Abstract

This paper compares the supply of specialist ICT skills in Britain and Germany from higher education and from apprenticeship and assesses the relative impact on companies in the two countries. In contrast to Britain, where numbers of ICT graduates have expanded rapidly, the supply of university graduates in Germany has not increased. Combined with the constraints of the German occupational model of work organization, it is concluded that this failure of supply may have contributed to slower growth of ICT employment in Germany. At the same time, German firms have turned to a newly developed model of apprenticeship to supply routine technical ICT skills. This strategy contrasts with British firms which recruit from a wide range of graduate specialisms and invest more heavily in graduate training. Probably in part as a consequence, apprenticeship in ICT occupations in Britain has failed to develop.

This paper was produced by the Skills for All Programme based at the Centre for Economic Performance

Acknowledgments

We are grateful to the Anglo-German Foundation for their financial contribution to this project. We also gratefully acknowledge financial support provided by the Esmée Fairbairn Foundation for the Skills for All Programme of which this paper forms a part (web address: http://cep.lse.ac.uk/research/skills/skillsforall.asp).

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Published by
Centre for Economic Performance
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

ISBN 0 7530 1634 6

Individual copy price: £5

The Impact on Firms of ICT Skill-Supply Strategies: An Anglo-German Comparison

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June 2003

The Centre for Economic Performance is financed by the Economic and Social Research Council

Introduction

The use of ICT technologies in the different economic sectors to organise business processes and information in the UK extends back to the celebrated device constructed for the catering and food producing company J. Lyons in the early 1950s (Land, 1999). However, it is generally considered that the impact of these technologies on business productivity and growth was not felt until considerably later. New communication and faster information retrieval and manipulation possibilities opened up in the early 1990s, with the advent of in-house networking and faster and more powerful electronic communication including direct communication between data capture and data manipulation devices.

The extent to which the potential of these technologies was exploited for the automation of many business and manufacturing processes (e.g. updating of customer accounts in financial services, improved inventory management in manufacturing) in advanced industrialised countries was undoubtedly driven by the heightened competitive environment of the last quarter of the 20th century. Entirely new types of economic activity, for example software development and, more recently, web page design and web server support assumed much greater relative weight. More established sectors of economic activity - for example, retailing, financial services, manufacturing – increased investment in ICT and consequently expanded ICT-related employment. The OECD estimates that employment in computer and related activities in the UK was 115 per cent higher in 1999 than ten years earlier (OECD, 2001).[1] Using an occupational measure developed by Dixon (CEPIS, 2002) Germany has fewer ICT practitioners than Britain – 550,000 in Germany compared to 850,000 in Britain.[2] ICT practitioners are 1.45 per cent of total employment in Germany and 2.1 per cent of service employment. In Britain the corresponding figures are 2.33 and 3.1 respectively.

[1] When writing about the United Kingdom the problem arises that government statistical sources usually refer to all the constituent parts of the UK while other sources and some policy measures may only refer to Britain (the UK not including Northern Ireland), England and Wales or sometimes only England. For the sake of simplicity and clarity we have used Britain in our text to refer to all or any of these combinations of the constituent parts of the UK (for accuracy footnotes and references use UK as appropriate).

[2] Dixon combines the two ISCO categories, 213 Computing Professionals and 312 Computer Associate Professionals to create the category of IT Practitioners in Germany. However, as the UK does not use the ISCO 312 category, the IT Practitioner definition for the UK is based only on ISCO 213. To provide greater comparability with Germany I have added numbers given by Dixon (from the LFS) for 'computer operators', computer managers and computer engineers to the ISCO 213 category to arrive at an IT Practitioner definition for the UK. There is still some lack of agreement on definition of ICT related jobs but other indicators point to a relatively small number of ICT workers in the German economy. EITO (2001) estimates German ICT skill supply as some 11 per cent higher than in the UK, but - German economy (GDP) is half as big again as UK economy and has one third more population.

The aim of this study is to analyse and to assess the contrasting national strategies of ICT (Information and Communication Technologies) skill supply in Britain and Germany, to examine the impact on firms and to assess the usefulness to companies of skills at different qualification levels. Policy implications for change in publicly-financed ICT skill supply strategies will be drawn from this analysis.

In order to examine the impact of skill supply policy on firms, around 90 firms in Britain and Germany were interviewed. These were selected at random from trade literature and the internet in a total of four sectors, financial services, retailing, motor manufacture and software development. In this way, we hoped to cover users of ICT in services and manufacturing together with a specialist ICT sector. Around half of those firms originally approached agreed to be interviewed within the time-frame of the project. Half the interviews were carried out face to face by two researchers, one from Germany and one from Britain. The remainder were interviewed by one researcher through telephone interviews. In both cases a structured questionnaire was used and, in the course of discussion, core questions and issues were put to our respondents in the companies in both countries. The resulting data was logged and analysed.

The report is structured as follows. Section 1 first examines trends in the supply of skills in the core ICT study areas supported in whole or in part by public funding and therefore subject to the decisions of government concerning priorities in education and training policy. This section then analyses and compares some important government initiatives to improve skill supply in Britain and Germany. Section 2 reports the results of our visits to companies in the two countries. Section 3 presents comparisons of skill procurement, deployment and supply in Britain and Germany and Section 4 presents and discusses policy implications, and Section 5 concludes.

1. British and German Government Responses to Demand for Skills in the ICT Producer and ICT User Sectors

1.1 British-German differences in the institutional organisation of Higher Education

The requirements of the national industries with respect to the fast evolving ICT fields seem to be similar while the British and the German higher education (HE) systems are organised in diverse ways and therefore the supply by the educational system differs considerably. In Germany two kinds of HE institutes exist: traditional universities with a common study period of at least five years and applied universities (*Fachhochschulen* (FHS)) with a study period of four years including a semester of internship at a company for practical experience. The transfer from applied universities to traditional universities to achieve the more advanced certificate is time-consuming and therefore not frequent. Thus, the decision for the more applied degree at FHS or for the more theoretical basis with a degree from the traditional university must be taken at the start of the studies. British universities also offer two types of degrees but with a different set-up: a Bachelor (also called first) degree which usually takes three years and a post-graduate degree which takes an additional one, or two years. These are usually taken in stages but need not necessarily cover the same academic field, e.g. a Master in Computer Science might be taken after graduation in a Bachelor of Arts or Modern Languages. In Germany the writing of a final thesis for which three to six months are allotted is part of the final examination in both degrees. Particularly at FHS the thesis work is often related to projects which have been done in companies during internships. This provides students with further experience in companies. At British universities the writing of a thesis is not normally required for a first degree.

A further difference is in the entrance requirements. German students get the right to study after finishing their school education with the *Hochschulreife* or *Fachhochschulreife*. The average starting age at universities is 21.1 years and 22.7 years at FHS. The average age of graduation was very similar in 2001: 28.5 years at traditional and 28.4 years at applied universities. 17 per cent of the students at traditional universities and 52 per cent of students at FHS have passed an apprenticeship before studying (BMBF *Grund- und* Strukturdaten, 2001). In Britain, around 80 per cent of all students on first degree courses are under the age of 21(HESA SFR 56 2002). If there is a higher demand for places than supply then German students are distributed centrally among the different state universities. Interviewing of students is hardly practiced. In Britain, universities can choose among students and set entrance requirements. This is one of the reasons why a higher quality variation exists among British universities than among German ones.

In addition to courses at applied universities (FHS) a similar standard is attainable at the *Berufsakademie* (BA). These courses combine theoretical training with in company experience. Students work part of the week at a company and study the remaining part at the BA. BA studies take only three years. They are offered only in a few Federal *Länder*. Because of their shorter duration and the dual training locations they are competing with the apprenticeship system in Germany. For example, in Baden-Württemberg, where this institution is introduced companies often prefer BA students and in our sample they had fewer ICT apprentices on average, but had taken on BA students.

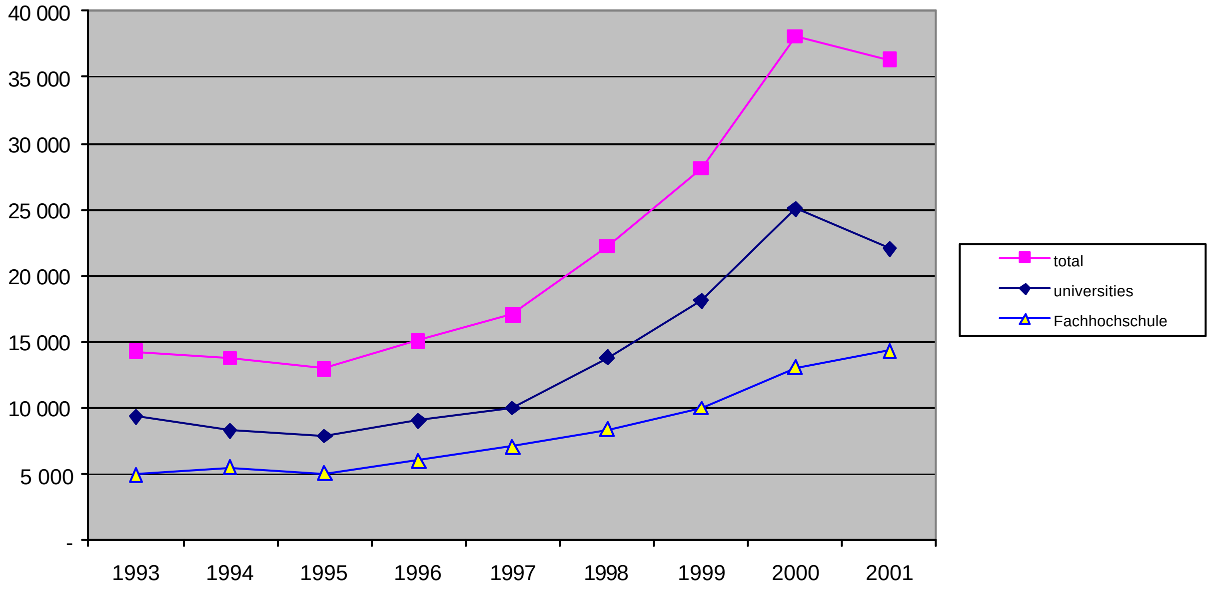
Bachelor and Master programmes have recently been introduced for the first time at German universities. These provide consecutive courses similar to those which are common in Britain. Up to now, the impact is still small as the numbers graduating was below 20 persons in 2001. Overall, these national differences in educational background lead to different types of graduates within and among the two national HE systems.

1.2 Development of computer science degree courses in Germany

Studies in computer science courses were not very popular in Germany at the beginning of the 1990s. The number of entrants to computer science courses even fell between 1993 and 1995 and started to increase only after 1995. At this time the total number of entrants was just 13,000 (see Figure 1). In the following years a strong increase is recognisable and 38,000 persons entered the courses in 2000. In 2001 the figure fell off slightly. These figures disguise the fact that the number of applications was much higher. Applied universities rejected about 70 per cent of the applicants because of a lack of places and the traditional universities restricted capacity as well (IWD, 2001). One reason for capacity problems was a lack of lecturers since the HE establishments could not offer competitive salaries in comparison to the private sector. To remove the obstacles and to enhance the supply of computer science places the German government issued funds of 50 million DM in June 2000 which are spread over five years[3].

[3] Sofortprogramm zur Weiterentwicklung des Informatikstudiums an den deutschen Hochschulen from June 20, 2000.

Figure 1 1st year computer science students in Germany from 1993 to 2000



Source: Statistisches Bundesamt, Fachserie 11, Reihe 4.1, different years, Wiesbaden

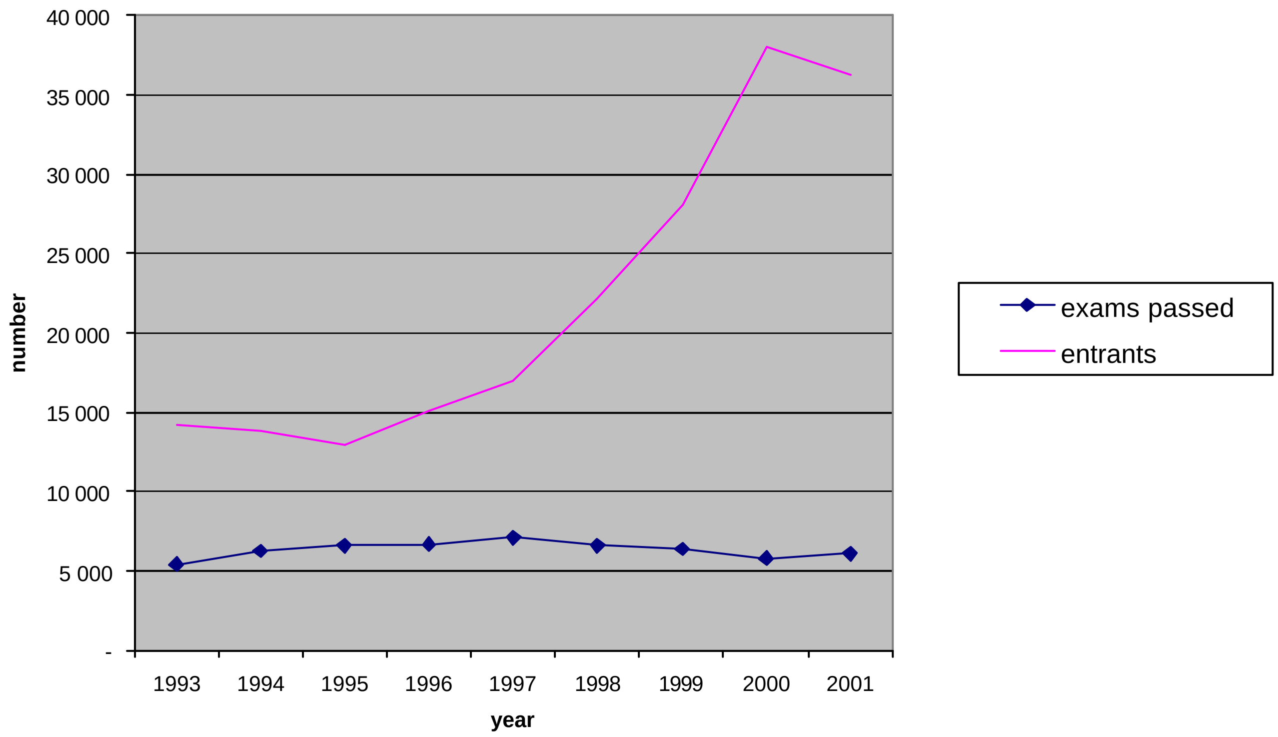
The share of female student entrants is relatively small but has increased during the time period from 13 per cent to 19 per cent. To achieve a further increase the government has initiated a large campaign in 2001 to interest women in studying engineering and computer science.[4] The declared aim is to expand the share of women to 40 per cent.

Despite the tripling in the number of entrants to computer science courses in the last six years the number graduating has been relatively constant and remained relatively small although the ICT sector has been growing considerably faster than the German workforce as a whole (see Figure 2). The number of graduates peaked in 1997 at 7,100 and fell to 6,100 in 2001. The reasons can be seen on the one hand in the relatively long studying times with on average 7 years at traditional and 5.5 years at applied universities which means that the entrants of the year 2000 will graduate only in 2006/7. On the other hand high attrition rates which are higher for traditional than for applied university courses reduce the number of graduates to less than 50 per cent in comparison to the number of entrants (Bruniaux et al, 2000; Heublein et al, 2002). Accordingly, the forecast for the numbers of graduates is about 9,000 in 2003 and 19,000 in 2006 (IWD, 2001). The high discrepancy between starters and graduates is illustrated in Figure 2. In 2000 the divergence is especially marked when 5,800 graduates left the HE system and 27,000 entered. The long response time in the German HE

[4] http://www.bmbf.de/presse01/399.html 'be.it www.werde-informatikerin.de', 08.06.2001.

system was a major factor in the ICT skills shortage in Germany when the ICT boom reached its height in 1999/2000.

Figure 2 Comparison between entrants and graduates in comp. science between 1993 and 2001



Source: Statistisches Bundesamt, Fachserie 11, Reihe 4.1 and 4.2, different years, Wiesbaden

A comparison between the numbers of graduates according to their qualification is shown in Table 1. Between 1995 and 2001, the number of doctorates increased by a third. The figure for graduates decreased for both HE institutions. In relative terms a slightly better positioning of the applied versus the traditional universities is recognisable during this period: the numbers graduating at traditional universities fell by 23 per cent between 1995/6 to 2001/2 while at applied universities it dropped by only by 4 per cent. This follows a policy by the Federal Government to expand the applied focus of the FHS more than the traditional university (Schönig, 2001). While about half of the IT professionals have a degree, the low output of ICT graduates means that the large majority are persons with a non-IT background. According to the German *Mikrozensus* 1996 only 33 per cent of the graduate employees in

ICT occupations had an ICT degree. However, 42 per cent attained a related degree (mathematics, electrotechnical, physics) (Licht et al, 2002).

Table 1: Numbers qualifying in German higher education computer science and computing courses 1995/6, 1998/9, 2001/02*

	1995/6	1998/9	2001/2
Doctorates	314	379	420
Traditional university	3257	3291	2527
Applied university	2913	2692	2792

*German and foreign students
Source: Statistisches Bundesamt, Fachserie 11, Reihe 4.1 and 4.2, different years, Wiesbaden

A comparison of the development in the number of ICT qualifications with regard to the total number of graduates illustrates that the negative trend which is found for ICT graduates does not reflect the general trend within HE. In the last three years, the number of graduates in all subjects has greatly increased (see Table 2). However, the negative trend in the numbers and passes in the ICT field is similar to the trend in the engineering industries where the number of graduates has been falling sharply (IWD, 2001; Bruniaux et al, 2000).

Table 2: Change in ICT qualifications gained at the three main levels of award in 1999 and 2002 with change in all HE qualifications gained at the same levels

	Doctorates		Traditional university		Applied university	
	ICT	All	ICT	All	ICT	All
1998	379	17901	3291	79150	2692	54631
2001	470	24796*	2527	92414**	2792	65954***
Increase 98-01	24%	39%	-23%	17%	4%	21%

*Foreign students: 8.8%; **5.1%, ***8.1%
Source: http://www.destatis.de/basis/d/biwiku/hochtab5.htm, 1.3.03

1.3 Development of computer science degree courses in Britain

Only around two-thirds of ICT graduates work in ICT related occupations and the majority of graduates in these occupations do not have an ICT degree (AISS/ITNTO, 1999). Nevertheless, our visits confirmed that computer science graduates form the 'backbone' of high-level skills in ICT producer and user companies in Britain. The output of degree level qualifications in this discipline is important to the health and growth of the sector. University education receives considerable financial subsidy from government in Britain and is therefore highly responsive to changes in government policy towards the Higher Education sector. Government policy currently (2002) has the following aspirations for Higher Education (henceforth HE).

- More young people aged 14-19 in schools, colleges and work-based learning, aspiring to progress to HE.
- Expanded provision to create opportunities for more people to enter HE.
- Funding arrangements that balance different needs and are targeted to those most in need.
- Further development of e-learning building on the e-universities project.
- Strengthened research and teaching excellence.

The governments target for HE is:

- By 2010, increase participation in HE towards 50 per cent of those aged 18-to-30. Also, to make significant progress year on year towards fair access, and to bear down on rates of non-completion.

The UK government has encouraged universities to expand to meet this target. The total number of students gaining HE qualifications (below first degree, first degree and post-graduate degree) has increased, by 16 per cent since 1996 (from 418,000 in 1996 to 486,000 in 2002).[5] Although no special measures were taken by government to encourage growth in computer science, numbers qualifying have increased far faster than the aggregate rate - by 67 per cent over the same period.

Table 3 below shows numbers gaining HE qualifications in computer science for selected years 1995-2001.

[5] Higher Education Statistics Agency (HESA) Statistical First Release PR28 and 61 Table 3

Table 3: Numbers qualifying in UK higher education computer science and computing courses 1995-6, 1998-9, 2001-02, UK domiciled students only

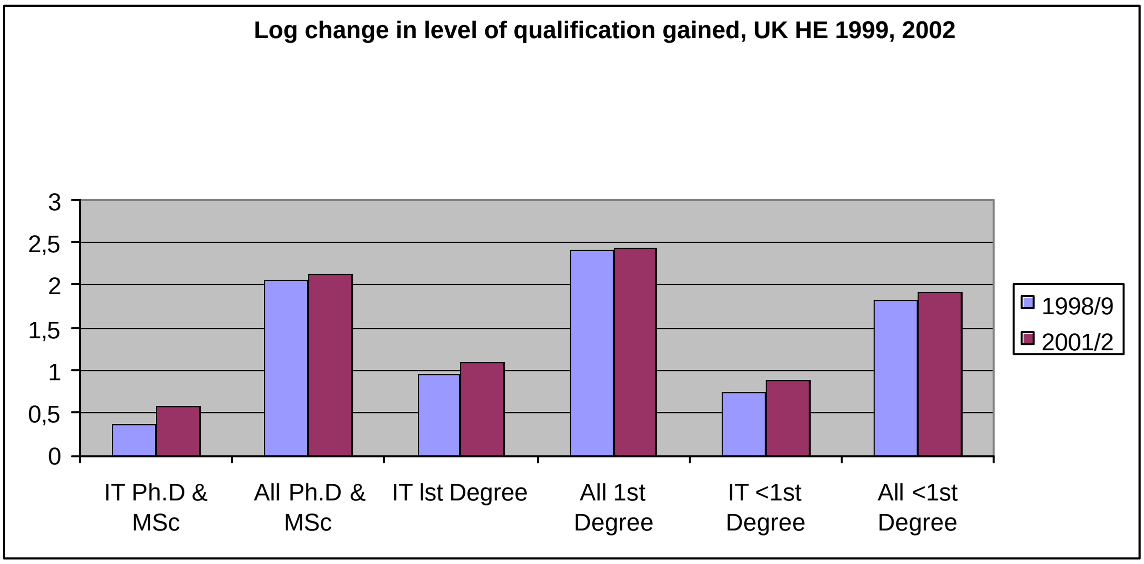
	1995/6	1998/9	2001/2
HE Awards (Doctorates)	164	178	203
HE Awards (Masters Level)	1534	2101	3541
HE Awards (Undergraduate)	8225	9015	12582
HE Awards (below Degree Level, excluding HNC/HNC)	889	1317	2091
HE awards (HND)	2322	2428	2807
HE Awards (HNC)	593	735	1160
HE Awards (other qualifications)	582	920	1498
All Awards	14309	16694	23882

Source: special tabulations provided by the Higher Education Statistics Agency (HESA).

However, this overall trend conceals considerable difference in the trends at different levels. Change in computer science awards over the period 1996-2002 was greatest at post-graduate level (+25 per cent) and at below first degree level (+15 per cent). The increase at first degree level was lower at +11 per cent.

Relative to 1999, computer science showed a marked increase in qualifications gained at all levels in 2002 (+ 37 per cent) compared to the trend for all subjects (+ 8 per cent). The increase over 1999 in numbers qualifying in computer science was, in fact, greater at every level of award compared to the increase in awards in all subjects (Figure 3). HE students and universities in Britain have thus shown themselves to be remarkably responsive to the marked increase in labour market demand for ICT qualifications.

Figure 3 Change in ICT qualifications gained at the three main levels of award in 1999 and 2002 and change in all HE qualifications gained at the same levels



Source: Special tabulations provided by the Higher Education Statistics Agency (HESA) and HESA Statistical First Release 61 Qualifications Obtained by and Examination Results of Higher Education Students at Higher Education Institutions in the United Kingdom for the Academic Year 2001/02.

Concerns have been voiced by industry and government about the quality of young people gaining computer science qualifications (Mason, 1999). A study by Bruniaux et al, (2000) gives some weight to this view. The mean A-level grade score of entrants to computer science courses was found to be well below that for all entrants and that for engineering entrants. However, the mean grade score of computer science entrants has also improved at a faster rate than the average for all entrants, indicating that the courses are increasingly attracting more able students. There has also been criticism of the content and scope of ICT degree courses. It has been suggested by influential voices in the ICT industry that a new model is needed for computer science courses in Europe. The salient features of this model would be:

- University staff actively involved with industry; relevant work experience for students
- Courses which develop ‘soft’ communication skills, flexibility and creativity
- Regular consultation with industry on university course curriculum

http://www.career-space.com/cdguide/index.htm

This initiative suggests that many computer science courses in European universities may still be too remote from what is required in practice by those entering employment in the ICT sector. This was a view that received much support from employers in Germany and the same opinion was expressed by a number of employers interviewed in Britain (Section 2.7 below).

1.4 Apprenticeship for ICT occupations in Germany

The German *Beruf* or professional occupation is defined by a coherent set of skills that combine together to form both an occupational and a social identity. Much has been written about the defining influence of this concept both as an instrument of social integration of new generations and as an organising principle for economic activity in German companies (Bertelsmann-Stiftung/Hans-Böckler Stiftung, 1998).

German apprenticeship is structured by the concept of Beruf and apprenticeship training can only be provided in a recognised occupation. The system covers about 360 training occupations in all economic sectors e.g. in craft, industry and trade, liberal professions, services. About two thirds of German school-leavers begin their vocational training with an apprenticeship. The system is also called 'dual' because vocational training takes place both in the company and in part-time vocational schools which the trainees attend for one or two days a week or in the form of block release. The part-time vocational school supplements company-based training by theoretical instruction. It is under the jurisdiction and finance of the individual Federal *Länder.* An apprenticeship is based on statutory training regulations which are nationally recognised and updated to comply with economic and technical/technological changes.

Entrants to the system come from the tri-partite schooling system at different age levels. In 1999 about 30 per cent had the *Hauptschulabschluss* (lower secondary school, 9-10 years of schooling), 36 per cent the *Realschulabschluss* (intermediate secondary schools, 10 years of schooling) and 16 per cent the *Hochschulreife* (upper secondary schools, 13 years of schooling). The remainder had done some additional vocational schooling. Because of the increase in schooling years and the military service which is done by some of the young men the average age of apprentices is 19 years. In 1970 it was around 17 years (BMBF, 2002).

Supply of apprenticeship places is voluntary by companies but not all companies are allowed to train. Several requirements have to be fulfilled. The qualifications of the instructors are regulated in a decree (*Ausbildereignungsverordnung*) and the enterprise must draw up a training curriculum in line with the requirements of the training regulations. Chambers of Commerce (to which all companies must belong) play an important role as they give approval for companies to train and set the examinations for the apprentices.

In general, an apprenticeship lasts between 3 and 3.5 years. For those who have gained the *Hochschulreife* certificate it can be shortened. Compensation for trainees is differentiated by year of training. On average apprentices get about a third of a skilled person´s wage. Apprentices have to take intermediate and final written and oral examinations. In 2000/01 1.7 million young persons were participating in apprenticeships. 614,000 of these contracts were started in 2001. Enterprises with 5-20 employees have the highest training ratio (http://www.destatis.de/basis/d/biwiku/beruftab1.htm).

More intense global competitive pressures, the premium on flexibility and adaptability of manufacturing and commerce have led to extensive questioning of the relevance of the traditional German apprenticeship (Baethge and Baethge-Kinsky, 1998). In particular, these authors argue that companies are moving towards a flexible, more customer-oriented model of work organisation characterised by more rigourous cost-control. This requires cooperation across traditional organisational boundaries, a less hierarchical work organisation and flexible working time. They argue that this type of organisation is incompatible with the traditional concept of *Beruf* defining at the same time the individual's status in relation to other employees and also his/her 'ownership' of a defined area of skills and action.

The development and application of ICT was characterised by all the elements identified as emerging from the more competitive environment of the 1990s. When the decision was taken in 1997 to establish four new apprenticeship occupations in the ICT field of economic activity, this was widely perceived as a test of the 'innovative potential' of the Dual System. Could the concept of *Beruf* be redefined as a dynamic process-oriented qualification that would allow employees to adapt to the rapid pace of change and highly competitive environment of ICT activity (Ehrke, 1997; Schelten and Zedler, 2001)?

The new qualifications were developed in less than a year, in contrast to the accepted wisdom that the development of apprentice qualifications was an inevitably lengthy and cumbersome procedure. Four occupations were identified and the apprenticeship programme incorporated much that aimed to ensure that those who graduated acquired relevant and cutting edge skills and competences.[6] In 1997 the first apprentices were recruited, the aim was 60,000 in training by 2001. This goal was, in fact, reached with 60,000 in training by the end of 2001.[7]

The rapid development in ICT required new training jobs and new content for old jobs. One of the old apprenticeships, the *Datenverarbeitungskaufmann* (Data entry clerk), was modernized and transferred into *Informatikkaufmann* (Computing clerk) with a new curriculum. This apprenticeship has been included in the graph below under new apprenticeships although it existed before 1997 (thus all persons in 'new' apprenticeships before 1997 were trained as *Datenverarbeitungskaufmann*). The other pre-1997 ICT-apprenticeships which deal with communication electronics, telecommunications, radio and TV, information techniques have been continued and are listed as 'old' ICT-apprenticeships.

With the introduction of the new ICT apprenticeships, examination methods have been updated. The old examination regulations made a distinction between knowledge and skills. This distinction can be traced back to the self-image of the vocational college as the source of knowledge and of the training company as the source of practical skills. This has been criticized for not taking adequate account of the candidate's proficiency in action.

The demands for a new examination system included:

- the development of practical examinations with a strong relevance to real-life practices;
- the measurement of proficiency in action in written as well as oral examinations;
- the removal of the distinction between knowledge and skills by means of integrated examinations;
- the introduction of holistic examinations (Schmidt, 1998).

The new examinations are less standardized and include an assignment composed of several sub-assignments which models an entire job assignment or business process as in-company project work (see Figure 4).

[6] The training programme is composed of Core Competences and optional elements which allow for specialised training relevant to the apprentice's training firm. Training in project management and team building are also envisaged and a proportion of assessment is based on successful completion of a project.

Figure 4 Structure of the final examination in the new ICT occupations

Part A of examination		Part B of examination
In-company		Holistic assignment 1
project work		
(max. 35 h / 70 h)		Holistic assignment 2
		Economic and social affairs
Presentation and discussion		possibly: supple-mentary oral examination

Source: Schmidt (1998).

The new type of examinations demands more time and effort on the side of the examiners. In addition, it includes the danger of creating qualifications of different value depending on the company in which the project work was carried out. Thereby the objectivity of the assessment and the information value to a potential employer who is about to decide on recruiting a newly skilled worker is reduced. A survey into the acceptance of the new concepts by firms shows that the majority agree with them. However, problems with the assessment practice are also recognized. In addition, some firms find it relatively difficult to synchronise training contents with examination requirements (Petersen and Wehmeyer, 2001).

As can be seen from Figure 5, apprenticeships in new ICT-occupations increased sharply with the creation of four new ICT apprenticeships in 1997. The number of these apprenticeships increased from 1200 in 1996 to 4300 in 1997. In the following years they increased at a rate of about 5,000 additional contracts per year until 2000. Then the increase levelled off at an annual entry level of just under 25,000. The new apprenticeships satisfied to a large extent a new demand while the old apprenticeships continued to be demanded although at a slightly lower rate.

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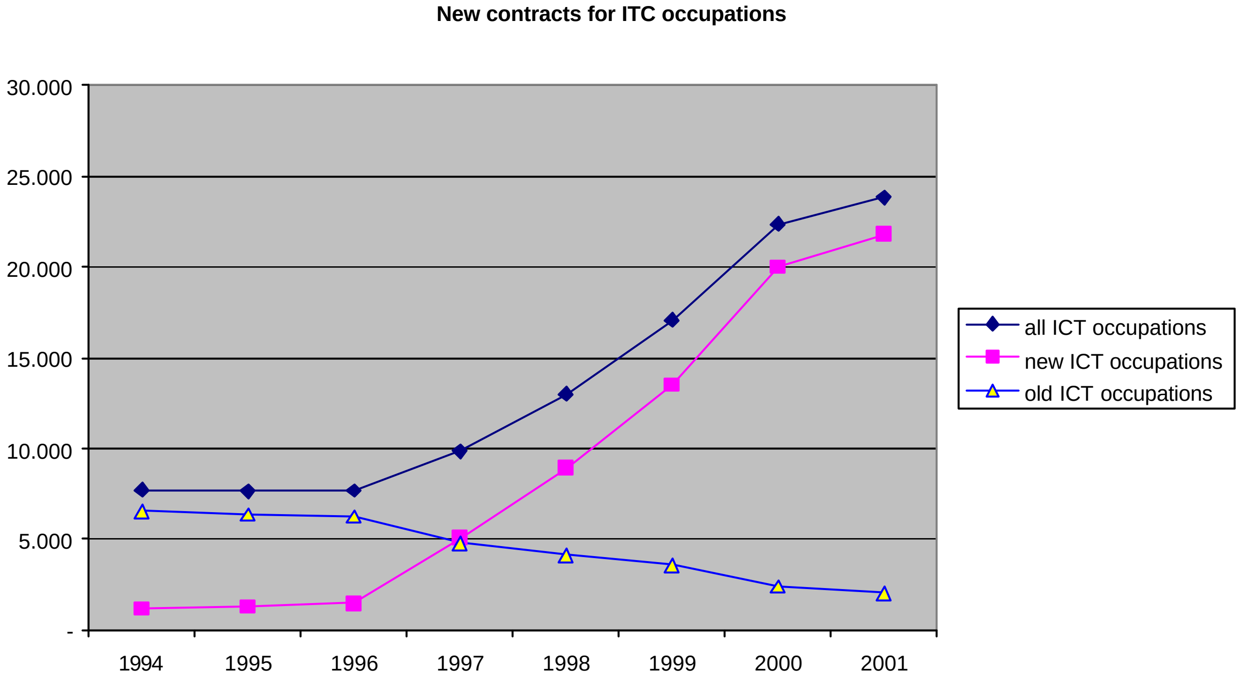
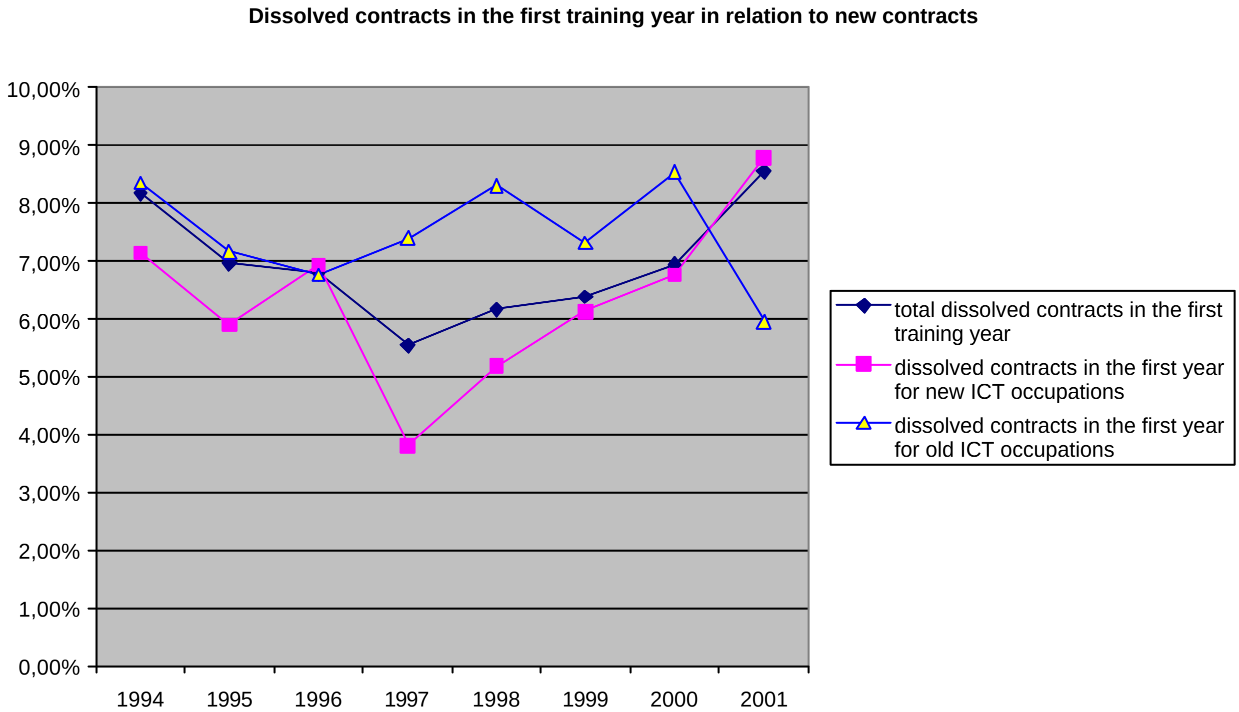
[7] This does not include 10,000 in the 'old' ICT apprenticeship (see Section 1.4 above).

Figure 5 Annual totals of new contracts for ICT occupations, Germany, 1994 -2001



Source: Statistisches Bundesamt, Fachserie 11, Reihe 3 (Berufliche Bildung), different years, Wiesbaden

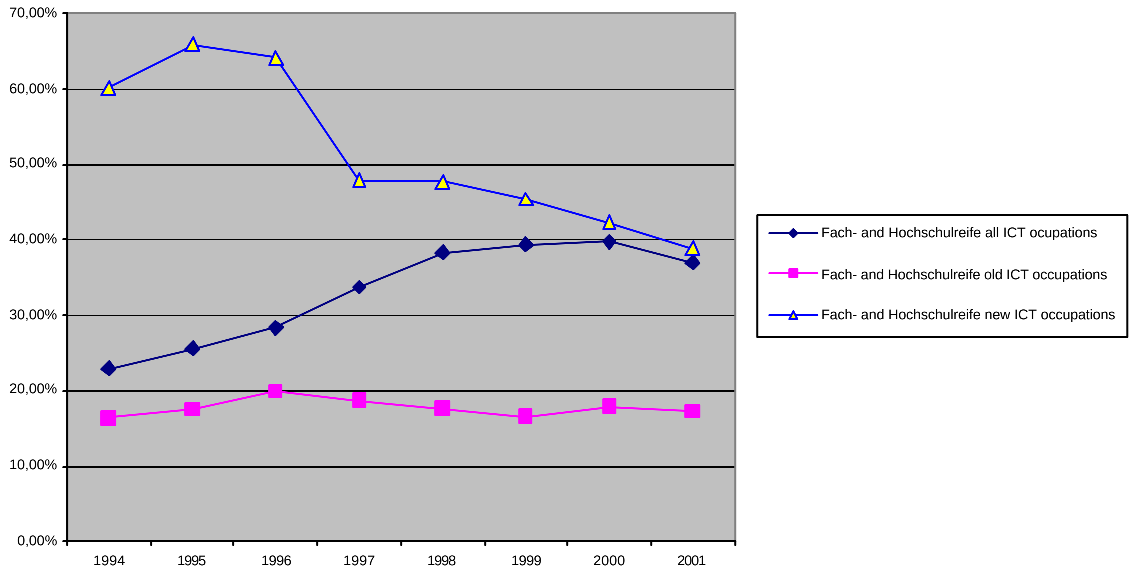
Figure 6 Attrition rate as a percentage of starts in ICT apprenticeships, Germany 1994-2001



Source: Statistisches Bundesamt, Fachserie 11, Reihe 3 (Berufliche Bildung), different years, Wiesbaden

Most attrition in apprenticeships happens in the first year when entrants find out that the chosen occupation does not fit with their ideas or the trainee and the firm notice that they do not get along with each other. In 1997 when only a relatively small number of apprentices started in the new occupations only 4 per cent dropped out. After that the numbers increased strongly and the numbers who left the apprenticeship doubled and rose to 9 per cent. The old ICT-apprenticeships have an attrition rate between 6 and 8 per cent which fell recently when the number of entrants diminished (Figure 6). In comparison to the average of all apprentices in industry and trade occupations which was 17 per cent in 1997 and 20 per cent in 2001 the attrition rate for ICT occupations is relatively low *(*BMBF, 2002).

Figure 7 Share of ICT apprentices with Fach- or Hochschulreife (A-level equivalent)



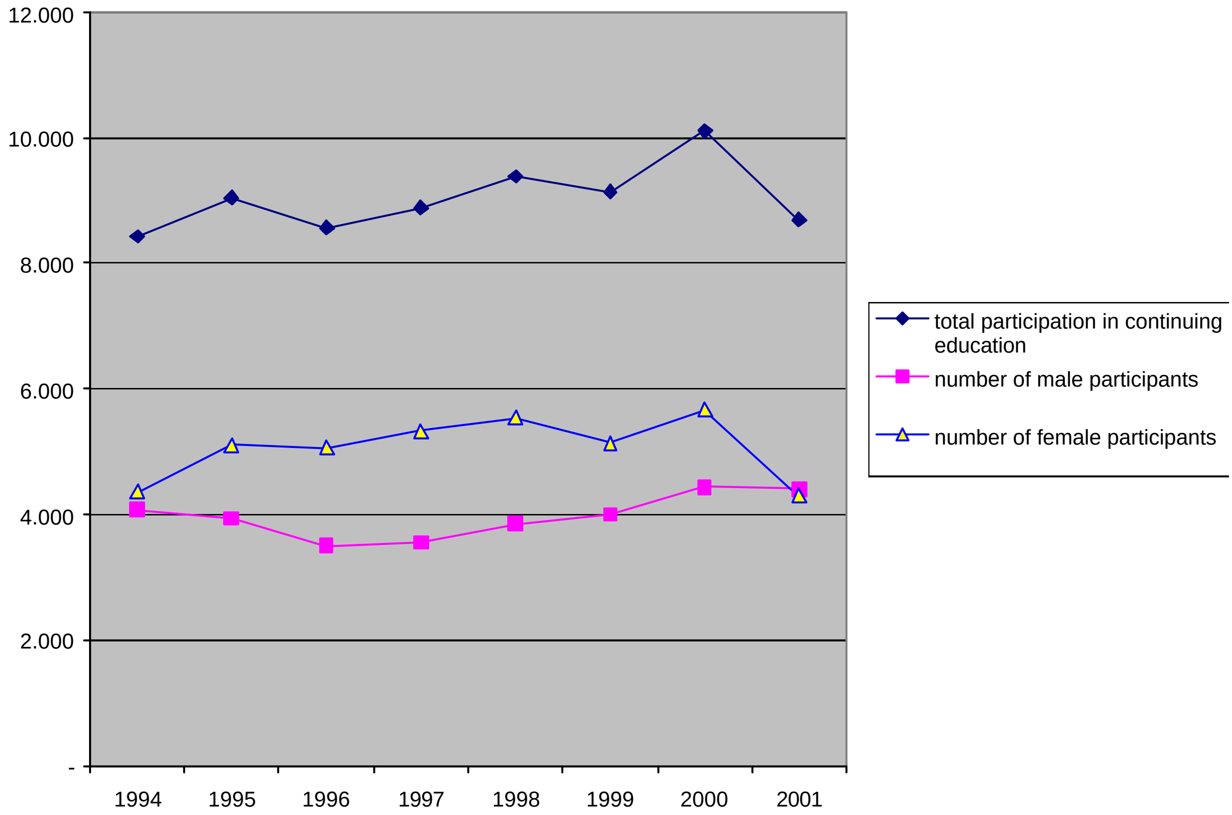
Source: Statistisches Bundesamt, Fachserie 11, Reihe 3 (Berufliche Bildung), different years, Wiesbaden

The 'new' ICT apprenticeships have a high share of apprentices with a higher level of schooling certificate (Figure 7). Before 1997 when only the first new apprenticeship existed it was very selective. The majority of apprentices – more than 60 per cent - had a university entrance qualification. After 1997 this share dropped to below 50 per cent when the other new ICT apprenticeships were introduced and the intake tripled. The old ICT apprenticeships show a much lower percentage of young persons with *Fach- and Hochschulreife.* The reasons for the higher schooling background in new ICT-apprenticeships are the demanding contents and examinations. Companies who offer the apprenticeship places know how demanding the training and task requirements are and choose the more able school-leavers. Nevertheless, it depends on the companies whom they will choose. Even in these challenging occupations about 7 per cent of the apprentices have the main school certificate. However, much depends on the quality of schooling which differs according to *Länder* (states). For example, in Bavaria which is seen as having a relatively good school education 12.6 per cent of the new ICT apprentices in 2000 had a school certificate from the *Realschule* (equivalent of 5 GCSE A-C), while there were only 4 per cent in Berlin which is considered to have a comparatively low school education level.

In addition to apprenticeship training, the Chambers of Industry and Trade and of Craft offer courses and examinations for continuing education. Despite the expansion of the ICT market the number of examinations is relatively stable over the period considered. One exception is the increase in the year 2000 followed by a drop in 2001. It could well be that in anticipation of the year 2000 problem some courses have been brought forward. The female participation rate was about 50 per cent (Figure 8). The relatively high female rate in comparison to the participation in apprenticeships (where female participation is extremely low) is caused by the type of further education courses. A large share is based on ICT office applications. Examinations which would correspond to a level at middle management such as *Meister* or *Fachwirt/Fachmann* are very rare. Only 18 persons passed such examinations in 2001.[8] It can be expected that the numbers at this level will strongly increase after comprehensive regulations for ICT further training have been issued in 2002 (see Section 1.6)[9].

[8] Fachmann für DV-Organisation (10), Fachwirt für Datenverarbeitung (8).
[9] Support for further education courses is available from the government (BMBF, 2002a).

Figure 8 Participation in examinations set by the Chambers in selected courses of continuing education in the ICT field by gender, Germany, 1994 - 2001



Source: data provided by the Statistische Bundesamt

Many employees in ICT firms have passed an apprenticeship but in another occupation. In many cases retraining has been done by their employer. Others have participated in the extensive retraining programme by the Federal Labour Office. For example, in 1999 the Labour Office spent DM 1 billion for retraining unemployed persons in ICT. In total some 32,000 persons were retrained by the Federal Labour Office in the year 2000, some 40,000 in the next year (Dostal, 2000). The labour office retraining programmes which are provided by different institutions last between a few months and two years. The retraining is set-up to familiarise unemployed persons from diverse backgrounds with IT. In 2001/02 the retraining included about 6,000 main stream graduates. This figure is as high as the total number of ICT graduates in that year (Dostal, 2002). The diversity of educational and vocational backgrounds as well as of courses and providers leads to a substantially varying quality output. In our survey we asked about the satisfaction of companies with these persons.

While smaller companies who only took one or two retrained persons had a very mixed experience, larger companies either mentioned that they are not satisfied or that they have their preferred training institutions. With these they cooperated, discussed standards and contents, provided internships and therefore knew what type of quality they would get. Among the industries retailing firms were often satisfied with the qualification whereas software companies were rather reluctant to take anybody from the funded labour office courses.

1.5 Development of ICT apprenticeship in Britain

1.5.1 Development of apprenticeship in the 1990s

Apprenticeship in Britain remained confined to traditional, mainly craft, industrial sectors until a new government initiative in the mid-1990s. It underwent a severe decline from the 1960s onwards which in the 1980s and early 1990s appeared to be almost irretrievable (Gospel, 1995). The situation was to some extent remedied through government action, aimed both at improving the national stock of skills and at reforming the government-funded vocational training available to young people: a state-sponsored Modern Apprenticeship was piloted in September 1994 and introduced nationally in September 1995. The aim was to introduce a new model of work-based training, applicable even to sectors where apprenticeship had not previously existed.

The new model was linked to the relatively new National Vocational Qualifications (NVQs). Instead of being examination-based, NVQs depend on demonstrating an agreed set of practical competencies in real work situations (offering older unqualfied workers accreditation of skills already possessed). They have been criticised for de-emphasising underlying theory, and for the complicated procedures they involve for documenting the candidate's mastery of each competency (candidates are required to assemble an extensive portfolio containing written documentation, witness testimony, etc., as proof that they have demonstrated each prescribed skill). The standard they have reached then has to be assessed and moderated by a system of internal and external verification, leading to the issue of an NVQ by an Awarding Body.[10]

Initially the new apprenticeships were all at NVQ Level 3, corresponding to today's

Advanced Modern Apprenticeships. A second, Level 2 apprenticeship was introduced in September 1997 and initially known as the National Traineeship, changing its title to Foundation Modern Apprenticeship in 2000. The scheme is open to young people aged between 16 and 24. Advanced Modern Apprenticeships are intended to last for about three years, and Foundation Modern Apprenticeships for about two, but young people are considered to have successfully completed their apprenticeships when they have gained their NVQ and (more recently) passed examinations in key skills and technical knowledge—in contrast to traditional apprenticeships where the emphasis was on serving a set time period. In practice the majority of Modern Apprenticeships are of much shorter duration than their official 'Planned Length of Stay'.[11]

The cost of off-the-job training, characteristically provided through FE colleges, was met by the state, which channeled the funding through regional Training and Enterprise Councils (TECs) who in turn contracted with local 'training providers' for the delivery of an agreed number of apprenticeships. In April 2001 this regional commissioning role was taken over by new bodies, Local Learning and Skills Councils, but the same contracting system remains. Although it may have been intended that employers should contract directly with the TECs to receive this money and use it to purchase off-the-job training for their apprentices, this only happened in a minority of cases. The dominant model, carried over from the previous system of residual state provision for unemployed youth, was of specialist training organisations (drawn from the private, public and voluntary sectors), securing these monies, recruiting young people, and then finding employers to take them on. This pattern has been heavily criticised for weakening the traditional compact between employer and young person, eroding in many cases the long-term commitment to give and to benefit from high-quality training. Advanced Modern Apprentices have employed status and receive a wage from the employer;[12] in some cases Foundation Modern Apprentices will not be employees and will receive a state training allowance.

A number of changes have been introduced to Modern Apprenticeships since the scheme began. Teaching and written examination of 'Key Skills' (verbal communication, number, and ability to use ICT) was introduced in 2001. In March 2001 the regionally-based system of commissioning and funding apprenticeships through training providers was strengthened and standardised, with the more autonomous TECs replaced by Local Learning

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[10] The occupational competency required to perform a specific role is broken down into Units, and it is possible for candidates who have not demonstrated all the competencies to gain individual NVQ Units (see below).

[11] See for example Fuller and Unwin (2001), 52.

and Skills Councils under the direction of a national Learning and Skills Council.

There have been problems with Modern Apprenticeships. A significant proportion of young people leave without completing their apprenticeship, and the proportion of successful completions is estimated at below 50 per cent.[13] The scheme varies from sector to sector in its quality, with very high drop out rates and poor success rates, especially in some low-paid service sectors with limited traditions of training. There has been disappointing take-up by employers and young people.

In 2001 the working of Modern Apprenticeships was reviewed in the Cassels Report [14]. The Committee noted that the scheme was relatively poorly supported by employers, and that often neither employers nor young people had any clear knowledge of what was involved. They expressed considerable reservations about the way the employer-apprentice contract had been distorted by the dominance of the 'training providers' and sought to set limits to the latter's involvement. They recommended that these apprenticeships should offer employers and young people a far more consistent, widely-known standard of quality through the formal examination of underlying theoretical knowledge and the award of a Technical Certificate as an integral part of the Modern Apprenticeship requirements. The Blair government adopted Cassels' recommendations, and ICT has been chosen as a sector where the new Technical Certificates will be piloted, a development affecting young people starting ICT apprenticeships from September 2002 onwards.[15]

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[12] In some cases, the training provider may act as employer. See Gospel and Foreman (2002).
[13] See below for discussion of the difficulties in calculating a precise success rate.
[14] Modern Apprenticeships: the Way to Work, the Report of the Modern Apprenticeship Advisory Committee (DfES and the Learning and Skills Council, Sept 2001).
[15] In 'Technical' ICT apprenticeships (see below for details of this distinction), three different BTec qualifications, each depending on the number of guided study hours the candidate undertakes, are available as Technical Certificates. For the highest number of hours, the technical certificate is an HND.

Table 4: Young people entering all ICT Advanced or Foundation Modern Apprenticeships (Technical qualifications) in England since September 1995

Table 4 **All Apprenticeship Starts**										
			1995	1996	1997	1998	1999	2000	2001*	All Years
technical		AMA	2	123	875	810	744	460	450	3464
technical		FMA			1	154	470	400	659	1684
All Technical			**2**	**123**	**876**	**964**	**1214**	**860**	**1109**	**5148**
*Combining DfES and LSC Starts figures.										

1.5.2 Development of ICT apprenticeships

Records of apprenticeship starts and completions are coded according to the Sector Skills Council or National Training Organisation to which they are in scope, and indicate the particular NVQ which the young person will be taking. The starting point for the analysis offered below was therefore to select all apprenticeships coded as being in scope to the e-skills NTO (now a Sector Skills Council, *e-skills UK*). The next step was the categorisation of these NVQs (where there have so far been 32 main titles relevant to ICT, many of them offered at more than one level and by more than one Awarding Body) into broad skill areas. The primary division is between

a) ‘technical’ NVQs - involving an understanding of computer hardware technology, software programmes or computer networks, and
b) ‘user’ qualifications, which denote proficiency as an end user of computer applications, characteristically office packages.

‘User’ apprenticeships are excluded from the discussion which follows because they are outside the scope of this enquiry into skills required by dedicated ICT departments or companies and have no counterpart in the German apprenticeship framework.

The technical NVQs, which are our principal interest here, have been divided into three groups:

a) ‘software development’, involving programming and systems analysis

b) ‘ICT services’, involving the installation and support of hardware and programmes—either within the workplace or for customer companies—or the administration and support of computer networks

c) ‘hardware’, which refers to the maintenance of ICT equipment.[16] [17]

Table 4 shows numbers of young people entering ICT Advanced or Foundation Modern Apprenticeships leading to technical qualifications (as defined above) in England since September 1995.

Compared to the numbers of young people studying Computer Science in higher education (Table 3), numbers starting apprenticeships are very low. By the end of 2001 only 5100 had entered technical apprenticeships.

From September 1997 when the lower level Foundation Modern Apprenticeship became available, the number of starts for ICT Advanced Modern Apprenticeships fell, while ICT Foundation Apprenticeships grew rapidly.

[16] See Appendix 1 below for my classifications. I am grateful to Christine Donnelly of e-skills UK for advice in this area. Within the ‘user’ category one very heavily-used group of NVQs bear the title “Use and Support of Information Technology”. These awards do not contain any element of technical ICT support, but were aimed rather at developing expert practitioners of business packages, sometimes working in a help desk role, who could enable less experienced colleagues to extend their abilities as ICT end-users.

[17] Confusingly, a minority of ICT apprentices take non- ICT NVQs. In some cases, it appears that training providers working in a variety of industrial sectors may have moved apprentices into completely different occupational areas; but we know that in other cases the apprentices are in fact taking a higher ICT qualification, while switching to an NVQ which is relevant to their work, but does not involve ICT skills. For example, an NVQ in Customer Care combined with an ICT BTEC or vendor qualification.

Table 5: All Technical IT Modern Apprenticeships Starts by area of specialisation 1995 – 2001

	1995	1996	1997	1998	1999	2000	2001	All Years
AMA development	0	71	480	369	266	11	95	1292
FMA development	0	0	0	0	0	15	9	24
AMA hardware	0	10	57	69	127	201	25	489
FMA hardware	0	0	0	10	33	36	42	121
AMA IT services	2	42	338	372	351	248	330	1683
FMA IT services	0	0	1	144	437	349	488	1419
All Software Development	0	71	480	369	266	26	104	1316
All Hardware Repairs	0	10	57	79	160	237	67	610
All IT Services	2	42	339	516	788	597	818	3102

Source: DfES Modern Apprenticeship Databases to 25th March 2001, and LSC Individualised Learning Records from 26 March 2001.
Notes: Figures for 2001 are produced by combining DFE to 25 March with the LSC records up to the end of the year. DfES figures are likely to contain an element of over counting, whereas LSC figures aimed to eliminate this. (See discussion in footnote 9.)

Table 5 shows all technical IT Modern Apprenticeship starts by area of specialisation 1995-2001. One striking trend is the decline in the numbers of starts in the area of software development from 480 in 1997 to less than 100 in 2001. It is possible that demand for these apprenticeships was inflated by the need for trained programmers in the lead-up to the year 2000. It may also be that business computer programs are becoming smarter, so that they can more readily be customised by the end user without the need for any programming.[18]

Numbers of apprenticeships in *Servicing ICT equipment* increased rapidly from 10 in 1996 to 237 (the vast majority of them at Advanced level) in 2000, before falling away to only 67 (mainly at Foundation level) the following year.

ICT Services apprenticeships, which were initially less numerous than programming, have generally grown impressively from 42 in 1996 to 818 (488 of them at Foundation level) in 2001. There was a significant downturn in 2000 (only 597 starts), but the 2001 figure represents a new high. ICT Services now represents the vast majority of technical ICT

[18] From discussion with Mick Brophy, Director of Technology and Telematics at Gateshead College. The apprenticeship training Gateshead College provides for Nissan originally involved programming for

apprenticeship starts. Although Foundation apprenticeships in ICT Services appear to have taken some numbers away from ICT Services Advanced Modern Apprenticeships, the Advanced apprenticeships appear to have achieved a sustainable level, with the Foundation apprenticeships growing steadily in addition.

This broad overall distinction between Software Development and ICT Services, with the latter flourishing as an area for apprenticeship training and the former employing progressively fewer apprentices, finds an echo in the interviews with companies conducted. Here, many firms appeared to regard it as axiomatic that graduates undertook software development work and that installation, network administration, network maintenance and help desk activities should be entrusted to employees below graduate level.

Turning now to the outcomes of technical and and ICT Modern Apprenticeships, Table 6 shows the number of full technical ICT NVQs and NVQ Units gained by ICT Modern Apprentices in each calendar year 1997-2000.

For a number of reasons the table is likely to understate the numbers gaining NVQs and units[19], but given the relatively modest number of technical apprenticeship starts and what we know of the high drop-out rate from Modern Apprenticeships[20], the final output of trained technical ICT staff from Modern Apprenticeships is bound to be extremely modest.

Table 6 shows a steady increase each year up to 523 full ICT NVQs and 57 partial awards of one or more NVQ units for the year 2000, followed by a very serious fall in 2001, with only 146 full technical ICT NVQs, the decline to less than the volume for 1998.

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mainframes, but now concentrates far more on installation and support activities in a factory where every ‘cell’ of workers on the production line makes extensive use of a networked PC.

[19] See notes to Table 3.

[20] See, for example, Fuller and Unwin (2001).

Table 6: Numbers of IT Modern Apprentices gaining full NVQs or one or more NVQ Units 1997-2000

	1997		1998		1999		2000		2001*		All Years	
	Full NVQ	**One or More Units**	**Full NVQ**	**One or More Units**	**Full NVQ**	**One or More Units**	**Full NVQ**	**One or More Units**	**Full NVQ**	**One or More Units**	**Full NVQ**	**One or More Units**
All Technical AMA	59	102	263	57	265	32	296	30	96	27	979	248
Alll Technical FMA	0	0	13	0	10	10	227	27	50	10	300	47
Software Development AMA	55	97	199	28	145	8	116	5	15	2	530	140
Software Development FMA	0	0	0	0	0	0	1	0	3	0	4	0
Hardware AMA	0	1	4	4	11	6	36	3	13	11	64	25
Hardware FMA	0	0	0	0	1	2	11	2	12	2	24	6
IT Services AMA	4	4	60	25	109	18	144	22	68	14	385	83
IT Services FMA	0	0	13	0	109	8	215	25	35	8	372	41

Source: DfES Trainee Database System. *2001 figures combining DfES Trainee Database System (January-March) with LSC Individual Learning Record data (March-December).

Notes: Chart it is likely to underestimate the numbers of NVQs awarded as some trainees are waiting for their NVQ award procedure to be completed at the point where a Leaver Certificate is sent out to DfES. (The alternative source of data, the six-month follow-up survey of former apprentices, it is equally unreliable because of a poor response rate and of concerns about ambiguity in the questions. (Ssee Fuller and Unwin, 2001.). No estimate is available of the extent of this under-representation.

Chart excludes awards which cannot be identified, and non-IT NVQs awarded to Modern Apprentices falling within one of the three Sector Codes representing the IT industry. This latter group has grown steadily in number, rising to 54 full NVQ awardsfor the year 2000). In some cases, including some of the latter group, apprentices may have taken a higher IT qualification in addition to the NVQ. Only one Software Development NVQ has been awarded to a Foundation Modern Apprentice in the period covered by this chart.

Table 7 shows how long ICT Advanced and Foundation Modern Apprentices have actually spent in training since 1997.

Table 7: Actual Average Duration (in weeks) of IT Advanced and Foundation Modern Apprenticeships 1997-2000

AMA	**1997**	**1998**	**1999**	**2000**	***2001**
Software Development	22.63	34.80	34.92	56.43	77.59
Hardware	39.00	60.00	58.94	103.44	79.47
IT Services	34.25	48.51	73.84	92.65	76.72
All AMA Technical IT	23.30	39.02	52.89	80.68	77.24
FMA					
Software Development				105	19.57
Hardware			46.25	52.23	40.23
IT Services		18.93	29.55	35.71	41.98
All FMA Technical IT		18.93	30.10	36.81	41.20

Source: DfES Trainee Database System.
*2001 data combines DfES TDS data to 25 Mar with LSC Individualised Learning Record data for the rest of the year.
Notes: These averages are based on returns for young people who completed their NVQ courses in an IT NVQ. Most of the apprentices who dropped out are recorded as 'Missing data', and average duration for this entire group is quoted without reference to the individual NVQ programs each one started out on.

The average duration for all technical Advanced Modern Apprenticeships was approximately three times longer by 2000 than in 1997, although even after these increases the apprenticeships were still only lasting a little more than 18 months when they had been envisaged as a three-year commitment. Advanced apprenticeships in software development are on average far shorter than other technical ones: it may be that they have always been regarded as a ‘fast track’ type of training, and this requirement may be linked with the way in which their numbers have declined.

The average length of ICT Foundation Modern Apprenticeships has also increased, doubling between 1998 and 2001. Despite this, the average length of training for a Foundation apprentice is still less than 10 months. Table 8 compares ICT apprenticeship starts with the numbers of apprentices gaining full NVQs in the following year.

Table 8
Technical ICT Modern Apprenticeships—Starts and NVQ Awards Compared 1997-2001

	Starts 1996	Awards 1997	Starts 1997	Awards 1998	Starts 1998	Awards 1999	Starts 1999	Awards 2000	Starts 2000	Awards 2001	All Starts to 2000	*All Awards to 2001	% of all starts resulting in Awards
Software development AMAs	71	55	480	199	369	145	266	116	11	15	1197	530	44.3
Software development FMAs	0	0	0	0	0	0	0	1	15	3	15	4	26.7
Hardware AMAs	10	0	57	4	69	11	127	36	201	13	464	64	13.8
Hardware FMAs	0	0	0	0	10	1	33	11	36	12	79	24	30.4
ICT Services AMAs	42	4	338	60	372	109	351	144	248	68	1351	385	28.5
ICT Services FMAs	0	0	1	13	144	109	437	215	349	35	931	372	40.0
Technical AMAs	123	93	875	368	810	265	744	296	460	96	3012	1118	37.1
Technical FMAs	0	0	1	13	154	121	470	226	400	50	1025	410	40.0

Source: DfES Trainee Database System. *2001 figure combines DfES TDS data to 25 March with LSC Individualised Learning Record figures for the rest of the year.

Note: See discussion of Table 4 above concerning the difficulty in calculating the number of awards. Figures here are based on numbers of NVQs recorded by training providers when they submit the 'leaver's certificate' as trainee leaves the scheme, but (1) NVQ awards are often pending at the point when the apprentice leaves and the statistical return is submitted. (2) DfES themselves prefer to base frequency of awards and success rate on self-reports by ex-apprentices in the follow-up questionnaire sent out six months after leaving the scheme - but problems here with low response rate and uncertainties about whether all the questions are understood by all the respondents.

The annual figures throughout reflect the numbers of starts in each specialist technical area in the preceding period - but at a considerably reduced level. Thus we can see how the decline of Advanced Modern Apprenticeship starts in software development, which began in 1997/98, shows up as reduced numbers of full awards from 1998/99 onwards. Similarly, the steady increase up to 1999 in ICT Services starts at both Advanced and Foundation levels is reflected in a very sustained growth in the number of ICT Services NVQs continuing up to the year 2000, but with Foundation NVQs in this area coming to outnumber Advanced ones.

Table 8 also shows that the early years of ICT Advanced Modern Apprenticeships saw large numbers of apprentices who only achieved individual NVQ units. It may be that some employers in this early period saw Modern Apprenticeships as a way of funding brief training courses rather than as a two to three-year commitment.[21]

The discrepancy between the number of starts and the number of full awards of ICT NVQs will be accounted for in a number of different ways: (1) by young people who have left the scheme and who are still waiting for their full NVQ awards to be confirmed once the Awarding Body has completed its procedures; (2) by the relatively small number of candidates who switch to non- ICT NVQs; (3) by the relatively small number of cases where poor record keeping has meant that the NVQ awards cannot be identified; (4) by the minority of young people who do not manage a full NVQ and are only awarded individual NVQ units, or who gained no units whatsoever despite this completing the period of the apprenticeship; and finally (5) for very large numbers of young people who drop out and never complete the training.

The final column attempts to indicate a percentage success rate, arrived at by dividing the cumulative number of awards after the end of 2000 by the cumulative number of starts up to the end of 1999. The 12 months difference is intended to reflect the numbers of young people who are still in training and could not be expected to have achieved awards yet. Because we have incomplete information about final NVQ outcomes, because of the problem of NVQ awards which are pending at the moment when the young person leaves, and because there is no set length for apprenticeships, this comparison is of limited usefulness.[22][23] Given

[21] The length of time Modern Apprentices are actually spending in training has increased since 1995.

[22] Recent estimates by DfES put the success rates for Advanced and Foundation Modern Apprenticeships in all occupational areas at around 49 per cent and 45 per cent respectively in 2000-1, but recognised very wide variations between different occupational sectors (DfES First Statistical Release SFR 47/2001, December 2001).

[23] Given the imperfections in the data available, there is no entirely satisfactory method for measuring the success rates of ICT modern apprenticeships. DfES itself relies on the follow-up questionnaires, calculating from these a total number of successful outcomes, but such figures for ex- ICT apprentices were not available to us: numbers in ICT were too low to assure the confidentiality of respondents and could not be released. A further problem with the follow-up questionnaire is that there is only a 30 per cent response rate, and Fuller and

that Foundation Modern Apprenticeships last less than one year on average, and that Advanced ones tend to last over 18 months, the calculation will tend to inflate the success rate for Foundation apprenticeships and to depress the rate for Advanced ones. However, the official DfEE measure also poses serious problems of reliability.[24]

Despite any reservations about the figures we have calculated, the apparent low rate of qualification in ICT Services Advanced Modern Apprenticeships is particularly striking, and would merit further investigation. The table also tends to confirm that the disappointing numbers of NVQs awarded in 2001 stem from a drop in the success rate as well as from sharply contracting numbers of starts.

Table 9 compares numbers of young people starting apprenticeships with different types of training provider. One finding emerges with great clarity: whereas Cassels found that across all industrial sectors employers acted as the registered training provider for only 5 per cent of apprenticeship places (although they will have been involved with many more apprentices than this through providing work placements and/or sponsorship) - employers nevertheless acted as training provider in 45 per cent of ICT apprenticeship starts. It may be that in ICT other types of training provider have difficulty in retaining sufficient technically qualified staff actually to train the apprentices in technical areas. Certainly, the financial rewards for working in a technical capacity within the ICT industry would far outweigh the salaries open to instructors working for other training providers, whereas ICT employers could arrange for their mainstream staff to extend their other duties into apprenticeship training. Further research might profitably examine the proportions of successfully completed apprenticeships achieved by different types of training provider.

Unwin (2001) further suggest that former apprentices may be misunderstanding some of the questions. (Research commissioned by DfEE on the non-responders (Sproston, Blake and Smith, 1999) is based on fieldwork done at a much earlier stage in Modern Apprenticeships, had its own problems with non-responders, and does not address the concern about whether ex-apprentices always understand what they are being asked in postal questionnaires.)

Once one tries to calculate a success rate by comparing an incomplete number of outcomes for each year against a total number of starts, one faces a methodological problem - which year's outcomes are to be compared with which year's starts, given that Modern Apprenticeships vary in length.

[24] It is worth comparing these figures with the Department's own percentages (arrived at from calculation; based on the follow-up surveys) suggesting that successful outcomes for all occupations averaged 48 per cent for AMAs and 36 per cent for FMAs in 1999-2000, with very marked variations between sectors. They report an improving qualification rate, with only 27 per cent of AMAs, for example, qualifying two years previously in

Table 9: All Modern Apprenticeship Starts (Advanced and Foundation) by Training Providers Type 1995-mid-2002

	Employers	Private Sector	FE Sector	Other	Total		% Employers
AMA technical	1192	836	521	314	2863		41.6%
FMA technical	1086	498	254	382	2220		48.9%
Total	2278	1334	775	696	5083		44.8%

Source*:* DfES Modern Apprenticeship Database to 25th March 2001, and LSC Individualised Learning Records from 26 March 2001.

In contrast to Germany, the Modern Apprenticeship initiative in Britain appears to have made only a marginal contribution to increasing the ICT skill supply in Britain. In Section 2 below in which we analyse the results of company interviews and in our comparative section (Section 3) we explore some of the reasons for this low take-up and the contrast with the German apprenticeship.

1.6 Government initiatives to improve investment in continuing training for ICT skills in Britain and Germany

The very rapid development of new tasks and functions within organisations (outlined in the introduction above) and the consequent urgent requirement for employees with the necessary skills caused quite severe problems for recruitment and training within companies in Britain and Germany. Particularly in user companies, ICT departments had to be built up at a rapid pace and in a rapidly changing and developing technological environment. This meant that, unlike managers in more established departments of a business, ICT managers often lacked a base of tried and tested understanding as to how the activities of the ICT department should be allocated and managed with maximum efficiency. Furthermore, the tasks required of the ICT department were changing and evolving rapidly, making stabilisation and reflection on effective management an unattainable luxury for many ICT managers and CIOs.

It is not surprising therefore, that, according to the National Training Organisation for the ICT sector (e-skills NTO), at the start of the new millennium, there was no commonly agreed classification of the jobs that exist in ICT or of the skills required to perform them. Employers lacked a framework which they could use to measure the skills they had in-house

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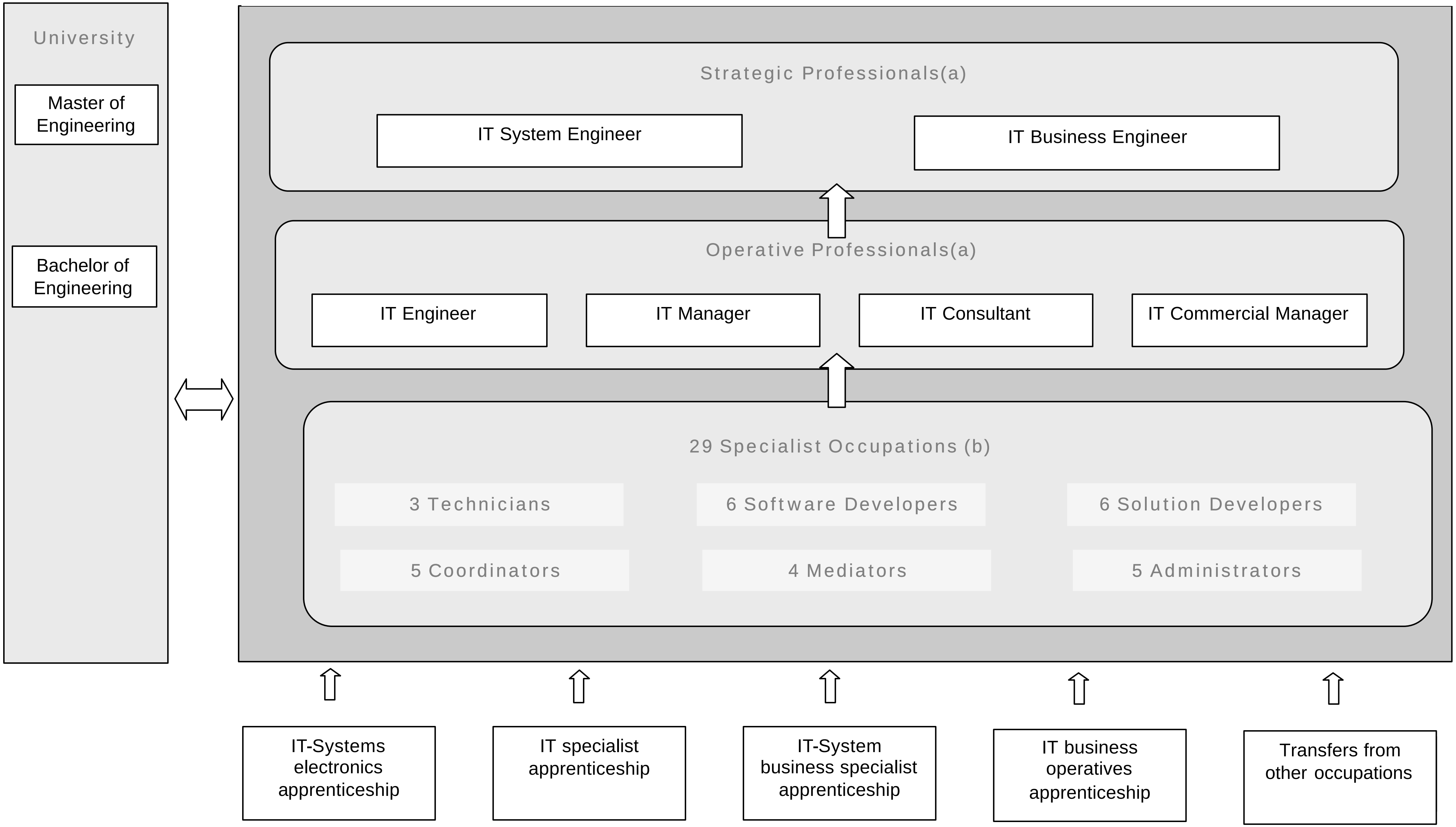
1997-98.

against skills needed. The plethora of ICT qualifications meant that identifying new employees' skills and skill levels from qualifications held was exceptionally difficult. In Britain, the e-skills NTO reported that 'Employers and individuals have difficulty understanding the relative merits of the 800 different ICT qualifications in Britain, and the inter-relationships between them'. In Germany, ICT managers faced similar problems, German experts reported more than 300 offers of further qualification in the ICT field, many of which were of dubious quality (Borch and Weissmann, 2002). Recruiters in the ICT field in Britain and in Germany were forced to fall back on candidates' reports of 'experience' of different applications, platforms etc. when recruiting externally. ICT staff often have no professional qualifications at all, further complicating and slowing recruitment. The lack of an agreed framework for identifying the skills needed by ICT developer and user companies also inhibited investment by individuals in further education and training in the ICT field.

The problems outlined above affected ICT development and user companies in both Germany and Britain during the 1990s. However, the higher activity levels that resulted from buoyant economic conditions and the Y2K changeover at the close of the decade led to damaging skill shortages in both countries. In the aftermath of the scramble for skills in 1999/2000, both countries initiated action to map the skills required by ICT professionals and to establish a stable framework for the development of initial and further qualifications. However, the German and UK conceptualisation of this task were radically different. The German approach was based on the principle of *Beruf* (occupation/profession) which underlies all training programmes in industry and the service sector in Germany and consequently influences the structure of much work organisation in Germany. The British approach reflected the functional analysis principle that gained favour with UK employers and The British government in the 1980s and which led to the introduction of competence-based National Vocational Qualifications (NVQs).

Figure 9 German APO-ICT – Continuing Education System
Business Careers in business and industry through work-based education and training



Notes: (a) subject to passing external examinations and being awarded State recognised qualification (b) subject to satisfying course requirements.

The German APO-ICT skill matrix, developed by the *Bundesinstitut fur Berufsbildung* (BiBB) is composed of occupational specifications in eight areas of activity grouped to form a three-level hierarchy of qualification.[25] Each level explicitly maps to a corresponding level of continuing education qualification (Figure 9).

The overwhelming majority (29/35) of the APO-ICT occupational profiles fall into the category identified as 'Specialists' in the BiBB model. This level requires a completed apprenticeship followed by at least 3 or 4 years of experience of which one year would be spent on-the-job obtaining the recognised further qualification needed in order to be recognised as competent at that level. Further career opportunities are open to 'specialists'. If they are successful in examinations which test working competence they can be recognised as competent at the 'operative professional' level, considered equivalent to a university first degree. The final stage in the further qualification process now being put in place requires a pass in additional work-process oriented examinations and this level, 'strategic professional' is recognised as being equivalent to a post-graduate Master qualification.

The structure proposed by the BiBB is thus designed to achieve two purposes. First, it offers companies structured routes that employees with apprenticeship qualifications can follow in order to operate at a more autonomous level of competence. Second, it offers employees and those considering entering on a career in ICT via the apprenticeship route a transparent alternative pathway to career development and graduate status.

The Skills Framework for the Information Age (SFIA), developed by the e-skills NTO with financial support from the Department of Trade and Industry (DTI), identifies 57 skill areas which can be deployed at one or more than one of seven levels in a total of six areas of activity (e-skills UK, 2000b). A complete list can be found in Appendix 4.

Clearly, the German Further Training Profiles and the SFIA are very different conceptualisations of the organisation of work within the ICT area. The German framework outlines a range of related skills that an individual is expected to apply in order to develop solutions, coordinate, ensure and advise in their own - admittedly broad - area of specialisation. The SFIA framework appears to suggest that many of the discrete skills required for ICT development and support might be exercised both at very low levels and at higher levels of responsibility and in a variety of unspecified combinations.

[25] APO= Arbeits-Prozesse Orientierte (Work process orientated). The continuing education qualification levels specified in the German skills matrix can only be obtained while in employment and, in most cases, the minimum pre-requisite is a completed apprenticeship.

The implication of the German framework is that work organisation in German companies might be more integrated ie that individuals would take responsibility for devising and implementing solutions in their own specialist area. While the SFIA framework does not exclude this possibility, the framework does not explicitly link devising and implementing in the same way.

At the same time, in the German framework, a skill and responsibility hierarchy is established at three levels above the apprenticeship (entry) level. In British companies the implication is that occupational identity is not necessary in order for a company to procure the skills required. Perhaps because of the lack of an occupational or professional conceptualisation of skills in the SFIA framework, a much more detailed hierarchy of responsibility and autonomy is envisaged with skills being exercised at one or more of a total of 7 levels.

The SFIA framework does not link skills to occupations or qualifications but only to levels of responsibility. This is in conformity with British employers' long-standing practice of avoiding wherever possible the specifications of qualifications as a condition of employment in a particular role.[26]

The direct link in the German framework to recognised qualification levels and the structuring of tasks in terms of occupational groupings derives from the very different German tradition of linking responsibility to work-based qualifications obtained in a recognised hierarchy of pay and responsibility.

Although the SFIA skill framework is careful not to link skills and qualifications, the levels of responsibility specified closely resemble the generic level specifications in the British National Qualifications Framework (See Appendix 4 for details). This leads us to map across from the SFIA 'levels of responsibility' to the British National Qualifications Framework as follows (Table 10).

[26] However, 200 of the most commonly used ICT qualifications have now been mapped to the SFIA framework. This mapping confirms the view offered above that qualifications at a variety of NVQ levels, ranging from Level 2 to Level 4 are considered appropriate for a single occupation e.g. Programming/Software Development. http://www.e-skills.com/pdfs/sfia-ict-qualifications.pdf

Table 10: Correspondence between SFIA Framework (UK) and National Qualifications Framework

SFIA Level	NQF Level
1	1
2	2
3	3
4	4
5	5
6,7	5 + experience

Source: See Appendix 4.

The full mapping of the SFIA and the German Further Education Profiles can be found in Appendix 5. It must be emphasised that this exercise is tentative and that correspondences are not exact. Nevertheless, the SFIA skills can almost all be identified as forming part of the German occupational profiles and, in some cases, as corresponding to a German occupational profile.

Three major differences emerge, however. First, the German framework envisages three levels of responsibility where the SFIA framework envisages seven levels. As can be seen from Table 11 below, the SFIA levels correspond to the German framework as follows.

Table 11: Comparison of SFIA and APO-ICT Levels of Responsibility

SFIA Framework Levels of Responsibility	APO-ICT Levels of Responsibility
Level 7 Set Strategy, Inspire, Mobilise	Strategic Professionals
Level 6 Initiate, Influence	Operative Professionals
{ Level 5 Ensure, Advise	ICT-Specialists
{ Level 4 Enable	
Level 3 Apply	Completed ICT Apprenticeship
Level 2 Assist }	ICT Apprentices
Level 1 Follow }	

Table 11 shows that the occupational concept used in the German famework allows the combination not only of a variety of related skills in one occupation but also of a wide range of responsibilities combining two of the seven SFIA levels. SFIA levels 1 and 2 would normally be undertaken by ICT apprentices during their period of in-firm training, or, if no apprentices are available, by individuals with no special training.

A second point to note from this comparison is the widespread reliance envisaged on the ICT-Specialist category in the German framework. Over two-thirds of the skills identified in the SFIA framework could be provided by the ICT – Specialist category, that is by an individual with a completed ICT apprenticeship and certified continuing education and training acquired principally on the job.

In the SFIA framework individuals with the highest (imputed) levels of qualification (Levels 5,6,7) are thought to be required to provide just under half of all the skills needed.[27]

The ICT sector leads the way in Germany by explicitly articulating the apprentice qualification to the APO-ICT ladder of further training and qualification, agreed between employer and employee organisations and government. This provides the apprentice with a clear route to qualifications recognised as equivalent to university degree. The APO-ICT framework has, therefore, a dual purpose. This route already had the purpose of providing a transparent route to additional skills and skill recognition for existing ICT employees and for those wishing to switch to a career in ICT. It was also designed to encourage employees to share some of the costs of upgrading and further training by leisure time study and payment for additional tuition. But a further important innovation is the explicit intention to open up employment in ICT development and service provision to those who do not have a university degree and to offer a route to degree equivalence through a combination of work-based upgrading and learning and off-the-job learning (BMBF, 2003).

There are a number of reasons for this new policy direction in German training. The first is the very severe skill shortage and consequent upward pressure on wages experienced by German companies in the years of rapid expansion of ICT employment. As will be seen from our investigation in the field, German companies recruit high proportions of graduates to posts in ICT from a higher education system which not only restricts entry but is characterised by a high drop-out. Graduates in the required disciplines are hard to find and expensive to employ. Graduates from apprenticeship could perform much of their work at considerably lower cost after some additional experience and further training.

The German Ministry and policy-makers also had a strong interest in the success of the new ICT apprenticeships and not only because they were designed to refute the accusation that the apprenticeship model could not be adapted to 21st century business requirements. The Ministry was also concerned with the image of apprenticeship among

[27] In the case of 11 SFIA skill areas, the German matrix specifies apprenticeship + further training where SFIA suggests that this is a graduate role. In a further 15 skill areas, SFIA suggests that the job could be performed by someone at graduate level while the German skill matrix specifies apprenticeship + further training.

parents and new entrants. Policy-makers had long been aware that an emerging trend towards higher education entrance either following on or instead of apprenticeship risked depriving firms of many of the well-educated entrants that were also essential to the long-term survival of apprenticeship. The ICT apprenticeship, with its superstructure of further training opportunities and its promise of degree equivalent qualifications is designed to counter that trend. Against the costs, particularly the opportunity cost of lengthy degree studies with high drop-out risk, the ICT apprenticeship claims to offer a low-cost, low-risk route to the same destination.

In Britain, the promotion of investment in continuing education and training for ICT skills is an explicit objective of the e-skills NTO Strategic Plan (e-skills UK, 2000a). However, the SFIA framework has not as yet been complemented by a framework for progression at work through continuing education and training as is the case with the German framework.

2. Company Strategies to Secure ICT Skills: Britain and Germany Compared

2.1 Contractors

2.1.1 Labour market situation, remuneration and employment status in Britain and Germany

By contractors we understand individuals who normally work on the company's premises but whose employment status differs from that of permanent company staff. The earnings of contractors are normally calculated on the basis of an agreed daily rate which might amount to three or more times the rate paid to employees. However, they receive no holiday, pension or other company benefits. Their contracts may be time-limited or open-ended. In some companies the same contractors had been employed for periods of several years. Estimates provided by authoritative sources in Germany and Britain put the pool of contractors at around 45,000 in Germany and 100,000 in Britain.[28] In accordance with the general economic situation the market for contractors is declining in both countries since the 2nd

[28] Source for German estimate Mikrozensus, 2001. Sources for British estimate a) Labour Force Survey 2001 estimates 97000 (http://www.statistics.gov.uk) and b) Professional Contractors Group – estimates 120,000 contractors.

quarter of 2001 (www.jobstats.co.uk). The number of projects has been decreasing by almost 75 per cent according to the amount of job offers in the internet in Britain. There were more than 18,000 jobs available in March 2001 but this number dropped to just 5,000 jobs in Dec. 2001. In August 2002 the number of available jobs was below 4,500. The development in Germany was similar. While in January 2000 7.5 per cent of the freelancers were available, in January 2002 there were 13.4 per cent, almost double. About 10 per cent of the registered freelancers are without sufficient work in 2002. The year before it was almost half that percentage. The number of projects in 2002 was 42 per cent below the amount in 2001, although in 2001 the projects had also decreased (http://www.gulp.com/).
According to another survey by *NamesFacesPlaces extern*, in May 2002 about 50 per cent of the interviewed contractors had at that moment no work, 29 per cent were engaged in a project, 10 per cent did not have a follow-up project, 7 per cent had taken on employment and 4 per cent have changed the job.

Contract prospects for freelancers are particularly difficult in the banking sector. Earlier about 25 per cent of the projects originated from banks, in 2002 the percentage has dropped to only 15-17 per cent. Accordingly, the banks have reduced the remuneration up to 30 per cent. The situation is more stable in the automotive sector.

Remuneration

Since contractors have to pay the full amount for insurances and for pensions as well as to save for times of unemployment, pay for their further education and to cover work risks their remuneration should be higher than that of employees. According to some surveys the British contractor gets on average £38 (60,47 EUR) per hour (www.contractoruk.co.uk) or according to jobstats a much lower rate of £20 per hour (www.jobstats.co.uk) which amounts to £35,800 per year. 26 per cent of them earn more than £51 (81 EUR). Within the last year there has been no increase in this top segment. In Germany a survey by Gulp (www.gulp.de)[29] shows that the average pay per hour is between 69 to 79 EUR. The

[29] Gulp is an internet company providing (offering) projects for freelancers. They have 37,000 freelancers as members, which accounts for 82 per cent of all in Germany (total is 45,000). One of their services for their members is that they calculate rates per hour for different tasks. A project manager, for example, would earn 78 Euro if he works in Berlin. Since January 2001 Gulp has offered 45,000 projects to its members. In the internet they display under www.gulp.de/kb/tools/gulpometer/pdb.html the offers according to software system, data banks, industry, etc with the respective pay rates. The display according to industries shows that the demand for project work in banks and trade is reducing. The displays also show how many of their total freelancers are available.

percentage of those who earn more than 80 EUR has increased from 22 per cent in 2000 to 34 per cent in August 2002. However, the averages disguise large individual differences. On average the remuneration in Germany is about 10 EUR per hour higher in Germany than in Britain.

Persons in Germany who are unemployed can receive financial aid when they decide to become self-employed. Instead of their unemployment benefits they receive the same amount as an '*Überbrückungsgeld*' for the first six months of their self-employment. In addition they receive contributions to their social, pension and health insurances. Further, they are able to get relatively cheap loans for their office equipment.

Qualifications in demand

The qualifications which were in high demand in both countries are very similar: e.g. Java, C/C++, UNIX und MS SQL Server. SAP R/3 which has a prominent place in Germany is not among the most demanded qualifications in Britain. However, most of these languages can now be dealt with within the companies by their own employees. Contractors have a good chance of getting contracts if they can offer special know-how or special combinations of experience which are not available in the companies. In addition, contractors are seen as being more motivated than permanent employees (www.dynamit-nobel.de).

A survey by the German journal *Computerwoche* (28.9.01) with 200 contractors showed that 55 per cent of the respondents were graduates, 20 per cent had *Abitur* and 18 per cent were skilled. About 70 per cent of them like to be self-employed and do not intend to become employed.

'Fictional' Self-employment

The British and German legal regulations with respect to 'fictional' self-employment (*Scheinselbständigkeit*) are also very similar. The laws have been issued to avoid companies outsourcing business to their own (former) employees to save costs of social benefits. In 1999 a law was issued in Germany specifying that self-employed contractors (and their employer) should pay contributions to social benefits if the situation of the contractor was very much that of an employee, e.g. no own employees, just one employer for a long period, working hours and holidays in accordance with other employees of the customer. If the contributions are not paid the payment can be enforced on the employer back-dated for up to four years. In Britain a comparable law was issued as IR 35 from the Inland Revenue in 2000.

2.1.2 The use of contractors in British and German companies

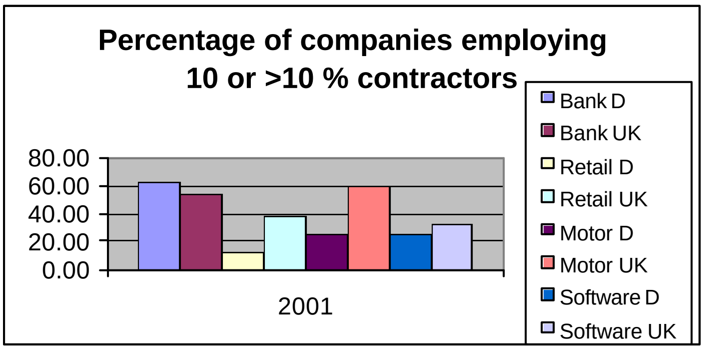
In the firms visited, contractors were used extensively in both Britain and Germany. Contractors almost invariably elect their status following a period of employment as a member of an ICT department. This means that a good part of their skills portfolio has been obtained while in more permanent employment. The skills obtained will have resulted in part from on-the-job experience and in part from company investment in their training. These skills, being highly transferable and portable are then appropriated and exploited by the individual in his/her capacity as contractor. Normally, it might be supposed that this investment would be lost to the company, however, it is fairly common, in England at least, for employees to change to contractor status and to stay working with the same company.

It was suggested to us in discussion with the Professional Contractors Group (PGC) (UK) that ICT staff might elect for contractor status if they had achieved a certain seniority and the next career step would take them into management and away from a technical role which they preferred. Others might learn from their appraisal interview that they were unlikely to be promoted further and elect for contractor status as a way of boosting earnings - at least in the short term. A desire for independence and freedom to manage one’s own career is also important. Once contractors, ICT staff had to take responsibility for their own upgrading and skill acquisition. The PGC suggested that contractors might seek out a project that gave them the chance to acquire scarce skills and lower their charges if necessary. However, we were told that, as a result of Inland Revenue rules, they are unable to claim tax relief on courses of training which they might undertake outside of employment in order to enhance their marketability. In the current climate, with large numbers of contractors unable to find employment, it is likely that this rule contributes to skill loss among contractors in Britain, a matter which may be of concern to companies when demand for ICT contractors improves. In Germany, expenses for training courses to preserve or improve skills are tax-deductable (see above, Section 2.1.1).

We were surprised to discover how widespread the use of contractors is in Germany. We had initially supposed that the well-known greater inflexibility of German employment legislation would make it more difficult for employers to take on contractors and also lessen the attraction of contracting to individuals. In fact, the total number of contractors employed in the companies visited relative to all ICT staff was 14 per cent in both countries.

However, there were substantial intra-country differences between sectors and also, but to a lesser extent, inter-country differences when sectors were compared. Figure 10 shows differences in the percentage of all companies in the sector samples in which contractor numbers were 10 per cent or more of all ICT employees.

Figure 10



Source: Own data and calculations

Figure 10 shows that in every sector except the financial sector, fewer German companies had substantial numbers of contractors than was the case for the English companies. Since, overall, the percentage of contractors relative to all ICT staff was the same in both countries, this points to a higher concentration of contractors in Germany in fewer companies compared to Britain. This is confirmed by an analysis of variance for the samples. Standard deviations (of percentages of contractors) were substantially higher in the German than in the British sample.[30]

The fast-moving technological environment in which ICT departments operate continually requires companies to source new technical skills. Furthermore, since ICT departments in three of the four sectors studied are 'service' departments, new projects, essential to be completed in a short time-frame, may require more work than is available from the established workforce. While we found that many companies in both countries are committed to ensuring that their ICT employees master a portfolio of skills through training and on-the-job learning, contractors are still an important source of specialist skills or additional skills when workloads are heavy.

[30] .30 and .17 respectively.

Companies in both countries explained the use of contractors primarily in terms of the need to meet a short-term temporary skills gap. However, other reasons were also detected. In a few cases contractors were taken on to circumvent a company ban on new hires. In a substantial number of companies, the same contractors had been with the company for a number of years – clearly skill gaps and time pressures were not the reason for their employment.

A further advantage that companies advanced for the employment of contractors was to enable their own employees to learn new skills from the contractors with whom they would work. In a few cases, knowledge transfer was a condition of the contractor's employment.

From our discussions with the companies in both countries it became clear that almost all would expect to need to employ contractors from time to time in order to provide the flexibility to complete new projects to tight deadlines and to avoid expanding the permanent (core) workforce at the top of the economic cycle and incurring unnecessary costs when demand fell. We concluded that contractors constitute a substantial and important reservoir of flexible skilled manpower for companies' ICT needs.

It is not surprising, however, given the sharp decline in the demand for ICT services that has accompanied the latest downturn in Britain and Germany, that all but one of the companies that supplied data on numbers of contractors in 1998 and 2001 had taken steps to substantially reduce their numbers. In Britain, many of these have returned to permanent employment.

2.2 The use of outsourcing by British and German companies

With the introduction of lean production many companies use outsourcing to reduce the number of their (permanent) employees. In our research we differentiated between outsourcing of ICT tasks and making use of contractors. The difference between these two is that outsourcing implies giving tasks out of house to another company while contractors are working within the company on particular projects but they are not employed by the company. The advantage of contractors in comparison to outsourcing is that they can be closely linked to tasks in the company, like becoming a project manager and leading a team of employees.

The main reasons given for outsourcing are as follows:

1. Economies of scale can be realised by outsourcing. It happens mainly with respect of standardized tasks (Henkel and Kaiser, 2002). Some companies outsource whole departments which handle, for example, data transactions or the hotline. An example in Germany is a large bank which outsourced its *Rechenzentrum* to IBM end of September 2002. This affected 900 employees and the value of the project was 2.5 billion Euro. Similar cases of outsourcing of large departments are found in Britain. Another example to take advantage of economies of scale was found in the German banking sector where many small banks and regional *Sparkassen* outsource most of their ICT tasks to special '*Rechenzentren'*. These provide the large data transactions as well as the special services needed by the banks while the particular banks or branches just employ a few persons to deal with the maintenance and operation of the system.
2. By outsourcing of non-critical, time-consuming tasks for which the existing labour force would be overqualified the highly skilled employees could be relieved to do more important and complex tasks. The efficiency is improved and at the same time the tasks for the skilled employees become more challenging and more motivating.

The intensity of outsourcing was quite different in the sectors investigated:

Financial Sector

34 per cent of German companies and 25 per cent of the British companies relied considerably on outsourcing to meet skill demands. Outsourcing of tasks abroad was relatively uncommon in German banks but common among the British banks. About 80 per cent of the banks which out-sourced had some work done in India.

Retailing

German retailers used 'extremely little' or 'hardly any' outsourcing. If they did it was mainly web design and internet portals as they did not have these 'new' skills in the company. About 50 per cent of the establishments used legacy systems and could not find the relevant expertise on the market. British companies used legacy systems at a similar rate but more companies made use of outsourcing. Out-sourcing was used for a variety of tasks: software development, maintenance and to get access to superior know-how. The reasons were different from the German side: cost savings, concentration on key competence (since ICT was not their key business) and to cope with demand peaks.

Motor manufacture

Outsourcing is only used to a small extent in German plants, the highest amount is 20 per cent of total ICT activity. These plants utilize outsourcing when they have problems with capacity or ask ICT companies to look after the infrastructure. British plants are divided up evenly among those with a lot and those with little outsourcing. The tasks differ between maintenance of the system to the major part of the system which is outsourced but deal almost exclusively with routine tasks.

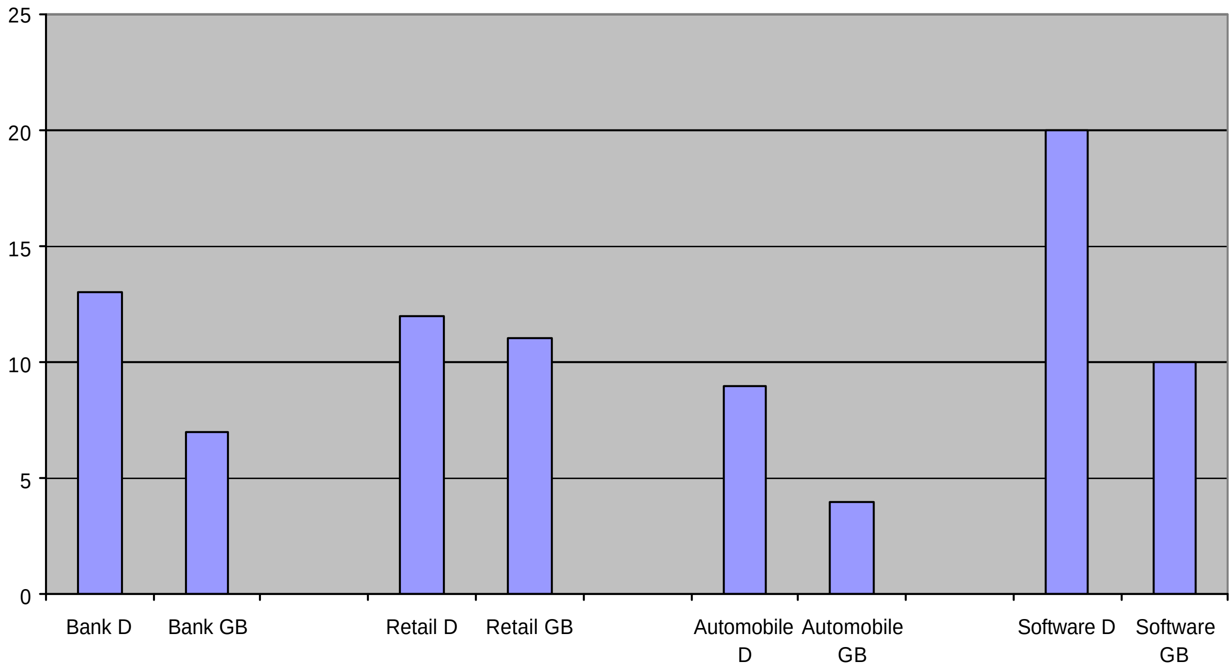
Software

Outsourcing in this sector is rather small. In both countries it occurs when peaks of demand have to be covered or if the required skills are not internally available. In general if outsourcing is done to companies abroad, UK companies have frequently connections to India. German firms co-operate more with European companies.

2.3 Recruitment

There was no difference between the German and British firms when measured by the probability of recruiting 10 or more than 10 new employees to ICT employment in 2001. However, in every sector UK firms recruited fewer new employees measured as a proportion of all company ICT employees (Figure 11).

Figure 11 Recruitment 2001 as percentage of all ICT employment by sector



Source: Own data and calculations.

Figure 10 shows the German software companies growing recruitment faster than any other sector while in Britain the retail sector appears the most buoyant.

A comparison of the existing labour force with the recruitment strategies in the last year was done to show the development of demand in the companies. In Britain all sectors except finance showed a considerable expansion of graduates in comparison to the skill composition of the existing labour force. The previously low share of graduates in automobile and retailing where a large share was formerly often recruited from the lower but experienced ranks in production or sales was offset by a strong tendency to recruit more professional personnel. The software sector was most interested to hire graduates (Table 12).

Table 12: Qualifications of present labour force and recruitment of employees providing ICT services/products by sector, Britain and Germany

Sector	Britain		Germany			
	Employees Graduates %	Recruitment Graduates %	Employees Graduates	Completed Apprentice-ship	Recruitment Graduates	Completed Apprentice-ship
Financial	**56**	**55**	**50**	45	***80***	19
Automobile	**54**	**77**	**79**	21	***75***	24
Retail	**49**	**77**	**33**	60	***32***	60
Software	**77**	**88**	**78**	5	***68***	20

Source: Own data and calculations

In Germany only banking increased its share of graduates. This increase reflects the more general tendency in the sector to move to higher education. Traditionally the banking sector recruited from inside via the banking apprenticeship and further education but is now moving to a higher share of graduate intake (Finegold and Wagner, 2002).[31] Within this general tendency the share of graduates in ICT is increased and the apprentices were mainly recruited from ICT.

Another major change in qualifications has been in the software sector. The proportion of recruited graduates in Germany was actually lower than in the existing labour force. However, this was offset by an increasing share of apprentices which consisted almost exclusively of apprentices who had followed the new ICT route.

Around one fifth of new employees in Germany had completed an apprenticeship. This would not normally be a specifically ICT apprenticeship since these were only introduced in 1997. ICT departments in the retail sector in Germany recruit heavily from those with apprentice training. This practice appeared to be echoed in a less formal way in the British retail sector where a distinct preference was expressed for internal recruitment from those with sound experience in the company's retail outlets. However, except for motor manufacture in Britain, formal apprenticeship qualifications were not found in the British companies.

We also enquired about the type of degree held by new graduate recruits to ICT departments. Except in software where 70 per cent had ICT related degrees, of graduates recruited to UK companies, around one half had degrees in computer science. Proportions

[31] The share of graduates of all bank employees is still relatively low but increased from 1990 to 1998 from 5 per cent to 8.5 per cent (Kreyenschmidt, 1997).

with computer science degrees in Germany tended to be somewhat lower but German companies normally only recruited those with closely cognate qualifications (physics, engineering) while UK companies recruited from a much wider range of first degrees.

Recruitment to ICT apprenticeship

The important initiative launched by German employer and employee organizations and the German government to establish a new apprenticeship formula for ICT occupations is described in Sections 1.3 and 1.5 above. The similar initiative launched in Britain at approximately the same date is described in Section 1.4 above.

The development of these initiatives in the two countries is very different. In Germany there are now some 60,000 young people in ICT apprenticeships while in Britain, the corresponding figure is just over 3000.[32] Add to this the fact that around 80 per cent of German apprentices complete the apprenticeship and gain their qualification compared to around 40 per cent in Britain and it can be seen that the development of the two initiatives has been very different in the two countries.

The success of German apprenticeship is frequently attributed to the long tradition built up in manufacturing industry. The implication is that companies are 'locked' into participation by a combination of tradition, inertia and restrictive labour market agreements. Without these supports, it is argued, the German apprenticeship model cannot survive. It is therefore instructive to find that the model is flourishing in the non-traditional, fast-changing competitive ICT environment. In our visits to companies in both countries we attempted to get a better understanding of the reasons why German companies recruited large numbers of apprentices and why the British companies did not, how the training was managed and the advantages that the companies found in the scheme.

Table 13 below shows that apprentices constituted a substantial proportion of employment in all sectors in the German companies visited. Most apprentices were recruited after completion of the *Abitur* (A-level equivalent), although there were exceptions, where those with a special interest in ICT had been recruited with lower level general qualifications.

A common complaint from the German companies was that the publicly-funded further education colleges (*Berufschule*) which normally provide off-the-job training for apprenticeship did not have the personnel qualified to provide high quality training required

[32] All starts on all ICT technical apprenticeships 1999 - 2001 at FMA and AMA level.

for the apprenticeship. Training courses by the Chamber of Commerce for teachers helped to remedy this situation[33]. As a consequence, many firms spent a lot on additional apprenticeship training when the apprenticeship was first introduced.

Banks had relatively many apprentices and invested a lot in them although they were quite cost conscious and had done cost comparisons for different qualification routes. Most banks had organised extra off-site training courses at their own expense which provided as much as 30 weeks of additional training courses to make the apprentices familiar with the specific requirements in the banking sector. Private sector further training centres with a high reputation did this training. A short case study of apprentice training in a German bank is provided in Appendix 2. Software companies had a similar percentage of apprentices (Table 13). Judging from the recruitment levels software companies were substituting graduates by ICT apprentices.

Despite the need for extra training expenditure for apprentices, the main reasons given for employing apprentices were

a) to ensure a good supply of skills for the future
b) to contain salary costs.[34]

German companies have less flexibility when restructuring their workforce than in Britain, for example, new employees have a trial period of only 3 months when they can be dismissed without formal procedures, compared to a period of two years in Britain. It is therefore of greater interest to German companies to enjoy a period of observation of a person's capabilities before making an offer of employment. Apprenticeship was used for this purpose – as were the graduate internships mentioned below (Section 2.6).

In general, German apprenticeship regulations require employing companies to adapt on-the-job training to fit within a prescribed occupational framework. The new ICT apprenticeships provide more flexibility and allow more freedom to companies to structure on-the-job training. This has encouraged a large variety of companies to take part in the training scheme. Apprentices were appreciated as requiring no additional induction training once qualified, in contrast to graduates who needed several months to become fully efficient at their jobs.

[33] According to a survey in the business sector an increase of 50 per cent for vocational teachers is required (Christensen, 2001).
[34] For information on the German banking apprenticeship see Finegold and Wagner, 2002.

Apprentices normally spend around two and a half years in apprenticeship with the company and are paid around one third of the salary they can expect when qualified[35]. Most companies agreed that apprentices could make a valuable contribution to project work or other areas of activity after the first year of apprenticeship so that productive work in the last 18 months could help to offset the costs of the training provided. Following apprenticeship completion, starting salary for apprentices is between 30 and 40 per cent lower than for new graduates.

Table 13: ICT apprentices as a percentage of total ICT employment by sector, Germany

Banks	6
Retail	4
Motor manufacture	4
Software	6

Given the small numbers of ICT apprentices in Britain, there was a very low probability that companies employing apprentices would be included in our sample. In fact none of the companies in our randomly selected sample had taken on ICT apprentices, most because they had not heard of the initiative.

Yet, as pointed out below (Section 2.9), many companies recruited young people at A-level, similar to the level of the German apprentices and provided them with a structured training programme at their own expense. It could not, therefore, be argued that British companies did not have need of intermediate level skills of the sort produced in apprenticeship. Indeed, it could be argued that companies could save considerably on the cost of own training schemes by using Modern Apprenticeship (MA). In order to learn more about British companies' experience of MA, we therefore visited two companies with experience of the ICT MA to learn their views on its advantages and disadvantages.

Both British companies visited were subsidiaries of an American parent company. One of the two mentioned that the American management had encouraged involvement in MA as a contribution to 'community development' – and this motivation was also mentioned by another US-owned company we visited which was considering taking apprentices.

[35] The regular training time is three years. However, school-leavers with Abitur can shorten the time because of their higher educational background.

Training managers interviewed in the two companies were positive about the benefits of apprenticeship to the company, however, both were highly critical of the constraining and largely irrelevant requirements of the NVQ qualification which constituted the principal mode of qualification and assessment for the MA. These views were echoed by a college lecturer with wide experience of taking apprentices through the NVQ requirements. These constraints contrast with the greater flexibility allowed to German companies to design a training programme[36] which fits with their work organization and skill needs.

Time required to fill positions

German companies reported requiring slightly less time to fill positions in 2001 than in 1998 although the average was still quite high (around two and a half months). It was not clear whether this reduction was solely a reflection of market conditions. Several German companies mentioned to us that they had considerably simplified and speeded up their recruitment processes. However, they have become much more concerned to recruit the right person with the right qualification. Whereas in earlier years, they recruited almost anyone who seemed somewhat capable to do the job they insisted in 2001 on finding the appropriate person which took more recruitment efforts and more time. As a result the quality of the recruitment process has improved. We did not obtain comparable figures for the British companies.

Recruitment agencies

Recruitment agencies were used in UK for all type of qualifications (at least in banks and retailing and to a lesser extent in automobiles and software) except for graduate trainees. In Germany, the use of agencies was mostly restricted to head-hunting for top positions. Particularly, motor manufacturers and banks emphasized that they like to choose their own employees. Because of their good reputation as employers they had no problems in finding good applicants. Retailing had more problems to attract good candidates as they were not seen as ICT employers and the pay was relatively lower in this sector (see following chapter).

[36] The in-company training programme has to be approved by the Chamber of Industry and Trade.

2.4 Salary levels

Companies were asked about starting salaries for new employees in their first job after completing their education. We also inquired about the earnings that a 'very successful' employee might expect after 3 years with the company. The categories of employees about which we inquired were, in Germany,

- university graduates (average age of completion 28)
- FHS graduates (average age of completion 28)
- certificated ICT apprentices (average age of completion 22)

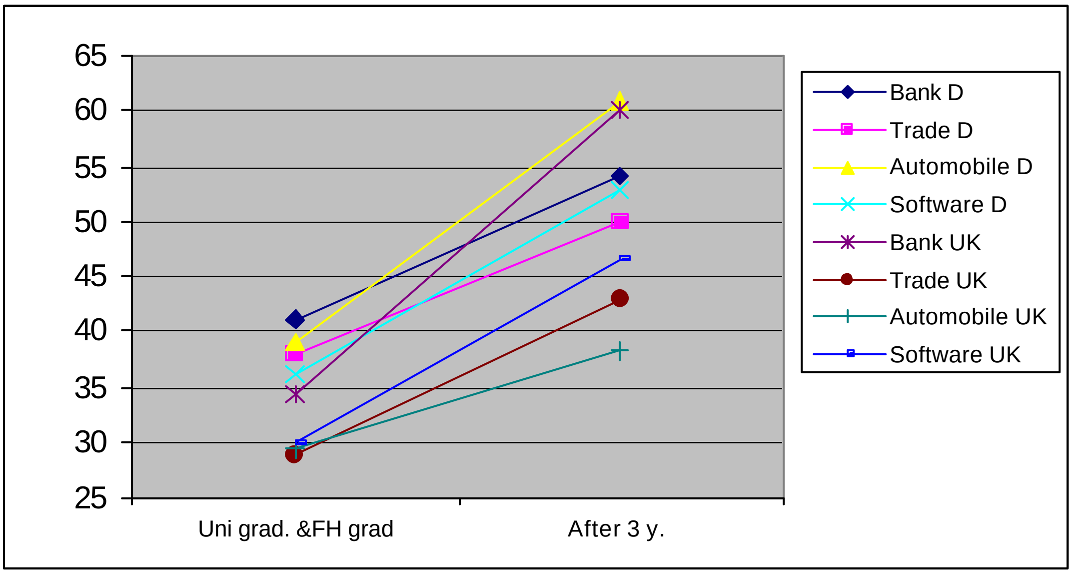
In Britain we asked about

- university graduates (average age of completion 23)
- those recruited directly from A-level studies (average age of completion 18)

Our main reason for these inquiries was to try to understand better the extent to which the additional years of study achieved by German students at all levels relative to British students were recognised in starting salaries as adding value for the employer company. The inquiry about earnings after three years with the company was added at a later stage as we began to notice that the earnings of British graduate employees increased faster than those of German graduate employees.[37] Figure 12 below shows earnings by country and by sector for university and FHS graduates in Germany and
university graduates in Britain.

[37] It should be noted that the figures we obtained for graduate earnings after three years do not relate to average earnings but only to the earnings of the 'most successful' i.e. the highest earnings that a graduate might expect to achieve after three years.

Figure 12 Average graduate salary levels by sector on leaving HE and after 3 years, adjusted for PPP



Source: Own data and calculations.

We found that starting salaries for university graduates in Germany were higher in all sectors than in Britain and this difference holds good even when an adjustment is made to take account of differences in purchasing power in the two countries (Figure 11). This suggests that the German graduate entering first employment may be more productive than the British graduate. Of course, one part of the explanation of higher German earnings could be the result of a higher excess of demand over supply in the German labour market for ICT skills.

Another factor explaining some of the difference in starting salary may be the higher probability that in Germany new graduate employees will either have a computer science qualification or a closely cognate subject degree (e.g. physics or engineering) (see Section 2.5 below) British companies are willing to take graduates from a wide range of academic disciplines into employment in an ICT department and to subsequently 'train them up' (see Section 2.9 below). This leads to longer initial training periods for British graduates recruited straight from university than is the case in Germany.

We cannot, therefore exclude the possibility that the difference in starting salary between the British and German new graduates reflects to some extent the added value derived from the longer education and maturation process in Germany.[38]

Table 14: Average percentage increase in gross salaries of university graduates on entry to employment and after 3 years of experience; by sector

Bank D	31.44
Bank UK	74.67
Retail D	31.28
Retail UK	48.68
Motor man. D	56.25
Motor man.UK	29.53
Software D	46.76
Software UK	55.90

Source: Own data and calculations

When we look at estimates of likely earnings growth for successful graduates in both countries we note that in all but one of the British sectors investigated, the percentage increase in earnings is higher than for the corresponding sector in Germany (Table 14). The exception is the automobile sector where earnings of German ICT employees increase at a faster rate than the British. However, in only one sector, the financial sector, do salaries of the most successful British graduates grow fast enough to overtake the salary level of German employees.

A number of interpretations can be put on these findings. The British graduates are younger and have had fewer years of education than the German graduates. Their rapid increase in earnings may be explained by their very much lower starting point. Nevertheless, the findings point to considerable learning gains resulting from experience and training while in employment and to a corresponding investment by the British companies in order to achieve the gains noted.

For ICT employees aged 30 and over the Kienbaum International Comparison of Salaries shows that on average British and German ICT employees earn similar salaries for comparable positions (Kienbaum Management Consultants, 2001). This suggests that in ICT over the longer term the investment by students in the time-consuming German university

[38] It is methodologically extremely difficult to disentangle the effects of education from maturation and this will not be attempted here.

education gives a lower return to the individual than the investment in the shorter British university course.

2.5 Skill Composition of companies/ICT departments in Britain and Germany

In our interviews we asked about the qualifications of all those in the company directly concerned with providing ICT services – or products, in the case of software companies. Previous projects in which we had asked similar questions had prepared us to expect that the German companies would be able to provide more precise answers than the British companies. This was indeed the case.

The British companies interviewed were normally only able to provide an estimate of proportions of graduates/ employees with A-levels in the ICT department. The German companies could normally provide more detailed accounts, distinguishing between university and FHS graduates and those with completed apprenticeship. These differing approaches are entirely consistent with the fundamental differences in approach to skill and occupational identity outlined in Section 1.5 above.[39]

It was not surprising to find that, in both countries, companies rely heavily on graduates as a source of ICT skills and expertise. Recent studies of skill supply in Britain (CEPIS, 2002) and Germany (Licht et al, 2002) have shown this to be the case.

Table 15: Qualifications of employees providing ICT services/products by sector, Britain and Germany

Sector	Britain		Germany			
	Graduates %	Non-graduates %	Graduates			Completed apprenticeship
				of whom university graduates	*FHS graduates*	
Financial	**56**	44	**50**	*25*	*25*	45
Automobile	**54**	46	**79**	*42*	*37*	21
Retail	**49**	51	**33**	*18*	*15*	60
Software	**77**	23	**78**	*47*	*31*	5

Source: Own data and calculations.

[39] In Section 1.6 we noted "British employers' long-standing practice of avoiding wherever possible the specifications of qualifications as a condition of employment in a particular role" and the "German tradition of linking responsibility to work-based qualifications obtained in a recognised hierarchy of pay and responsibility".

Table 15 shows the qualifications of employees providing ICT services/products based on responses to face-to-face and telephone interviews. In both countries the software sector is the heaviest user of graduates. In Germany, automobile manufacture employs similar proportions of graduates to software while in Britain the proportion is lower. The financial sector has similar proportions in both countries, however, in financial services and in the retail sector German companies employ large numbers of employees with a completed apprenticeship, normally one that relates to occupations in the sector rather than an ICT apprenticeship. The relative newness of the ICT apprenticeship in Germany (see Section 1.4 above) explains the low proportions with completed apprenticeship in the software sector.

We also asked about the percentage of employees in ICT departments who had qualifications in ICT, for example, degrees in computer science. Overall, the averages in each sector for current employees were not very different between the two countries. For the software sector it was estimated that around 50 per cent had computer science degrees (Table 16). The motor manufacture sector in both countries had the lowest share of ICT degrees and the German companies clearly preferred graduate engineers.

Table 16: Percentage of employees with ICT degrees by sector, Britain and Germany

Sector	Britain	Germany
Financial	29	39
Automobile	15	21
Retail	21	30
Software	50	54

Source: Own data and calculations.

However, the attitude of companies in the two countries towards graduates without computer science qualifications was very different. In addition to computer science graduates, German companies employed almost exclusively those with cognate degrees, e.g. physicists (who were highly esteemed by ICT departments) or engineers as in the automobile industry. The British companies, by contrast, were much more likely to employ graduates from a wide variety of disciplines. In some cases, the British companies were quite frank in stating that they were more interested in the calibre of the student (i.e. the university attended) than the degree subject. Some German companies also employed what they called *Quereinsteiger*, that is, individuals who had graduated in a subject that fitted them for a different occupation but who had followed an ICT course financed by the Labour Office. However, unlike the

British companies, the German companies considered these employees as rather less useful than those who had qualified in ICT or a cognate discipline. We were left with the impression that the *Quereinsteiger* laboured under a prejudice against occupational switching which is still prevalent in German company thinking.

2.6 Companies' links with universities

In our interviews with companies we tried to obtain an indication of formal and informal links/contacts between companies and universities. We asked whether companies tried to recruit from named universities and enquired about other types of contact.

The German companies were much less likely than the British to name universities that they were trying to recruit from. We attributed this to the very different way in which students in Britain and Germany are allocated to universities and the consequences for the distribution of ability between universities. In Britain, universities vary widely in their entrance requirements, types of degree course offered and in their academic ratings (based on research published by staff). In Germany, institutions of higher education are formally divided into two groups. Students frequently choose a university or applied university (FHS) in the city or region in which they live (Section 1.1 above).

German employers are therefore less concerned with an informal hierarchy of institutions as exists in the higher education sector in Britain and usually only specify a preference for a university or FHS if it offers specialist courses required by the company.[40]

We enquired in the German companies whether there were differences in performance and capabilities between university and FHS graduates. Scarcely any German companies expressed a preference for university graduates over FHS graduates and some made no distinction at all. Where views were expressed on the comparative strengths and weaknesses of the two groups, university graduates were considered to have good analytical skills and to be particularly well-suited to project management and strategic thinking. FHS graduates were recognised as having good specialised skills and a more practical approach. To some extent, it appears that the skills of the two types of graduate are complements rather than substitutes.

British companies were much more likely to name specific universities from which, ideally, they would prefer to recruit. Usually this choice appeared to stem from a desire to screen applicants for ability using university attended as a proxy rather than from a requirement for specific skills.

All this should be put in a wider context, however. German companies were more likely than the British to be prepared to recruit new employees straight from university and qualifications were taken seriously. Views and practice in British companies were very variable. Some British companies stated that they 'only looked at experience, not qualifications' and/or emphasised that they could not see any advantage in recruiting students from ICT degree courses as opposed to students from other (non-cognate) disciplines. Other British companies, usually those with graduate entry programmes, professed themselves well satisfied with the quality of graduates recruited. The greater confidence of the German companies in the reliability of the signaling value of German qualifications probably reflects the lower degree of variability of standards and intake of the German universities compared to the British.

'Interns' and 'sandwich' students

Around half of the German companies interviewed were employing 'interns' – university/FHS students who were spending several months working in the company as part of their programme of study. Usually the students were also writing a dissertation as part of their course assessment and the companies arranged a work-based project for them which they could write up and present in order to fulfill this part of their degree requirement. Interns constituted a surprisingly large proportion of all employees in the firms which were employing them – 7 per cent in the financial sector, 3 per cent in retailing, 10 per cent in motor manufacture and 5 per cent in the software companies. The German companies were generally enthusiastic about the contribution made to the company by interns. They could be entrusted with or participate in projects that were useful to the company, their salaries were considerably lower (often they worked for free) than those of graduate employees and their suitability for permanent employment could be assessed during the internship. It is clear that the requirement for university and FHS students to write up a project in dissertation form as part of their degree benefits both students and the companies that employ them.

The closest we come to internships in Britain are sandwich students who spend part of their course in employment as a course requirement. Only one of the British companies

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[40] For example, one of the German car companies interviewed expressed a preference for electrotechnical

interviewed employed a student as part of a sandwich course. A further five companies offered paid summer placements which were open to any students who applied. There was no great enthusiasm in the British companies visited for employing students in this way. Companies complained of the difficulty that ICT departments had in finding suitable projects for the students and their consequent reluctance to take them in.

2.7 Companies' views on how university education could be improved

German companies' views on how university education could be improved were also more consistent than the views of the British companies. Almost unanimously they felt that university students did not have enough experience of the real world, particularly the realities of the business environment. FHS students were recognised as having followed more practical applied courses. In the case of graduates from traditional universities and in particular of PhDs companies spoke of the 'work shock', explaining that it took new graduates some time to become accustomed to the pace and demands of the business environment.

The views that British companies expressed about how university education could be improved and respond better to industry's requirements were very varied and no consistent pattern could be detected. A number of companies expressed themselves very satisfied with the graduates they had recruited. Arts graduates were appreciated for better communication/soft skills and lack of communication skills was identified as a weakness in ICT graduates.[41] But around half of the comments recorded echoed the criticisms of the German companies; lack of understanding of the business environment and poor communication skills were a major weakness of new graduates.

2.8 Ways in which new graduates were employed in companies

British companies are less likely to take graduates without previous experience than German companies. It should also be remembered that British graduates study for about half the time it takes a German student to graduate. It is not surprising, therefore, that new British graduate entrants (not on a recognised graduate training scheme) often needed substantial off the job training before starting work in the company. Once in the company, it was common

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training from a particular German university.

for new graduate entrants to continue learning on the internal help-desk or as junior members of a project or programming team. In this capacity they would frequently be mentored and were expected to learn on the job for a period of several months.

New graduate entrants to German companies were given much shorter formal training periods than their British counterparts. Human resource managers from multinational companies visited made clear that new German graduates were expected to take more responsible positions than their British counterparts. However, they too were expected to spend several months learning on the job. German companies which employed both new graduates and apprentices pointed out that, unlike graduates, the qualified apprentice requires no further period of introductory training when first employed in a permanent position. This was considered to be an important advantage of apprenticeship contracts.

2.9 Skill deployment

We have shown above (Table 16) that companies in both countries employ a mix of skills in ICT departments/ ICT production. In both countries the software companies are the heaviest employers of graduate skills (over three-quarters of all employees in both countries). The retail sector in both countries employs quite high levels of non-graduates (higher in Germany than in Britain) while in the financial sector in both countries graduates constitute around half of all employees. It is only in the motor manufacture sector that large differences arise; German motor manufacturers employ 50 per cent more graduates than the British.

ICT services and software production are characterised by considerable technological convergence, that is, the capital infrastructure, the software used and the principles of work organisation are similar in both countries and intra-sector variations may be larger than intra-country variations. This can be attributed to two main factors, first the virtual monopoly power of the hardware and software and other services suppliers which leads to companies in both countries investing in identical or similar capital equipment. Second, competitive pressures - particularly strong in the financial services and motor manufacture sectors but also important in the other two sectors – force companies to continuously innovate and upgrade their ICT services.

Because of these strong pressures we did not expect to find a radically different work organization or job role definition in the companies in the two countries. This is confirmed

[41] Similar findings were reported in Mason (2000).

by comparison of the skill frameworks devised in Britain and Germany (see Section 1.5 above) where the job roles identified in the ICT sector are substantially similar in the two countries.

However, we were interested to learn how companies used the different skill sources available in the two countries. In addition, we wanted to understand better how far companies in Germany differentiated between the skills of the university graduates and FHS graduates in the tasks they were expected to undertake. The view of the German companies on this last question was fairly unambiguous. Although no rigid distinctions were observed between university and FHS graduates, it was more likely that university graduates would take the lead on important projects, contribute to strategic thinking and systems architecture planning. They were considered to have good analytical skills. The FHS graduates were considered to be technically better trained and able to focus on particular problems and come up with solutions. They were more likely to be working on software development, often managing a development project.

British companies did not have the benefit of such clear signaling devices as the university/FHS distinction in Germany and were confronted by graduates with very great variability of skills and abilities. However, a majority of larger companies differentiated their graduate intake into graduates who were recruited to an established graduate training scheme and graduates who were recruited by the normal route. Those taken on the graduate training scheme were normally expected to advance to management level within a fairly short space of time. Many companies tended to recruit from the older universities and from Oxbridge to fill places on their graduate scheme. The quality of the graduate training scheme, often lasting up to two years, was considered an important factor in ensuring that the company gained a share of the 'best' graduates. Training of graduates on these schemes was costly, often extremely costly for the company. However, the aim of recruiting a share of the most able with the intention that they should ultimately contribute to strategic management is clearly similar to that of German companies who recruit the older and more highly-trained university graduates.

New graduate recruits who were not on a graduate scheme were allowed a longer period of 'internal apprenticeship' in the company than in Germany. During this period they received – often considerable – additional training and on-the-job mentoring. This period allowed the company to make their own assessment of potential and help to plan careers. The best graduates would be able to progress to similar positions of responsibility as those on the graduate training scheme. Similarly, German companies often emphasised that there were no barriers to progression for FHS graduates. A proportion of those British graduates who did not progress or wished to concentrate on purely technical tasks would frequently opt for self-employed status as contractors, often staying with the same company, as a way of increasing their salaries in the absence of promotion. In this way, benefits of company investment in initial graduate training could accrue almost entirely to the individual. On the other hand, companies gained increased flexibility in the workforce. Thus the differentiation between employees who work with high levels of responsibility or who contribute strategic analysis and those who specialise on technical tasks is found in both countries. However, in Germany the difference is largely institutionalised while in Britain differentiation is carried out through company recruitment strategies.

Non-graduate functions were similar in both countries. Technical support, maintenance and repair, installation and help desk were most frequently mentioned. In Germany, almost all non-graduates had completed an apprenticeship while in Britain this was practically unknown. However, very few in the German companies had completed the new ICT apprenticeships which were only launched in 1997. Normally, those with completed apprenticeship had qualified in an occupation relevant to the sector. In Britain, non-graduates had a wide range of qualifications and experience. Companies were not able to provide any details of this range. However, recruitment practices provide some idea of the base entry level required.

In the financial sector in Britain most of the companies recruited at A-level for functions similar to those carried out by non-graduates in Germany. A-level recruits were then provided with a period of training similar to that provided in apprenticeship in Germany.

In the retail sector in Britain, around half the companies mentioned A-level entry recruitment. One company offered an 18 month training programme for A-level entrants to Junior Technician level. However what might be termed 'internal apprenticeship' was more widespread. This involved encouraging staff employed in the retail outlets to move over to ICT services where they would be trained to work in one of the support functions mentioned above. These staff were appreciated for the detailed knowledge of the retail business that they brought to ICT services.

As mentioned above, software companies in the two countries employed very large numbers of graduates. Their roles involved a great deal of customer contact and work on customers' premises and soft/communication skills were at a premium. It is perhaps no coincidence that the only two examples of companies with substantial commitment to ICT apprenticeship that we were able to find in Britain were in this sector. The need to provide high and consistent standards of service to customers was an important motive for this more systematic approach to training of non-graduate employees. A further motive in our view, may be a wish to reduce payroll costs by substituting qualified apprentices for graduates. This is understandable in a sector where there is reliance on graduates and cost consequences in times of skill shortage.

3. Anglo-German Comparisons of Skill Procurement, Organization and Supply Policy

3.1 Work organization – theory and practice

The view of career and work organization in ICT departments and in the ICT sector in Germany as expressed in the APO-BiBB Skill Matrix is based on the core concept of occupational competence. This concept has a long history in German work organization and has more recently been criticized as lacking the flexibility required by modern organizations. The concept of occupation developed for the ICT user and producer sector apprenticeships is broader and more flexible than in many older industrial occupations and is complemented by a semi-institutionalised career development structure with officially accredited continuing education qualifications. Industry bodies in Britain, in partnership with government, have also developed a Skills Framework for ICT. However, this matrix uses functional analysis rather than occupation as its basis and breaks the skills required down into 57 skill elements which can be exercised at one or more of seven levels of responsibility covering six areas of work. By contrast, the German Skills Matrix specifies only three levels of responsibility (excluding apprenticeship) and 35 occupations.

While the German model bundles together work functions into occupations and produces individuals capable of a range of functions, the British model leaves freedom to develop any combination of skills. The German model could prove to be more constraining and less flexible than the British – in our visits to companies we were interested to discover how far the theoretical model was found in practice.

German companies used a variety of strategies for managing the skills available for the tasks that needed to be performed. While a few referred to fairly formal structures of three or four levels of promotion and promotion on the basis of qualifications, a larger number promoted employees on the basis of performance as evaluated in appraisals and stressed the need for individuals to take responsibility for their own career development.

All this was not, of course, incompatible with work organization based on defined occupations. While German companies that were part or wholly foreign-owned were implementing an Anglo-Saxon skill/performance based HR model, evidence from recruitment practices suggested that most were strongly influenced by the occupational concept. German companies rarely entertained the notion - common in Britain - that an individual with aptitude could switch occupations, from, say, personnel to ICT. The German companies normally only recruited graduates with ICT or ICT cognate qualifications and had little time for those who switched into ICT from a different degree subject by means of further training courses.

Some anecdotal evidence from the companies suggested that there was resistance to attempts to promote greater movement of employees to undertake tasks within their competence but not part of their recognised occupation. In one German company our interlocutor commented that 'In Britain, the manager orders what type of job has to be done, in Germany there is a big discussion if somebody has to change his job …. And sometimes people leave because of this.'

Another company stressed that a conservative attitude to a change of roles within the company was more common among older workers with apprenticeship qualifications than among graduates. However, it would be wrong to give the impression that German companies generally felt constrained by the occupational model of competence. Those who complained were a small minority. It must also be remembered that German ICT employers were at the forefront in initiating action to set up new apprenticeships for the ICT industry. This support was largely echoed in the German companies visited. This backing is further evidence that German companies do not see the occupational model of competence (as developed in the new ICT apprenticeships) as a barrier to effective work organization. It must also be remembered that a majority of German companies in every sector made quite extensive use of contractors to meet specific skill needs which, of course provided considerable flexibility.

Just as most of the German companies did not conform to the theoretical German model of skill developed in the Skill Matrix, the British companies did not conform to the SFIA framework in their management of skills and work. In particular, the British companies did not normally recruit at a level below A-level or equivalent professional experience. There was little evidence that the lowest two levels, Levels 1 and 2 (NVQ Levels 1 and 2) of the SFIA framework were much used. In fact the organization of work in the British companies seemed closer to the three level German model, with A-level type entrants carrying out the more routine tasks, graduates carrying out project-type work and high-flying graduates performing strategic managerial roles.

Some British companies had sophisticated skill monitoring and audit in place so that they could plan ahead to fill skill gaps on future projects. However, this was not normally the case. More frequently, the British companies carried out annual or twice-yearly appraisals in which employees identified skills acquired and agreed on targets for additional skill acquisition. Some companies claimed that this process was left entirely to employees who were expected to continually upgrade their skills - for example, by using the company Intranet. We were unable to ascertain how effective this was in practice.

From company recruitment strategies however, it became clear that skills acquired, whether through experience, or education plus experience, were the most important criterion on which British companies' recruitment decisions were based (Section 2.6 above). All this points to the use of a skills-based model, close to the SFIA framework, as a basis for skill management.

3.2 Relative skill supply

In this study we aimed to assess how the available skill supply impacted on companies' skill strategies. To summarize briefly, the skill supply in Germany is characterized by:

- a relatively small number completing university courses in computer science with a long study period of between six and eight years
- FHS graduates who study for four years and spend often two six month periods working in companies
- an increasing number of apprentices
- difficulty in attracting/integrating employees from other countries to work in Germany under the Green Card arrangements
- substantial use of contractors and some out-sourcing

The output of computer science graduates from German universities and FHS institutions was in the region of 6,000 in 2001. In Britain in the same year, some 20,000 - three times as many- computer science graduates left university with either two year diplomas, first degrees or post-graduate qualifications. Of these, some 16,000 had first or higher degrees. This puts Britain ahead of Germany by a factor of 2.5. The relatively low numbers qualifying at graduate level in computer science have had an important impact on the skill supply strategies of German companies. German companies pay higher real starting salaries to graduate entrants than in Britain, and continue to experience concerns about future supply. The pool of contractors available to German companies is considerably smaller than in Britain, probably as a result of the relative scarcity of graduates. The German language is a barrier to employment of non-German speakers in ICT occupations, even though English is the working language in ICT. As some German companies pointed out to us, employees still need to communicate with other colleagues and customers and to fit into the working environment. Lack of knowledge of the German language had proved a significant barrier. Because of this, German companies considered that they were losing out to Anglo-Saxon countries in the competition to attract good ICT practitioners from abroad, precisely because foreign workers usually had English as a second language and preferred to work in an English-speaking environment. However, the situation has eased since 1999-2000.

German companies have thus faced a much lower supply of university graduates with computer science degrees than in Britain. Together with the difficulty of recruiting from overseas, this may well be an important part of the explanation for the smaller relative size of numbers in ICT occupations in Germany. This problem has been greatly compounded by German companies' reluctance to recruit and train graduates from disciplines not connected with computer science as is common practice in Britain.

These important rigidities affecting the supply of skills in Germany and the associated higher costs help to explain German employers' strong support for the initiative to increase the number of young people entering a career in ICT through the apprenticeship route (Section 1.2 above). German employers co-operated with the government and with the trade unions in planning the curriculum and regulations governing the new apprenticeships. Since the apprenticeships were launched in 1997 German companies have recruited and trained some 50,000 young people in the three year apprenticeship programme; a further 60,000 are currently in training.

German employers were clear from the outset that one aim of promoting apprenticeship was to produce the skills the company needed at a lower cost. 'Skilled manpower trained within the dual system (apprenticeship) are to replace the overly costly higher education graduates' was the expectation put forward by an employer representative at a conference held in Germany two years ago (Dubiella, 2000). While in training, German apprentices are paid around one third of the full rate for the occupation they are training in. The data we collected on apprentice salary levels when qualified confirmed that salaries for those with apprentice qualifications are around two-thirds of graduate salaries. Many of the German companies with apprentices in training expected that apprentices would take on some tasks similar to those now carried out by graduates. Other companies hoped to develop a core of personnel which did not aim for fast promotion and provided stability at the base of the firm. In line with the APO project for continuing qualifications, it was emphasised that apprentices would need to continue training and study. However, if that condition was satisfied, there was confidence that they would play a significant part in combating skill shortages in the future.

The very great contrast between employers' enthusiasm for apprenticeship in Germany and British employers' almost complete neglect of the British Modern Apprenticeship will be apparent from our analysis in Section 1 above. Just under 1000 young people started an apprenticeship in ICT in Britain in 2001 compared to 20,000 in Germany.

We investigated the standard required of the German and British apprenticeships to see whether a difference in the usefulness of the standard of training given could explain the difference in numbers. The expert consulted considered that the British and German standards were not grossly out of line. A good Modern Apprentice capable of attaining NVQ Level 3 could cope with most of the demands of the German apprenticeship.[42]

We must also recall that in Germany, there is no tradition of apprenticeship training in an industry as young as the ICT industry; in fact the ICT Modern Apprenticeship in Britain was established in 1995, two years before the establishment of the four German ICT apprenticeships discussed here. A tradition of training cannot therefore explain the investment by German players in apprenticeship.

It cannot be argued that British companies do not need or use intermediate skills in ICT occupations as an explanation for the neglect of Modern Apprenticeship. On average, only around two thirds of those employed in ICT in Britain have been educated to degree level, the remaining third almost invariably have reached at least the equivalent of A-level (ISCED 3) (CEPIS op cit). Many of the companies we visited in Britain, in particular those in the 'user' sectors, recruited young people at A-level and devoted a considerable proportion of their own resources to training them in ICT occupations. It is not, therefore possible to

[42] This comparison of standards will be explored more fully in a separate paper comparing German and British ICT apprenticeships.

argue that British companies do not need intermediate skills below graduate level, or that they are not interested in training at this level.

Two factors may help to understand the difference between German and British companies in their attitude to the development of intermediate skills. First, as has been pointed out, British companies have benefited from a larger supply of graduates and have been more flexible in their attitude to employment of non-ICT graduates. Second, a larger pool of contractors and a relaxed attitude to the issue of Green Cards for foreign workers has also helped to ease skill shortage problems[43].

British companies undoubtedly suffer from an information problem in relation to apprenticeship. Hardly any of those we spoke to had heard of Modern Apprenticeship and we could, therefore, not explore with them reasons for not taking it up. By contrast, German managers we spoke to were familiar with the introduction of the new ICT apprenticeships and had usually considered whether or not to take apprentices on. Considerable campaigns by the German government and the chambers had informed them, the public and the school-leavers about the new ICT apprenticeships.

Perhaps the most important difference between the two countries, however, is the difference in the pool of young people available to enter apprenticeship. When, as in Germany, around two thirds of all young people expect to enter apprenticeship (of whom around 20 per cent will subsequently enter university or FHS), the pool of those able to take on a challenging apprenticeship such as ICT is relatively large. Thus the relatively small numbers in Germany entering university proves to be a positive advantage when promoting an intermediate skills route. When, as in Britain, around 50 per cent of the age cohort is aiming for university on the A-level route, the pool of those able to work to the demanding standards required in an ICT apprenticeship is considerably smaller. This pool is further reduced when companies recruit young people with A-level to their own training schemes.

While the behaviour of the German companies in the face of skill shortages appears rational, that of the British companies cannot be so easily understood. We must conclude that a combination of factors explains that behaviour. The first is information failure. Companies may not have sufficient information about Modern Apprenticeship to appreciate possible advantages. Second, anecdotal evidence from discussions with two British companies that

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[43] In 1999, two-thirds of British immigrants seeking employment in an ICT occupation were from India and the remainder were mainly from other English-speaking Commonwealth countries (such as Australia and Canada) and from the USA (Connor et al, 2001). In the same year 115,000 visas were issued by the US government (Greifenstein, 2001). In Germany the supply of Green Card holders was estimated to be 5,000 in 2000/01 and

have taken on ICT Apprentices suggests that the regulations governing the assessment and certification of Modern Apprentices in Britain are burdensome and costly to companies. Third, evidence from training providers who try to place young people on ICT apprenticeships suggests that insufficient young people with the requisite educational level are currently coming forward.

3.3 Comparison of company skill procurement strategies

Companies in the two countries were faced with very similar challenges of reacting fast and flexibly in a rapidly changing technological and competitive environment. Both British and German companies were keenly aware of the vital importance of the role played by skills in achieving profitable operation.

British companies were extremely flexible in their attitude to recruitment of skills. New employees were predominantly graduates; however, little attention was paid to degree qualifications once sufficient experience had been obtained. We were told that ‘The last three jobs’ were what really counted in the decision about recruitment. Graduates seeking first employment could be employed from a wide range of academic disciplines and not just from ICT or cognate courses. This obviously widened the pool of recruits to encompass those who were self-taught, had switched careers, were seeking permanent employment after a spell in self-employment. However, a fairly undiscriminating approach to recruitment led to problems in narrowing down the pool of applications and locating good quality from the pool. British companies used recruitment agencies (and incurred high costs as a result) to assist with this task. However, as a result, we surmise that shortage of skills has had less of an effect on the British than on the German companies. It was not difficult for British companies to get work permits for skilled ICT staff and there was a ready supply of skilled personnel overseas willing to apply. A number of British companies recruited skills from overseas or outsourced to other countries. British companies showed lack of innovation in recruitment practices below graduate level, however. Hardly any companies had considered taking advantage of the public funds available for ICT apprentice training in the Modern Apprenticeship initiative. Instead, a considerable number continued to meet all the costs of training for non-graduate entrants. The corollary of a flexible approach to graduate recruitment is, of course, relatively high initial training costs. British companies trained new

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3,000 in 2001/02 (Dostal, 2002). Between August 1st 2000 and June 30th 2002 a total of about 12,000 graduate recruits for longer and more intensively than was the case in Germany although at lower salary costs.

German companies were less flexible in their recruitment strategies. Mostly, they mistrusted those who had been through ICT 'conversion courses' from the Ministry of Employment even when those who came from these courses already had a first degree. Companies sought a mix of graduates and non-graduates, as in Britain. However, they sought almost exclusively ICT graduates or those from a closely cognate discipline. Inevitably, this restricted the pool of potential recruits. German companies spent longer than British locating skills and rarely used recruitment agencies. It was harder for German companies to persuade non-German speakers from outside Germany to apply for work permits and lack of German language skills created difficulties for team-working etc. We had the strong impression that German companies expected university and FHS graduates to become fully effective at a relatively high level within a short space of time. Certainly, German companies supplied much less off-the-job training to new graduate recruits than did the British. Most learning was on-the-job through projects and short seminars. It was rare for German companies to invest in graduate recruitment programmes to enlist and train top managers as found in Britain. This requirement was already met by recruiting university graduates who, it will be recalled, had studied for at least six or seven years and were likely to be aged around 28 on graduating.

However, a number of sources of additional flexibility were used by German companies that were not taken up by British companies. German companies paid higher salaries than British companies to new graduate recruits and, perhaps for this reason, were conscious of the need to reduce costs at this level. Substantial numbers of interns (university undergraduates) were employed for three month or longer periods and, we were told, made a useful contribution to the company. Many German companies had taken on apprentices in the new ICT apprenticeship programmes. These non-graduate entrants would be paid only two-thirds of graduate earnings (as mentioned before) once qualified and would require no additional training once employed. While in training (usually 2.5 –3 years), apprentices were paid a training allowance of around one third of their earnings when qualified. It was hoped that, with experience and further training, apprentices could fill many of the posts currently taken by graduates.

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applications were done.

British companies usually expected employees to cross occupational boundaries and acquire the skills needed by the company as required by the work programme. It is not clear how well this worked or how high the re-training costs were. However, few British companies complained that employees were unwilling to work flexibly in this way. Indeed, for those contemplating self-employment, a broad skills portfolio acquired while in permanent employment could become a personal asset. A number of German companies suggested that employees were finding it difficult to adjust to this sort of flexible working. However, we did not get the impression that German companies were allowing this to stand in the way of necessary restructuring.

3.4 The supply of skills from publicly-funded sources

The very long lead time taken to produce graduate level skills in Germany and the high drop-out rate have combined to create a very low annual output of ICT graduates. Numbers have now been expanded but increased supply will not be available for some years. In Britain shorter courses and lower drop-out have led to a steady increase in ICT graduates.

a) An important advantage of the British system is that there is flexibility to move from first to postgraduate degree (Bachelor and Master are usually consecutive courses in Britain). It is also possible to change between subjects when moving from the first to the postgraduate degree. Persons with first degree and some years of experience often return to university for additional one or two year courses to attain a Master degree. In Germany the courses at traditional and applied university (FHS) are parallel and take at least four years, changeover between subjects is cumbersome and time consuming and rarely occurs. However, introduction of newly designed Bachelor and Master courses in Germany will lead to higher flexibility. (Output is still rather low: in 2001 it was 2 Bachelor and 15 Master graduates).

Compared to Britain, an advantage of the German system is the requirement of internships at applied universities (FHS). This leads to an early contact of the students with companies and provides experience of the world of work. This facilitates an easier recruitment process if the student subsequently enters a job at this company. In consequence this will reduce the training costs for the company. This effect is strengthened when the student also writes his/her thesis at the same company.

The length of German degree courses means that universities cannot react in a timely fashion to changes in market demand. Together with high attrition rates this leads to wasteful use of public resources devoted to higher education in Germany. At the same time, the government incurs heavy costs of further training courses for unemployed graduates. To reduce the attrition rates the government has announced measures to improve the provisions for studying.[44]

4. Policy Implications

4.1 Policy implications for companies

In British and German companies a a distinct change has taken place in the quality of the ICT workforce since 1999. The stagnation or even downturn in the business has allowed companies to look more for quality than quantity. Before 1999 the scarcity of ICT-personnel and the growth of business meant that almost anybody with some ICT experience was recruited and trained. In the case of software companies these extra costs could easily be billed to the customer. With the higher cost consciousness of companies this is not feasible anymore. However, not only software companies but in all the sectors considered here, the performance of existing employees was reviewed and high performers were exchanged for non-performers. This has led to a higher intake of graduates. Although more job applicants were available on the market after 2000, the time required to recruit a new employee has not really changed as the quality of new hires has become more important. This was supplemented in Germany by firms taking on a higher share of apprentices. Banks and software companies showed a particularly strong involvement.

In general, companies in both countries were satisfied with the technical skills of graduates but asked for more soft skills. Key skills were a particular problem with regard to ICT graduates. They were often seen as having difficulties in communicating with colleagues and customers in projects and were too much focused on the ICT area. This assessment was emphasised more strongly by British companies. This preference helped to explain why British companies would recruit someone with an arts or language degree if the person had the required soft skills.

The low proportion of graduates in retailing companies seemed not to be completely self-chosen or just salary driven but was implied by the utilisation of ICT. Retailing

[44] www.bmbf.de/presse01/811.html, March 17, 2003.

companies had the highest share of self-developed programmes and legacy systems. This implied a number of disadvantages. Firstly the choice of personnel for recruitment was restricted as usually ICT professionals do not like to work with 'old' technology. Secondly, the training times even of new graduates to master these legacy systems were long and costly. Finally, the developed ICT solutions were laborious and not very efficient. It can be expected that the increased importance of supply-chain management which necessitates a fast and efficient data exchange with suppliers and customers will impose a fast move to more standardised systems if the industry wants to be competitive.

The ICT departments in the automobile industry showed a relatively low deployment of ICT graduates although the share of graduates was high, in Germany even the highest of all considered industries. At a first glance this was surprising as the software fraction of the electrics/electronics share in a car is , at 20 per cent already high in 2001 and is anticipated to double by 2010. In addition, the automobile industry is leading in supply chain management so that it might be expected that there would be a high demand for ICT skills. In fact, graduate engineers were preferred and accounted for a large share of employees. This was explained by the strong impact that the knowledge about the product and the manufacturing process has on the development and implementation of software. Given the above mentioned problems of ICT graduates to integrate into projects, graduate engineers were preferred who usually had some ICT training integrated in their studies. Taking this into account the university training should emphasize a relevant training in computer science of engineers and press for key skills in general and for ICT students in particular. As automobiles were taken as a sample for the manufacturing industry and in fact this particular branch is seen as a leader in supply chain management and manufacturing processes this effect might be found in other manufacturing industries as well.

4.2 Public policy implications: Britain

British universities have proved responsive to the need to increase numbers studying overall and to increase numbers studying ICT. This has benefited British companies and may well help to explain the greater expansion of ICT employment in Britain relative to Germany. Variability in quality and course coverage in Britain poses a problem for companies when recruiting and contacts between universities and the companies in our sample were not common. At the same time, it must be recognised that universities and apprenticeship in Britain are increasingly competing for the same young people. The ICT sector could gain from implementing current government policy aimed at opening up a route to higher education through apprenticeship. This would prevent young people having to choose between university and work-based apprenticeship training.

There was no equivalent to the German thesis and internships which provide contact between German companies and German undergraduates. A development of internships and projects to be carried out in companies as part of the university course could help to remedy this and promote greater understanding between universities and companies.

There is considerable scope for apprenticeship to be more widely used by British companies to train new employees to Levels 3 and 4 on the job. Both companies and new employees could benefit. New employees would gain a recognised qualification and companies could use the scheme to ensure a good supply of skills. However, in such a fast-moving area of activity, companies must be allowed more flexibility to base on the job training on their own patterns of work organization and skill deployment. Greater flexibility in Germany has led to a rapid expansion of ICT apprenticeship places.

The German example shows that good ICT apprenticeship recruits can be found from those who have the equivalent of good GCSE passes and that A-level type qualifications are not an essential pre-requisite. The challenge of finding young people of sufficient prior standard to undertake an ICT apprenticeship should be tackled by clear routes into apprenticeship from full-time preparatory college courses and, as mentioned above, clear routes through to higher education for those who wish to take that route.

British companies could benefit from working together to put in place universally recognised continuing training qualifications - independent of particular operating systems - that would encourage individual employees to invest in their own training. Companies could thereby reduce costs both of recruitment and of further training.

We have pointed out that contractors in both countries usually benefit from training provided by an employing company before becoming self-employed. However, the tax treatment of training expenses of self-employed contractors is less generous in Britain than in Germany. British contractors are not able to offset the costs of maintaining or improving their ICT skills even during periods when they do not have a contract. For this reason, skills may rapidly become outdated during periods such as the current downturn or may be lost to the industry altogether. In Germany, tax treatment of training expenses incurred by contractors is more favourable.

4.3 Public policy implications: Germany

Two important changes have been introduced in Germany during the last three years. First, the establishment of three further national levels of specialisation in ICT in 2002 (APO-ICT framework) provide opportunities for apprentices with experience to move up to gain a level comparable to the Meister in industry and then to go on to university level. The opportunity to achieve a qualification equivalent to university graduation along a route which is based largely on on-the-job experience is completely new in Germany. Second, the introduction of a new course arrangement with a three-year Bachelor (first) degree and the possibility to continue education by adding a one or two-year Master course will improve the system in several ways.

a) Up to now the transfer from FHS to traditional universities was difficult for students who wanted a post-graduate degree and caused a loss of time as few FHS courses were accredited at the traditional university. The new arrangement will allow the achievement of the higher Master certificate at both types of universities. With a Master degree it should be easier for FHS students to continue even to a doctorate. Up to now this route was open in theory but many additional requirements by the traditional universities put great obstacles on this path. Since a doctorate is a basic requirement for university positions this might also help to enlarge the pool of candidates who might take teaching positions.

b) Since many first degree courses will just be three years this shorter period might reduce the attrition rate because the planning of courses as well as the examinations will be easier. Students will be more inclined to finish and might be less attracted to start work before taking the examinations.

c) Shorter courses allow the system to react more flexibly to market demand.

d) With respect to the fast changing technology in ICT and the need for life-long learning experienced persons might go back to university to take a Master level and learn new techniques. Returning to university after a first degree is quite common in Britain but did not exist in Germany since a postgraduate degree (Master) was not offered.

e) The introduction of Master courses provides a recognised national standard for main stream graduates. Up to now main stream graduates were retrained by a variety of (expensive) programmes funded by the Federal Government but did not receive a standardised qualification. As a result the companies were doubtful about the usefulness of these qualifications and hesitant to offer employment. The availability of a Master course might be an incentive for many individuals to choose this nationally recognised course.

f) Finally, assessment of international courses and certificates will be less complicated with respect to the Bachelor/Master level than the longer German certificates. Students will be more flexible to integrate courses abroad and to fulfil the requirements of firms for international education and experience.

However, the system has also become less transparent since it is less standardized. Instead of two Diploma degrees (traditional and applied university) which will continue to exist and well accepted there are now four more degrees (Bachelor and Master), two each from both institutions. Up to now it is not clear whether Bachelor and Master degrees of the two HE institutions will be comparable. If the bachelor degree from a FHS is not accepted as a basis of a Master course at university the expected utilities from easier transfer are not given. These doubts are legitimate because German government policy regulates that the Master degree from the two types of universities leads to quite different career paths in the public service. It has also to be awaited how the private employer will assess the different qualifications from the new system.

With regard to the new ICT apprenticeships a higher training flexibility is given as the accreditation of practical experience is more company specific and the new further education route includes a lot of in-company training. The results have to be closely watched, however, to insure that the information contents of certificates is retained. First surveys show that this flexibility is accepted by companies and the signalling effect of apprenticeship has been kept.

5. Conclusions

It is widely accepted that differences in national institutions have a significant effect on the national economy through their effects on the behaviour of firms and individuals. However, many studies have concentrated on labour market regulation and social welfare benefits as sources of major institutional difference between countries that affect economic growth and productivity.[45]

This study of how firms in Britain and Germany source and secure ICT skills points to important differences between countries in external constraints, originating in the education system, on the supply of highly-educated ICT graduates and graduates in cognate

[45] Such studies are too numerous to cite here; however, a recent example is Freeman, R. B., 'Institutional Differences and Economic Performance among OECD Countries', Centre for Economic Performance Discussion Paper 557, October 2002.

disciplines. Combined with other factors discussed below, these have impacted differentially on firms in the two countries and led to substantially different recruitment and training policies.

In Britain, the supply of graduates has increased substantially in the latter half of the 90s and early 2000s. The supply of graduates from ICT degree courses has increased even faster. This has been made possible by a high degree of responsiveness from universities (providing additional places) and students (choosing courses where demand from industry is high). In addition, government funding has met part of the cost of expansion and low drop-out and short (3 year) courses have meant that lead times for skill production from universities are relatively short.

In Germany, unlike Britain, there was, until recently, no expansion in numbers entering universities and applied universities (FHS); universities and FHS have not been able to find places for all those who applied to study computer science. The very long lead times to degree qualification (between five and seven years) and high drop-out rates have resulted in very low numbers qualifying at the time of particularly high demand around 1999/2000. While numbers studying have now increased substantially, those who complete the course will qualify at the earliest in 2006/7.

Firms' approach to recruitment in the two countries has been structured and conditioned by different traditions of occupational identity. In Britain, occupational identity is relatively weak except in certain recognised professions (law, medicine, etc.) and the older industrial crafts. Employees in the service sector are used to carrying out a variety of tasks as required, and shifting into new areas of work. New employees are recruited on the basis of relevant experience and those hired straight from university frequently hold qualifications that are unrelated to the job they are expected to do. Firms expect to provide this latter group with substantial training and place them in 'starter' positions within larger teams where they can acquire relevant knowledge and experience.

Most of the German firms visited adhered to the occupational model of competence whereby each employee is expected to own and apply a recognised set of skills which are held to comprise the occupation trained for and practised within the firm.[46] While this model may well lead to greater breadth and depth of technical competence it undoubtedly creates difficulties when flexible reaction is required to fast-moving technological change. Furthermore, the model can create difficulties in integrating new employees from abroad and new employees without the recognised occupational preparation – for example those from 'conversion' courses.

These factors - the unresponsiveness of higher education and the occupational competence model were, in our opinion, important reasons for the difficulties that German companies experienced in recruiting the skilled employees that they were seeking in the late 1990s.

However, these same difficulties have also spurred German companies on to work together to 'by-pass' the universities and create a system of skill production – apprenticeship and continuing work-based training structures - that is more flexible and offers the prospect of training large numbers of highly-skilled ICT employees. These will undergo principally work-based training and constitute a pool of work-ready employees at lower cost than graduates. While graduates will still be needed and recruited, company-based skill production will provide for many of the middle level posts which had previously proved difficult to fill.

British companies have benefited from a relatively plentiful supply of graduates and a flexible approach to skills. Individual companies have invested heavily in training new employees and upskilling existing employees to combat skill shortages. However, because companies were able to 'get by' on the basis of these strategies, there has been little concerted action on the part of companies to tackle future skill shortages comparable to that undertaken by German companies. A lack of concertation between firms has led to companies bearing much of the training costs of new recruits and losing that investment a few years later when employees move to self-employed status.

In both countries public institutions which generate high-level skills are of prime importance to all companies which require specialised ICT practitioner skills. When, as is the case in Germany, importing skills or outsourcing work is more difficult for linguistic and cultural reasons, the power of these institutions to restrict or open up the supply heavily constrains companies' ability to respond to new business opportunities. Britain benefits from the universality of the English language and strong cultural links to the Indian and Asian sub-continents. Importing skills and outsourcing is less problematic. However, a plentiful supply of relatively unspecialised graduates has shaped company behaviour in Britain, leading to training investment which benefits the individual rather than the company and a lack of standardisation of qualifications and experience.

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[46] In fact the only firms where we were told that employees moved freely between tasks as required were

Appendix 1

The Classification of ICT NVQs

Classification	NVQ Title	Levels
development	Developing ICT Programs	2
development	Developing ICT Systems	3, 4
development	Information Systems Acquisition	3
development	Information Systems Analysis	3
development	Information Systems Design and Programming	3
development	Information Systems Development	4
development	Software Creation	2
hardware	Computer Network System Selection and Installation	4
hardware	Controlling Use of Information Technology	3
hardware	Electrical and Electronic Servicing	2,3
hardware	Electrical and Electronic Servicing	3
hardware	ICT Services—Repair Centre	2,3
hardware	Servicing Electronic Systems (Field)	2,3
hardware	Servicing Electronic Systems (Workshop)	2,3
ICT Services	Implement Information Technology Solution	3
ICT Services	Install and Support ICT Systems	3
ICT Services	Install Information Technology Products	2
ICT Services	ICT Services—Customer Response Centre	3
ICT Services	ICT Services—Customer Systems Support	3
ICT Services	Operating Information Technology	1
ICT Services	Operating Information Technology	2
ICT Services	Servicing Software (Field and Support Centre)	3
ICT Services	Servicing Software (Support Centre)	2
ICT Services	Stand Alone Computer Operations	1
ICT Services	Stand Alone Computer Services Operation	2
ICT Services	Stand Alone Computer Services Supervision	3
ICT Services	Stand Alone Computer System Selection and Installa	3
ICT Services	Support Users of Information Technology	3
use/support	Use and Support of Information Technology	3

foreign-owned or had merged with a foreign company.

Appendix 2

Case study of Apprenticeship at Bank A, Germany

The majority of apprentices at Bank A have *Abitur*. In addition to a broader school background they are older and therefore more mature, have more critical attitudes, learn faster, can fulfil the rather demanding training syllabus (write a report of about 20 pages about a project for the final exam, present and discuss it). Most of those with *Abitur* will do the apprenticeship in a shortened time, namely within 2.5 years.

Because of the high increase in the numbers of ICT-apprentices the training at vocational schools had to be increased accordingly. Teachers had to be qualified, materials provided and examination boards had to be set up. In addition, the national syllabus had been changed to the 'ganzheitliche Methode' ('holistic', teaching the different subjects by using one project) which required largely changed teaching and examining methods. At the beginning many companies were not satisfied with the training at vocational schools. The chamber of commerce helped to bring teachers and companies together and to offer seminars for teachers. Companies with a large intake of apprentices organised the theoretical training at private vocational instead at public schools run for example by Siemens. With this measure they were able to exercise a higher influence on the specific contents of the syllabus, e.g. teaching programming languages used in the company (bank) or projects related to the work in the company or bank. Sometimes the private vocational institutions also provided additional training periods up to half a year requested and paid for by the companies. In these courses the apprentices would be taught the specific company related technical systems.

While the investment into the apprenticeship is quite high with all the required and additional training contents some companies/banks quoted that about 50 per cent of their apprentices leave the company to go to university or FHS. Despite their high investment into the apprenticeship the companies do not mind. Instead they partly have expected it by taking school-leavers with *Abitur* and partly, they hope to get them back as graduates. For this they offer them good jobs during their semester holidays and invite them to seminars. This pays off as the companies get well-educated graduates who are up to date with the company specific equipment and technologies, and who are efficient from day one and the usually high recruitment costs can be saved.

Appendix 3

SFIA and APO ICT-Weiterbildungssystem			
SFIA	APO-ICT WBS	APO-ICT	SFIA
		Q-level	Skill level
Strategy & Planning			
Information management			
Information resource management	Geprufter Informatiker	MSc.(Eng)	6,7
Advice & Guidance			
Consultancy	Geprufter ICT-Berater	BSc (Eng)	5,6,7
Technical specialism	Geprufter Entwickler	BSc (Eng)	5,6,7
Business IS Strategy&Planning			
Business Process Improvement	Geprufter Informatiker	MSc.(Eng)	5,6
IS Strategy&Planning	Geprufter Wirtsschaftsinformatiker	MSc.(Eng)	5,6
Business risk management	Geprufter Entwickler	BSc (Eng)	5,6
Technical strategy and planning			
Systems architecture	Geprufter Entwickler	BSc (Eng)	6,
Change control	ICT-Konfigurationskoordinator-in	Appr.+WB	3,4,5,6
Business continuity planning	Anwendungssystemberater/in	Appr.+WB	4,5
Emerging tech.monitoring	Geprufter ICT-Berater	BSc (Eng)	5,6
Methods and tools	E-Logistikentwickler/in	Appr.+WB	4,5,6
Network planning	Netzplaner/in	Appr.+WB	5,6
Management&Administration			
Supply management			
Contract management	Geprufter ICT-Projektleiter	BSc (Eng)	3,4,5,6
Procurement	Geprufter ICT-Okonom	BSc (Eng)	5,6
Project management			
Programme management	Geprufter Informatiker	MSc.(Eng)	6,7
Project management	Geprufter ICT Projektleiter	BSc (Eng)	5,6,7
Project office	ICT-Projektkoordinator	Appr.+WB	2,3,4,5
Quality management			
Quality management	ICT-Qualitatssicherung	Appr.+WB	5,6,7
Quality assurance	ICT-Qualitatssicherung	Appr.+WB	3,4,5,6
Compliance	Sicherheitstechniker/-in	Appr.+WB	3,4,5,6
Resource management			
Asset management	Geprufter ICT-Okonom	BSc (Eng)	5,6
Systems devt.management	ICT-Systemanalytiker	Appr.+WB	6,7
IS-co-ordination	WMsystementwickler/in	Appr.+WB	6,7
ICT management	ICT-Systemanalytiker	Appr.+WB	5,6,7
	and ICT-Systemplaner	Appr.+WB	
Service delivery management	ICT-Qualitatssicherung	Appr.+WB	6,7
Sales and Marketing			
Account Management	ICT-Kundenbetreuer-in	Appr.+WB	5,6
Marketing	ICT-Vertriebsbeauftragte/r	Appr.+WB	3,4,5,6

Sales support	ICT-Produktkoordinator/in	Appr.+WB	1,2,3,4,5,6
Development and Implementation			
Systems development			
Business analysis	ICT-Systemanalytiker/in	Appr.+WB	3,4,5,6
Data analysis	Dokumentationsentwickler/in	Appr.+WB	2,3,4,5
Technical authority	ICT-Sicherheitskoordinator/in	Appr.+WB	5,6
Systems design	ICT-Projectkoordinator/in	Appr.+WB	2,3,4,5,6
Database design	Datenbankentwickler/in	Appr.+WB	2,3,4,5,6
Programming/software development	Softwareentwickler/in	Appr.+WB	2,3,4,5
Systems testing	ICT-Testkoordinator/in	Appr.+WB	2,3,4,5,6
Human factors			
Systems ergonomics	Nutzerschnittstellenentwickler/in	Appr.+WB	3,4,5,6
Media creation	Multimediaentwickler/in	Appr.+WB	2,3,4,5,6
	E-Marketingentwickler/in	Appr.+WB	
Installation and integration			
Systems integration	ICT-Systemplaner/in	Appr.+WB	2,3,4,5
Systems installation/decommissioning	Komponentenentwickler	Appr.+WB	2,3,4
Service Delivery			
Education and Training			
Education and Training Mngment			5,6
Development & Training	ICT-Trainer/in	Appr.+WB	5,6
Training Materials Creation			3,4
Education and Training Delivery			3,4,5
Infrastructure			
Configuration management	ICT-Systemplaner/in	Appr.+WB	3,4,5,6
Network Control	ICT-Systemadministrator/in		5,6
Capacity Mngment	Geprufter ICT-Okonom	BSc (Eng)	4,5,6
Security Admin.	Sicherheitstechniker/in	Appr.+WB	3,4,5
Operation			
Application & System support	Wmsystementwickler/in	Appr.+WB	2,3,4,5
	& ICT Kundenbetreuer/in	Appr.+WB	
ICT operations	ICT-Systemadministrator/in	Appr.+WB	1,2,3,4,5
Database administration	Datenbankadministrator/in	Appr.+WB	3,4,5
Service level control	ICT-Qualitatssicherung	Appr.+WB	2,3,4,5,6
User support			
Network admin. & support	Netzwerkadministrator/in	Appr.+WB	2,3,4
User support	Anwendungssystemadmin	Appr.+WB	1,2,3,4,5
User			
Business-IS alignment	Geprufter Wirtsschaftsinformatiker	MSc.(Eng)	5,6,7
Information Handling	Wmsystementwickler/in	Appr+WB	1,2,3,,4,5
Use of ICT			

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