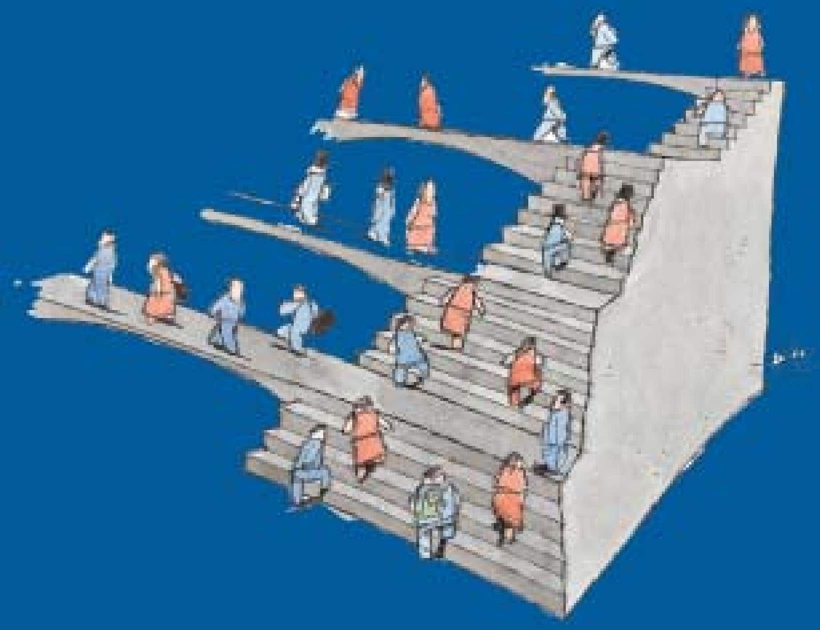
PUBLICATIONS OF THE ACADEMY OF FINLAND 5/03

PhDs in Finland: Employment, Placement and Demand



Academy of Finland

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PhDs in Finland: Employment, Placement and Demand

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1.1 Background

High quality research grounded in a strong foundation of knowledge and know-how is a major asset that is crucial for national competitiveness. Finland's national research system and the growing trends of internationalisation, most particularly the project to build a European Research Area (ERA), both require high-quality experts. The EU Commission has also drawn attention to the adequacy of human resources, to the need to raise educational standards and to the benefits of harmonised degree systems. In Finland, the review published by the Science and Technology Policy Council in December 2002 says that the national development challenge for Finland is to increase research and innovation funding with a view to accelerating the internationalisation of the innovation system and to further developing innovation. There are three main targets: 1) to develop education and career prospects in research and to inceare broad-based research knowledge; 2) to strengthen social and technological innovation; and 3) to develop innovation funding flexibly and expertly.

Responding to the need for information to support decision-making in education and science policy, this survey provides an overview of the employment and placement of PhDs in different fields of study. It has its background in the recent debate on the increasing number of doctoral degrees awarded and in growing concerns about stiffening competition and the declining prospects of PhD placement. In studying the employment and placement of PhDs it is important to recognise that this is a highly heterogeneous group of people whose main common denominator is their level of education. Do PhDs get jobs that are compatible with their education? How do graduates from different fields of study differ in terms of employment and placement? If the numbers with doctoral degrees continue to rise, what kinds of future trends can we expect to see with regard to their employment and placement prospects?

Earlier surveys have shown that most PhDs are employed in the university sector. Looking ahead and trying to predict the future demand for PhDs in different sectors of society and to see what kind of degree structure would be the most sensible, the key questions that will provide the most valuable clues for purposes of policy decision-making are the identification of other sectors in which PhD graduates have been placed; the identification of the sectors in which PhD graduates might be placed; and the identification of the sectors that show future growth potential. These questions will draw our attention primarily to the non-university public sector and to the private business sector.

The increase in the number of PhDs and the demand for doctorates in our society also needs to be examined from the point of view of the general employment situation and economic growth. All forecasts are that new jobs will be created in branches requiring high levels of expertise and know-how. How many PhDs can the public and the private sector job market accommodate? Have current PhD programmes been able adequately to satisfy demands in different fields; are there any branches that are looking at a shortage of people with the necessary skills and qualifications?

1.2 Implementation

In a letter dated 12 March 2002, the Ministry of Education requested the Academy of Finland to compile an estimate of the demand for PhDs in different fields of research and to conduct a survey of the placement of PhD graduates. For purposes of conducting this work, the Academy of Finland appointed on 31 May 2002 a steering group consisting of representatives of the Academy's Research Councils and other interest groups. The steering group has been chaired by Professor Riitta Keiski, Research Council for Natural Sciences and Engineering. Its Vice Chair has been Secretary General Liisa Savunen, Academy of Finland; and its other members Risto Andberg, Senior Advisor, Academy of Finland; Anne Heinänen, Senior Advisor, Academy of Finland; Vesa-Matti Lahti, Research Director, Finnish National Fund for Research and Development Sitra; Professor Erno Lehtinen, Research Council for Culture and Society; Annamaija Lehvo, Senior Advisor, Academy of Finland; Heikki Liede, Secretary for Education and Labour Policy, Akava, the Confederation of Unions for Academic Professionals in Finland; Professor Markku Löytönen, Research Council for Biosciences and Environment; Professor Marja Makarow, Research Council for Health; Ari Mikkelä, Senior Technology Advisor, National Technology Agency Tekes; Marja Pulkkinen, Counsellor for Education, Ministry of Education; Director Kari Purhonen, Confederation of Finnish Industry and Employers; and the steering group secretary (until 31 Jan 2003) was Kustaa Multamäki, Senior Advisor, Academy of Finland. Survey planning and preparation of the report was the responsibility of Liisa Savunen.

There is no shortage of information about the completion of doctoral degrees or about PhD employment and placement in Finland, but that information is scattered across different databases and statistics. The reliability and comparability of the materials available also leave much to be desired.

Maintained by the Ministry of Education, the Kota database provides basic information on degrees awarded by fields of study (with breakdowns by gender as from 1989), on university staff and on researcher mobility. Some information is also available on graduate employment and placement. The data on employment are largely derived from Statistics Finland's employment statistics and workforce statistics maintained by the Ministry of Labour; the figures for graduate placement are based upon Statistics Finland's employment statistics. A separate dataset was compiled jointly by the Academy of Finland and Statistics Finland using person level data from different statistical areas. The material is based on figures from the employment statistics complemented with data from the degrees and students registers. This dataset is based on a major ongoing survey on PhD placement and mobility in the labour market (see Husso 2002).

Two interview studies were conducted during the course of the survey. Taloustutkimus Oy was commissioned to measure the willingness of employers in the private sector, in the public sector and in public administration in particular to recruit PhD graduates. The interviews covered four main target groups: 1) large, medium-sized and small enterprises (net sample size 952); 2) major corporations with their own research departments (100); 3) ministries, government agencies and university cities (38); and 4) government research institutes (50). Separate questionnaires were developed for each target group, taking account of their distinctive features. Respondents were asked to indicate their need for people with PhDs at the present time and in five years' time, i.e. in 2007. A total of 1,140 telephone interviews were conducted in autumn 2002.

In order to gain an overview of the employment and placement situation among people who had completed their doctorate, the Academy joined forces with Statistics Finland to interview all persons in Finland who graduated with a PhD in 2000. The data were collected in November 2002: 830 persons out of the total sample of 1,031 were contacted and interviewed, giving a response rate of 80.5 per cent. According to Statistics Finland's non-response analysis, the respondents were highly representative of the population in terms of their gender, age and discipline. The most common reason for non-response was failure to contact the person.

Data compiled by universities on graduate employment and placement were used in the survey as background material. Some university faculties and departments have also compiled their own reports on the placement of their graduates.

The overall volume of and need for extension studies has long received attention. During the past 20 years large numbers of surveys, reports and other documents have been published on the volume and needs for researcher training (e.g. Barros 1980; Räty 1983; Pimiä 1989; Tutkijanuran kehittämisryhmän muistio 1997; Arasmo 1998). The recruitment and placement of PhDs most particularly in the private sector has also been surveyed (e.g. Välimaa 1998).

During the course of its work the steering group consulted the following experts: Kai Husso, Consulting Officer, European Commission; Professor Fred Karlsson, University of Helsinki; Professor Juhani Keinonen, Finnish Union of University Professors; Managing Director Anders Laurén, Biotech Job Partner Oy Ab; Kari Luukko, Research Manager, Finnish Forest Industries Federation; Anneli Manninen, Deputy Manager, Federation of Finnish Electrical and Electronics Industry; Minna Suutari, Senior Advisor, Akava, the Confederation of Unions for Academic Professionals in Finland; and Esko-Olavi Seppälä, Chief Planning Officer, Science and Technology Policy Council of Finland.

On 20 November, 2002, the Academy of Finland hosted a seminar on the challenges and opportunities of a professional career in research. One of the topics covered was the position of highly educated groups on today's labour market.

1 Trends in Science Policy

In 2000, Finland's R&D spending as a proportion of GDP was the second highest within the OECD group. The figure has shown consistent growth for some time; in the late 1990s the annual increase was the highest among all EU countries. In 1995, R&D spending accounted for 2.35 per cent of GDP, rising to 3.3 per cent in 2001.

Most of the growth is attributable to the private sector and specifically to the electrotechnical industry. The contribution of the public sector also increased in the late 1990s. Current figures indicate that in the past few years, this trend has come to a halt: since 1999, public sector investment in research has no longer been growing in Finland. In the private sector, however, R&D spending continues to grow. In 2001, the public sector accounted for 26.2 per cent of the R&D budget, while the figure for the private sector stood at 70.3 per cent – higher than the average for both the OECD (63.9%) and the EU (56.3%). Finland is the only EU member where business and industry accounted for a larger proportion of R&D than in the United States, and only slightly less than in Japan.

At the Barcelona Summit in March 2002, the EU countries agreed to set the target of raising R&D investment in all Member States to three per cent of GDP by the year 2010. The target was formulated against the backdrop of the Lisbon objective (March 2000) to make the European Union by 2010 "*the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion*". To date only two countries – Finland and Sweden – have exceeded the three per cent target level; the average for the EU in 2002 stood at 1.93 per cent.

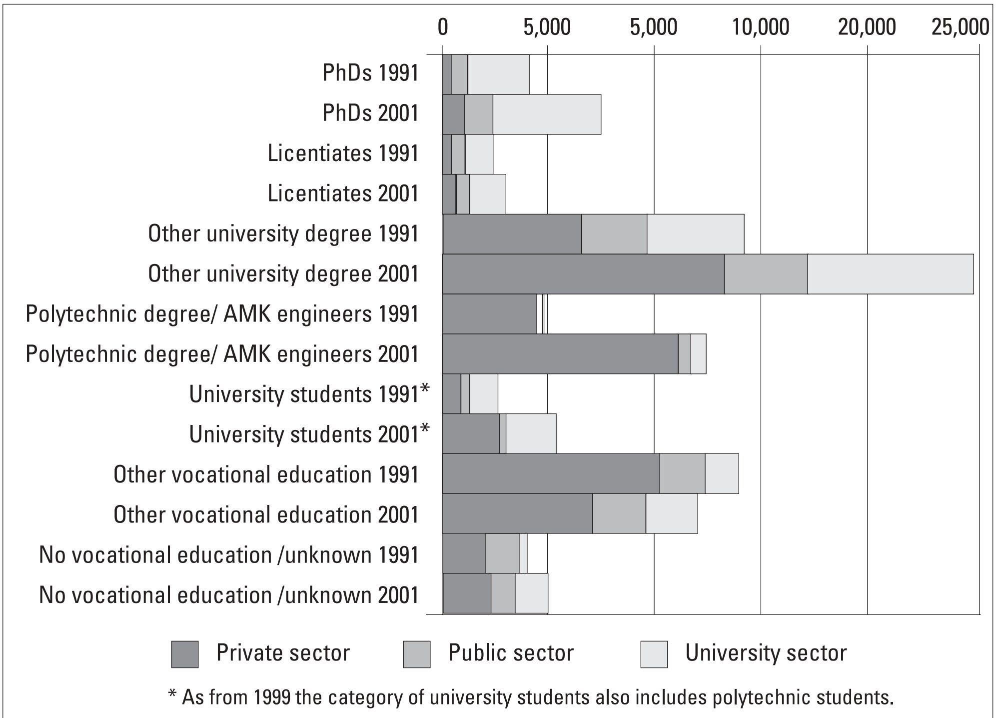
The sharp increase in Finland's R&D investment is partly explained by a government spending programme that in 1997-1999 brought an extra 250 million euros to public sector research investment compared to the original figure in the 1997 state budget. The programme was aimed at supporting the national innovation system and in this way at boosting the national economy, business and industry and employment in general. At the time the programme was launched, the target was set that public research investment should stand at 2.9 per cent of GDP by 1999. That target was reached and exceeded in 1998.

One-fifth or 20 per cent of the monies from the additional government funds went directly to universities, which also saw an increase in external funding. This was mainly in the form of fixed-term research project funding granted by the Academy of Finland and the National Technology Agency Tekes. In the evaluation of the government spending programme, Prihti et al. (2000) concluded that the increase in public spending had had a positive impact on private research investment as well. In addition, the programme created new jobs for highly educated groups, but not for people with less education.

Combined with these economic and structural investments in research, the pro-research climate in society led to a sharp increase in the numbers working in research and development in the 1990s. Over the ten-year period from 1991 through to 2001, the numbers employed in research and development increased by more than 50 per cent from 46,181 to 69,788 (Figure 1). At the same time the research staff in the university sector almost doubled in size. Over half of all the people working in research were engaged in business and industry. The private sector's relative share of R&D staff remained unchanged over this period, but the number of R&D staff in companies went up by 53 per cent. In 2001, women accounted for less than one-third of the total research personnel: they numbered 22,580. In the public sector and in the university sector, women accounted for over 40 per cent of the research staff, in business and industry for no more than one-fifth.

The number of people with a PhD as a proportion of R&D staff increased during the 1990s, but in relative terms there have been no major changes since 1993. At that point the number of people with a PhD as a proportion of R&D staff rose from 8.8 per cent in 1991 to 10.5 per cent. In 2001, a total of 7,441 research jobs were occupied by people with a PhD. People with training ranging from basic education to at maximum a higher academic degree continue to account for the bulk of all research and development work.

Figure 1. R&D staff by education in different sectors in 1991 and 2001.
Source: Statistics Finland



In 2001, over 60 per cent of R&D staff who had a PhD worked in universities. The number of R&D staff with a PhD outside the university sector was 2,854, or twice the annual number of doctorates completed. Both the absolute number of people with a PhD and their proportion of R&D staff in private sector companies has increased. In 1991 business companies had 452 PhDs on their payrolls, representing 11 per cent of all PhDs in R&D. The figures in 2001 were 1,030 and 14%, respectively.

According to the European Commission's Key Figures 2002, Finland had the highest proportion of researchers per thousand labour force in the OECD (13.1 in 2000), followed by Japan, Sweden and the United States. The average proportion for EU countries was 5.4. Since 1995 the figures have shown the strongest growth in Greece, Finland, Ireland and Spain: in all these countries the growth rates have gone up by more than 10 per cent, while the EU average is around three per cent. The number of women as a proportion of researchers ranges from 19 and 43 per cent; the figure in Finland is 29 per cent.

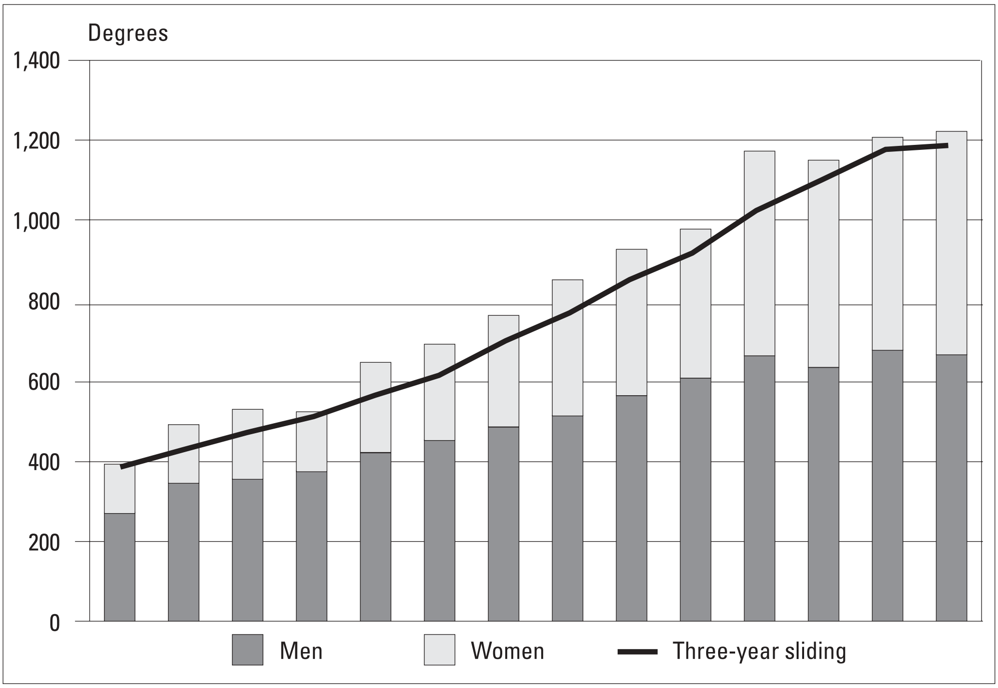
In 2000, the number of new doctorates completed per thousand of the population aged between 25 and 34 in Finland was the second highest in the European Union. Sweden's ratio per 1,000 population aged 25-34 was 1.2, Finland's 1.1, and the EU average was 0.56. From 1999 to 2000, the number of doctorates showed the largest increase in Portugal (14%), followed by Finland (9.76%) and Greece (9.09%). In all EU countries the average increase in the number of doctorates awarded was 1.5 per cent.

The number of doctorates increased sharply in Finland during the 1990s. In 1989 the number of new doctorates awarded stood at 402, by 2002 it had soared to 1,224 (Figure 2). Women now account for a much larger share of PhD graduates than ten years ago. In 2002, women accounted for almost 46 per cent of all PhD graduates. The number of degrees completed by women increased by 300 per cent from 1989 to 2001, for men the increase was 150 per cent.

Over the past three years the number of doctoral degrees has no longer shown any substantial growth. During the period from 1989 to 2002, a total of 11,577 persons earned a doctorate; at the same time 142,119 higher academic degrees were completed. This increase in the number of degrees ties in with the various university and science policy reforms carried out in the 1990s, most notably the increase in public research spending, the introduction of management by results in universities and the launch of the graduate school system.

The biggest structural change in researcher training took place in 1994 when the Ministry of Education decided to create the graduate school system. The underlying goals of the reform were to promote more systematic and higher quality researcher training, to reduce the amount of time required by the completion of postgraduate studies, and by the same token to lower the average age of graduating PhDs. The first four-year graduate schools were introduced at the beginning of 1995. The funds for their operation were secured in the second supplementary budget for 1994, which was motivated by a programme aimed at reducing the problem of youth unemployment in the early 1990s. The government spending programme for 1997-1999 included an additional appropriation of around 20 million euros for purposes of developing and expanding the operation of graduate schools and for the start-up of new graduate schools. In line with government policy, this appropriation was earmarked primarily for engineering studies, natural sciences and fields of study

Figure 2. PhD degrees awarded in 1989-2002.
Source: Kota database



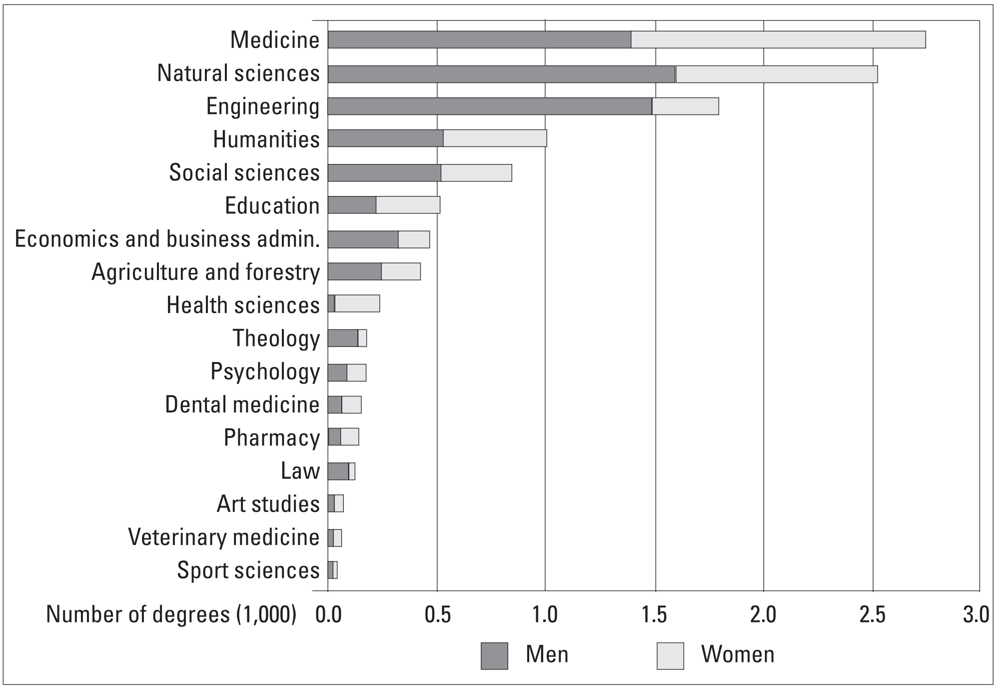
important for the development of knowledge intensive business. The funds were allocated to establish 12 new graduate schools at the beginning of 1998 and to expand the operations of 31 schools that had had started up earlier. A total of 267 new student places were created within the graduate school system.

At the beginning of 2003 there were in Finland a total of 114 graduate schools with 1,426 student places funded by the Ministry of Education. In addition, it is estimated that a further 2,500 or so students are researching their doctoral thesis at graduate schools with funding from other sources, such as private foundations. A clear indication of the intense interest in postgraduate studies is that the number of applicants to vacant student places clearly exceeds the number of places available: on average the ratio is around five to one, in technical fields four to one.

Since 1994 the Ministry of Education has supervised and monitored the performance of universities through agreements on target outcomes: the purpose of the system is to link appropriations with performance. The targets are defined for a three-year term at a time. The agreement for 2001-2003 specifies quantitative targets for higher academic degrees, doctoral degrees, international student exchange, the number of full-year student places in open university education and for the numbers proceeding through the avenue of open university education to studies leading to academic degrees. The development plan for education and university research 1996-2000 adopted by the government on 21 December 1995 set the target of 800 new PhDs during this period. The development plan adopted on 29 December 1999 revised the target upwards to 1,400 degrees by 2004.

The number of doctorates awarded has increased in all fields of study. In this regard it is possible to make a distinction between three fields of study, i.e. large, medium-sized and small (Figure 3). Medical fields accounted for 23.7 per cent of all PhD degrees awarded in 1989-2002; the natural sciences accounted for 21.8 per cent; and engineering sciences for 15.5 per cent. Together, these three major fields accounted for almost 61 per cent of all PhD degrees during this period. The intermediate category (humanities, social sciences, education, economics and business administration, agriculture and forestry) accounted for 28 per cent and the smallest fields of study (health sciences, psychology, dentistry, pharmacy, law, the arts, veterinary science and sport sciences) for 11 per cent.

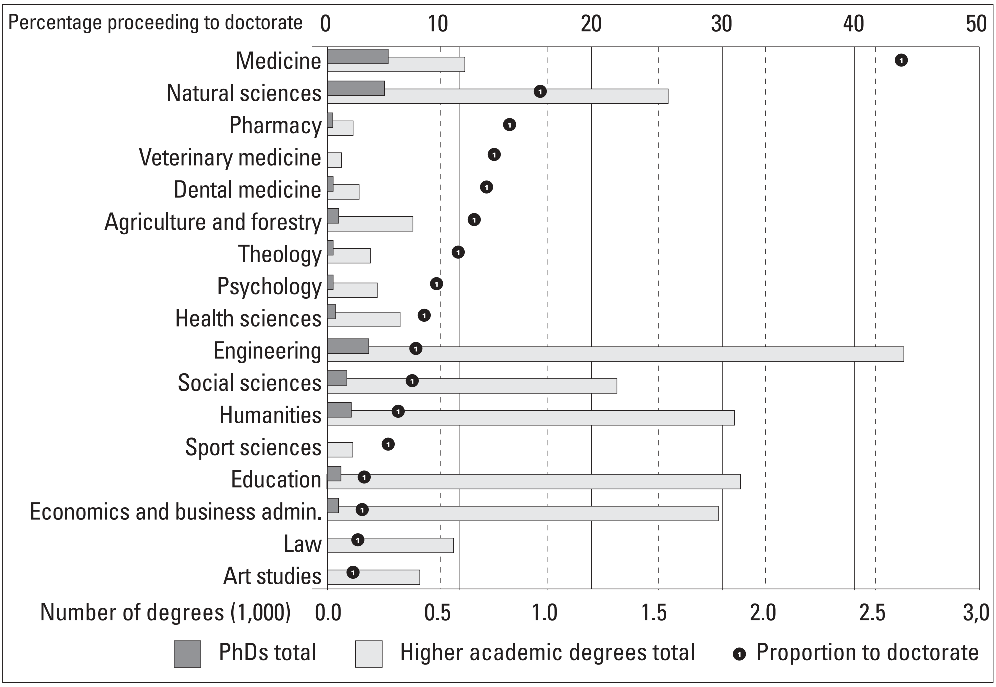
Figure 3. PhD degrees awarded by field of study and gender, total in 1989-2002.
Source: Kota database



Women accounted for at least 40 per cent of the PhDs awarded in each field of study with the exception of the natural sciences, engineering sciences, social sciences, economics and business administration, law and theology. Although there is some annual fluctuation, in the longer term the proportion of women among PhD graduates has grown in each field of study. For example, in 1989 women accounted for 10.6 per cent of PhD degrees awarded in engineering sciences, by 2002 the figure had risen to 21.6 per cent.

The increase in the number of PhD degrees in different fields of study can be studied both in absolute terms and in terms of the number of degrees completed in each field of study as a proportion of the total. A comparison of the number of degrees awarded in different fields of study in 1989 and 2002 shows strong growth for the humanities, education, economics and business administration and engineering sciences. An examination of absolute figures based on three-year sliding means indicates that education, natural sciences, law and engineering are currently on a growth track. Looking then at the figures for different fields of study as a proportion of the PhDs awarded each year, it seems that in spite of the growth recorded in overall numbers, the share of the humanities, economics and business administration and medical fields of study is declining, whereas that of education, natural sciences, law, health sciences and social sciences is on the increase.

Figure 4. Ratio of higher academic degrees to PhDs in 1989-2002 and proportions proceeding to take the doctorate by field of study.
Source: Kota database



Relative to the number of higher academic degrees awarded, the field of study with the highest proportions proceeding to take the doctorate is medicine: almost 45 per cent of those who have completed a higher academic degree proceed to the doctorate (Figure 4). Medicine has traditionally shown the highest figures in this comparison. The doctorate in medicine may well be described as a professional degree where formal level of education has a major influence upon labour market placement. The number of higher academic degrees completed in engineering fields was four times higher than in medicine, but only in one fifteen proceeded to the doctorate.

3 Avenues to the PhD

The graduate school system was set up in 1994 with a view to promoting more systematic and higher quality researcher training, to reducing the amount of time required by completion of the doctorate and lowering the average age of graduating PhDs, improving cooperation among research teams and increasing international cooperation in education and research. With this system now fully effective, the funding of studies leading to the doctorate as well as avenues to the PhD are changing: full-time postgraduate student places are gradually emerging as a major avenue to the PhD. In 2003, 13 graduate schools are active in the field of biosciences and the environment, with a total of 217 postgraduate student places (15.2%); the figures for culture are society are 40 graduate schools and 346 student places (24.3%); for medicine and health sciences 16 graduate schools and 245 student places (17.2%); and for natural sciences and engineering 45 graduate schools and 618 postgraduate student places (43.3%). Most graduate schools are network schools under one department or several departments/universities. Network schools are either multidisciplinary or they specialise in one discipline. All in all some 320 postgraduate student places are aimed at information industry branches, and roughly the same number at biotechnology branches.

Apart from graduate schools, other major avenues to the PhD in Finland are the postgraduate student places offered by universities and research institutes, project funding provided by the Academy of Finland and support from private foundations. It is considered important that in the future, people looking to proceed to the PhD will continue to have a diversity of options apart from that of graduate schools, and that special attention is given to the provision of further training for people in active employment.

Doctoral students usually get their funding from various different sources. An interview study by Statistics Finland showed that of those doctorated in 2000, 41 per cent of PhD graduates had held a university position, 23 per cent had received funding from a research institute and 21 per cent had received project funding through the Academy of Finland. One-third of the interviewees had at some stage of their studies leading to the doctorate occupied a graduate school place with funding from the Ministry of Education, a university or the Academy of Finland. Industry had funded 10 per cent of all PhD graduates. Close on 10 per cent of all PhD graduates had received funding through the EU or an international exchange programme.

Private foundations represented a significant source of funding. Almost 70 per cent of PhDs in 2000 had received scholarships at some stage of their studies. Three-quarters had also received funding from sources other than those identified above (e.g. ministries, inheritance, support from family, unemployment allowance).

In 1999 over half or 55 per cent of PhDs were primarily employed in the university sector two years before graduation, while 45 per cent were employed outside of universities, for instance in local government (13%), private businesses (8.5%), government research institutes (6.5%), etc. Examined by main disciplines, the largest number of the doctorates researched in universities and research institutes were in the natural sciences; in local government in medicine and nursing science; in central government in the social sciences; and in the business sector in engineering and technology (see Husso 2002).

In recent years there has been a conscious effort to try and reduce the amount of time required by completion of the doctorate. When the graduate school system was created in 1995, one of the specific objectives was to reduce the amount of time that people spend researching their thesis and in this way to lower the average age of newly graduated PhDs. In 2000, 60 per cent of new PhD graduates took less than four years in full-time work to complete the degree, 20 per cent spent four-five years and 20 per cent at least five years. Students in education and in health and social services spent the least time completing the doctorate measured in terms of full-time work. The picture is different when we take into account the amount of time taken to complete the PhD on both a full-time and a part-time basis. In this case more than 12 per cent of PhD graduates took less than four years to complete the doctorate, almost 17 per cent spent less than five years and 70 per cent more than five years researching their PhD. Women took slightly more time to complete their doctorate than men did. The fields where PhD graduates took the most time to complete their doctorate were agriculture and forestry, the humanities and arts as well as the health and social services field, where 75-82 per cent of PhDs took more than five years to complete their studies.

The age range of people taking their PhD each year is wide indeed. In 2000, for instance, 16.5 per cent of PhD graduates were under 30, while graduates aged 30-34 accounted for more than one-quarter of the total. The oldest age group of PhD graduates aged over 45 accounted for 18.5 per cent.

It would seem that PhD graduates from graduate schools complete their studies at a younger age than do graduates from outside the graduate school system. According to a survey conducted among graduate schools in 2000, a total of more than 900 PhDs graduated during the first four-year term. Around 30 per cent of PhDs graduating from graduate schools took the doctorate before age 30. The average age of graduating PhDs was 32.4 years, for women 33.5 years and for men 31.7 years. The average age at which graduate school students are awarded their PhD is probably influenced by the predominance of the natural sciences as well as engineering and technology in these schools. In addition, recruitment into graduate schools usually takes place relatively soon after completion of the first degree.

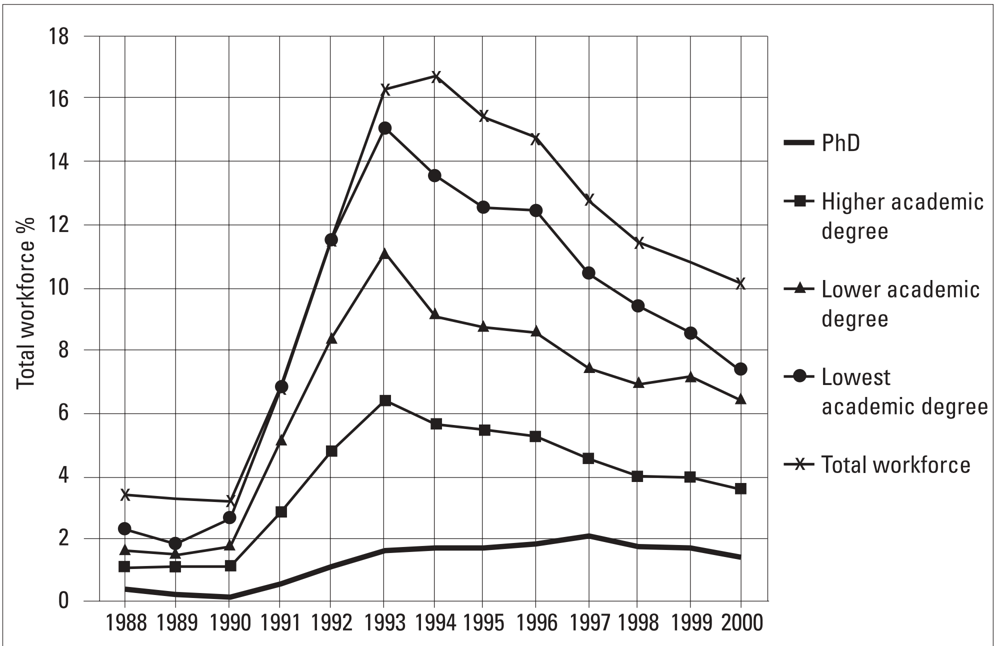
Figures compiled by Statistics Finland on educational institutions indicate that in 2001, the average age of PhD graduates from universities was 36.3 years. The figure varies by field of study: in the natural sciences the doctorate was completed at age 35-36, in the social sciences and the humanities on average at over 40. However, within these disciplines there are considerable differences between individual fields of study: for instance, the average age of PhD graduates in economics and business administration was 35.4 years, in education 44.2 years.

4 Employment and Placement of PhDs

4.1 Employment of PhDs

Statistics Finland's employment statistics show that in 1987-1999, the unemployment rate among PhDs was markedly lower than in the whole population. PhD unemployment increased during the economic recession of the 1990s, peaking in 1997 (Figure 5). The unemployment rate seems to correlate directly with level of education, and in an international comparison Finland has one of the lowest figures for PhD unemployment (around 1.5% in 2000).

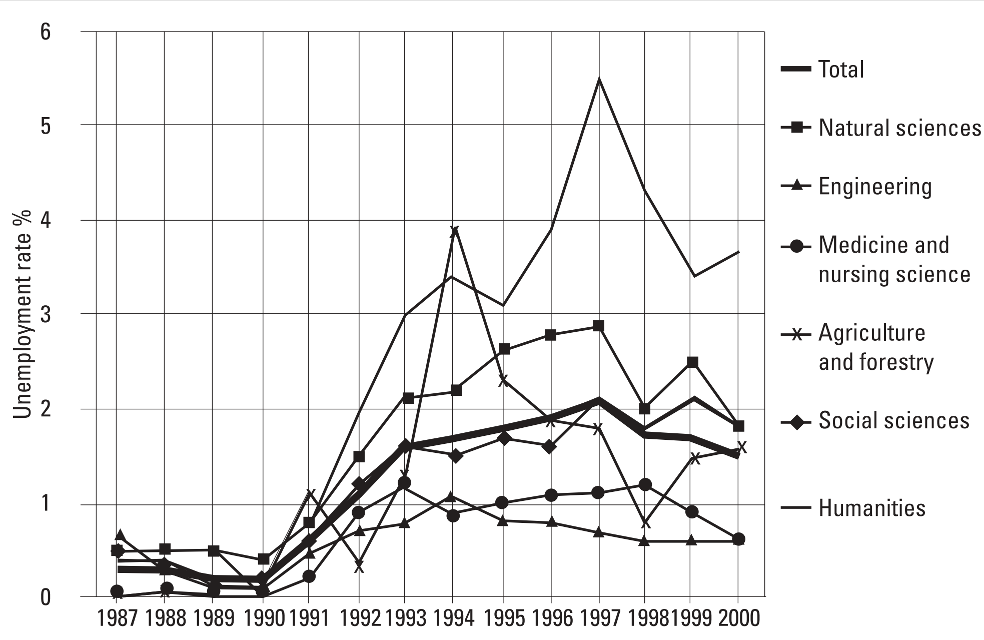
Figure 5. Unemployment by level of education in 1988-2000.
Source: Husso 2002



PhDs also seem to differ from other educational level groups in terms of their labour market behaviour. The labour markets of PhDs are less dependent on business cycles and fluctuations than is the case for the rest of the workforce. This is due in part to the fact that the majority of PhDs work in the public sector.

In 1988-2000, PhD unemployment was lowest in engineering fields, in medicine and nursing science, and highest in arts fields and the humanities (Figure 6). Overall PhD unemployment was highest in 1997, when the figure stood at 2.1 per cent. For PhDs in the humanities, the figure that year was 5.5 per cent, whereas in engineering fields it was 0.7 per cent. Unemployment in engineering fields peaked a few years previously, in 1994 at 1.1 per cent. Since 1997, unemployment dropped in all main disciplines. Compared to the peak figures of 1997, the jobless rate among humanities graduates declined by almost two percentage points by 2000. In engineering sciences the figures remained effectively unchanged. In 2000, 1.5 per

Figure 6. PhD unemployment rate in 1987-2000, total and by main discipline.
Source: Husso 2002

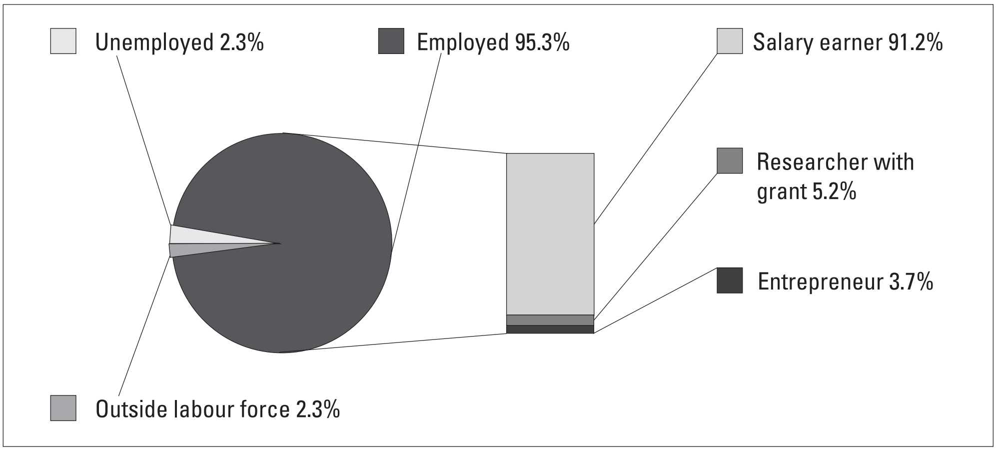


cent of all PhDs were out of work. Unemployment continued to vary between main disciplines, standing at 3.7 per cent in the humanities, 1.9 per cent in the social sciences, 1.8 per cent in the natural sciences, 0.6 per cent in engineering and 0.6 per cent in medicine and nursing science.

The average unemployment rate among women PhDs was consistently higher than among men PhDs throughout the 1990s. This was apparently due to differences in how women and men PhDs are represented in different fields of study. There is some difference in the unemployment rate of men and women in different fields of study. Throughout the period under review women's unemployment rate was lowest in engineering and highest in the humanities.

According to Statistics Finland's interview study, 95.3 per cent of PhDs who graduated in 2000 were employed two years later (Figure 7). Among those in gainful employment, 91.2 per cent were wage earners, 5.2 per cent were researchers with a grant and 3.7 per cent entrepreneurs or self-employed. The figures for those out of work as well as those outside the workforce were 2.3 per cent. Although no more than 2.3 per cent of all respondents were out of work (19 persons), a much larger proportion had had experiences of unemployment since their graduation (6.5%, 54 persons). For one half, the amount of time they had been out of work was less than six months and for 81.5 per cent less than 12 months. Five respondents (0.6% of all respondents and 9.3% of those with experiences of unemployment) had been out of work for more than two years. It would seem that unemployment is equally common in men and women. In 2000 a total of 1.7 per cent of women PhDs were unemployed at the time of the interview. Unemployment was highest in the humanities (3.1%) and lowest in medicine and nursing science (1%).

Figure 7. Principal activity in November 2002 of PhDs graduating in 2000. *Source: Statistics Finland interview survey*



Although unemployment among PhDs graduating in 2000 was low, it seems that many doctorates have had to content themselves with fixed-term employment. Among PhDs who graduated in 2000, 60 per cent had a permanent job contract, while 40 per cent were in non-permanent jobs. In the public sector permanent and non-permanent contracts were almost equally common. Fixed-term contracts were most typical among PhDs working in universities, less so among people in the employ of private companies. The private sector accounted for 25.5 per cent of all job contracts, but 95 per cent of all contracts in the private sector were permanent. The numbers describing the proportion of people with permanent and non-permanent contracts are explained by the fact that most of the PhDs engaged in the public sector were hired as researchers at universities, where research-related job contracts often are made on a temporary basis because the funding available is also for a fixed term.

Men PhDs had a permanent contract (64%) somewhat more often than women PhDs (58%). The proportion of permanent job contracts was highest in agriculture and forestry, where the figure was 70.3 per cent: this field was followed by engineering (67.3%), education (66.7%) and health and social welfare (62.6%). However, in the humanities the proportion of permanent job contracts is over 50 per cent.

Universities have also commissioned their own studies on the placement of PhD graduates. A survey at the University of Helsinki indicated that over 93 per cent of those who graduated with a PhD in 1997 were in gainful employment in the autumn of 2000, while 0.6 per cent were registered with the labour authorities as unemployed. Figures released by the University of Jyväskylä indicated that 1.8 per cent of all those who graduated from the university with a PhD in 1996-2000 were out of work and seeking employment in autumn 2001. In Tampere, 1.9 per cent of the PhDs who took part in the survey said they were out of work. In Oulu, 1.1 per cent of those graduating in 1997-2000 were unemployed.

Most PhDs have found employment that is compatible with their qualifications. When PhDs who had graduated in 2000 were asked whether they thought their current job was compatible with their training, almost 95 per cent said their current job was at least reasonably compatible with their training and almost 66 per cent said their job was very compatible with their qualifications. Men (55%) slightly outnumbered women (45%) among those PhDs who felt their current job was highly compatible with their qualifications. By fields of study, people with a PhD in agriculture and forestry rated their job as somewhat more compatible and those with a PhD in education as somewhat less compatible than PhDs in other sectors. However, the differences between fields of study were not very great. People working in the public sector reported somewhat more often than those engaged in the private sector that their job was highly compatible with their level of education. Assessments of the compatibility of one's qualifications with the demands of the job may be dependent upon the formal skills requirements associated with the job. The general economic climate at the time of graduation and the overall unemployment rate will also have a major influence on whether or not graduates are successful in finding employment that is compatible with their qualifications.

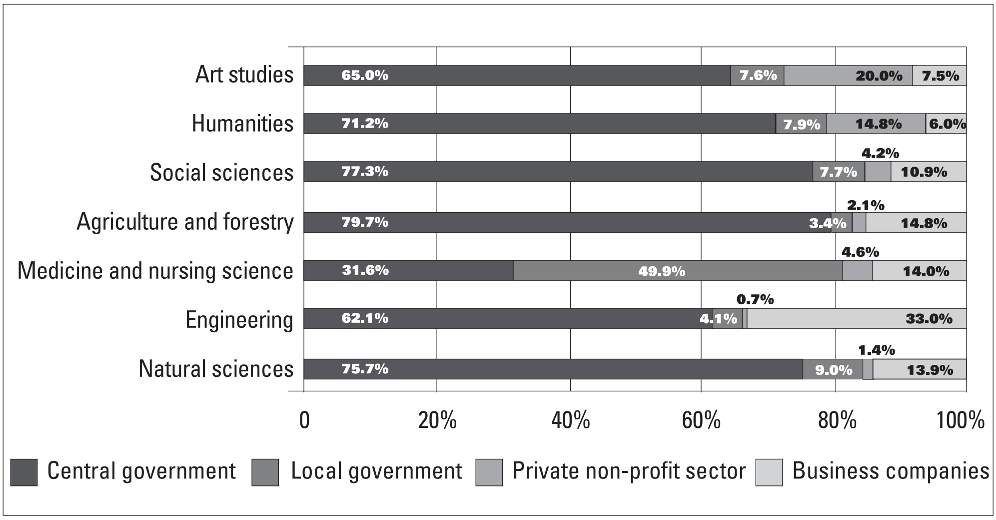
The gross earnings of PhDs graduating in 2000 varied according to the field of study and the employer sector. Two-fifths of all PhDs earned less than 3,000 € a month; 90 per cent of them were employed in the public sector. A small minority of 1.9 per cent had gross monthly earnings of over 7,000 €. Male PhDs earn more than their female colleagues. Among those earning less than 3,000 € a month, almost 60 per cent were women, while almost 70 per cent of those earning at least 4,000 € were men. Gross monthly incomes were lowest among humanities scholars and natural scientists, of whom almost 60 per cent were in the wage bracket under 3,000 € a month. Close on half or 44 per cent of the PhDs who earned at least 4,000 € a month had graduated in the health and social welfare sector.

4.2 Placement of PhDs

Long-term follow-up data indicate that PhD placement tends to concentrate in the public rather than the private sector. According to unpublished data compiled by the Academy of Finland (Husso 2002), 80 per cent of all these employed PhDs in 1999 (n=10,968) whose sector of employment is known, worked in central or local government, 4 per cent in the private non-profit sector and over 15 per cent in private business and industry. Over 70 per cent of the PhDs in central government worked in universities, while almost 80 per cent of those in local government worked in the health care sector (Figure 8).

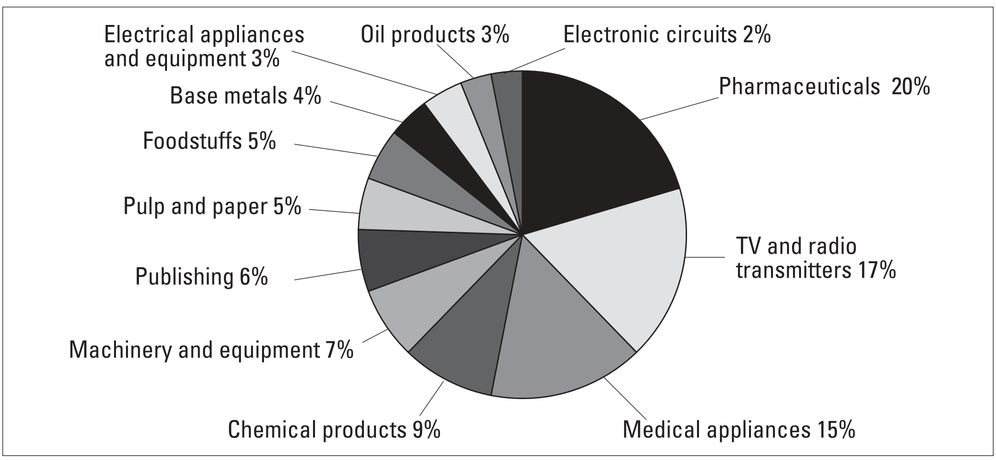
Two in three doctorates in the private sector were employed in services. In industrial manufacturing, the major employers of PhDs are high tech branches (e.g. pharmaceuticals, television and radio transmitters, electronic circuits), whereas the top service sector branches are represented by health care and business services (Figure 9). Industrial manufacturing mainly employed people

Figure 8. Employment of PhDs by field of study and industry in 1999 (n=10,968).
Source: Husso 2002



with a PhD in natural sciences and engineering: more than 70 per cent of all PhDs in industry represented these disciplines. In practice the only branch of industry that employed people with a PhD in the humanities was publishing. Social scientists were another group who found employment in publishing. Almost 80 per cent of all PhDs working in industry were men. Women with a PhD in medicine and nursing science were mainly recruited by the pharmaceuticals industry: almost half of all people with a PhD in this industry were women.

Figure 9. PhDs in the employ of business and industry in 1999 (n=577).
Source: Husso 2002



The picture of PhD placement is the same when we look at the placement of those graduating in 1997-1999. In this group 80 per cent were in the employ of local or central government two years after dissertation, i.e. in 1999: 75 per cent of men and 85 per cent of women. Sixteen per cent of all PhDs worked for private business and industry; 71 per cent of them were men, less than one-third women. Close on 40 per cent of people with a PhD in engineering were employed in business firms.

In 2002, almost 40 per cent of those PhDs who had graduated in 2000 were working at a university, either on the university's payroll or with Academy of Finland funding. Three per cent of them were engaged as senior teachers or lecturers at polytechnics. Almost 80 per cent worked in the public sector in the employ of central or local government, while 16 per cent were engaged in the private sector. All fields of study were more or less evenly represented among those PhDs who were working in the public sector, whereas people with a PhD in engineering were overrepresented among those recruited into the private sector: they accounted for one-third of all those employed in the private sector.

The results of a recent interview survey by Taloustutkimus Oy in one hundred major companies with their own R&D operations lend further support to the conclusion that PhD recruitment in the private sector is at a relatively low level. Half of these firms did not have a single PhD on their payroll. In those 51 companies that did have PhDs, 34 had 1-5 PhDs, six had 6-10 PhDs and 9 had more than 10 PhDs.

Linguistics PhDs in the job market

Fred Karlsson (1998, 2002) says that during the ten-year period from 1992 to 2001, the number of PhDs awarded in several fields of linguistics was at least twice as high as during the previous period from 1982 to 1991. From 1997 through to 2001, a total of 175 dissertations were completed, marking an increase of almost 100 per cent on the previous five-year period. Over the past 20 years the median age at graduation has been around 40 years, the mean 42 years. In recent years the median for women has been 40 years and for men 41 years.

At year-end 2002 there were 436 linguistics PhDs in the Finnish labour market. Two of them were aged under 30, around 100 were aged 40 or under. Among these 436 linguistics PhDs, over 200 will be retiring in 2003-2015, leaving an estimated 250 PhDs in the labour market in 2015. If during the period from 2003 to 2015 an average of 40 PhDs graduate each year, the number of new PhD graduates would stand at 520; consequently the total number of PhDs in the job market in 2015 would be around 670.

PhDs graduating today are expected to show other than just the competencies required by a traditional university career. In this regard new business concepts emerging at the interface between so-called hard and soft disciplines are of particular interest. A significant development in linguistics during the 1992-2001 term has been strong growth of new applied fields of study, including applied linguistics, English translation and interpretation, logopedics, speech

communication, language technology and Russian translation and interpretation.

Karlsson, Fred 2002. Kielitieteiden tohtorinväitöskirjat Suomessa 1992-2001: määrällisiä trendejä [Doctoral theses in linguistics in Finland 1992-2001: quantitative trends]. Memorandum 22 October 2002 and paper presented at the Academy of Finland 11 December 2002.

Karlsson, Fred 1998. Kielitieteiden väitöskirjat Suomessa 1840-1997 [Doctoral theses in linguistics in Finland 1840-1997]. Helsingin yliopiston yleisen kielitieteen laitoksen julkaisuja 29. [Publications of the University of Helsinki Department of General Linguistics.] Helsinki.

5 Demand for PhDs

If the number of PhDs awarded each year remains at its present level, a total of almost 12,000 new PhDs will graduate during the first decade of the 21st century; by 2015, the figure will have grown to almost 18,000. The Ministry of Labour has sought to forecast the changing patterns of labour demand resulting from the changes in the industrial structure, changes in occupational structures, the declining size of age cohorts entering the labour market and the exit of the babyboom generation. On the other hand, future trends in employment are closely dependent on economic growth, which is expected to slow down in the longer term. It is difficult to predict the net impacts of these changes on the future employment of PhDs, because the forecasts are based on analyses not of level of education but occupational groups (Table 1). The Ministry of Labour expects to see the number of new job vacancies peak around the turn of the decade with an increase in the demand for labour and large numbers exiting the labour market. The people leaving the labour market have a lower level of education than those entering the labour market.

Table 1: New job vacancies.
Source: Labour 2020 final report

		Base scenario			**Competence and employment scenario**		
	Employed 2000	Change 2000-2015	Attrition	New job vacancies	Change 2000-2015	Attrition	New job vacancies
Occupational group							
Agriculture and forestry	99,600	–24,800	50,900	26,200	–22,000	50,900	28,900
Industrial production	408,200	–15,800	157,900	142,000	8,200	157,900	166,100
Construction	84,500	–5,600	40,200	34,600	2,700	40,200	42,900
Transport and communications	78,000	3,000	33,800	36,700	6,400	33,800	40,200
Production and communications expertise	186,700	61,400	68,800	130,200	91,700	68,800	160,500
Services	414,400	–3,300	152,700	149,400	1,900	152,700	154,500
Clerical work	231,400	–43,300	86,700	43,400	–43,600	86,700	43,100
Administrative and managerial expertise	156,100	69,800	60,300	130,200	90,200	60,300	150,600
Nursing	287,900	79,900	123,400	203,400	86,100	123,400	209,600
Teaching and culture	139,800	26,400	53,000	79,400	34,700	53,000	87,700
Public order and safety	36,600	4,500	15,800	20,200	4,600	15,800	20,400
Unknown	113,300	–92,500	50,500	–41,900	–93,300	50,500	–42,800
Total	2,236,500	59,700	894,000	953,800	167,600	894,000	1,061,700

The medium-range and long-term labour forecasts compiled by the Ministry of Labour include separate figures for the base scenario, on the one hand, and the competence and employment scenario, on the other (Table 1). The former option is based on relatively stable changes during the outlook period, with no dramatic deviations from earlier trends. The latter scenario involves stronger employment coupled with higher competencies. Occupational groups with higher competency requirements include those engaged in research and development work, positions of expertise as well as marketing. The Ministry outlook also predicts changes in the occupational structure, leading to an increase in various expert positions and to the growth of nursing and social care. Among the occupational groups that are expected to grow in the different scenarios are production and communications expertise, administrative and managerial expertise, nursing work and teaching and cultural work, which already showed strong growth in the latter half of the 1990s. The competency scenario is based on higher forecasts of annual growth. The changes in the occupational structure and the increasing qualification requirements underline the importance of training and education in ensuring a healthy labour market.

The Ministry outlook forecasts a continued increase in the proportion of aging employees in the public sector, whereas in the private sector the age distribution will be a more balanced. According to the Ministry of Labour the numbers exiting the active labour force by 2015 will be equivalent to 40 per cent of the total workforce in 2000. In the shorter term, i.e. by 2010, the corresponding proportion is close on 30 per cent of the total workforce in 2000. The numbers exiting the workforce vary across different occupational groups depending on their age structure, but the two categories affected most are agriculture and forestry as well as building and construction. PhD graduates are found in at least four occupational groups: production and communications expertise, administrative and managerial expertise, nursing work and teaching and cultural work.

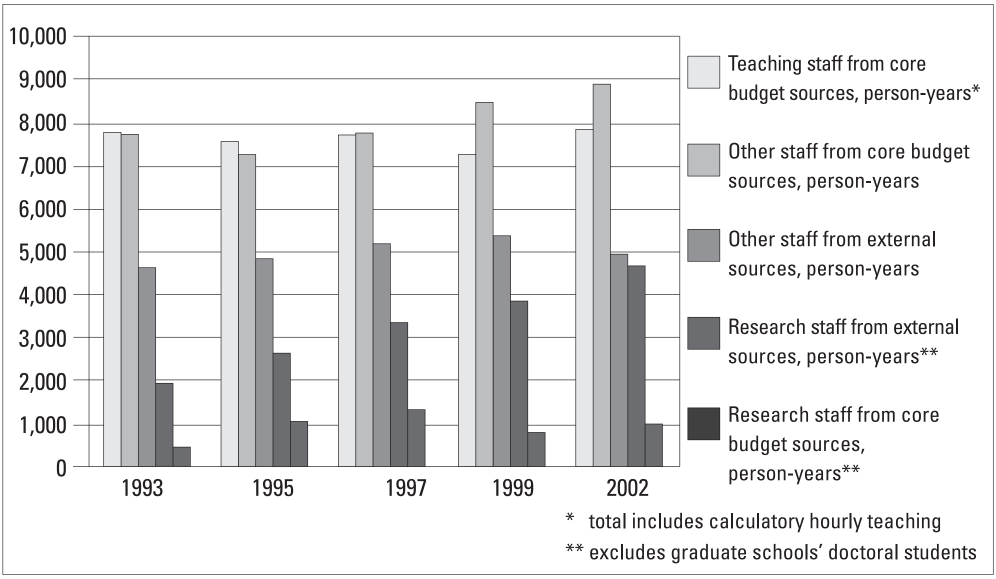
In the 1999 workforce there were a total of some 11,000 PhDs; the figure is higher still if we include those outside the active workforce. By 2015, some 4,400 PhDs will be exiting the workforce, by 2010 around 3,300. However, in an analysis of the labour market exit of PhDs we need to bear in mind that in older age groups in particular the proportion of PhDs is smaller than in younger age groups, which means that the impacts of PhD exit will probably be greatest in the latter third of the outlook period, i.e. from 2010 to 2015. On the other hand, since PhDs are traditionally employed in the public sector, this will no doubt be clearly seen in trends in labour demand within this sector.

5.1 Universities

Most PhDs work in the public sector, where universities are traditionally the biggest employers of PhDs. On average, PhDs account for close on 25 per cent of university staff. The figures vary. For example, at universities of technology the share of PhDs is between 11 and 15 per cent. Women account on average for some 30 per cent of the PhDs in the employ of universities; this figure is lowest in universities of technology.

The number of university teaching staff whose salaries are paid from core budget funds has remained more or less unchanged throughout the 1990s. By contrast the number of research staff with core budget and external funding has been increasing (Figure 10). The number of professors as a proportion of teaching staff increased by a few percentage points during the 1990s, reaching 28 per cent in 2002.

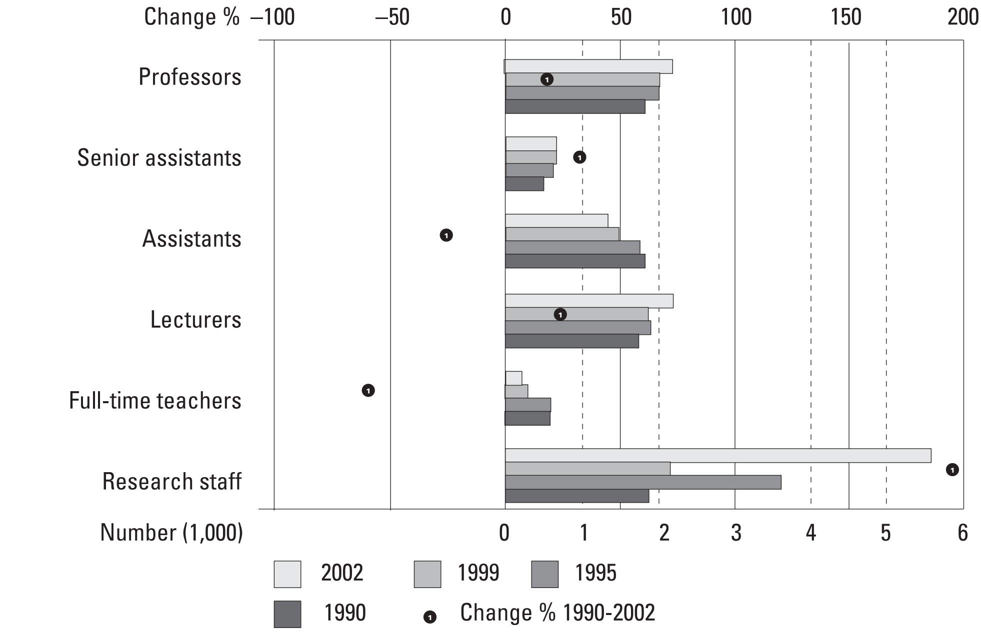
Figure 10. University staff by source of funding.
Source: Kota database



There have been marked changes during the 1990s in the composition of teaching staff whose salaries are paid from core budget funds (Figure 11). Since the downturn in the late 1990s, it seems that the number of professorships has begun to increase over the past three years. The number of assistants and full-time teachers began to drop in the early 1990s and the same trend has continued since. As for intermediate positions, there have been no major changes in the number of senior assistants over the past three years, but in the longer term the number of these posts has been rising. The number of lecturers showed strong growth especially towards the end of the 1990s. The universities of Helsinki and Turku have both moved to reform the structure of their teaching and research posts (and other universities around the country have plans to carry out similar reforms), which will increase the number of intermediate posts funded from core budget sources and/or these posts will become more clearly profiled as postdoctoral positions. At the University of Helsinki the reform has been carried out by changing postgraduate positions into postdoctoral posts; in practice the opening of one post for a research lecturer has meant closing down two posts for assistants.

Newly graduated PhDs have been recruited into universities primarily with external project funding allocated on a fixed term basis. The demand for PhDs in universities and the career paths of PhDs are dependent on several different factors, such as the development of funding for universities, changes in the structure of teaching and research posts and funding, as well as the retirement of the babyboom generation.

Figure 11. Changes in the structure of university posts.
Source: Kota database



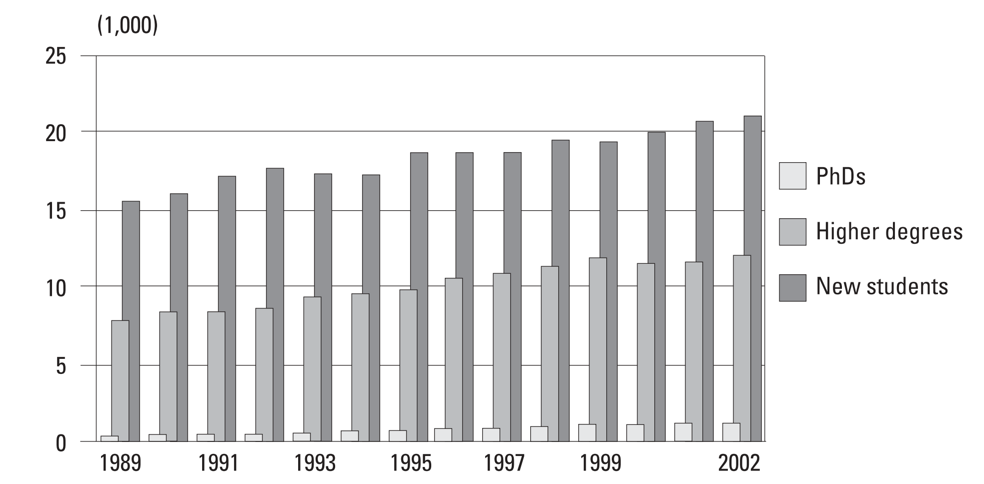
* Research staff includes people funded from core budget and external sources.
People working at graduate schools are not included in research staff.

Universities need PhDs first and foremost for teaching and research positions. With the growing absolute number of university students, the student to teacher ratio has also grown steadily throughout the 1990s. The number of degrees awarded has also increased (Figure 12). The future development of the student to teacher ratio is entirely dependent on the funding made available to universities. A further question that must be addressed is the need for PhDs in other than teaching and research posts and the justification of increasing the number of such people.

If there is no increase in the amount of core budget funding made available to universities, it is unlikely there will be any significant improvement in the employment prospects of PhDs in university teaching positions. Most graduating PhDs will probably be recruited into universities with external project funding, and the volume of that funding will in turn largely depend on economic trends more generally. The volume of external funding currently represents around 60 per cent of universities' core budget funding.

The limited opportunities of the university sector to hire PhDs in the future will mainly affect those disciplines from which people traditionally have been recruited into the public sector and universities in particular. One such discipline is represented by the humanities, which is divided into several smaller fields of study whose needs are difficult to incorporate and take into account in science policy planning. New PhDs cannot necessarily content themselves with the traditional role

Figure 12. New students, higher academic degrees and PhDs in 1989-2002. *Source: Kota database.*



of university researcher, but they may well require a broader training for instance in business skills.

5.2 Polytechnics

PhDs account for a relatively small proportion of the staff of polytechnics. In 2002, polytechnics had a full-time teaching staff of 5,573 and 301 of them or 5.2 per cent had a PhD. Almost half of the teaching staff with a PhD or 45 per cent worked in the fields of engineering and transportation. Among full-time teachers 583 or 10.1 per cent were licentiates, 3,834 (66.4%) had a higher academic degree. Senior teachers numbered 942, accounting for 16.3 per cent of all full-time teachers at polytechnics, while the figures for lecturers were 3,318 (57.4%) and for other teachers 1,513 (26.2%). In the category of senior teachers 217 (23%) had a PhD, among lecturers 57 (1.7%) and among other teachers 27 (1.8%). Women accounted for 38.5 per cent of all senior teachers at polytechnics, for 62.9 per cent of lecturers and 52.7 of other teachers.

By field of study, the number of PhDs among the full-time teaching staff of polytechnics was highest in the humanities and education (9.5%) and in engineering and transport (8.5%). The smallest proportion of PhDs was recorded in tourism, catering and economics (0.7%).

The polytechnic with the highest proportion of PhDs on their teaching staff was the Evtek Institute of Technology (12%). In comparing individual polytechnics it is important to take into account both the field of study that they represent as well as the structure of their teaching and research posts. With some exceptions it seems that the number of teaching staff with a PhD is highest in polytechnics that are within the sphere of influence of university cities. On the other hand, all 29 polytechnics that there were in Finland in 2002 had PhDs on their teaching staff.

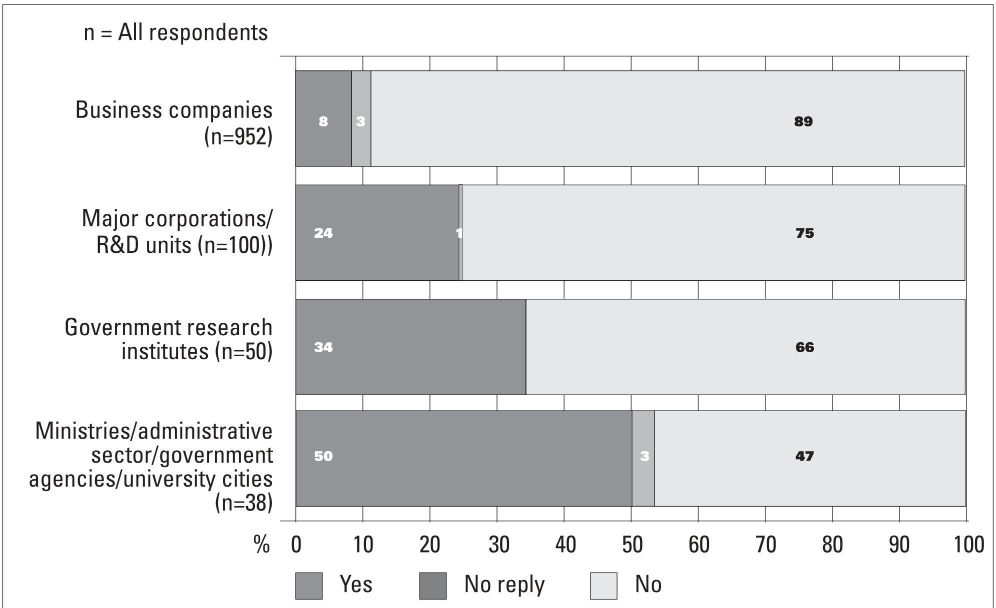
5.3 Demand for PhDs in public administration and in the private sector

In forecasting the future demand for PhDs it is important to consider the role of the non-university public sector and private businesses. Taloustutkimus Oy was commissioned to carry out survey on the views and opinions of public administration and private business companies with regard to their need to hire people with a PhD. At the same time the purpose was to explore attitudes and views to hiring PhDs more generally.

In sum, the findings pointed at a perceived need for people with a PhD in ministries, government agencies and other sectors of public administration as well as in university cities (Figure 13). Half of the respondents representing these organisations said they would need to hire one or more persons with a PhD. In government research institutes, one-third or 34 per cent reported a need for one or more PhDs. In the public sector the need for PhDs often ties in with the question of qualification requirements. In most cases a higher academic degree provides sufficient qualifications for appointment and there is no need to recruit people with a PhD.

Among respondents representing R&D units of major corporations, one in four considered it necessary to hire PhDs. The need was lowest among firms with less than 100 staff and highest in larger companies with more than 500 staff.

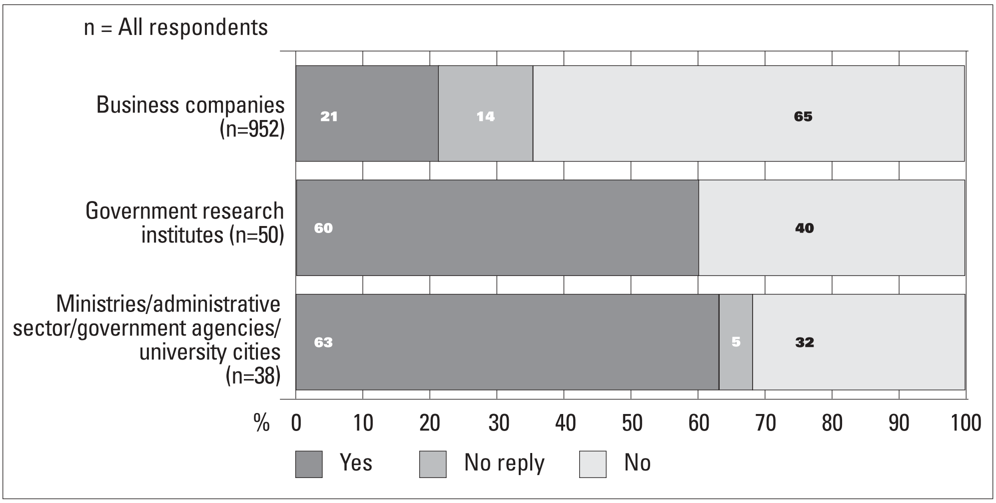
Figure 13. Need to hire people with a PhD at the time of the survey.
Source: Taloustutkimus Oy 2002.



In all groups it was felt that in five years' time, they would have a much greater need to hire PhDs than at the time of the survey in autumn 2002 (Figure 14). Some two-thirds or 63 per cent of the respondents representing ministries, government agencies and other public administration as well as university cities said they would need to recruit one or more people with a PhD in five years' time in 2007. In government research institutes three in five or 60 per cent would have been prepared to hire a PhD in five years' time, in private business companies one in five or 21 per cent.

In relative terms it is expected that the biggest change in the demand for PhDs will be seen in the R&D units of major corporations. In this category 71 per cent indicated that they would want to hire more PhDs in five years' time. Major corporations are not shown in Figure 14 because the data base (71 companies) does not come directly from one item but is compiled on the basis of several items. That is, the question presented to R&D units of major corporations was differently formulated than to other target groups. Major corporations were first asked to identify three areas of their R&D operations that they expected to see increase most over the next five years. Then, they were asked to identify the disciplines from which they would need to hire PhDs for these growth areas.

Figure 14. Need to hire people with a PhD in five years' time.
Source: Taloustutkimus Oy 2002.



Recruitment needs in the forest industry

The volume of R&D in Finnish forest industry companies has more than doubled from 100 million euros in 1998 to around 220 million euros in 2001. In value terms around half of all Finnish R&D is done outside the country's borders. Most of the staff are local, but Finnish people are also recruited to work in foreign operations.

The majority of Masters of Science and PhDs working in the European paper industry have received their training in Finland. In 2000, for instance, a total of

215 paper industry engineers graduated in Finland, while the figure for the rest of Europe taken together was less than 90. Special attention is given to the training of Masters of Science in Technology, but the number of PhDs is also expected to start growing. At the moment five Finnish universities award less than 10 PhDs in wood processing each year.

Many graduating PhDs in these fields have researched their doctoral thesis as part of an assistantship. The graduate school system has helped to speed up the process and at the same time encouraged young people to proceed to the doctorate. Graduate schools have 15 postgraduate student places that are funded by the Ministry of Education, two places funded by the Academy of Finland and 1-2 places funded by industry. The Global University project will be bringing foreign doctoral students into Finland.

There are still comparatively few PhDs in the forest industry, even though the numbers have increased several times over during the past five years. The industry has been content to recruit Masters of Science, so there has been no real incentive or interest to pursue one's studies any further. The general climate of opinion has not favoured the recruitment of PhDs, but the situation is slowly changing with the increasing supply. There is a definite need for PhDs in forest clusters.

PhDs have had little difficulty finding employment: branches closely affiliated with the paper industry (machine and equipment suppliers, chemicals and raw materials suppliers, consultants etc.) are keen to recruit young PhDs. Growing numbers of PhDs are also being recruited into different sectors of the paper industry, and the degree of Doctor of Science in Technology is highly respected in the forest industry. However, the decisive factor is always the individual job applicant's personal characteristics, and PhDs have to battle it out in the job market with Masters of Science in Technology. According to the Industry Skills Needs Probe commissioned by the Confederation of Finnish Industry and Employers, the forest industry's annual recruitment needs in 2001-2003 have been in the region of 200 Masters of Science in Technology and six PhDs.

Industry Skills Needs Probe. Rekrytointi jatkuu – riittääkö työvoima? [Recruitment continues – will the labour reserves suffice?] Confederation of Finnish Industry and Employers, 2002.

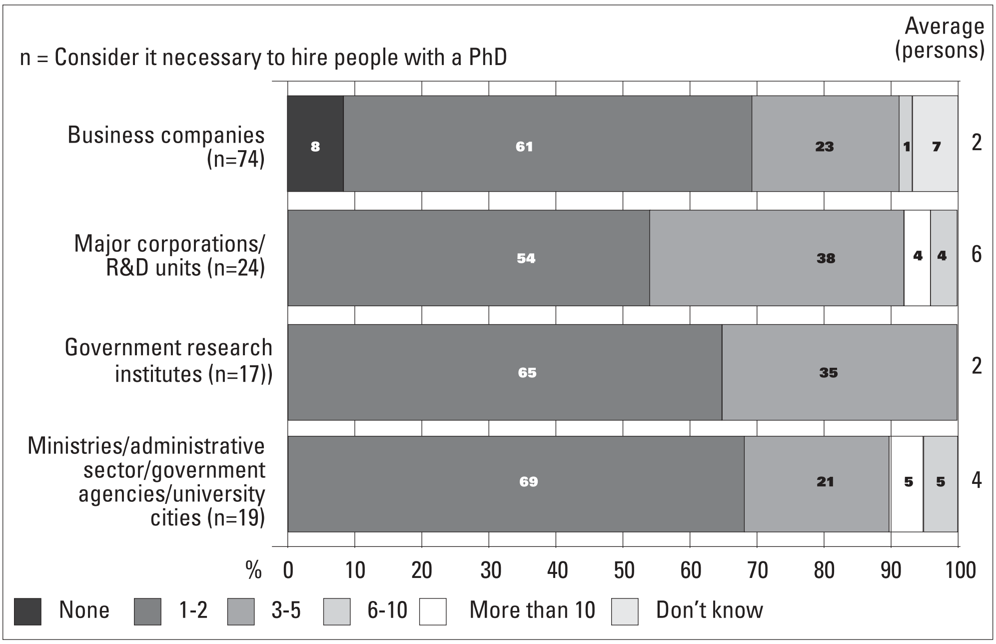
Kari Luukko, Director of Research: The forest industry's views on the demand for PhDs, paper presented at the Academy of Finland on 13 November 2002.

5.3.1 Public sector

Autumn 2002: Over half of the 38 respondents who represented ministries, government agencies, the rest of public administration and university cities said that they needed in autumn 2002 to hire one or more people with a PhD. In most cases these organisations would have recruited 1-2 PhDs (Figure 15). The demand was greatest for people with a PhD in the social sciences, engineering and natural sciences. The demand for people with a PhD in the humanities and medicine and nursing science was markedly lower (11%). PhDs were needed for positions in research, teaching and management. The most common reason for the reluctance of these organisations to hire PhDs was that the formal qualification requirements in these jobs were only for a higher academic degree.

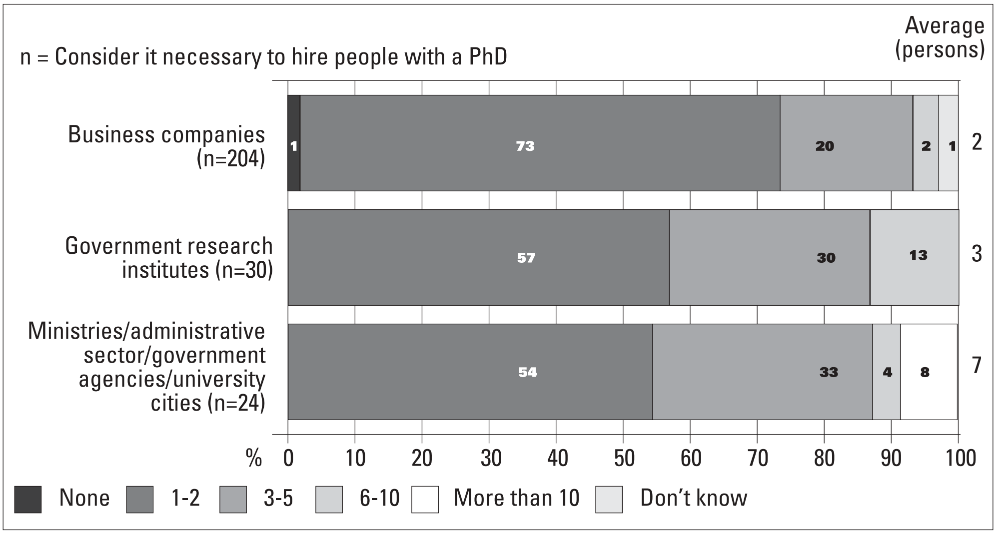
In government research institutes one-third (34%) said that there was a need in the organisation for one or more PhDs. The demand for PhDs was greater in those research institutes that already had PhDs on their payroll. In the research institutes the demand was greatest for people with a PhD in the natural sciences, engineering and medicine. PhDs were mainly required into research and management positions.

Figure 15. How many people with a PhD would the organisation need to hire at the time of the survey?
Source: Taloustutkimus Oy



<u>In five year's time:</u> It would seem that in the public sector the demand for PhDs will be much greater in five years' time than it was at the time of the survey (Figure 16). About two-thirds or 63 per cent of the respondents representing ministries, government agencies, the rest of public administration and university cities said it would be necessary for them to hire a person or persons with a PhD in 2007. Eight per cent of the respondents would have been prepared to hire more than ten PhDs. On average, these organisations would hire seven PhDs. In five years' time the demand would still be greatest for people with a PhD in the social sciences, engineering and the natural sciences.

Figure 16: How many people with a PhD would the organisation need to hire in five years' time?
Source: Taloustutkimus Oy



Thirty, or 60 per cent, of the 50 respondents representing government research institutes said they would need to hire a person or persons with a PhD in five years' time or in 2007 (Figure 16). The biggest category was again represented by people with a PhD in the natural sciences: 50 per cent of the respondents representing government research institutes said they needed people with these kinds of qualifications. People with a PhD in the social sciences, medicine and nursing science as well as in agriculture and forestry would also be in demand in the future. The demand for people with a PhD in the humanities was by contrast lowest in government research institutes (3.5%). Almost 70 per cent of those recruited would work in research. Other tasks identified by the respondents included corporate management, marketing and personnel management as well as product development.

Research institutes with more than five PhDs on their payroll reported a much greater demand than did those with no PhDs. Similarly, research institutes that had several units and offices in different parts of the country and those employing at least 200 personnel reported a greater than average demand for PhDs. In research institutes that had just one unit and that had a staff of less than 50, the demand was accordingly lower than average. An association was also seen with the organisation having international operations: research institutes operating in Finland alone did not report a demand for PhDs at least at the time of the survey.

Research institutes are clearly less keen to recruit people with a PhD than they were five years ago. In 1997, 94 per cent of the respondents of the interview survey by Taloustutkimus Oy indicated that in five years' time they would consider it useful to hire PhDs. At that time the demand was greatest for people with a PhD in the social sciences: no less than 20 research institutes (as compared to just three in 2002) indicated that they would be prepared to hire such people. In 1997 the demand was second greatest for people with a PhD in the natural sciences, with 18 research institutes (as compared to eight in 2002) reporting a demand. The third biggest category in this comparison was represented by people with a PhD in agriculture and forestry: nine research institutes (three in 2002) said they would be recruiting such people.

ICT industry

In 2002 the Finnish ICT industry employed some 150,000 people and had a turnover of 44.6 billion euros. At year-end 2001 around one per cent of all salaried employees in the member companies of the Confederation of Finnish Industry and Employers had completed a doctorate or licentiate. According to the Confederation's Industry Skills Needs Probe (2002), member companies expected to hire 350 people with a doctorate or licentiate, with the electric and electronics industry accounting for roughly half this figure. In 2002, the demand for PhDs and licentiates was estimated to be 250. According to preliminary assessments of the Industry Skills Needs Probe, the chemical industry has stepped up its recruitment of PhDs, whereas the demand has declined in the electric and electronics industry.

A corporate survey conducted in 2001 (Meristö et al. 2001) found that in the short term, the ICT industry's labour demand is affected by the market situation. In the longer term, key factors impacting labour demand include changes in customer behaviour, the appearance of new markets and innovations, and technological development. In the future the ICT industry will have to adjust to slow growth. Most respondents took the view that the labour situation was in balance, or that the shortfall amounted to no more than 10,000 people both in 2005 and in 2010. Most of the companies felt that the number of information workers in their service will increase by no more than 10 per cent in 2001-2003. However, these assessments were made before the recession. At year-end 2002, the industry was in a US-led recession, and it is now expected that the situation will change in perhaps two years' time.

The firms that answered the questionnaire said they would be needing more people in customer services and contacts, in project management and administration, in technical positions, planning, research and product development as well as in marketing and sales. As far as qualitative requirements are concerned, personnel need to show business expertise, technical expertise and various personal qualities, including tolerance for change. The electrical and electronics industry is characterised by a tendency to recruitment on a case-by-case basis and a high relative increase in competence levels: it is no longer enough for people to have a basic training, but additional competencies are required in core areas of expertise. It is important for young people to get into work as early as possible. Two-thirds of R&D personnel work with new software, and there is a need for PhDs. R&D input represents an ever greater part of all final products, and people's know-how is very much restricted to individual products. Therefore individual companies may have very different kinds of needs in this regard.

In the ICT industry the level of competency requirements is set to rise even further. Finland's strength lies in the close cooperation of universities and the business sector.

Manninen, Anneli (2002). ICT-alan osaamistarpeet. [Competency needs in the ICT industry.] Paper presented at the Academy of Finland 11 December 2002.

Meristö, T., Leppimäki, S. & M. Tammi (2002). ICT-osaaminen. Tietoteollisuuden ja digitaalisen viestinnän osaamisen ennakointi. [ICT know-how. Predicting know-how in the information industry and digital communication.] Åbo Akademi University. Institute for Advanced Management Systems Research, Corporate Foresight Group, CoFi Report 1/2002.

5.3.2 Private sector

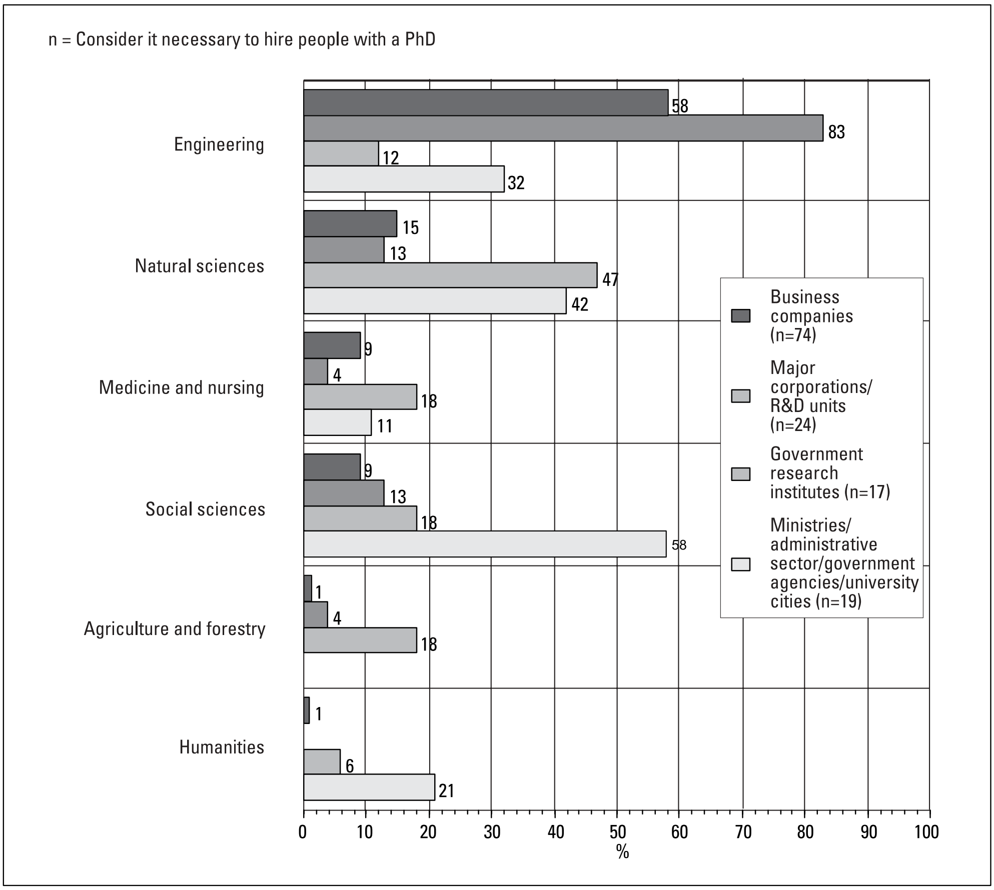
Autumn 2002: Eight per cent of the 952 companies interviewed considered it necessary to hire PhDs in autumn 2002. The need was greatest in the metropolitan Helsinki area in such companies that had major international operations as well as in industrial companies. Examined by industry, the demand for PhDs was greatest in companies representing the petrochemical industry and the pharmaceuticals industry (23%) and in the research, product development and education sectors.

In the private sector the demand for PhDs was greatest in engineering and the natural sciences. In the social sciences, medicine and nursing science, the demand for PhDs was at roughly the same level at close on 10 per cent. The demand for people with a PhD in the humanities and agriculture and forestry was low. PhDs were primarily required for jobs in research and product development as well as corporate management; occasional references were also made to marketing, administration, production and finances, personnel management, training and information and communication.

One in four companies that had their own R&D unit said they needed to recruit a PhD. The R&D units of major corporations would primarily recruit people with a PhD in engineering (particularly electrical engineering, electronics, information and automation technology and technical physics). Four in five or 83 per cent of the representatives of major corporations' R&D units that considered it necessary to hire PhDs, said they would recruit people with a PhD in engineering sciences. In these target groups the perceived need for people with a PhD in other fields of study was markedly lower.

In five years' time: One-fifth (21%) of the 952 respondents representing the business sector believed that in five years' time it would be necessary to recruit PhDs in the company they represented. The future demand for PhDs clearly increased with increasing company size: in corporations with more than 500 employees almost

Figure 17. Need to hire people with a PhD in different fields in autumn 2002. *Source: Taloustutkimus Oy*

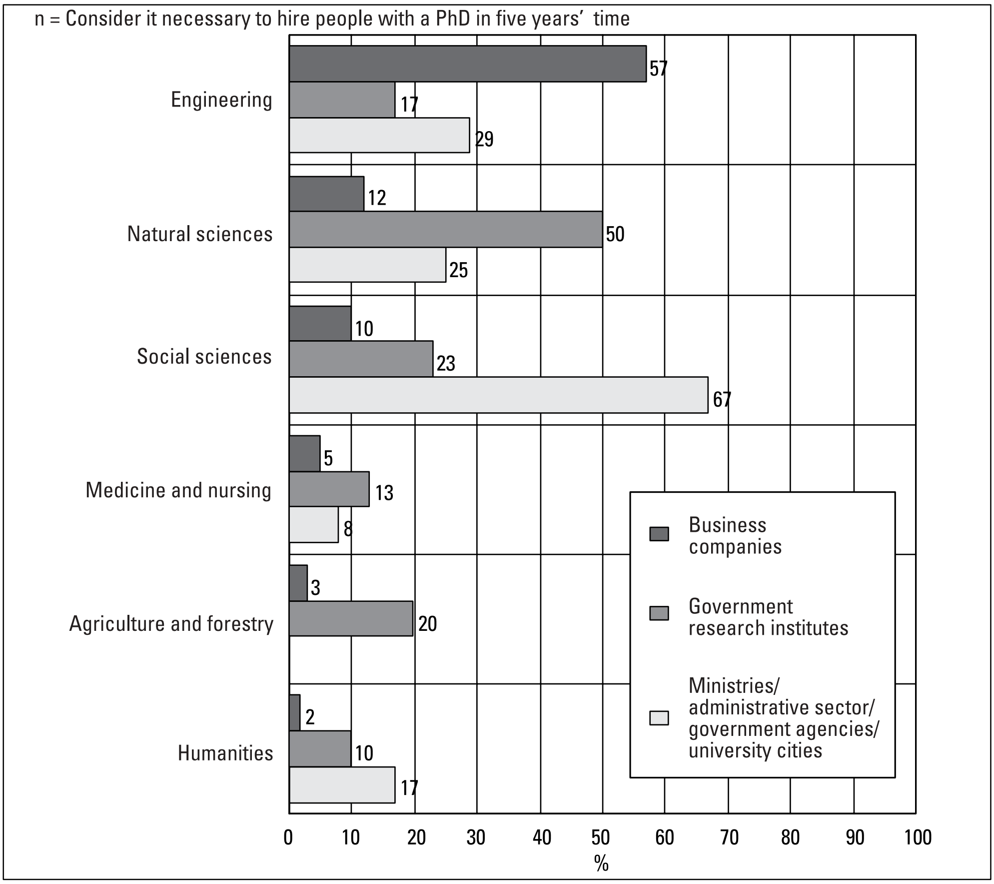


two-fifths (38%) took the view that it would be necessary to hire PhDs in five years' time. The number of PhDs in the company's employ at the time of the survey also influenced opinions on the future demand for PhDs: the greater the number of PhDs currently in the company's employ, the greater also the perceived future demand for PhDs.

Most typically, companies would hire 1-2 people with a PhD, but 20 per cent of the respondents said it would be necessary in the future for them to hire 3-5 PhDs. The most prominent disciplines were engineering (particularly electrical engineering, electronics, information and automation technology and technical physics) as well as the natural sciences (and particularly chemistry) and the social sciences (particularly business administration). The need was lowest for PhDs in the humanities (Figure 18). In the future, too, PhDs would primarily work in jobs related to research and product development. There was also work for Doctors of Science in Technology in production and corporate management, and for Doctors of Social Science in corporate management.

Major corporations also thought that in the future, they would be needing people with a PhD in engineering and the natural sciences. If R&D operations were declining over the next five years, then it was thought that the number of PhDs engaged in the declining operations would nonetheless remain effectively unchanged. Three in four respondents took the view that the numbers would not change. One-quarter or 24 per cent of the respondents opted for the don't know option. One respondent believed that the numbers would decline in the fields of metallurgy and extractive industry, but without giving any exact figures.

Figure 18. Need to hire people with a PhD in different fields in five years' time.
Source: Taloustutkimus Oy



Demand for PhDs in biotechnology industries

In 2001 there were at least 120 biotechnology companies in Finland (Hermans & Luukkonen 2002). Companies established prior to 1991 employed more than 10,000 people, and more than 40 per cent of these companies had at least 250 employees. Companies founded during 1991-2001 were on average much smaller: their combined payroll was around 1,000 persons, i.e. less than 10 persons per company.

Hermans and Luukkonen looked at 84 companies in closer detail. Thirty per cent of these companies had had difficulties recruiting highly qualified people. A large part of the people who work for biotech companies have an academic education, particularly so in younger companies, which clearly testifies to the intensity of their research and development and to their potential for future growth. Around half of the management of biotechnology companies had a PhD or a licentiate's degree, in the companies started most recently the figure was close on 60 per cent. Over 60 per cent of the managers of companies established before 1991 did not have a researcher training. Sixty per cent of the staff in these companies also held some university position: 22 per cent had professors on their payroll, 36 per cent docents, 27 per cent people who taught at university and 30 per cent thesis supervisors. In short, biotechnology companies have close links of contact with universities.

According to Anders Laurén, small, research-intensive companies in the biotechnology sector have in relative terms recruited more PhDs than major corporations. In smaller companies the proportion of PhDs is 20-30 per cent, in major corporations around five per cent. Biotechnology is a business that requires people with multiple skills, although on the other hand it is sometimes necessary to locate a PhD who specialises in a relatively narrow area of expertise. Companies say that newly graduated PhDs sometimes tend to believe they know everything, but in fact it is often a steep learning curve for these people to get to know how the world of business actually works. On average the induction period takes six months.

Laurén says that companies by and large are pleased with the way in which researcher training has been developing, and they accept that graduate schools cannot teach everything. On the other hand, it is also felt that researcher training could show greater initiative and that there could be closer cooperation between the business world and the university sector. Students should have better opportunities for long-term career planning and they should be encouraged to build up international careers in industry. Researcher training should include periods of on-the-job training in industry, and universities could offer more interdisciplinary training courses. Companies should do more to support people researching their doctoral thesis.

Hermans, R. & T. Luukkonen 2002. Findings of the ETLA Survey on Finnish biotechnology firms. Keskusteluaiheita 819. Elinkeinoelämän tutkimuslaitos.

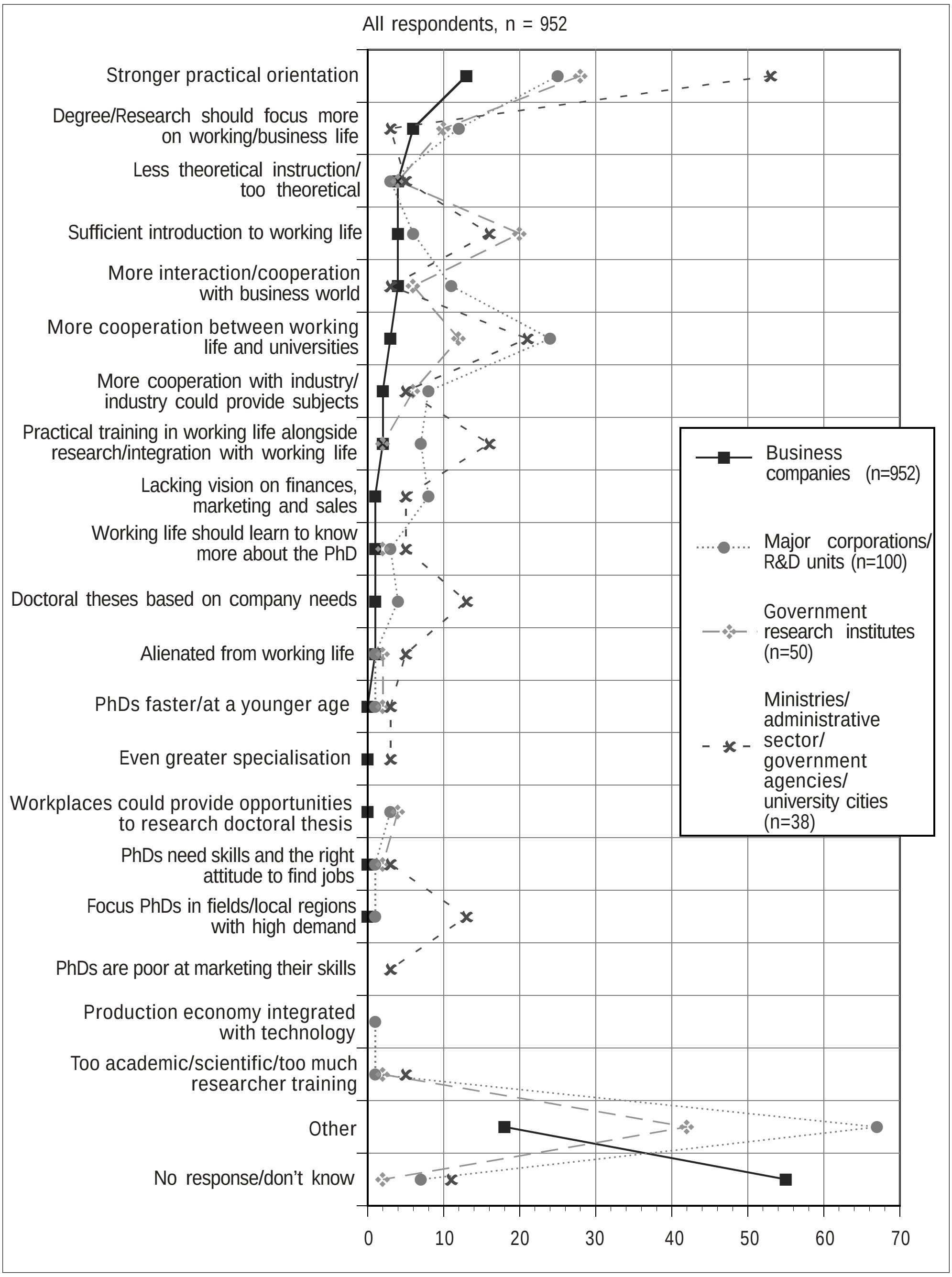
Laurén, A. (Biotech Job Partner Oy Ab). Rekrytoimisen ja rekrytoitumisen haasteita biotekniikka-alalla. [The challenges of recruitment in the biotechnology industry.] Papers presented at the Academy of Finland 25 June 2002 and 22 November 2002.

Further information on biotechnology in Finland:
Biotechnology in Finland. Impact of public research funding and strategies for the future. Evaluation report. Publications of the Academy of Finland 11/02.

5.3.3 Views on the development of PhD training in the public and private sector

The main reason why companies and organisations in the private and the public sector are reluctant to recruit people with a PhD is the perception that the training is theoretical in its orientation (Figure 19). This came across most clearly in the responses from ministries, the administrative sector, government agencies as well as university cities. The point was made in all sectors that the approach to PhD training should be more practice-oriented and that the degree and/or the research involved should focus more on the real world of business and working life. It was felt that PhDs do have a sound knowledge base as well as know-how in research, but that they lacked the ability to put that knowledge to practice; at the very least there was room for improvement in this regard. The respondents stressed the importance of know-how and more practically oriented training. It was felt that a broadly-based, multidisciplinary degree would contribute to the development of skills and competencies relevant in society as well as to a broad understanding of how that society works. International experience gained through employment or training was seen as an important addition to the doctoral degree. The importance of language and communication skills was also stressed. It was strongly recommended that universities and business and industry should have closer interaction and cooperation.

Figure 19. How could PhD training be improved and developed with a view to better meeting the requirements of working life?
Source: Taloustutkimus Oy



6 Conclusions and Recommendations

At the present rate a total of almost 12,000 new PhDs will graduate in Finland during the first decade of the 21st century. It is important that all this expertise and know-how is put to the best possible use in different sectors of society. So far PhDs have had little difficulty finding employment; throughout the 1990s their unemployment rate has been at less than three per cent. People with a PhD have managed to make good use of their education in that most of them are in jobs that are compatible with their qualifications.

Yet it is by no means a matter of course that these favourable trends in development will continue: that will require a determined effort of cooperation among the various actors in the field as well as sound science policy. It is impossible to set up PhD training programmes for specific needs because in most cases the completion of the doctorate takes several years. Forecasts of the future demand for PhDs are further complicated by economic uncertainties: it is impossible accurately to know how that demand is going to develop in the longer term. However, at least so far there are no indications that the demand for PhDs is going to decline. Reports published by the Ministry of Labour, the Research Institute of the Finnish Economy, and the Confederation of Finnish Industry and Employers all suggest that the amount of expert work is set to increase. The changing industrial structure, the growing investment in the private sector in research and product development, the increasing competency requirements of different job tasks and the departure of the babyboom generation from the labour market all lend support to the expectation that the demand for people with a PhD is set to continue in the labour market.

During the 1990s people with a PhD in engineering, medicine and the natural sciences have been the most successful in terms of finding employment in the labour market. These were at once the fields of study that had the highest number of PhD graduates. However, different fields respond to the labour market in different ways. In the 1990s, the labour market accommodated virtually all PhDs who graduated from engineering sciences. The electrical, electronics and information industry has accounted for a very substantial proportion of research in the business sector, and in relative terms the Finnish information industry has ranked as the biggest employer in the OECD group. The Confederation of Finnish Industry and Employers, for instance, predicts that the competency requirements in the information industry will continue even further. Investment in researcher training in these fields is paramount to maintaining high standards of university education as well as high-quality research and development in industry. The relative number of doctoral students is now declining, which may become a threat both to the quality of basic university education and to the standards of research work.

Almost half of all PhDs in medicine and nursing science are engaged in the municipal health care system. Medical doctors are employed more often than PhDs from other fields of study in the private sector. PhDs are more or less evenly spread out across different business sectors.

PhD unemployment has been high in the humanities and the arts. The higher unemployment rate among people with a PhD in the humanities compared to other fields of study is indicative of a mismatch between supply and demand during the 1990s. However, the number of humanists out of work declined sharply when the recession bottomed out after 1997. Most people graduating with a PhD from the humanities found employment in the public sector, mainly in universities, whereas only few of them went to work in the private sector. PhDs graduating from art universities constitute a special group in that they have not yet had the option of postgraduate studies for very long and the number of PhDs awarded is still quite small.

With the single exception of medicine, the most common career path for people graduating with a PhD is to go to work at a university. At universities, the future need for PhDs will be created on the one hand by the exit of the babyboom generation from the labour market; and on the other hand it will be dependent on the future development of public research funding. Now that the public monies made available for research are no longer increasing, the possibilities of the university sector directly to hire people are inevitably affected. It is unlikely that fixed-term funding from external sources can provide an answer to the future employment new PhDs.

On the other hand, we also need to ask whether and to what extent it is possible and indeed necessary to swell university staff numbers, and whether the proportion of PhDs in universities can still be increased from the current level. Employment in the university sector was made possible by the sharp increase in the amount of external funding that was poured into universities, and by the fact that not all staff holding university positions had a PhD (this applies, for example, to teaching staff in engineering sciences). Universities have recruited large numbers of PhDs in information technology and mechanical engineering, for instance.

A balanced future development in both the business sector and universities requires that a sufficient number of talented young people proceed to the doctorate and that the career path following on graduation is an attractive option in both the private and public sector. For fields that rely heavily on research and product development, it is crucially important to have access to the necessary competencies in the form of a sufficiently large number of high-quality researchers. With the current trends of internationalisation and the globalisation of research and business environments, the ability to act in an international networked environment will assume ever greater importance. Competitive, high-quality education and research environments will for their part help to encourage top Finnish researchers to stay in the country and to attract top foreign researchers and research teams into Finland.

Raising the educational level of research and product development staff

The increasing competency requirements for R&D staff mean that training and education requirements are set to grow as well. In 2001, the number of PhDs as a proportion of R&D staff was 10.7 per cent. This figure has shown no essential change over the past ten years. Key to deciding on the right volume of PhDs in the future is the question of whether this level is correct or whether it is necessary to further raise the qualifications of R&D staff by increasing the proportion of people with a PhD. It would be crucially important to establish exactly how that proportion could be increased if that is deemed necessary, and what kind of commitment and cooperation it would require of the different actors concerned.

Needs for structural development in universities

A professional career in research should be seen as a competitive and attractive option in universities. Investments in building up professional careers in research and postdoctoral research vacancies represent a major development challenge for universities. If the structure of teaching and research posts is not overhauled, universities face the risk that talented PhDs more and more often find good job opportunities outside the university sector. Work to reform the system of university posts should take a broad overall view of its objectives. On the one hand, it is important to create bridgeheads for newly graduated PhDs so that they can build up their research careers, and to facilitate interaction and mobility between universities and business and industry. On the other hand, greater inputs are also needed into the later stages of the research career and into creating opportunities for career advancement with improving qualifications. The need for universities to revise the structure of their teaching and research posts was also raised in the biotechnology evaluation report published in December 2002. In some universities this work has now got underway and they have opened lecturer posts for PhDs that combine teaching responsibilities as well as research work.

The system of university posts is so overhauled that the number of postdoctoral posts is increased, which will reduce the significance of so-called postgraduate positions (and assistantships in particular) as an avenue to the PhD. This, in turn, will open up new challenges and opportunities for the development of graduate schools and strengthen their role as a key avenue leading to the doctorate. Steps taken within the ongoing Bologna Process to reform the structure of the Master's degree also support the development of PhD training. The harmonisation of postgraduate degrees on a European level is also under discussion. Implementation of the Bologna model and the opportunity for students to begin on the path of researcher training while they are still engaged in their basic studies, will probably lead to the earlier start-up of postgraduate studies in a growing number of disciplines. This, in turn, can be expected to reduce the amount of time required by the completion of the doctorate.

Polytechnics

Teaching and research at Finnish polytechnics is currently in the process of being developed, and it is hard to predict how the outcomes of this development effort will affect the future demand for PhDs. Polytechnics are charged with applied research and development, while universities are responsible for scientific research at a high international level. The Ministry of Education recently gave the go-ahead for six experimental postgraduate training programme at polytechnics. The launch of postgraduate studies at polytechnics and the intensification of applied research and development will require competent teaching staff and supervisors. This can probably be expected to mean a growing demand for PhDs in the future.

Improving cooperation between the business sector and universities

The number of PhDs working in the business sector continues to remain comparatively low. However, since the late 1990s their share of R&D personnel in business and industry has been growing, and it is probably within this sector that the demand for PhDs will increase most in the future as well. The willingness of private business to recruit PhDs in the future will depend not only macroeconomic trends but also on changes in the industrial structure. If the economy develops favourably, then it is reasonable to assume that companies will continue to hire PhDs in the future as well.

Interviews conducted by Taloustutkimus Oy give reason to conclude that business companies will be increasingly willing to recruit PhDs in the future. On the other hand, it seems that companies continue to regard PhD training as rather theoretically-minded and impractical. The discrepancies and contradictions reflected in the responses of business and industry may be indicative of positive changes in the attitude climate that can be further reinforced among other things by developing the cooperation between graduate schools and business and industry.

In the global economy where know-how and competition are all-important, the competency requirements of the workforce will continue to rise. This will mean growing demands for competent people with a high level of education and presumably a growing demand for PhD training. However, as far as business companies are concerned the key requirement is not for specific degrees; what matters is a high level of competency and the ability to produce business results. This is something that must be given greater attention in PhD training.

Largely the same that was said about the future demand for PhDs in business and industry applies to public administration as well. In the future, public administration will be needing competent experts, but degrees alone will not necessarily be the decisive factor. The more systematic promotion of cooperation between universities and the business sector, and between universities and public administration will require new forms of collaboration and interaction between universities and business companies.

Will the PhD become mundane?

One of the key challenges for the future will be represented by the relationship between the Master's degree and the PhD: with more and more people on the labour market with a PhD, it is possible that the doctorate will become mundane and that people with a PhD and a higher academic degree will increasingly be competing for the same jobs. If a Master's degree will land you a demanding job, why go to the trouble to get a PhD? What in the end is the job that is the PhD's exclusive domain, and how does it differ from the Master's job?

Developing the contents of researcher training

It is important that the scientific quality requirements and the competency requirements of the PhD remain high. However, the contents of researcher training should be so developed that it would give people with a PhD the opportunity and the competencies they need for career paths outside of (basic) research as well. Training programmes should give special attention to the needs of business and industry (e.g. business know-how and marketing), and greater efforts should be invested in improving cooperation and interaction between the business and the university sectors. It is not necessary to create different types of doctoral degrees. By contrast, it is necessary to look into how the contents of different options within PhD programmes could be developed and how a multidisciplinary approach could be more broadly and firmly integrated into PhD programmes. It is important that the structure of education remains flexible within different programme options.

Developing monitoring mechanisms

The demand for PhD graduates and their meaningful placement in different sectors of society shall be regularly monitored to provide a sound basis for education and science policy decision-making. This will require the collection and analysis of statistical data as well as work to systematise and facilitate access to databases.

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The survey on the employment, placement and demand of PhDs in Finland responds to the need for information to support decision-making in education and science policy. It has its background in the recent debate on the increasing number of doctoral degrees awarded and in growing concerns about stiffening competition and the declining prospects of PhD employment.

At the current rate, almost 12,000 new PhDs will graduate in Finland by 2010. This expertise should be utilised efficiently by the different sectors of society.

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