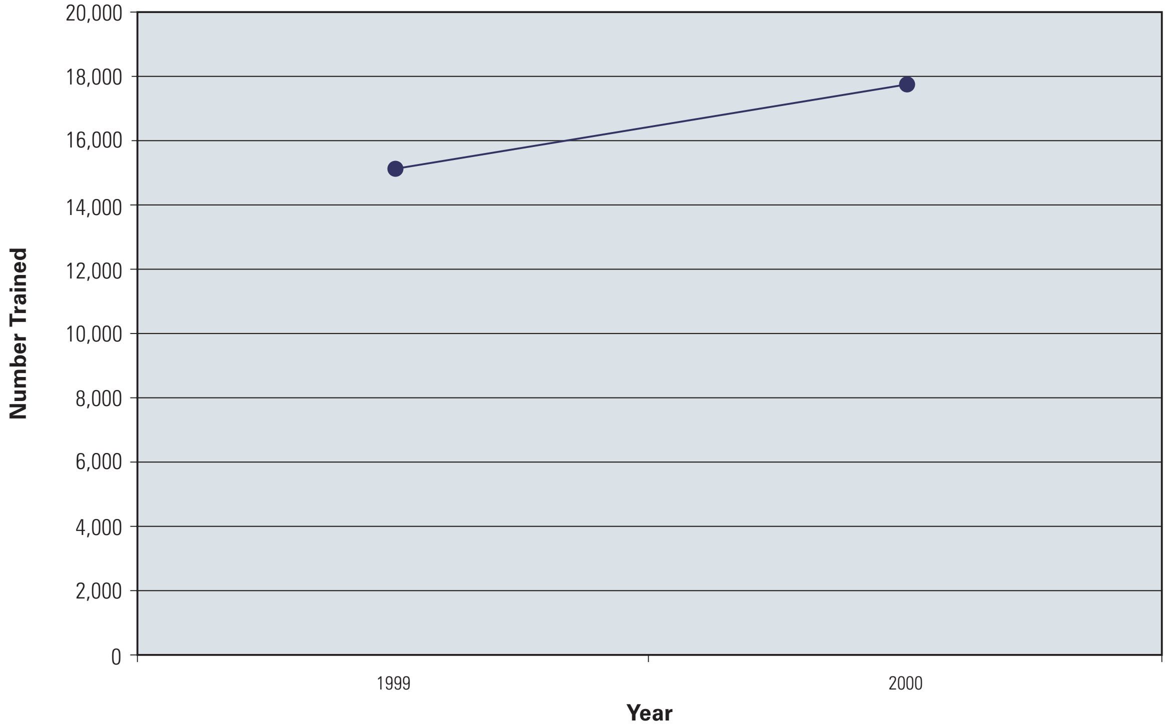
(Source: Eurostat Holdings of Member State LFS Quarter 2 Data:
Figures below 9,000 - i.e. data for ISCED 0-2 - are not statistically reliable)



Status of *Computing Professionals* in Sweden one year before Survey:
No statistically reliable data available from Eurostat

Figure D-7
Number of *Computing Professionals* in Sweden who had received training in Four Weeks before Survey

(Source: Eurostat Holdings of Member State LFS Quarter 2 data: values below 9,000 are not statistically reliable)

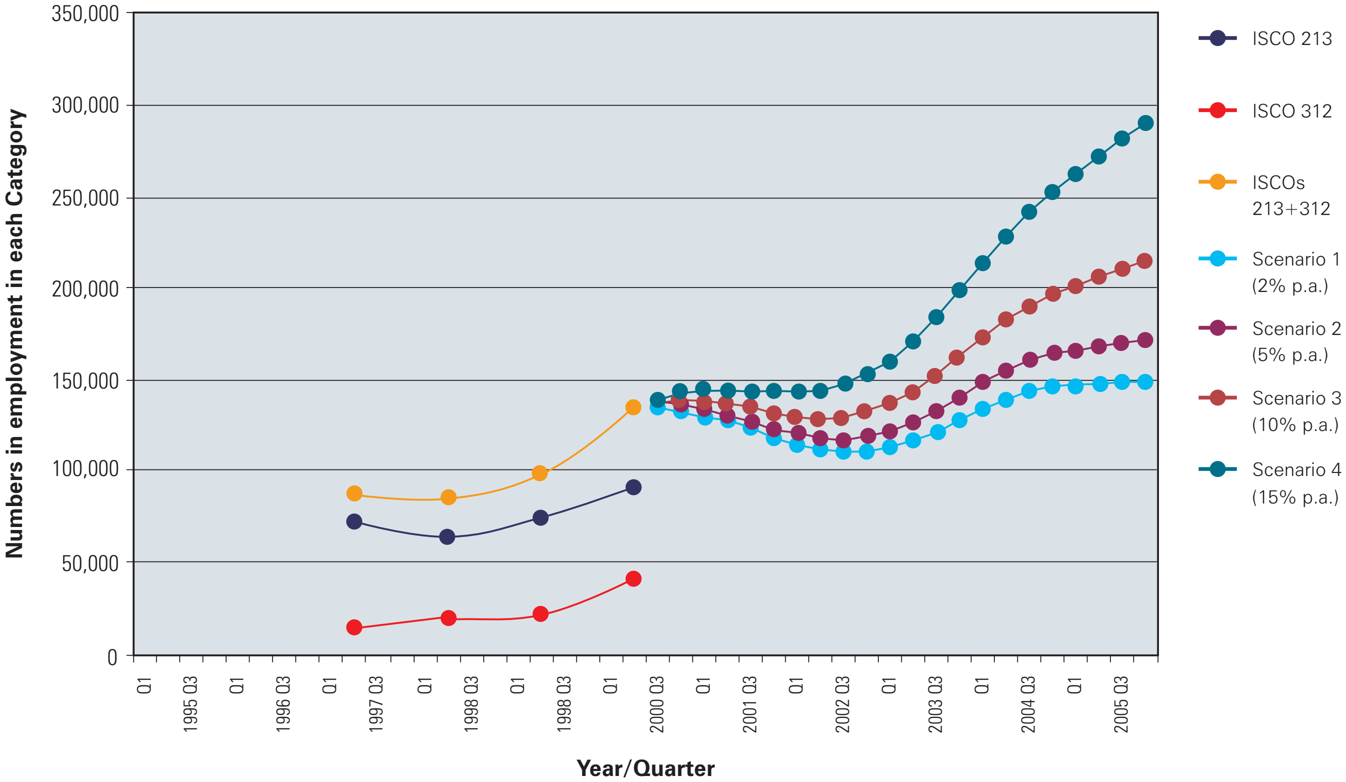


Possible Futures of IT Practitioner employment in Sweden

As for Germany and Ireland, Figure D-8 shows four scenarios for the development of the size of the IT Practitioner workforce in ***Sweden***, based on the Eurostat totals for *Computing Professionals* (ISCO 213) and for *Computer Associate Professionals* (ISCO 312), based on assumptions of employment growth at 2% p.a., 5% p.a., 10% p.a. and 15% p.a., subject to the initial "trough".

Table D-1 shows, for the four scenarios given, the ***Total (net) new supply*** of skilled manpower that would be required to sustain that level of employment growth. It is recognized that the validity of the assumptions – in particular about the shape of the initial "trough", the "phasing" in relation to the relevant national business cycle, and the level of replacement demand - would be refined as the first step in deeper review analysis at the national level.

Figure D-8
Recent development of Swedish ITP workforce total and Forecast Scenarios



N.B. Average employment growth of previous 3 years was 15.6%; previous year's employment growth was 34.7%

Table D-1
Development Scenarios for IT Practitioners in Sweden
Net supply estimation for each Scenario
(estimates have not been rounded)

	Year/ Quarter	Scenario 1: initial trough +2%		Scenario 2: initial trough +5%		Scenario 3: initial trough +10%		Scenario 4: initial trough +15%	
		Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment
Scenario Starying Point:	2002 Q2	135,180		135,180		135,180		135,180	
2000-2001:	2001 Q2	129,535		132,888		138,104		145,836	
Growth Demand			-5,645		-2,292		2,924		10,656
Replacement Demand			3,238		3,322		3,453		3,646
Total (Net) Demand			-2,406		1,031		6,377		14,302
2001-2002	2002 Q2	114,811		120,832		130,504		145,526	
Growth Demand			-14,724		-12,056		-7,601		-311
Replacement Demand			2,870		3,021		3,263		3,638
Total (Net) Demand			-11,854		-9,036		-4,338		3,327
2002-2003	2003 Q2	119,625		129,157		144,970		170,708	
Growth Demand			4,814		8,325		14,467		25,182
Replacement Demand			2,991		3,229		3,624		4,268
Total (Net) Demand			7,804		11,554		18,091		29,450
2003-2004	2004 Q2	140,719		155,864		181,814		226,080	
Growth Demand			21,094		26,707		36,844		55,371
Replacement Demand			3,518		3,897		4,545		5,652
Total (Net) Demand			24,612		30,604		41,389		61,023
2004-2005	2002 Q2	148,707		168,976		204,846		268,980	
Growth Demand			7,989		13,112		23,032		42,900
Replacement Demand			3,718		4,224		5,121		6,724
Total (Net) Demand			11,706		17,336		28,153		49,625

Annex E

Analyses of Eurostat Data: United Kingdom

Annex E

Analyses of Eurostat Data: United Kingdom

The detailed profiles of the *Computing Professional* working community in the United Kingdom, on which the summary in section 4.6 is based, drawing on official British data, are shown in the following charts (as for the Irish IT Practitioner community, there is no corresponding data for the *Computer Associate Professional* occupation).

Figure E-1
Numbers of *Computing Professionals* in the UK
(Source: Eurostat holdings of Member State LFS Quarter 2 data: values below 10,000 are not statistically reliable)

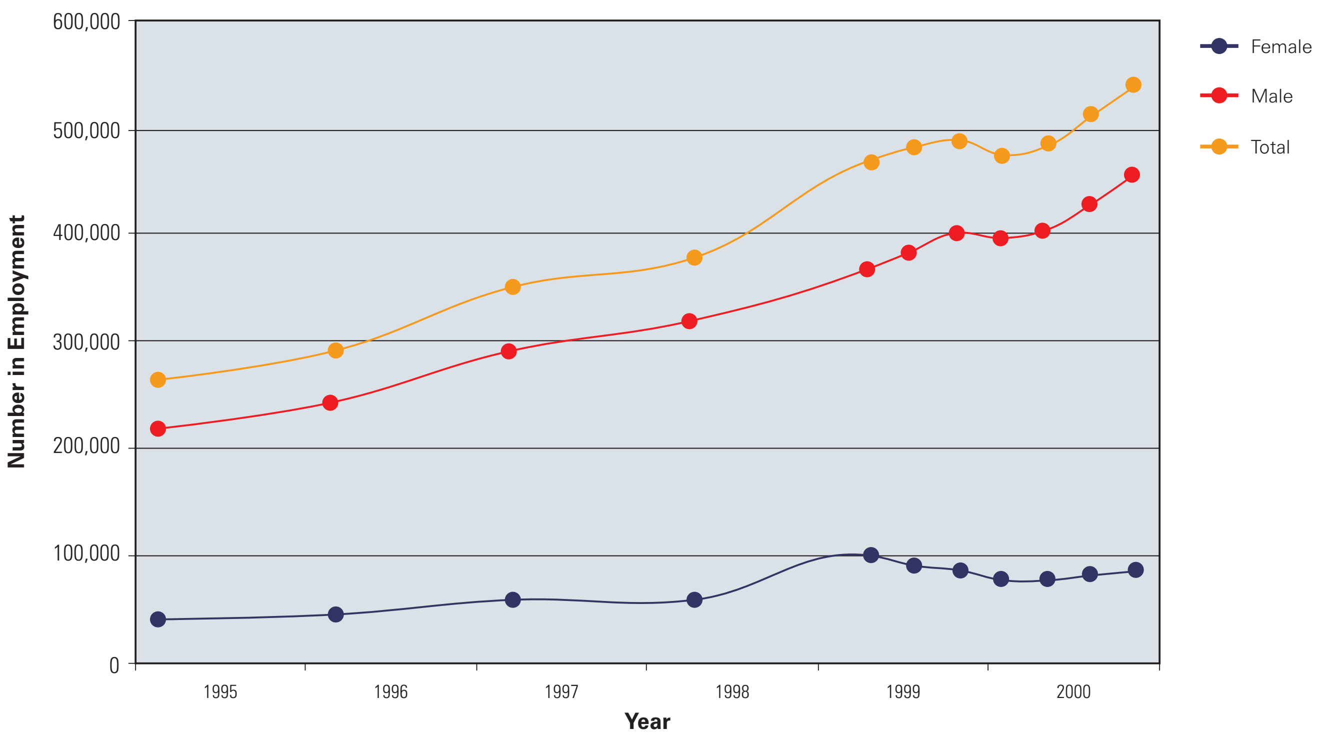


Figure E-2
Age Profiles of *Computing Professionals* in the UK
(Source: Eurostat Holdings of Member State LFS Quarter 2 data:
values below 10,000 - i.e. data for agebands over 55 - are not statistically reliable)

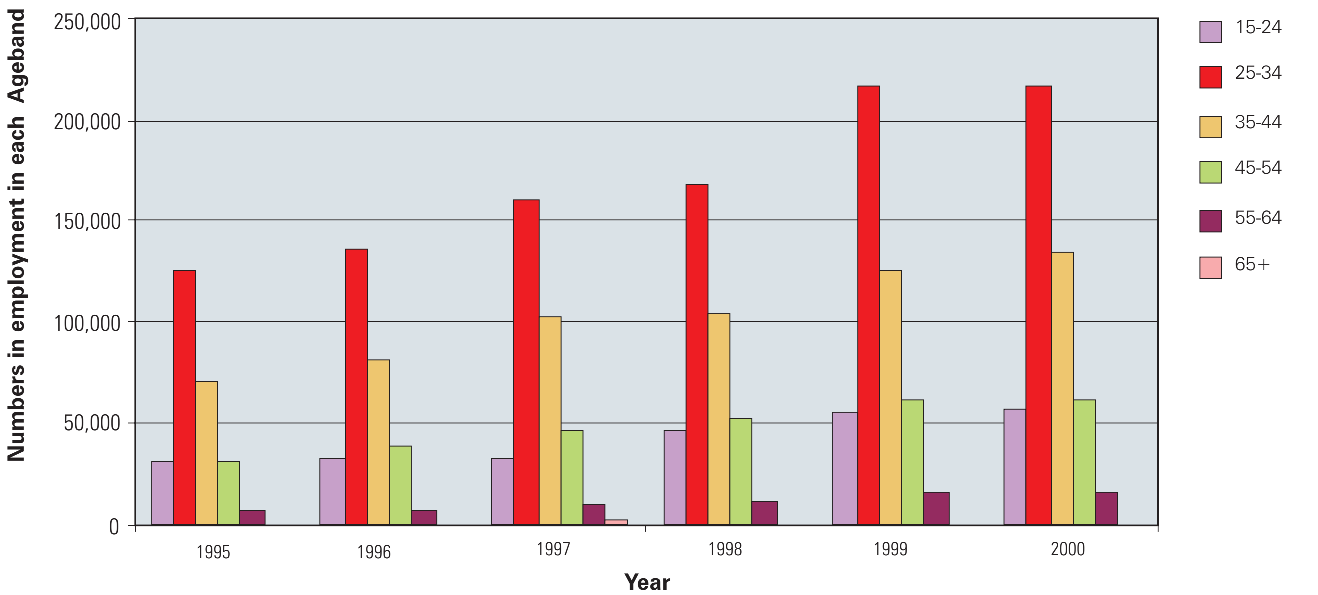


Figure E-3
Computing Professionals' Employer Size Distribution in the UK

(Source: Eurostat Holdings of Member State LFS Quarter 2 Data:
values below 10,000 - inc. 97 data for organisations with 11-19 employees - are not statistically reliable)

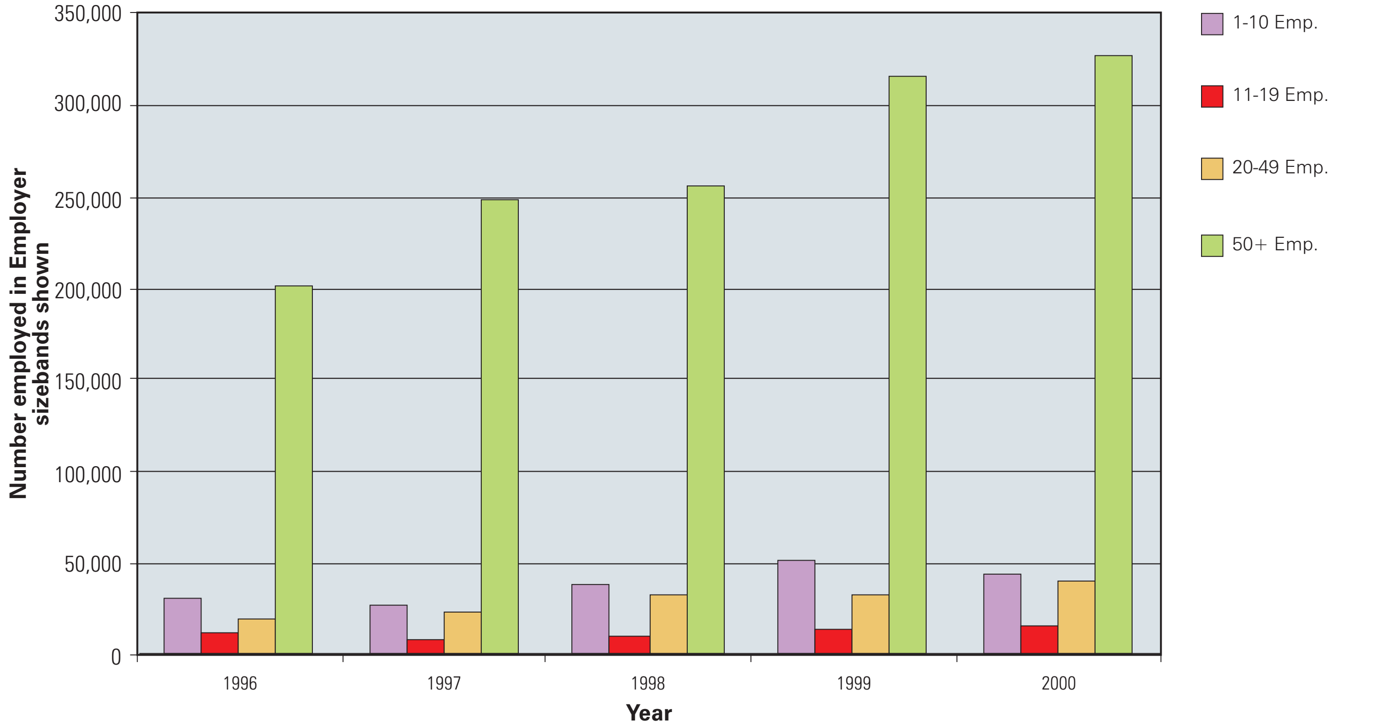


Figure E-4
Employment of *Computing Professionals* between Employer Sectors in the UK

(Source: Eurostat holdings of Member State LFS Quarter 2 data:
values below 10,000 - inc. Government sector data in early years - are not statistically reliable)

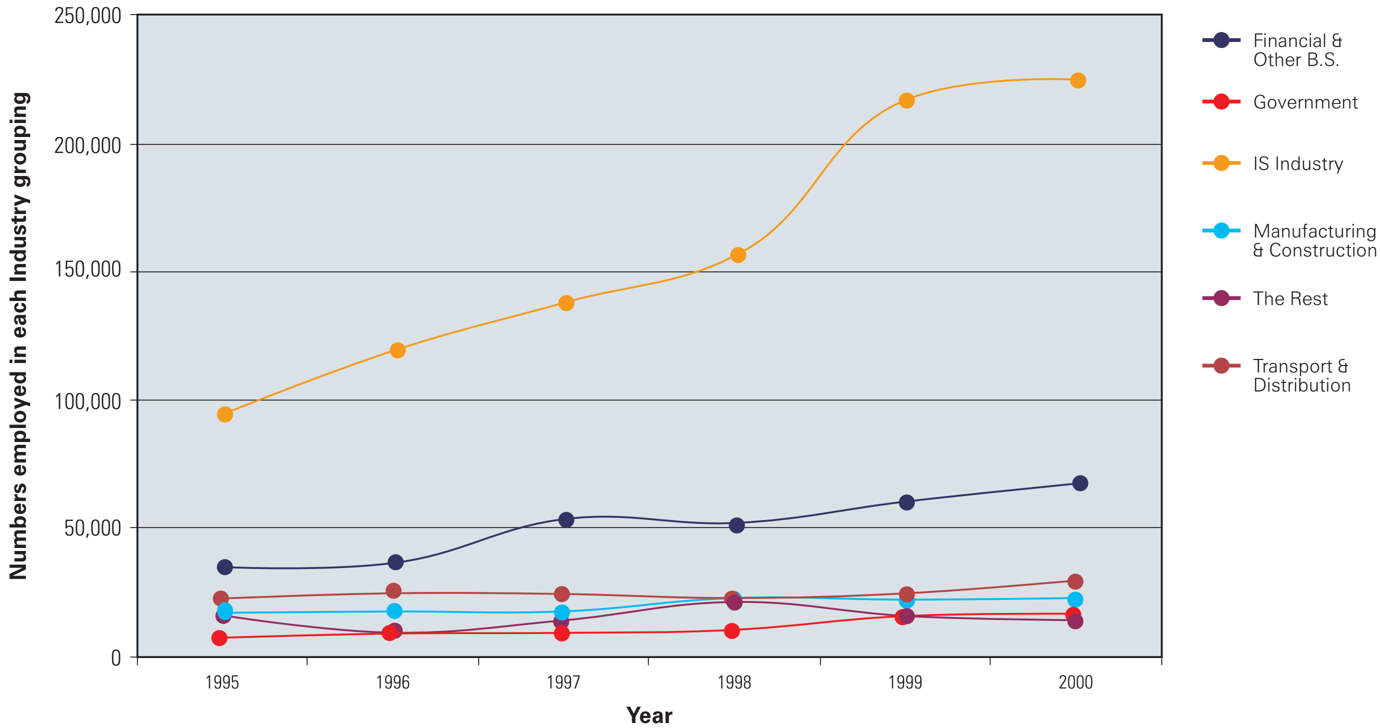


Figure E-5
Numbers of *Computing Professionals* in the UK by Employment Status

(Source: Eurostat Holdings of Member State LFS Quarter 2 data: values below 10,000 are not statistically reliable)

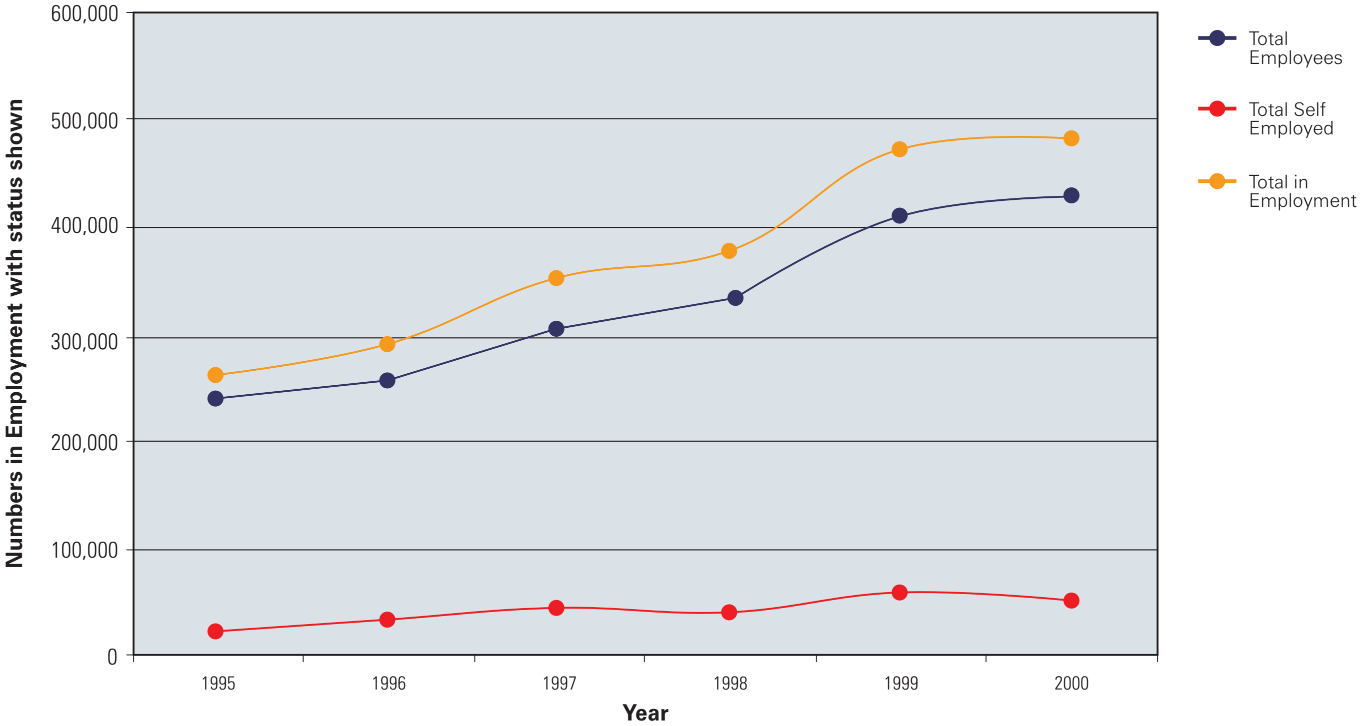


Figure E-6
Highest Education Level of *Computing Professionals* in the UK

(Source: Eurostat Holdings of Member State LFS Quarter 2 data:
values below 10,000 - inc. ISCED 0-2 data - are not statistically reliable)

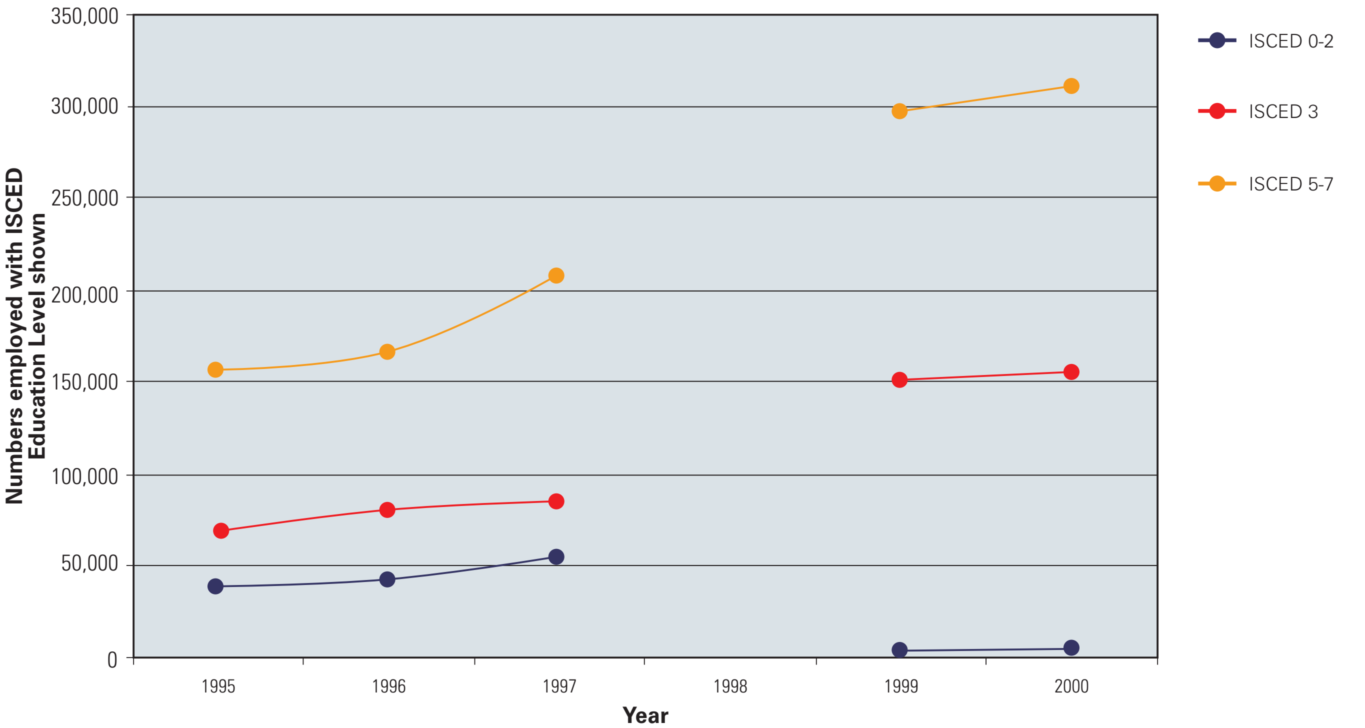


Figure E-7
Status of *Computing Professionals* in the UK one year before

(Source: Eurostat Holdings of Member States L.F.S Quarter 2 data:
values below 10,000 - inc. most data for unemployed status - are not statistically reliable)

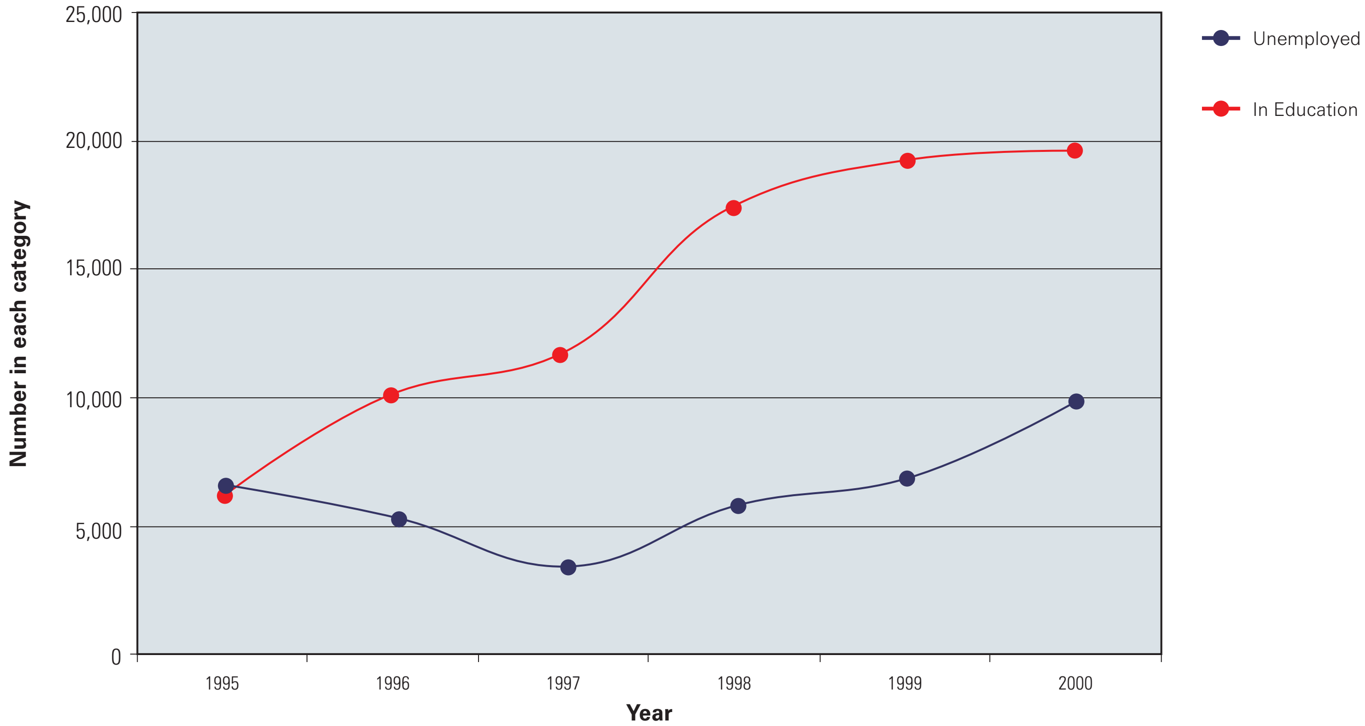
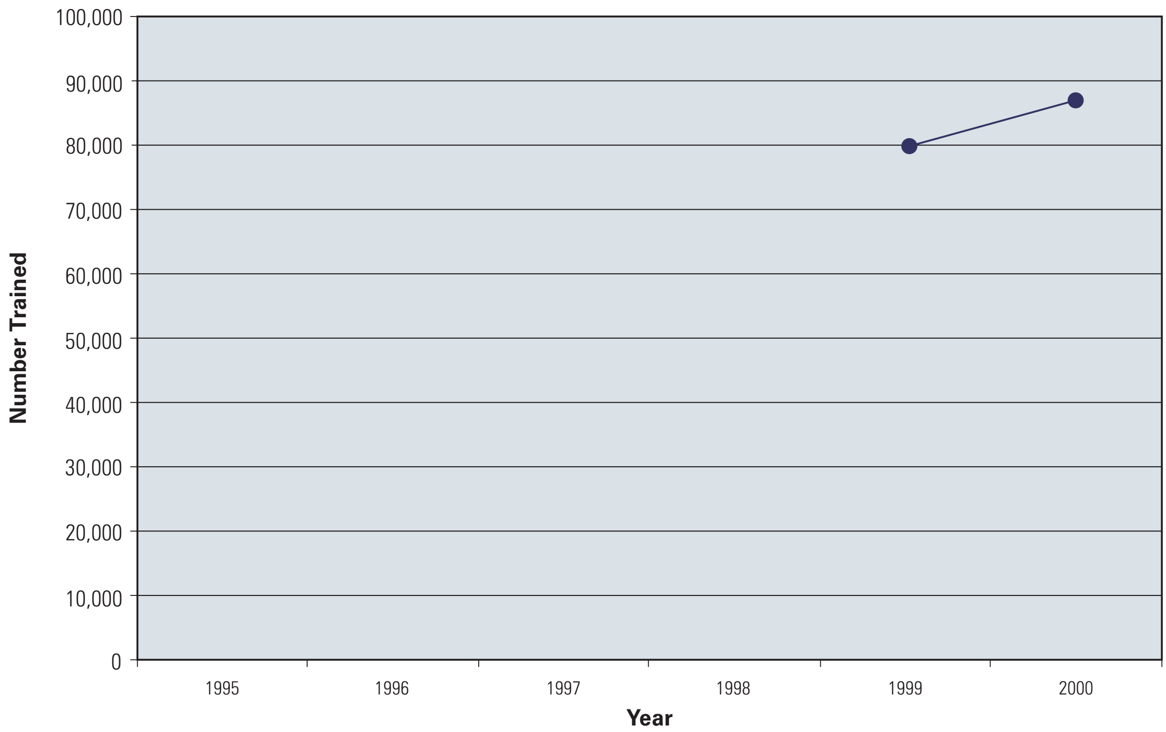


Figure E-8
Number of *Computing Professionals* in the UK who had received Training in four weeks before Survey

(Source: Eurostat Holdings of Member State LFS Quarter 2 data: values below 10,000 are not statistically reliable)

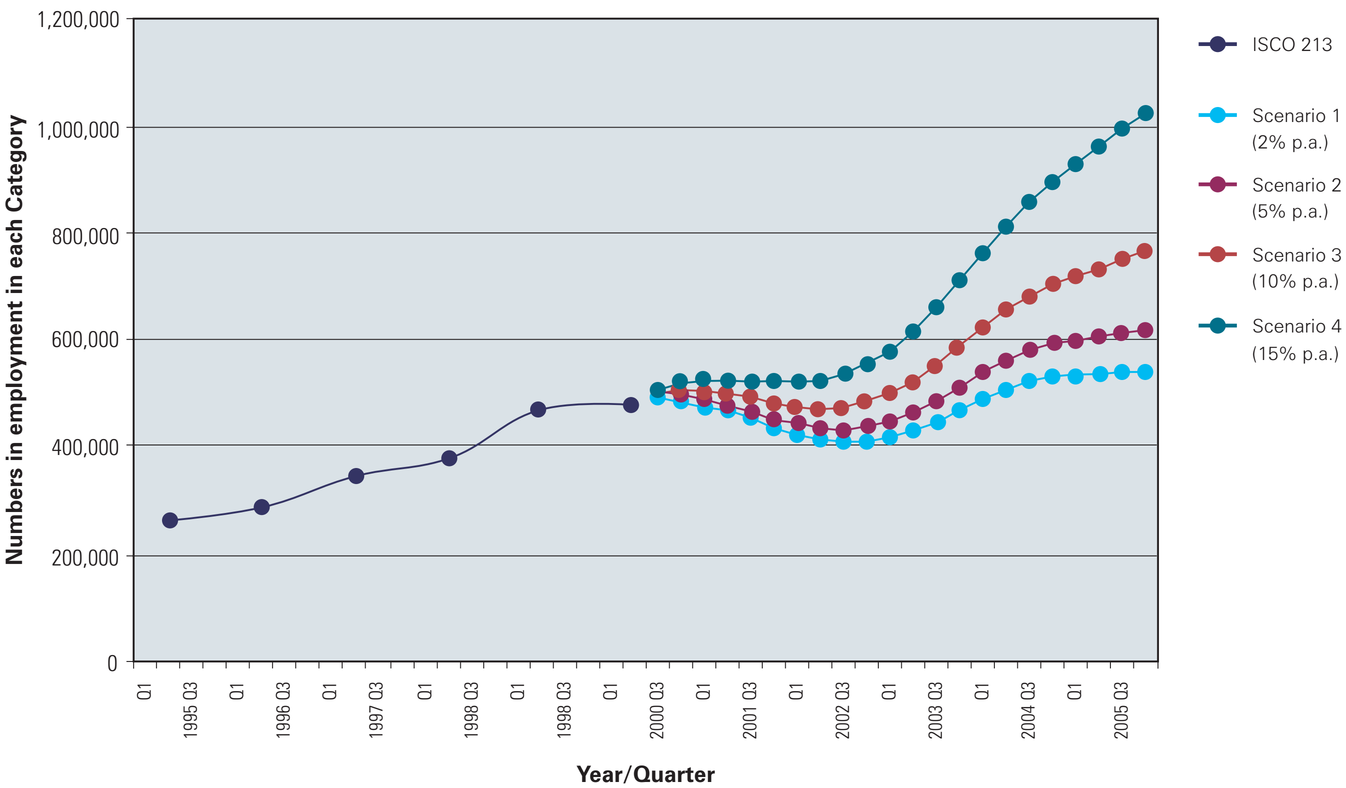


Possible Futures of IT Practitioner employment in the United Kingdom

Figure E-9 shows four scenarios for the development of the size of the IT Practitioner workforce in the ***United Kingdom***, based on the Eurostat totals for *Computing Professionals* (ISCO 213) (the UK has submitted no data for *Computer Associate Professionals* (ISCO 312*)), based on assumptions of employment growth at 2% p.a., 5% p.a., 10% p.a. and 15% p.a., subject to the initial trough.

Table E-1 shows, for the four scenarios given, the ***Total (net) new supply*** of skilled manpower that would be required to sustain that level of employment growth. It is recognized that the validity of the assumptions – in particular about the shape of the initial "trough", the "phasing" in relation to the relevant national business cycle, and the level of replacement demand – would be refined as the first step in deeper review analysis at the national level.

Figure E-9
Recent development of British ITP workforce total and Forecast Scenarios



N.B. Average employment growth over previous 5 years was 12.9%; most recent annual employment increase was 2.5%

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* because, as for Ireland, the main national IT Practitioner category included workers both with and without degrees

Table E-1
Development Scenarios for IT Practitioners in the U.K.
Net supply estimation for each Scenario
(estimates have not been rounded)

	Year/ Quarter	Scenario 1: initial trough +2%		Scenario 2: initial trough +5%		Scenario 3: initial trough +10%		Scenario 4: initial trough +15%	
		Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment	Forecast for total in employ-ment	Annual New Supply Require-ment
Scenario Starying Point:	2002 Q2	485,066		485,966		485,966		485,966	
2000-2001:	2001 Q2	465,674		477,728		469,479		524,275	
Growth Demand			-19,392		-8,238		-16,487		38,309
Replacement Demand			11,642		11,943		11,737		13,107
Total (Net) Demand			-7,750		3,705		-4,750		51,416
2001-2002	2002 Q2	412,741		434,386		469,155		523,158	
Growth Demand			-52,933		-43,342		-324		-1,117
Replacement Demand			10,319		10,860		11,729		13,079
Total (Net) Demand			-42,614		-32,482		11,405		11,962
2002-2003	2003 Q2	430,046		464,313		521,161		613,688	
Growth Demand			17,305		29,927		52,006		90,530
Replacement Demand			10,751		11,608		13,029		15,342
Total (Net) Demand			28,056		41,535		65,035		105,872
2003-2004	2004 Q2	505,877		560,324		653,613		812,746	
Growth Demand			75,831		96,011		132,452		199,058
Replacement Demand			12,647		14,008		16,340		20,319
Total (Net) Demand			88,478		110,019		148,792		219,377
2004-2005	2002 Q2	534,596		607,462		736,412		966,970	
Growth Demand			28,719		47,138		82,799		154,224
Replacement Demand			13,365		15,187		18,410		24,174
Total (Net) Demand			42,084		62,325		101,209		178,398

Annex F

References and Brief Abstracts

Annex F

References and Brief Abstracts

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Steedman, H., Mason, G. and Wagner, K. (1991): "Intermediate Technical Skills: Britain, France and West Germany", National Institute Economic Review May 1991

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F-2: Structured list with Synopses

Author/Organisation/ Publication	Date	Title (language, where not English)	Synopsis
1. Work at European Level (and beyond, plus general analysis)			
Booth, A.L. and Snower, D.J. (eds)	1996	"Acquiring Skills" Cambridge University Press	A comprehensive review of the state of labour market economics in relation to skill acquisition, in particular distilling the key theories in relation to *externalities*.
Smith, R. Economic Modelling 15 (pp. 429 - 442)	1998	"Emergent policy-making with macro-economic models"	A review of the use of economic models in policymaking, in particular in the United Kingdom
IDC (Boyd, H.M. and Rajah, P.) (An IDC White Paper Sponsored by Cisco Systems)	1999	The Internet Economy – an Employment Paradox: A Study into the Network Skills Shortage	A short paper examining various aspects of the supply and demand for networking skills, including some estimates for networking staff numbers in European countries, implications for formal education and training programmes, certification, Industry-government and education partnerships.
OECD (Working Party on Indicators for the Information Society)	1999	Defining and Measuring e-Commerce: A Status Report	Comprehensive examination of the position in relation to Information Society statistics.
Bruniaux, Hansen, Steedman, Vignoles and Wagner (2000)	2000	International Trends in the Quantity and Quality of Entrants to Computer Science Courses in Higher Education	A valuable comparative survey, covering the situation in France, Germany, Singapore, the UK and the U.S., and taking into account a range of different H. E. traditions, including the relatively longer degrees on the continent of Europe as compared with the Anglo-Saxon "Bachelors – Masters" model.
OECD	2000	Measuring the ICT Sector	Prepared by the OECD Secretariat under the guidance of the *Working Party on Indicators for the Information Society* and the *Working Party on the Information Economy*, the report aims to provide a set of statistics drawn from official sources that measure the output of the ICT sector in a consistent manner and that adheres to a common international definition agreed to by the OECD Committee for Information, Computer and Communications Policy.

IDC (Milroy, A. and Rajah, P.)	2000	Europe's Growing IT Skills Crisis: A Special Report by IDC compiled for Microsoft	An analysis of the Demand for and Supply of IT Skills in Europe, using a view of Demand Composition by "Technology Composition", forecasting estimates for *Internetworking*-, *Technology-Neutral*-, and *Host-based*- environments as well as *Application*- and *Distributed*- Skills.
Datamonitor (Elcock, E.)	2000	The economic impact of the skills gap in Western Europe	An analysis focusing on three main areas: the general impact, the effect of the skills gap on Small and Medium Enterprises (SMEs) & the effect of e-commerce.
EITO	April 2001	European Information Technology Observatory 2001	The ninth annual comprehensive review of ICT within Europe, covering, inter alia, the evolution of the European e-economy, the ICT market in Europe, the technological evolution of ICT and standards, mobile e-commerce – market perspectives, the evolution of ICT e-business services, the impact of e-commerce on five vertical sectors, and the use of the Internet b the European consumer. This edition includes (for the first time) employment estimates and forecasts (produced by IDC).
"*Career-Space*" International Co-operation Europe Ltd	2001	"Determining the future demand for ICT skills in Europe"	A structured analysis estimating employment of ICT people in European Member States, and forecasting future skill needs. The approach draws on OECD data for employment in ICT (supply) companies, and on ratios of ICT specialists within supply and user industries derived from United Kingdom Labour Force Survey.
OECD Employment Outlook (pp. 167-205)	2001	"The Employment of Foreigners: Outlook and issues in OECD Countries"	A review of participation rates of foreigners within OECD countries, covering the main trends in international migration, comparative analysis of the legislation and procedures governing the immigration of family members in certain OECD countries, and recent changes in migration movements and policies.
OECD - DEELSA (Centre for Educational Research and Innovation)	2001	"Education at a Glance" OECD Indicators	The annual compilation of education and skills statistics from OECD Member Countries, covering Financial and Human Resources, Access, Participation and Profgression, The Learning Environment, and various Outcomes of Education.
Steedman, H. and McIntosh, S. (Oxford Economic Papers, July 2001)	2001	"Measuring low skills in Europe: how useful is the ISCED framework?"	An analysis of the strengths, weaknesses and used of the International Standard Classification for Education (ISCED) framework in comparing educational achievement in different countries.
Mason, G., and Wagner, K. NIESR Report No. 6, 1994	1994	"High Level Skills and Industrial Competitiveness: Post-graduate Engineers and Scientists in Britain and Germany"	Thorough comparative review of experience in this area in the two countries.

Steedman, H., Mason, G. and Wagner, K. in Nat. Inst. Economic Review May 1991	1991	"Intermediate Technical Skills: Britain, France and West Germany"	Thorough comparative review of the position on Technical Skills in the three countries at the Intermediate level.
CEDEFOP	2001	"The Transition from education to working life: key data on vocational training in the European Union"	The volumes of this report cover: • A conceptual framework for the analysis of young people's school-to-work transition • General Education, vocational training; the institutional characteristics of national educational systems • Where does the transition process begin • Labour Market entrants • The integration of young people into working life and Community policies
Ekeland, A., & Tomlinson, M. Institute for Prospective Technology Studies (ESTO, EC-JRC, Seville)	2001	"The Supply and demand of high technology skills in U.K., Norway and the Netherlands	Detailed review of the development of characteristics of workers with Higher Education qualifications in a number of science and technology-based sectors, based on data from national Labour Force Surveys.
European Commission High Level Task Force secretariat	2001	"Report of the High Level Task Force on Skills and Mobility"	Review of EU policy in relation to the European labour market, with recommendations in relation to: a) Occupational Mobility and Skills development, b) Geographic Mobility, and c) Information and Transparency.
Deiss,R. (Eurostat): Statistics in Focus Industry, Trade and Services, Theme 4 34/2001 (ISSN 1561-4840)	2001	"Information Society Statistics"	A summary of key statistics for the ICT sector to the total economy, covering Numbers of enterprises, number of persons employed, value added at factor cost, ICT imports and exports, and comparing with equivalent figures for the U.S. and Japan.
OECD (DSTI and DEELSA Directorates)	2002	"International Mobility of the Highly Skilled"	Proceedings of a Seminar on "International Mobility of Highly Skilled Workers: From Statistical Analysis to the Formulation of Policies", Paris 11-12 June 2001. A series of papers covering clarification of data, analysis of mobility of highly-skilled workers and their impact, and examination of appropriate policies.
EITO	2002	European Information Technology Observatory 2002	The tenth annual comprehensive review of ICT within Europe, covering the evolution of the European e-economy, the ICT market in Europe, the technological evolution of ICT and standards, mobile e-commerce – market perspectives, developments of ICT e-business services, the impact of e-commerce on five vertical sectors, and the use of the Internet b the European consumer.

2. National Level Work:			
a. Germany			
IIE + Infratest Burke (for BMWT)	2001	"Monitoring Informationswirtschaft": Band 1: 2. Kernbericht 2001 (German)	A significant, thorough, analysis of the current international technology/ market position, covering the overall market for the Information Economy (IE), Infrastructure basics, and Applications. The analysis of the "ICT and Information Economy Labour Market" covers employee numbers in ICT, Salaries in the IT field, "Green Card" arrangements, Education and Training, and Call Centre requirements. The study reports a number of figures, based on a survey of experts in the field, associated with estimated numbers of workers and shortages (where sources are given, they are generally organisations).
IIE + Infratest Burke (BMWT)	2001	"Monitoring Informationswirtschaft" 1. Trendbericht Management Summary (German)	Summary of the key elements of the assessment of the current position and prospects for ICT in Germany.
Empirica (for BMWT)		"Status Quo and Development Prospects of e-Commerce"	A similar analysis focusing on e-commerce
b. Ireland			
Expert Group on Future Skills	1999	First Report	Initial report of the top level group set up by government to assess Ireland's future skill needs in response to strong economic growth.
"	2000	Second Report	An analysis of the labour market outlook for Ireland, tracking the unprecedented growth of the Irish economy since the mid-1990s and the consequent rapid increase in employment, and forecasting likely future demand and supply of labour up to 2009. The report made a number of recommendations to try to ensure a sufficient supply of labour.

Expert Group on Future Skills	2001	Third Report	This report, as well as considering the position in other key sectors/ occupations of particular shortage (construction, life sciences and scientific research) included a significant review of the IT skills position and set of policy recommendations, focusing in particular on the skill needs of the Software Industry, demand for software skills across the economy and the emerging areas of e-Business, digital media and multi-media, the changing skills requirements and overall demand for skills in the hardware sector, and labour market projections and forecasts for the supply of third level graduates in IT.
Expert Group on Future Skills	2001	e-Business Skills	A detailed analysis of the additional skill needs arising from the development of e-business, including a number of policy recommendations, including suggestions for coverage of broader business and management skills within tertiary technical courses.
c. Sweden			
Teldok (Gull-May Holst et al)	2000- 2001	The Teldok Yearbook 2001: *Sweden in the Information Society*	A comprehensive review of the current state of ICT within Sweden (covering Fixed and Mobile telecomms., Computers and Related technologies, convergence, e-business, IT R&D, organisations shaping the Swedish "Cyber world" etc.)
IT-Företagen (IT Industry Association)	2001	IT-Företagens program för kompetensfrågor för 2001 (Swedish – English summary of main points)	A wide ranging qualitative analysis of the IT skills position within Sweden from the perspective of the IT (Supply) industry, with broad conclusions and recommendations for government, education and employers.
(Swedish Government report?)	2000?	SwIT – Training for Jobs in IT created a platform for growth	Review of a major government initiative that provided training for nearly 12,000 participants (Jan 1998 – Feb 2000), resulting in 10,000 finding work in 3,000 enterprises.
d. United Kingdom			
ITNTO/AISS (for DTI + DfEE)	1999	"Skills 99"	Comprehensive analysis of the IT Practitioner skills position in the UK, covering the *Current Labour Force*, *Demand* as measured by a range of indicators, *Supply* as measured by HE and FE flows and qualifications, and proposal of a "Workforce (stock) Flows" model. Significant amount of trend data.

ITNTO	1999	"Bugbuster" Final Report to DfEE	Final Report on the provision of training for UK Small Businesses in the needs for handling the "Y2K" date change problem to 40,000 people within 12 months.
G. Mason, NIESR for DfEE	2000	"Key issues in` IT skills research in the UK"	A summary of issues to be tackled in research on labour markets involving IT Practitioner skills, based on the work for the DfEE National Skills Task Force and subsequent employer case studies.
Institute for Employment Studies (IES) for DfES (*"ICT Skills Dialogue" Report*)	2001	"An Assessment of Skill Needs in Information and Communication Technology"	A detailed and thorough assessment of the current and projected skill needs in ICT, drawing on secondary data.
Institute for Employment Research (IER) for DfES	2001	"Skills and Performance: an Econometric Analysis of Employers Skill Survey 1999"	Detailed regression analysis of results of a large general employer survey carried out for the DfEE "National Skills Task Force" in 1999, covering *Determinants of Skill Deficiencies*, *Performance & Skills*, and various different types of Skill Deficiencies
e-skills NTO (based on fieldwork undertaken by the ***NOP Research Group***)	2002	"IT and Communications Professionals in the UK"	Major employer survey concerning ICT skills in the UK carried out in early 2001, drawing on responses from telephone interviews of nearly 4,000 establishments.
e. Other Member States			
Austria:			
Austrian Institute for Economic Research (WIFO, with VIW)	2000	"Arbeits- und Qualifikationsnachfrage im Telekom und Medien-sektor"	WIFO study on ICT skill needs, providing estimates and forecasts of skill shortages in ICT in Austria, with particular reference to the position in Vienna and in the telecomms. and media sectors.
IDC	2000	IDC Study on the ICT skills gap in Austria	One of a number of national analyses carried out by IDC in relation to their skill needs forecasting work at the European level
FEEI/VIW Federation for the Information Industry in Austria	2000	"Sectoral Qualification Initiative of the Electronic Industry"	A set of proposals to tackle Austrian labour shortages in the sector, including addition investment in education and relaxing of immigration requirements in this area (latter recommendation not agreed!)
Belgium:			
Belgium Information Services Association (INSEA)	2000	Annual INSEA Salary Survey	Annual review of the IT labour market, covering salaries, conditions, and demand for labour, including estimates of shortages.
Belgium Information Services Association (INSEA)	2001	Economic Survey of Belgium ICT services	More general business review of the sector.

Finland:			
The employers' Confedera-tion of the Finnish Services Industry (Palvelutyonantajat ry)	2000	Need for Employees in the IT Services sector	Annual survey of employer skill needs in the services sector. IT services companies are expected to need 5,000 (additional) workers in 2000 and 2,500 – 3,000 in 2001.
TIPAL, FiCom, SET, Satu, Ministry of Education, educational establishments	2001	Tietoteollisuuden ja digitaalisen median osaamisen ennakointi) ("TIDE")	The purpose of the TIDE initiative is to forecast both quantity and quality of needed skills up to 2010, so produce result of value to both companies and associations operating in the IT sector and to education providers.
National Technology Agency (Tekes)	1999	Growth Strategy and challenges for the Finnish Software Industry	The report describes the growth strategy for the Finnish software industry to the year 2010, focusing particularly on the development of collaboration between Finnish information technology centres of expertise and business development organizations and companies.
Italy:			
Assintel	2001	Indagine Retributiva Assintel	An annual salary survey carried out by the Italian ICT Companies Association *(Associazione Nazionale Imprese Servizi Informatica, Telematica, Robotica, Eidomatica)* providing a picture of the salary and benefits trends, skill requirements, employee number growth, etc.
Government with Assintel	2000	Assintel Iniziative	Provision of training courses supported by public funds: Opportunities for three month courses followed by two months of work experience, each on a specific technical area (e.g. database, networking, software development) with 20 participants per course.
Netherlands:			
FENIT and V-ICTN, with Heliview		ICT Marktmonitor	Annual(?) review of the labour market, providing detailed data on number of people working in the IT sector, job growth, job openings and the effect of ICT on employment in the Netherlands
Spain:			
Rafael Fernández Calvo, in *Present and Future of the Informatics Profession* *Upgrade* Vol.II, Issue no. 4	August, 2001	"The Shortfall of Informatics Professionals and the Legislation Regulating the Informatics Profession in Spain"	Review of the arrangements for developing informatics engineers in Spain and proposals for how traditional approaches may need to be reviewed in response to likely forthcoming shortages

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