Research Report
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Progress through partnerships

Engineering UK 2006

A Statistical Guide to Labour Supply and Demand in Science, Engineering and Technology

produced in association with ec uk

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> Foreword

Welcome to the 2006 edition of Engineering UK, the Engineering and Technology Board's guide to labour supply and demand in science, engineering and technology.

Since our last edition, public awareness of the impact of climate change has continued to grow. High levels of media coverage, the 'Stern Review on the Economics of Climate Change' and the continuing weight of evidence from the scientific community, have resulted in a loud call to action in 2006.

Our Government is committed to tackling climate change and has pledged investment, supported by policy and international co-operation, to secure the future of our planet for the next generation.

Although climate change is one of the greatest threats we face, we agree with Gordon Brown that it is also the greatest opportunity to mobilise the scientific knowledge and engineering expertise of the UK to deliver technological solutions.

In response to the Stern Review the Chancellor said:

"Each one of the challenges of climate change is also an opportunity for Britain: for new markets; new jobs; new technologies; new exports where British companies, universities and social enterprises can lead; in cleaner, healthier and greener communities, countries and continents."

Furthermore, science, technology, engineering and mathematics are strategically important to the future development of the UK economy as a whole, and the Government's desire for the UK to be the world's leader in the most technologically intensive and science based industries has continued apace this year.

The 'next steps' document for the Science and Innovation Investment Framework 2004-2014 was published alongside the Budget, and the Department for Education and Skills launched the Science, Technology, Engineering and Mathematics (STEM) Programme Report in October. Both reports showed a renewed commitment to the sector and advancing STEM skills with funding for initiatives to support science in schools and the appointment of John Holman, Chief Executive of the National Science Learning Centre, as the National STEM Director.

To be a world leader in science and to rise to the challenges of climate change we need a skilled science and engineering workforce. As we go to print with Engineering UK 2006, we are awaiting the final Leitch Review which will identify the UK's optimal skills mix in 2020. We can be certain that it will be a wake up call for our nation to step change its skills base in order just to maintain our position in the global economy, let alone become a world leader in science and engineering based businesses.

The work presented in this edition of Engineering UK provides a clear picture and underpinning evidence of the state of supply and demand in STEM skills.

While the title of this publication focuses attention on engineering, in reality the route to engineering, particularly in schools, is via science and mathematics. One should therefore think not of science, engineering and technology as discreet entities but of a continuum from science to engineering.

The supply and demand of STEM skills is not a simple issue – it involves the subtle and complex interaction of a number of interrelated socio-economic factors. Nonetheless, we at the ETB see research into supply and demand issues and the charting of the subsequent trends as crucial to our overall mission of promoting the engineering profession.

Engineering UK 2006 provides accurate data to help inform Government policy makers, academics and leaders within the Further Education and Higher Education sectors, and other STEM promotional organisations, but also to UK companies whose future prosperity is dependent on the sufficient supply of engineers and scientists.

As we all rise to the challenges of inspiring and creating the innovative, enterprising and skilled science and engineering workforce of the future, we hope this report will provide the underpinning knowledge framework that will together help us achieve this goal.

Dr John Morton
Chief Executive,
The Engineering and Technology Board (ETB)

> Introduction

This is the ninth in a series of annual statistical guides published by the Engineering and Technology Board (ETB). It is intended as a valuable resource for anyone interested in labour supply and demand issues within the science, technology, engineering and mathematics (STEM) community.

This year's report has built on the work presented in previous editions and includes a large amount of new material and analysis. Engineering UK 2006 presents material that focuses on the engineering profession but also includes information which is relevant to the wider STEM community – particularly in relation to schools and Further and Higher Education.

The material is structured around the career timeline of a typical engineer. It begins with a review of statistics relating to mathematics and science within UK schools – this looks at both GCSE and A-level examination performance (section 1). The discussion then moves onto vocational routes for engineering, technology and manufacturing in Further Education (section 2). The world of Higher Education is then reviewed; trends for undergraduate and postgraduate courses are presented for all areas in science, engineering and technology (section 3). This edition has seen a major expansion of this work with data from UCAS and HESA being presented in detail. Work on graduate destinations six months after university is outlined in section 4 and sheds light on the realities of the 'drain' of qualified engineering graduates to non-engineering careers.

Work on engineering salaries and the employment conditions of engineers is reviewed in section 5 including data from the ETB's 2005 survey of registered engineers. Trends associated with professional registration are reviewed in section 6 and provide data directly from the Engineering Council UK (EC^{UK}) register of professional engineers. The position of engineers in the economy is reviewed in section 7. The final section examines international perspectives on STEM Higher Education (section 8).

This annual programme of research is funded by the ETB. We would like to acknowledge the support of our colleagues at EC^{UK} in the creation of this report. The ETB would also like to acknowledge the valuable support and input from Ugo Ogali, our student placement from the Year in Industry programme.

A copy of this publication together with the detailed statistical and reference material on which it is based appears on our website at www.etechb.co.uk.

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> Summary

1. Secondary Education

As the primary supply mechanism for the Higher Education and vocational pathways, the state of science and mathematics education within UK secondary schools is a key input into our understanding of the supply and demand of science, technology, engineering and mathematics (STEM) skills.

> The increased number of students taking GCSE mathematics, sciences, information computer technology (ICT) and design and technology is partly down to the increase in the size of the 16 year old cohort over the last decade.

> The data indicates that there has been an upward trend, affecting all the aforementioned GCSE subjects, in the percentage of students reaching a grade C or above.

> GCE A-level numbers appear to be rising again in mathematics. They are still falling in physics.

> GCE A-level students who achieve grades A-C have seen an encouraging growth trend over the last decade. While the overall student numbers for science, engineering and technology subjects is at best static, average grades within subjects are on the increase.

> Serious concerns include the possible knock-on effect of design and technology becoming non-statutory at ages 14-16, and substantial numbers of learners being moved to single science or applied science GCSE.

2. Further Education, Vocational Education and Training

This section looks at the state of engineering and technology within the Further Education (FE) and vocational sectors and includes interim findings from elements of the ETB's new vocational skills research programme in 2006.

> In 2005, just over one tenth of the total English workforce held no qualifications; nearly one fifth were qualified up to Level 1 and Level 3, respectively. A slightly higher proportion of the population held Level 2 and Level 4 qualifications, with Level 4 the highest of those illustrated here at 24%.

> Research indicates that engineering technicians make up a substantial part of the UK workforce, nearly 2m jobs, or just over 7% of the total workforce.

> 16% of technicians work in manufacturing and 8% work in construction. It is also worth noting that many engineering technicians work in other sectors.

> Department for Education and Skills (DfES) data suggests that the success rate for engineering, manufacturing and technology courses in FE appears to be rising from 71% in 2002/03 to 74% in 2004/05. This is counterbalanced by a fall in starts but may well indicate that the candidate capability is rising (OFSTED, 2005).

3. Higher Education

The training of the majority of graduate level engineers takes place within Higher Education (HE). This section looks at trends within HE and their implications for the science, engineering and technology industry sector as a whole.

> In 2005 there were over 330 institutions offering Higher Education courses in the UK with over 306,000 undergraduate degree awards being made during the year; 85,000 of these were awarded in STEM subject areas.

> Nearly 120,000 postgraduate degrees were awarded at masters and doctoral level in 2005, with 34,000 being awarded in STEM subjects.

> The last five years have seen an expansion in overall student numbers taking STEM subjects within the UK Higher Education system. STEM student numbers have increased by nearly 25% from 424,000 in 2001 to just under 529,000 in 2005.

> Engineering and technology as a whole has seen increases in home student numbers of 12% over the past five years, rising to 17,200 home acceptances in 2005.

4. Graduate Recruitment

This section looks at what happens to engineering graduates after they leave Higher Education and enter the workforce. The analysis looks at where the graduates work and what salaries they are likely to earn.

> The destinations breakdown for SET shows a diverse picture across the subjects. Engineering and technology see the largest percentage of graduates working in finance and business (28%), with the second largest group working in manufacturing (24%).

> Whilst engineering and technology sees 28% of its graduates entering the finance and business field, it is similar for social studies graduates (28%) and mass communication and documentation graduates (27%); the drain to finance and business is not a phenomenon specific to engineering and technology.

> The propensity of graduates to enter careers in professional engineering differs across the engineering disciplines.

> A striking feature of the data is the fact that 5 out of the top 17 graduate salaries are attributed to engineering disciplines, with chemical engineering leading the way in third place with an average salary of just below £23,000.

> Analysis of graduate starting salaries from the Association of Graduate Recruiters (AGR) shows that engineering does not perform as well as other graduate professions amongst the membership of the AGR.

5. Engineering Salary Levels

Salary levels are a popular subject among all members of the engineering profession. Traditionally there has been a view that engineers are underpaid and this section attempts to assess whether this is the case through the presentation of engineering salary data. The Survey of Registered Engineers conducted by the ETB and EC^{UK} that includes questions on salary takes place on a bi-annual basis; the next survey is due in 2007. Therefore this section uses the last available data from the 2005 survey.

- According to the Office of National Statistics (ONS) data the average annual gross earnings of professional engineers was £33,300 at the end of 2002.
- More recent ONS salary data show that the engineering profession are paid significantly lower salaries than other professions.
- The negative salary situation contrasts data presented in the Engineering and Technology Board 2005 Survey of Registered Engineers, which put the average annual gross earnings for registered Chartered Engineers in 2005 at £53,000.
- The median Chartered Engineer salary in 2005 was £45,500 (up from £43,500 in 2003).
- Figures published by the Royal Institute of British Architects (RIBA) show that over the year to April 2003, its members had median earnings of £35,000. This compares directly to the Chartered Engineer median salary of £43,500 for the same time period.

6. Professional Registration

Trends in the uptake of professional registration are dealt with in this section. The material is sourced from the Engineering Council UK (EC^{UK}) register of professional engineers.

- The total number of registrants has declined from just over 267,100 in 1995 to just under 243,000 in 2005, representing a fall of 9.0% over the decade.
- New registrations have seen positive growth over the last two years, reversing the declining trend in new registrations seen over the last decade.
- The overall age profile of registered engineers in 2005 reflects their median age of over 55.
- The average age of registered engineers is increasing.

7. Engineers in the Economy

This section looks at the role of engineers in the economy, their position at senior management level in large companies, their distribution across UK industry and the impact of engineering on the UK economy.

- The number of top business executives with engineering qualifications in FTSE 100 companies fell from 17 in 1997 to 12 in 2004, however rose to 14 in 2006.
- The manufacturing sector still dominates the employment of registered engineers. The proportion of employment in manufacturing rose from 32% in 1995 to 40% of employment in 2003. In 2003, the remaining 60% are found throughout all other sectors of the economy.
- Estimates suggest that only 39% of UK engineers are registered with the Engineering Council UK.

8. International Dimensions of STEM Higher Education

In order for the UK, within an extremely competitive global marketplace for STEM skills, to compete successfully in products and services requiring technical innovation, it is crucial that the UK continues to produce high quality engineers and scientists in sufficient quantity to supply the needs of industry. This section examines the international aspects of STEM Higher Education.

> China has seen a massive increase in output of STEM degrees over the past decade. This accounts for a 124% increase in STEM student degrees of just under 350,000 per year.

> Over the last decade the UK also saw a 53% growth in STEM degree output to nearly 75,000 degrees.

> There has been a fall in percentage of non-EU students in engineering and technology studying in the UK between 2001 and 2002 where the number fell from under 13% to 5% in a single year. This highlights the highly elastic nature of demand for UK STEM provision from the non-EU student market.

> It is clear that many postgraduate students are from outside the UK. This is particularly the case at doctoral level with student numbers from abroad at 50% in engineering and technology.

> The gender imbalance on STEM degree courses is very high – all countries studied had at least 60% male student participation rates.

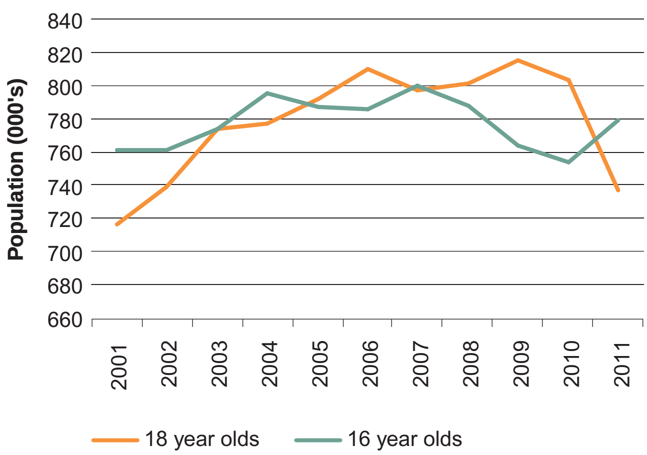
1. Secondary Education

Data on GCSE and A-level mathematics, science, and design and technology education within UK secondary schools is key to our understanding of the supply of, and market demand for, STEM skills. This section reviews the size and characteristics of the population taking secondary education level qualifications which prepare the way for further and higher level learning in the various science, engineering and technology disciplines.

1.1 The Cohort: The 16 and 18 Year Old Populations of the UK

Population estimates for the number of 16 and 18 year olds living in the UK are shown in Chart 1.1. The period from 2000 has seen the populations of both cohorts recover after a relative decline in the mid 1990s. Government estimates suggest that the population has increased in recent years, with both age cohorts approaching 800,000 by 2007.

Chart 1.1: 16 and 18 Year Old Population of the UK



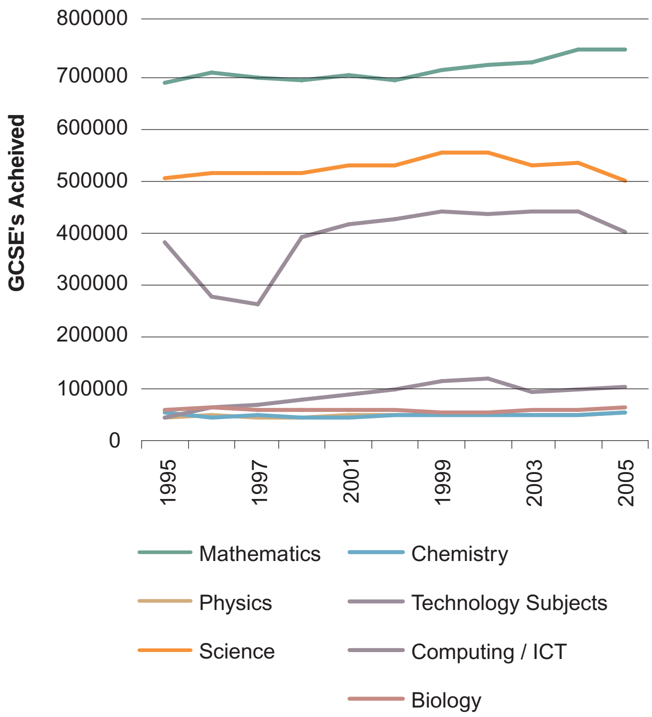
Source: ONS & Government Actuaries Department Populations Estimates, 2006

The population estimates for 2006 are 786,000 for the 16 year old population and 810,000 for the 18 year old population. The demographic data suggests a decline in the size of both cohorts between 2007 and 2010, with the 16 year old cohort falling from 786,000 to below 755,000 in 2010, and the 18 year old cohort to under 740,000 by 2011. A sharp upward gradient of 16 year olds from 2010 may indicate, however, an anticipated rise in 18 year olds from 2012.

1.2 GCSE

Against this background of population trends for the 16 year old cohort, Chart 1.2 shows the GCSE awards made over the ten year period to 2005 in mathematics, selected science subjects, information communication technology (ICT), and design and technology. The mid-1990s onwards saw a gentle rise in total GCSE mathematics awards from 678,000 in 1995 to 741,000 in 2005 with over half of candidates now achieving grades A to C. This increase in GCSE mathematics awards is influenced by the demographic increase in the 16 year old cohort, which in 2005 was just over 785,000, in number. Provisional figures indicate that 751,000 UK candidates sat a GCSE in mathematics in 2006. Provisional figures for 2006 also indicate that 54.3% of these learners gained an A*-C grade, and 96.2% gained an A*-G grade.

Chart 1.2: GCSEs Achieved in Mathematics, Selected Science Subjects, and Design and Technology (All Grades, All Boards, UK Candidates)



Source: Joint Council, AQA 2006

Double award science is usually shown in full (i.e. counted as two awards) but we have shown half the full number in the chart above in order to help comparison with other subjects. Demographic increases in the 16 year old cohort may also have had an impact on the number of science awards; the 16 year old cohort declined slightly from 499,000 in 1995 to 495,000 in 2005. Provisional figures for 2006 indicate a further fall to fewer than 480,000 candidates. This indicates a fall of around 15,000 candidates from 2005 – 2006, with the proportion of female candidates at approximately 8,500. In parallel, the number of candidates taking single award science and applied science (double award, previously known as a Vocational GCSE) has risen sharply, along with small increases in the number taking what are generally known as the 'separate sciences' – single GCSE awards in physics, chemistry or biology. The number of candidates taking the single award science has risen from just over 89,000 candidates in 2005, to, provisionally, 96,000 in 2006; in applied science from 18,000 in 2005 to around 27,500 in 2006. As can be seen in Chart 1.2, the number taking separate sciences is small in comparison to double science, reflecting the fact that these courses are mainly offered in independent or selective state schools. The rise in candidates taking these awards (2005-2006) was around 3,500 (on average). It is worth noting that students are required to take at least a single GCSE in science. This can be taken in a number of formats; either as part of a double award in science (the most popular option), as a single full GCSE in science, or as a single GCSE award in physics, chemistry, biology or applied science.

So, for example, the number of physics awards rose by 8,700 over a decade to 52,600 in 2005, and provisionally, to 56,100 in 2006. However, in 2005 just over 91% of physics candidates achieved a grade C or higher, reflecting the tendency for pupils from more selective schools to be put forward for 'separate science' subjects. Similarly, both chemistry and biology have relatively low numbers of students taking the exams (53,000 taking chemistry in 2005, 62,000 taking biology) but with percentages of A*-C grades in 2005, running at above 88%.

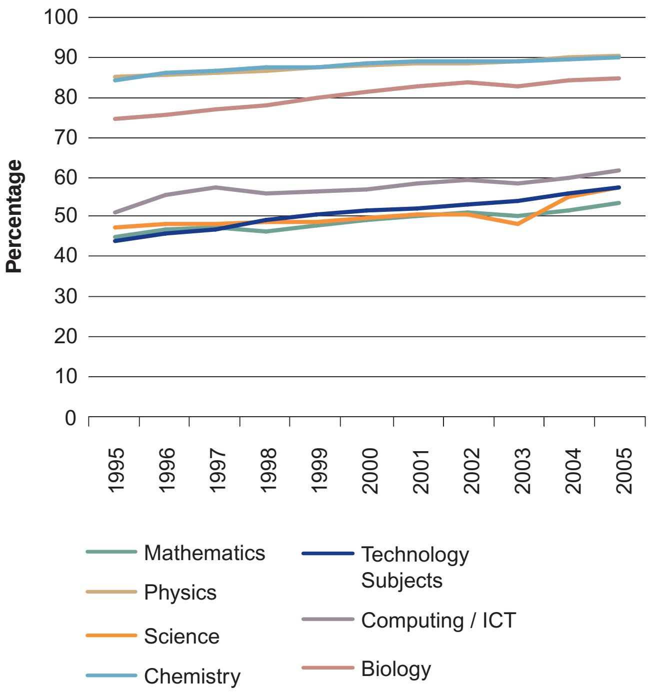
From the early 1990s until 2004, design and technology (D&T) was a statutory subject in the National Curriculum in England and Wales, including at Key Stage 4 (14 to 16 years) alongside, for example, mathematics and science. However in the mid-1990's there were two years, 1996 and 1997, when D&T became optional and then mandatory again and this largely explains the drop in D&T GCSE awards from 376,000 in 1995 to 261,000 in 1997. Since 1997 the number of candidates taking D&T GCSE awards has risen from around 261,000 in 1997 to around 397,000 in 2005, an increase of 52.1%. However, provisional figures for 2006[1] reflect D&T's removal from statutory status with (provisionally) a fall of nearly 25,000 candidates in 2006.

The number of GCSE awards made in information and computing technology (ICT) has been expanding rapidly in recent years, rising from 43,000 in 1995 to a peak of 117,000 in 2002. This represented an expansion over this period of 172%. However, the number of awards in this subject fell in 2005 to just under 104,000. There was, however, a rapid increase from 2002 in the number of candidates sitting the GNVQ intermediate full awards in information technology and more recently the applied ICT double awards. However, perhaps reflecting some perceived downturn in job-market demand for ICT skill sets, or, for example, movement to other applied (vocational) GCSEs.

The relative grade breakdown of pupils achieving grades A*-C in GCSE mathematics, some sciences, ICT, and design and technology is outlined in Chart 1.3.

The data indicates that there has been an upward trend, affecting all subjects, in the percentage of students reaching a grade C or above, with GCSE mathematics increasing from 44.9% in 1995 to 53.6% in 2005. This compares to GCSE double science which also saw an increase from 47.6% to 57.3%. This upward trend is important as the entry requirement to Level 3 (for example, GCE A-levels) is usually a grade C or higher at GCSE. The higher percentage of students achieving grade C and above in these subjects is encouraging.

Chart 1.3: Percentage of GCSE Candidates Achieving a Grade A*-C in Mathematics, Selected Sciences, ICT, and Design and Technology (all UK candidates)



Source: Joint Council, AQA 2006

[1] Provisional 2006 A*-C grades running at 58.3%, very similar to double science (58.6%) and above mathematics (54.3%).

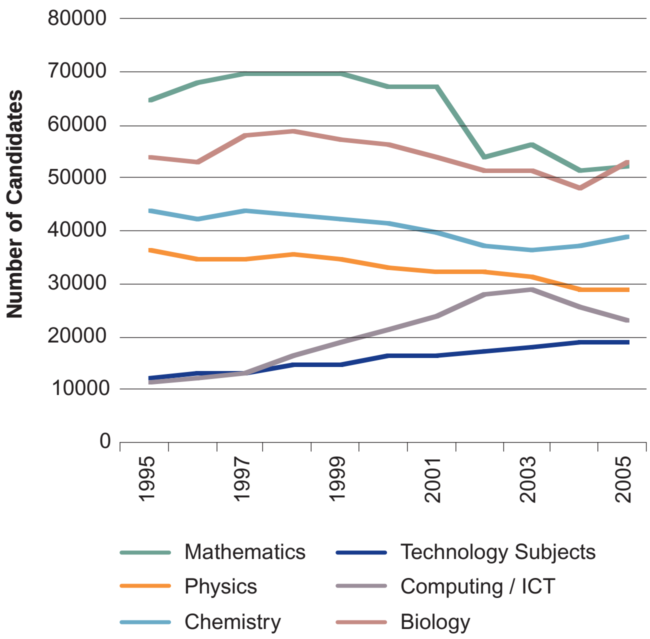
1.3 Young Apprenticeships

Young Apprenticeships are offered to the 14-16 age group alongside general curriculum subjects. These Apprenticeships include 50 days of work experience over two years and are only available to those with around average or above average results from the national tests in mathematics, English and science at age 14. An Ofsted review (Ofsted October 2006) of the Young Apprenticeships programme is positive – although engineering needs to improve the proportion of female students as courses tend to comprise in the majority of male students. Currently there are 3,000 students following this scheme, although this covers areas of learning outside engineering.

1.4 A-levels

As the subjects often required by admissions tutors for engineering undergraduate degrees, and by employers, mathematics, physical sciences (physics and chemistry), computer science/ICT, and technology subjects (D&T) at A-level are of particular interest to the SET profession. Chart 1.4 shows the trend in A-levels taken in these subjects in the UK over the period 1995-2005.

Chart 1.4: GCE A-levels: Candidates in Selected Subjects (all UK candidates)



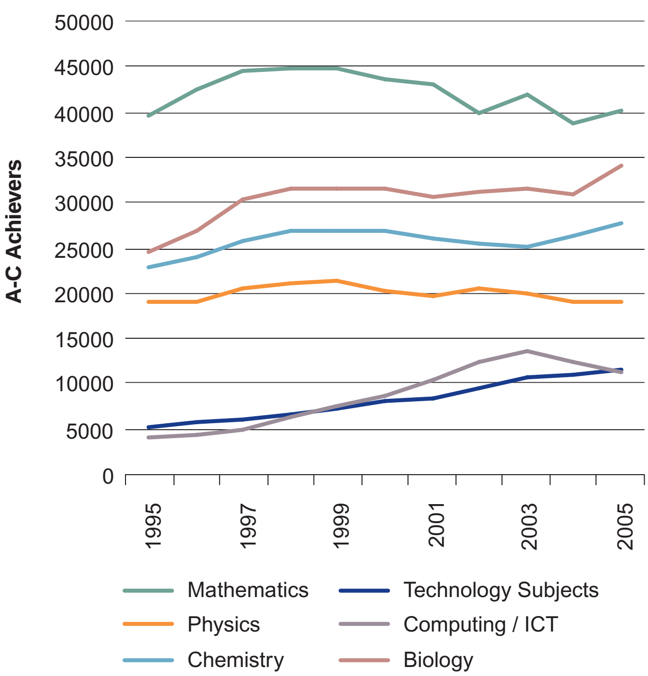
Source: Joint Council, AQA 2006

From 1995 until 2001 there was a modest rise in GCE A-level mathematics awards. However, in 2002 there was a sharp decline in candidate numbers, falling from 66,000 in 2001 to 51,000 in 2005 and representing a 23% decline. The decline may be attributable to initial problems resulting from the introduction of Curriculum 2000. At the time this was widely seen as a one-off event but more recent data suggested that candidate numbers had not recovered and continued to decline. However, there was an upturn in 2004/5, and provisional data for 2006 shows a further rise of around 3,000 entries in mathematics from 2005, with provisional entry of 56,000 candidates. The decline in A-level student numbers between 1995 and 2005 seen in mathematics was also seen in biology (8% decline), chemistry (12% decline) and physics (21% decline). However, chemistry took a positive turn in 2004/5 and in 2006 (provisional data) there has been a rise of around 1,200 candidates in chemistry although physics candidate numbers appear to have fallen further by around 750, of which over 500 were male. Less than 6,000 female students sat physics A-level in 2006 (provisional data). There has been a steady increase in the number of candidates sitting A-level technology subjects (D&T), 66% increase to 2005, with a further rise to 19,000 candidates in 2006 (provisional data). Of these, around 7,600 were female. However, the fall in GCSE numbers may well impact on future A-level numbers – and this is already evident in provisional 2006 data for technology subjects at AS-level (fall of around 600 candidates). Computing/ICT, saw a 120% increase in candidate numbers to 2005, from 10,000 to nearly 22,000 over a decade, but with a slight fall of 600 candidates in 2006.

Many university engineering departments require a grade A-C in A-level attainment for Honours degree entry and Chart 1.5 shows selected GCE A-level achievement at grades A-C.

In 2005, mathematics was contributing a similar number of A-level grades at A-C to those seen in 1995, in fact there has been a 1% increase in student numbers achieving these levels over the decade. Biology has seen an encouraging increase of 40% in those reaching grades A-C; chemistry also saw an increase in students attaining grades A-C of 21% over the same period and physics remained relatively constant. Technology subjects (D&T) and computing/ICT also realised increased numbers in grades A-C, with technology subjects seeing an increase of 140%, and computing seeing a massive rise in grades A-C of 175% over that period. The key point to take from the analysis of GCE A-level student numbers is that, despite any fluctuation in numbers of candidates taking mathematics, physics and chemistry, the number of candidates achieving grades A-C has remained relatively steady and in most cases shown a healthy increase.

Chart 1.5: Number of GCE A-Levels at Grade A-C in Selected Subjects



Source: Joint Council, AQA 2006

1.5 Further Mathematics A-level and AS Mathematics

Further mathematics A-level was taken by nearly 6,000 candidates in 2005, with a 75.6% A-B grade pass and provisional figures for 2006 indicate a steep rise to around 7,300 candidates with pass rates being maintained, indeed improved to a 76.6% A-B pass rate.

At AS-level, 68,200 candidates sat mathematics in 2005 (A-B grades at 45.6%) – with provisional data for 2006 indicating a rise to 70,800 candidates (A-B grades at 46.1%).

1.6 Gender Balance

In 2005, female students represented 38% of the A-level mathematics entrants and accounted for 22% of those taking physics, 49% of those taking chemistry, 39% of design and technology, 28% of those taking computing/ICT and 59% of those taking biology. Although, from provisional 2006 A-level data it seems that the gender gap is closing in mathematics, and there is a good balance in chemistry, a continuing concern is the gender skew in physics. Historically, engineering departments have sought physics as a prerequisite, in recent years many universities, including those within the Russell Group have accepted design and technology A-level as (at least) a third offering along with mathematics. With increased numbers of female students taking D&T A-level than physics A-level, this may be a potential solution to improving gender balance in engineering courses at university. However, if D&T numbers continue to drop at GCSE and A-level, and substantial numbers of female students move to single science or applied science GCSE, future prospects of addressing the gender balance in engineering look vastly more challenging.

1.7 Summary and Conclusions

> The increased numbers of students taking GCSE mathematics, sciences, ICT and design and technology is partly down to the increase in the size of the 16 year old cohort over the last decade.

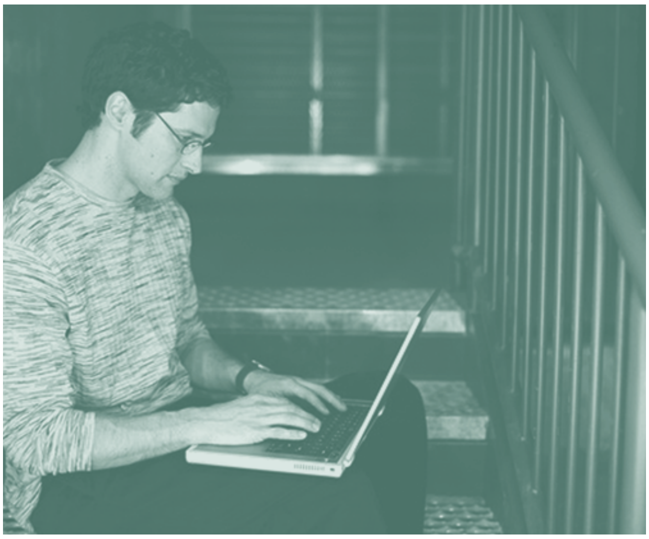
> The data indicates that there has been an upward trend, affecting all the aforementioned GCSE subjects, in the percentage of students reaching a grade C or above.

> GCE A-level numbers appear to be rising again in mathematics. They are still falling in physics.

> GCE A-level students who achieve grades A-C has seen an encouraging growth trend over the last decade. While the overall student numbers for STEM subjects is at best static, average grades within subjects are on the increase.

> Serious concerns include the possible knock-on effect of D&T becoming non-statutory at ages 14-16, and substantial numbers of learners being moved to single science or applied science GCSE.

2. Further Education, Vocational Education and Training

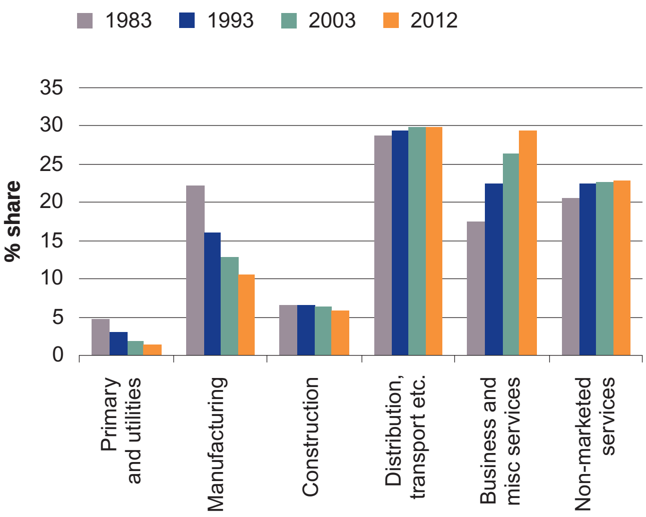


Skills at technician level underpin the entire fabric of UK engineering. The supply of technician level skills is an area often overlooked in analysis. This section looks at the state of engineering and technology within the Further Education post-16 sector; the main supply route for skills and qualifications at the technician level. As previously mentioned, this section also presents some initial findings of the Engineering and Technology Board's research project investigating engineering data within Further Education.

2.1 Changing Skill Requirements

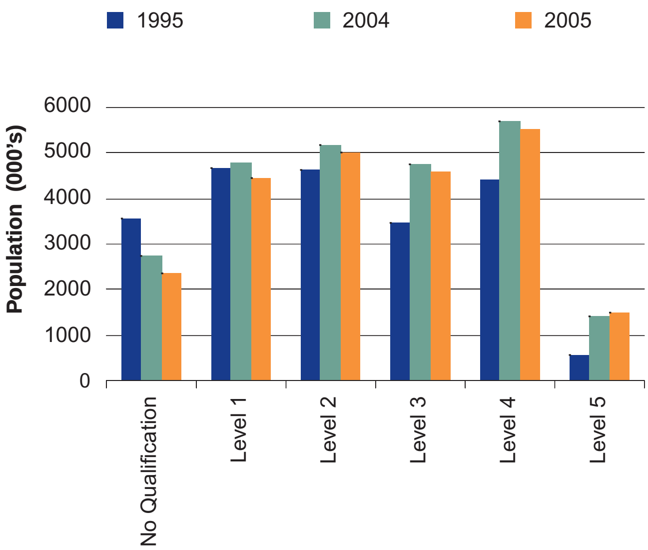
Demand for skills in the UK economy is changing. Engineering is not immune to these changes. Whilst engineering is by no means confined to manufacturing, this sector has seen the largest fall in employment of all the major sectors in the engineering economy. Chart 2.1 describes the changing employment patterns across the economy between 1983 and 2012. Of interest is the large reduction in employment being seen by the manufacturing sector – a fall from 22% of employment in 1983 to just over 10% in 2012. Whilst not all occupational roles in manufacturing require engineering skills, contraction of employment in this traditionally engineering intensive part of the economy reflects the on going transition from unskilled and semi-skilled mass employment towards an increasingly mechanised, high-tech, high skill economy of the future. However, manufacturing alone will still provide nearly 3 million jobs to the UK economy in 2012. At the same time there is still a large demand for engineering skills in other engineering dependent sectors of the economy.

Chart 2.1: Percentage Share of Employment in England 1983-2012



Source: LSC 2005

Chart 2.2: Qualifications Held by Workforce, England 1995, 2004 and 2005



Source: LSC 2006 / Labour Force Survey 2004

In the current absence of detailed data about the number of holders of Level 3 engineering qualifications, we have to use all workforce (England) data from the Learning and Skills Council as a broad-brush indicator. Chart 2.2 shows the total number of those in the workforce who hold qualifications at Levels 1 to 5. In this analysis technicians are usually recognised to hold qualifications and or experience around the Level 3 mark. Level 4 is equated to first degree and Level 5 to higher degree or professional qualification.[2] Successive surveys have demonstrated the relatively small numbers in the workforce who hold qualifications at Level 3, compared to competitor nations such as France or Germany, and have drawn the inference that their greater productivity is, at least in part, attributable to this standard of achievement (Department of Trade and Industry DTI, 2005).

In 2005, just over one tenth of the workforce held no qualifications and just under one fifth were qualified up to Level 1 and Level 3, respectively. A slightly higher proportion of the population held Level 2 and Level 4 qualifications, with Level 4 the highest at 24%. Nearly 7% of the population held Level 5 qualifications. Long term trends since 1995 suggest that the proportion of the population without qualifications has fallen from just under 17% to 10%. Level 1 qualifications have fallen slightly from 22% to 19%. Level 2 qualifications have remained steady at around 21.5%. Over the past decade, the biggest gains have been seen in Level 3, 4 and 5 qualifications which have all experienced increases indicating a slow up-skilling of the workforce.

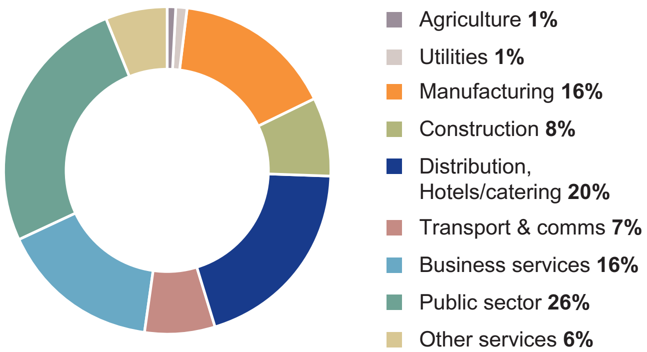
[2] It is worth noting that during 2005 a new form of grading system was introduced for the National Qualification Framework, replacing Levels 1-5 with a new system of levels 1-8. Future analysis from the LSC will utilise this new 8 level classification system. See the following link:

http://www.qca.org.uk/14279.html

As mentioned earlier, in engineering, Level 3 broadly equates to 'Technician'. A recent sector skills agreement report (SEMTA, 2005) indicates that the most significant area of a future skills shortage in the engineering footprint covered by that Sector Skills Council is at Level 3. Chart 2.3 highlights employment in 'technician' related occupations. The chart shows where engineering technicians work in the economy. Earlier work carried out by the 2002 Labour Force Survey suggests that engineering technicians make up a substantial part of the UK workforce – nearly 2m jobs – or just over 7% of the total workforce.

Chart 2.3 indicates that 16% of technicians work in manufacturing, 8% work in construction and many technicians work in other sectors – as many as one fifth work in distribution, hotels and catering, whilst over a quarter of engineering technicians work in the public sector. The main supply mechanism for technician related qualifications is the Further Education (FE) and other post-16 education and training provider sector which offers vocational courses and Work Based Learning (WBL) such as apprenticeships.

Chart 2.3: Engineering Technicians by Sector, All UK



Source: LFS (Averaged Quarterly Estimates, December 2001/November 2002)

2.2 Overview of Vocational and Work Based Learning in Further Education (FE)

There were 4.21 million FE learners funded by the Learning and Skills Council (LSC) in 2004/05. This represents a 1.2% increase on the 2003/04 figure. The most popular areas of learning in 2004/05 continued to be information and communication technology (17.8%) and followed by health, social care and public services (16.1%). Engineering, technology and manufacturing ranked at 3.8% of the total number of students. It is worth noting here however that the LSC category 'Engineering, Technology and Manufacturing' may include non-engineers and excludes engineers.

In addition, there were a total of 519,000 people participating in WBL during 2004/05. The average number in learning on apprenticeships in 2004/05 was 154,000, an increase of 7.6% over 2003/04. The most popular area of learning continues to be engineering, technology and manufacturing with 20% of total participants. For engineering, the importance of Work Based Learning cannot be over emphasised. Without exposure to engineering workplace equipment, workflows and disciplines, qualification-holders are often found to be inadequately equipped with the skills engineering employers seek.

DfES published data from 2006 details the situation for engineering, technology and manufacturing within FE and WBL in October 2004 and 2005. This consists of student numbers at the commencement of the learning programme – as such it does not take into account the effect of drop out rates, a point which we will discuss later. Neither is there indication of learning levels.

Turning first to FE, the number of learners in engineering, technology and manufacturing rose from 132,100 to 158,300 – an increase of only 26,200 learners on the previous year (a 19.8% increase). This is in contrast to the whole of FE which saw a 1.2% increase in student numbers, up by 51,000 at a national level. In comparison, between 2004 and 2005, WBL showed a decline in learner numbers from 535,900 to 518,500 across all subject groupings. However, during this time period, engineering, technology and manufacturing WBL learner numbers remained steady, at just over 101,100, up 1000 on the previous year. This figure is important, since engineering, technology and manufacturing accounts for nearly a quarter (20%) of the WBL learners.

2.3 DfES Published Data on Further Education Student Numbers

Looking at another set of DfES data provides additional analysis on the state of engineering within FE. Table 2.1 outlines the number of starts for full time students within FE across the main areas of learning for the last three academic years.

Table 2.1: Starts for Full Time Full Year Students Enrolled on Learning and Skills Council Funded FE Provision in all FE Institutions, by Selected Area of Learning, England 2002/03 to 2004/05

	2002/03 Starts (000's)	2003/04 Starts (000's)	2004/05 Starts (000's)
Arts, Media & Publishing	473	488	496
Business, Administration & Law	338	333	329
Construction	141	140	136
Education and Training	102	89	85
Engineering	258	230	190
Health, Public Services & Care	868	965	967
History, Philosophy & Theology	111	92	140
ICT	909	813	675
Languages, Literature & Culture	392	390	378
Leisure, Travel & Tourism	257	256	246
Retail & Commercial Enterprise	287	262	256
Science and Mathematics	351	320	314
Social Sciences	122	123	118
All areas of learning	5915	5888	5768

Source: DfES 2006

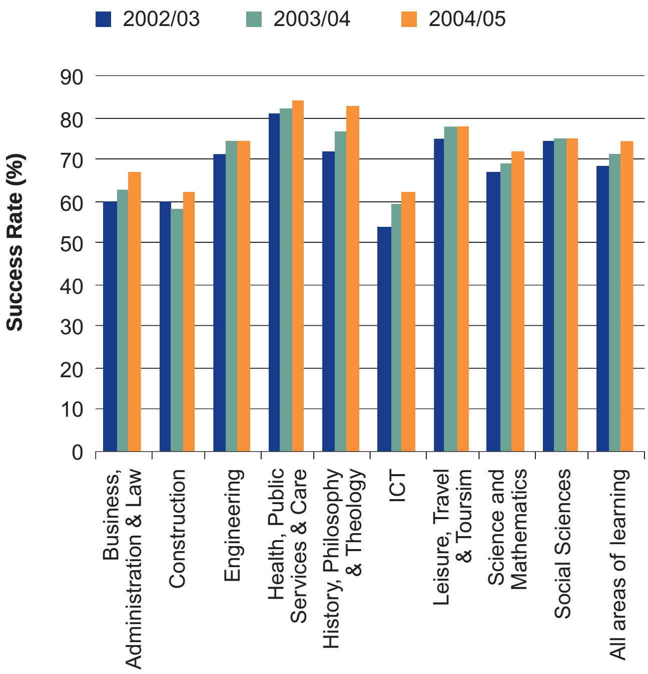
The data illustrates a fall in starts in engineering from 258,000 in 2002/03 to 190,000 in 2004/05, and in construction a fall from 141,000 in 2002/03 to 136,000 in 2004/05. In the 'engineering' category, for example, this represents a fall in student numbers of 26% over the period. This is in contrast to FE as a whole which only witnessed a 2.5% contraction in student numbers.

Another issue touched on earlier is that of drop out rates within vocational training. This is a complex area in its own right as 'drop-out' does not necessarily mean ceasing learning – for example, a learner might transfer to another programme. The data presented to date in this section has relied on published material from the DfES. The DfES material focuses on the number of learners who start vocational courses in FE and WBL – this data is inadequate to forecast the supply of skills without details of the significant number who fail to complete their training. Data on this is less readily available. Chart 2.4 summarise DfES data on the success rates of courses in FE institutions.

The data illustrated in Chart 2.4 looks at selected areas of learning within FE. During the three year period, engineering, technology and manufacturing courses in FE institutions exhibited a success rate of 71% in 2002/03 and 74% in both 2003/04 and 2004/05. This is in comparison to average success rates across all areas of learning which also increased to 74% in 2004/05.

In an effort to better understand the supply of engineering learners (engineering in its broadest and more accurate sense) within the FE sector, the Engineering and Technology Board (ETB) has undertaken a project in conjunction with the Learning and Skills Council (LSC).

Chart 2.4: Success Rates Full Time Full Year Students Enrolled on Council Funded FE Provision in all FE Institutions, for Selected Areas of Learning, England 2002/03 to 2004/05



Source: DfES 2006

2.4 Analysis of LSC Data

The Engineering and Technology Board commissioned York Consulting to examine the state of engineering and technology within FE and school based 16-19 vocational education. One of the main aims of the project was to combine the secondary analysis of existing statistical data, with primary research to examine the underlying causes of the most serious challenges facing engineering and technology within FE and school-based 16-19 vocational education. Central to this was an analysis of the main source of LSC data on the subject; the Individual Learner Record (ILR) database. This database is owned and administered by the National LSC and contains details of all learning aims pursued by every learner in FE for a given year. Early findings from the analysis are included below.

Table 2.2: Headline Figures from the ILR Database

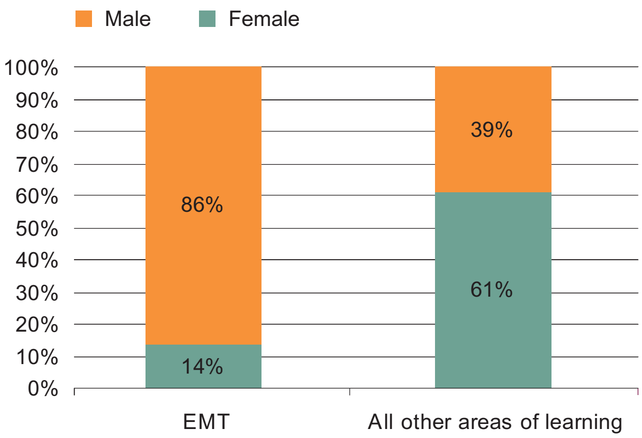
	Success Rates		Retention Rates		Learner Numbers	
	EMT	National	EMT	National	EMT	National
2002/03	71%	68%	85%	83%	258,000	5,915,000
2003/04	74%	71%	85%	85%	230,000	5,888,000
2004/05	74%	74%	85%	86%	190,000	5,768,000

Source: ETB / York Consulting analysis of LSC ILR database

Table 2.2 presents an initial analysis of the LSC ILR data. The DfES published data mentioned earlier suggested that there had been a 26% decline in student numbers over the last three years; analysis of the LSC data confirms the DfES analysis. However, the data in Table 2.2, given the limitation of the engineering, manufacturing and technology (EMT) category, indicates that EMT retention rates have stayed constant over the 2002 – 2005 period, at 85%, whilst national retention rates have risen by 3% over the same period.

The analysis also looked at the gender mix on engineering, manufacturing and technology courses in FE. As is the case in engineering generally, engineering, manufacturing and technology courses in FE are heavily male dominated. This is detailed in Chart 2.5 where in 2004/05 the proportion of males in EMT was more than twice that in all other areas combined.

Chart 2.5: Gender Mix in Engineering, Manufacturing and Technology FE in 2004/05



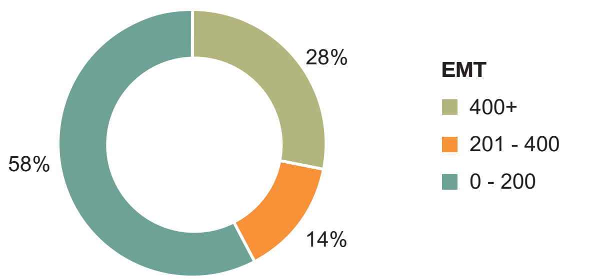
Source: ETB / York Consulting analysis of LSC ILR database

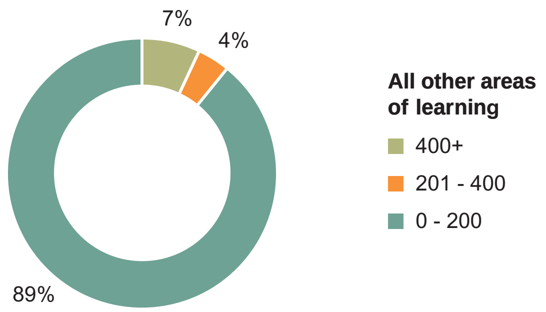
However, it must be highlighted that there has been a slight increase in the proportion of female students in engineering, manufacturing and technology, from 11% in 2002/03 to 14% in 2004/05. Despite this increase, a 14% female participation level is of significant concern, and, again, it must be remembered that the EMT category may include non-engineering roles.

The LSC data also indicates that an above average proportion of engineering, manufacturing and technology learners are released by their employers to study FE courses. The figures remained fairly constant between 2002/03 and 2004/05, although the gap narrowed slightly: in 2002/03 16% of engineering, manufacturing and technology learners were released by their employers, compared with 4% in all other areas combined. In 2004/05, the figures were 14% and 6% respectively.

The analysis also touched on the issue of guided learning hours. LSC surveys of guided learning hours inform funding arrangements. Chart 2.6 illustrates that engineering, manufacturing and technology courses in FE had at the time of the surveys above average guided learning hours (Chart 2.6 relates to 2004/05 but the situation was similar in 2002/03 and 2003/04). The data perhaps illustrates that more FE engineering courses are of the 'long', 'programme' variety than in some other areas. More recent impetus to meet needs of employers for 'bite-size'' training – for example up-skilling in newly introduced technologies or business practice – may change these proportions.

Chart 2.6: Guided Learning Hours in FE





Source: ETB / York Consulting analysis of LSC ILR database

2.5 Summary and Conclusions

> In 2005, just over one tenth of the total English workforce held no qualifications, nearly one fifth were qualified up to Level 1 and Level 3, respectively. A slightly higher proportion of the population held Level 2 and Level 4 qualifications, with Level 4 the highest of those illustrated at 24%.

> Research indicates that engineering technicians make up a substantial part of the UK workforce – nearly 2m jobs – or just over 7% of the total workforce.

> 16% of technicians work in manufacturing and 8% work in construction. It is also worth noting that many engineering technicians work in other sectors.

> DfES data suggests that the success rate for engineering, manufacturing and technology courses in FE appear to be rising from 71% in 2002/03 to 74% in 2004/05. This is counterbalanced by a fall in starts but may well indicate that the candidate capability is rising (OFSTED, 2005).

3. Higher Education

The training of graduate engineers and scientists takes place within the Higher Education sector. The UK's universities therefore have a vital role in supplying the next generation of the professional engineering workforce. This section looks at trends within Higher Education and their implications for the science, engineering and technology industry as a whole.

3.1 Introduction

The UK's Higher Education sector's role in science, technology, engineering and mathematics (STEM) is widely seen as one of the vital contributors to innovation and economic growth and development. STEM Higher Education provides the higher level skill base needed for a competitive UK workforce in the 21st century global market place.

In recent years, demographic trends and the rapid expansion of UK Higher Education have had an impact on the numbers taking STEM courses in UK Higher Education. Since the 1990s the UK Higher Education sector has seen a massive increase in student participation; this growth has been driven by the UK Government's target of having 50% participation in Higher Education by 2010. As a result, participation rates amongst university age students in Higher Education have increased to 42% in 2005 (DFES, 2005). This rapid growth of Higher Education has also had an impact on the demographic mix of the university population with students from a wider mix of economic and social backgrounds now participating. However, the expansion of UK Higher Education has had a differential effect on specific subject areas; STEM subjects have each fared differently in terms of student demand over the last decade.

Over the past ten years there has also been a growth in the number of foreign students undertaking Higher Education study in the UK. This growth has been especially prevalent within the STEM subjects, and is a particularly strong phenomenon within STEM post-graduate study. However, the global marketplace for Higher Education is increasingly competitive.

Although the UK has historically been one of the world leaders in the provision of broad access Higher Education and has also done well in attracting foreign students, our position is now under threat as many other countries are expanding their own Higher Education systems, providing comparable educational access to their own population and attracting large numbers of foreign students.

In recent years, a number of countries including the United States, Japan, Canada, Australia, and Germany, have expanded their recruitment of foreign STEM university students. This is in addition to the growth of indigenous Higher Education sectors within newly developing economies such as India and China, who have historically been one of the main sources of foreign students within the developed countries Higher Education sector.

3.2 The Structure of UK Higher Education

Higher Education in the UK is diverse in terms of the size and type of institutions offering degrees. At present the Higher Education sector offers a number of different levels of qualification, broadly grouped by level from two year foundation degrees, three and four year undergraduate degrees, one year masters degrees, and three year doctoral programmes. The size and diversity of the UK Higher Education sector is reflected in the fact that there is a wide range of course options available for students. In 2005, there were over 330 institutions offering Higher Education courses in the UK with over 306,000 undergraduate degree awards being made during the year; 85,000 of these were awarded in the STEM subject area. In addition, nearly 120,000 postgraduate degrees were awarded at masters and doctoral level in 2005, with 34,000 being awarded in STEM subjects.

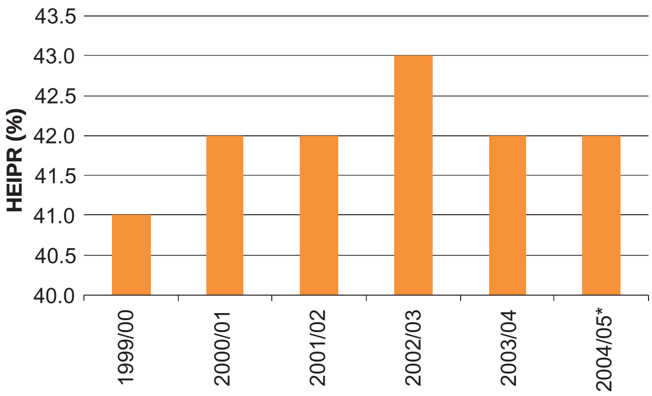
3.3 The Supply of Students in Higher Education in the UK

The UK has witnessed a rapid expansion of participation in Higher Education over the last 10 years; the number of undergraduate programme entrants has risen by nearly 45% from just under 241,000 in 1995 to 349,000 in 2005 (UCAS, 2005). This increase in the input of students expanded the UK student population to just under 2.3 million in 2005 (HESA, 2005).

Whilst the number of UK students entering university has increased dramatically over the last decade, the introduction of student tuition fees in 1998 does not seem to have seriously influenced the number of young people entering Higher Education. However, we will have to wait and see whether increased tuition fees, which come into effect in 2007, will have an impact on university student entrance numbers.

The UK Government has set itself a target of achieving a 50% level of university participation for the 18 year old population. Chart 3.1 details the Higher Education initial participation rate for students in England over the last six academic years. Participation according to these Government figures has been stable at 42% for the last two years, well short of their ambitious 50% target.

Chart 3.1: Higher Education Initial Participation Rate (HEIPR) to Higher Education Courses, 1999/2000 to 2004/05



Source: DfES 2005

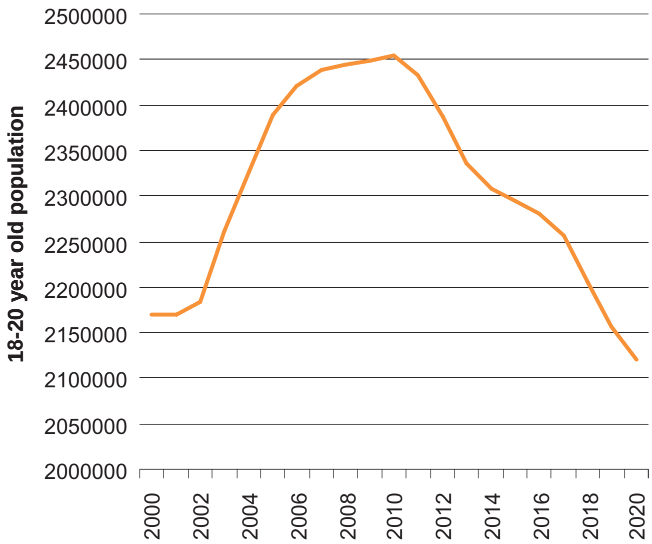
This data suggests that the percentage of participation is remaining steady. However, during the same period there has been a growth in actual student numbers in UK Higher Education, a picture supported by data from both HESA and UCAS. The continued growth in actual student numbers over the last decade has been supported by demographic changes in the university age cohort, which has seen the 18 year old cohort increase in size.

3.4 Demographic Changes to the University Age Cohort

Work carried out by the Higher Education Policy Institute (HEPI) suggests that the UK's Higher Education sector cannot rely on an expanding cohort to fuel future growth in student numbers (HEPI, 2005). The main conclusion of the HEPI study is that between now and 2010-11, the population of young school leavers (18-20 year olds) who have always provided the majority of full time Higher Education entrants will increase, leading to a continued growth in student numbers. However, after peaking in 2010-11, the number of young people will begin to decline until the end of the next decade. This analysis is confirmed by work from the ETB which is highlighted in Chart 3.2.

The ETB data analysis suggests that there will be a 14% decline in the young persons' population between 2010 and 2020. The work by HEPI also suggests that this will be particularly associated with those social groups who have the lowest participation rates in Higher Education, resulting in a less severe effect on student demand than would otherwise be the case. The demographic challenge over the next 15 years will mean that UK universities will have to manage an increase in student numbers followed by a reduction, though a lot less severe than first feared. As for government policy, the HEPI data calls into doubt the likelihood of the prospect of the UK achieving the 50% participation target by 2010.

Chart 3.2: Projected Changes in the 18-20 Year Old (under 21) Population, 2000 to 2020



Source: ETB analysis of ONS and Government Actuaries Department Population Estimates 2006

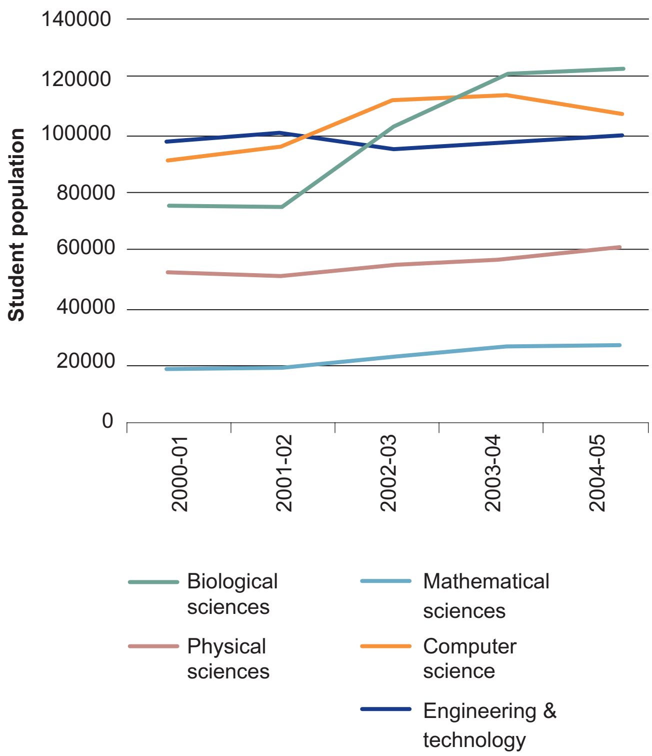
3.5 Trends within STEM Subjects

The last five years have seen an expansion in overall student numbers taking STEM subjects within UK Higher Education. STEM student numbers have increased by nearly 25% from 424,000 in 2001 to just under 529,000 in 2005. This shows that STEM is flourishing in comparison to the rest of the UK's Higher Education (over the same period the overall average increase in student population for all subjects was 15%). However, there are significant variations between subject groupings within STEM and differences in trends between levels of qualification.

Chart 3.3 indicates broad trends for the undergraduate population studying STEM subjects. It is worth noting that this data includes all undergraduate students, both home and foreign. For the purpose of this analysis the STEM subjects have been split in line with the JCAS codes used by both UCAS and the Higher Education Statistics Agency (HESA). This breaks STEM into five distinct subject groupings; biological sciences including all the life sciences; physical sciences including physics and chemistry; mathematical science, computer science including all the IT disciplines, and engineering and technology including all the traditional engineering disciplines and material science.

The expansion of these five main branches of STEM has varied over the last five years. The undergraduate student population for the biological sciences has grown by over 65% with student numbers expanding from 73,000 to over 121,000. Mathematical sciences have also seen a growth in student numbers of 53% up to just over 25,000 students. Steadier growth has been seen in the physical sciences with a growth of 16% and computer science has also seen a growth of 19% over the period, although over this period the subject has seen a massive rise and subsequent fall in student numbers. However, undergraduate student numbers in engineering and technology have been static with nearly 98,000 students in 2005. These figures highlight the massive growth in biological sciences over the recent period. It is encouraging to see the high growth in the mathematical sciences, albeit from a small base. Of more concern is the fact that engineering and technology, whilst maintaining a steady level of student numbers, does not appear to have enjoyed the growth in student numbers seen within other STEM subjects and in UK Higher Education more widely.

Chart 3.3: Undergraduate Student Population Studying in UK HE by STEM Subjects



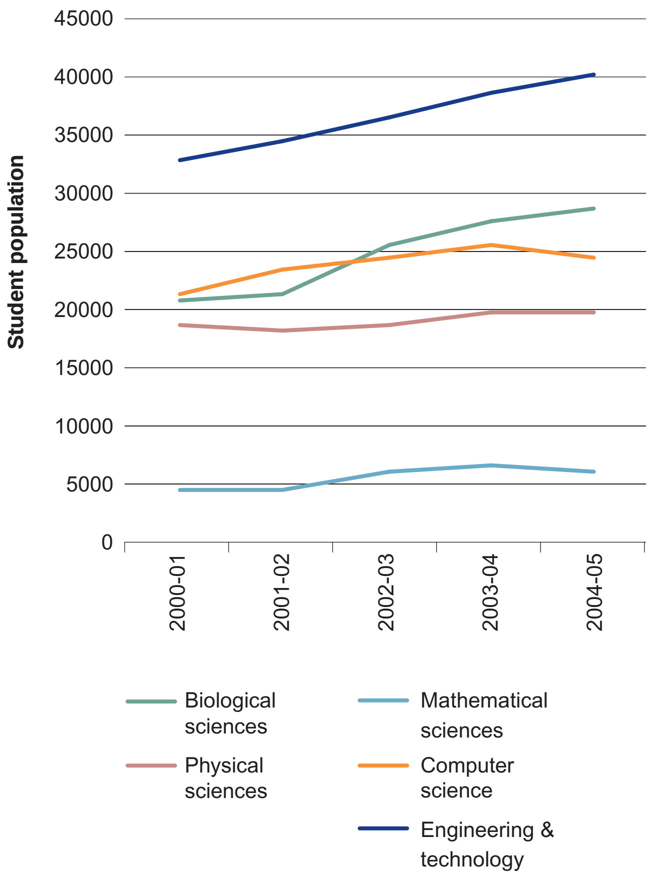
Source: HESA 2005

3.6 Postgraduate Participation in STEM

Chart 3.4 outlines the student postgraduate population amongst the five main STEM subject groupings. The picture for the STEM subjects at postgraduate level is quite different from that seen at undergraduate level. The biggest subject grouping by far is engineering and technology with just over 40,000 students, representing a 21% growth in student numbers over the last five years. The expansion in undergraduate student numbers in the biological sciences and mathematical sciences have also been matched at postgraduate level with the postgraduate student population increasing 37% and 49% respectively. It is worth noting that the physical sciences have had a relatively small increase in postgraduate student numbers at just under 7%. This compares to the overall growth of the postgraduate sector at 19%.

There is much anecdotal evidence to suggest that the majority of the students studying engineering and technology are non-UK students. This has major implications in terms of knowledge transfer and the ability of the UK Higher Education sector to provide the skills to meet the needs of the UK industry. The issue of foreign student participation will be examined in more detail in our comparative international analysis of STEM Higher Education (section 8).

Chart 3.4: Postgraduate Student Population Studying in UK HE by STEM subjects

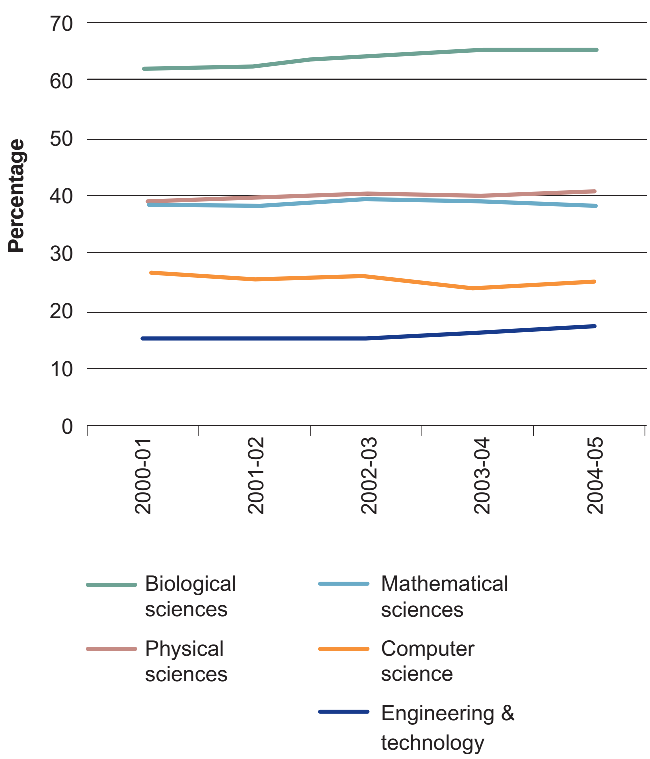


Source: HESA 2005

3.7 Female Participation in STEM

One of the key issues facing the STEM community is encouraging female participation to a level more representative of the UK population as a whole (the current participation of female students in Higher Education stands at 56%). In some cases, increasing the number of female students studying STEM courses may, in the future, be one of the main opportunities available to teaching departments to expand the numbers of students studying STEM courses. Nowhere is this more obvious than within engineering and technology where female participation hovers at just above 15%. This is highlighted in Chart 3.5 which outlines female student participation on all STEM courses in UK Higher Education.

Chart 3.5: Percentage of Female Students by STEM Subject in UK Higher Education



Source: HESA 2005

Clearly, STEM subjects have markedly different levels of female participation. On one extreme is engineering and technology at 15% participation. Computer science fares slightly better with 24%. At the other extreme are biological sciences with over 64% female participation. Mathematical sciences and physical sciences have mid levels of female participation at 38% and 41% respectively. One worrying aspect to the levels of female participation within the STEM subjects is the fact that participation levels have remained relatively static across all of STEM. This in itself suggests that attempts to increase the numbers of female students studying STEM subjects should be reviewed as they appear to have made little if any impact upon overall female participation in recent years.

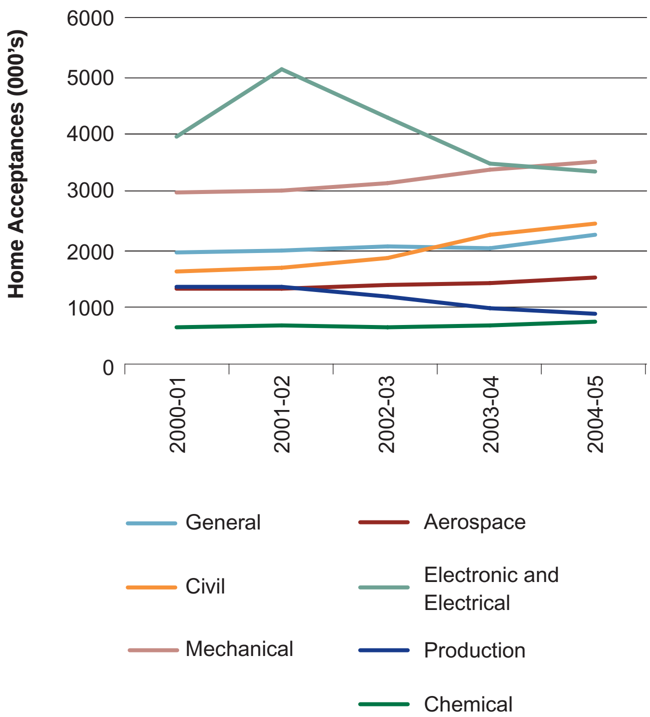
3.8 Individual Engineering Disciplines

As this report illustrates, one of the problems of looking at trends within STEM Higher Education is that specific differences between subjects are often disguised. Nowhere is this better illustrated than within engineering and technology where the various disciplines have experienced a range of trends over recent years. The following section begins with a look at acceptance rates onto engineering as a whole and then examines trends within each of the main branches of engineering.

3.81 Acceptance Rates on Engineering Courses

Engineering and technology as a whole has seen increases in home student numbers of 12% over the five year period, rising to 17,200. However the data suggests that new students are picking their particular engineering field based on future job opportunities; undergraduates are therefore becoming more selective about the type of engineering they follow. The collapse of the “dot-com” boom may have encouraged engineers to move away from electrical engineering and towards civil and mechanical engineering; areas with perceived benefits in terms of future employment and also reflecting expansion in demand for future skill requirements in those areas. This also may account for the sharp decline in electronic and electrical engineering entry from 5,110 in 2001 to 3,336 in 2005. If students are making their engineering course selection as part of long term career decisions then it may be likely that the numbers of students following general engineering courses will increase as students keep their options open. If this is to happen then there should be an increase in acceptances onto general engineering degree courses – a trend which according to the data is beginning to happen.

Chart 3.6: Home Acceptances onto Engineering Courses 2001-2005



Source: UCAS

The number of students accepted through UCAS to engineering and technology degree courses by discipline over the last five years is shown in Chart 3.6.

The trends in admission onto individual engineering disciplines vary. Civil engineering has been leading the way over the last five years with a 52% increase in acceptances to just under 2,500. Strong growth has also been seen in mechanical engineering (18%), chemical and process engineering (16%), general engineering (15%) and aerospace engineering (15%). One of the most striking trends is that of electrical & electronic engineering which saw a dramatic increase in acceptances to a peak in 2002.

However, since then they have dropped back significantly with a 35% decline in applications in the last five years; this contraction in demand may in part be in line with negative public perceptions associated with the IT industry and particularly the collapse of the "dot-com" boom of the late 1990s, or, as some allege, the increasing disparity between the demands of electronic engineering and the content of mathematics and physics A-levels. We will now look to the trends within each of the separate engineering disciplines.

3.82 Aerospace Engineering

Higher education in aerospace engineering has seen a 155% increase in home acceptances over the last five years, to a level just above 1,500 per year. The overall undergraduate population studying the subject has also increased by 37% to nearly 6,300. Healthy growth has also been seen in the postgraduate population studying aerospace engineering with 38% growth over five years to 1,300 in 2005.

Aerospace engineering	2004-2005	Annual Change	5 Year Change %
Home acceptances	1,522	7.8	14.7
Undergraduate population	6,260	4.8	37.4
Postgraduate population	1,345	3.8	37.6
Percentage of female students	10.1	-1.9	-13.3
Percentage of foreign students	23.1	25.4	14.3

Source: HESA, UCAS

The proportion of females studying aerospace engineering further declined by 2% to just over 10%, bringing it to a five year low; however this needs to be tempered by the fact that overall female student numbers have grown by 19% over the five year period. The percentage of foreign students studying the subject rose to just over 23%, a continuation of the increased trend in foreign students studying the subject.

3.83 Chemical, Process and Energy Engineering

Whilst the undergraduate population in chemical, process and energy engineering has fallen by just over 8% over the last five years, this has been offset by a 16% increase in home acceptances into the subject, with home acceptances at a record high since 2000 at 768. The increase in acceptances has been concentrated in 2005, suggesting that the undergraduate population should stop declining if current growth rates can be maintained.

Chemical, process & energy engineering	2004-2005	Annual Change	5 Year Change %
Home acceptances	768	11.5	16.4
Undergraduate population	3,500	5.9	-8.1
Postgraduate population	2,580	4.4	9.8
Percentage of female students	27.5	0.5	0.4
Percentage of foreign students	63.0	66.7	108

Source: HESA, UCAS

The postgraduate population has also increased by almost 10%. Increases in student numbers in this subject may have been influenced by the massive increase in foreign students studying the subject, reflected in a 108% increase in foreign student participation over the five years. The 63% figure for foreign students in 2005 is one of the highest seen within the engineering disciplines. Female participation in this subject group is, however, extremely strong relative to the rest of engineering at 27.5%.

3.84 Civil Engineering

Civil engineering has seen a massive increase in home acceptances over the last five years, with acceptances up by nearly 52% to just under 2,500 per year. This is reflected in an increase in the undergraduate population over the same period of 31%.

Civil engineering	2004-2005	Annual Change	5 Year Change %
Home acceptances	2,469	8.9	51.9
Undergraduate population	14,065	18.9	30.5
Postgraduate population	5,685	10.6	28.1
Percentage of female students	17.3	-6.6	1.0
Percentage of foreign students	41.8	38.2	23.9

Source: HESA, UCAS

The postgraduate population saw an increase of 28% over the last five years. Foreign student numbers are also on the increase to nearly 42% in 2005. The overall health of this branch of engineering appears to be good, perhaps reflecting the buoyant state of the UK construction and civil engineering labour market.

3.85 Electronic and Electrical Engineering

As the largest branch of engineering, electronic and electrical engineering has been an important measure of the health of the sector as a whole. However the last five years has seen a 16% decline in home acceptances to just over 3,300. This has led to a reduction in the undergraduate population of 6.4% over the last five years to just over 24,300.

Electronic & electrical engineering	2004-2005	Annual Change	5 Year Change %
Home acceptances	3,336	-3.8	-15.6
Undergraduate population	24,305	-4.9	-6.4
Postgraduate population	10,285	-3.0	3.1
Percentage of female students	12.0	-1.9	40.6
Percentage of foreign students	64.9	76.3	135.0

Source: HESA, UCAS

On a more positive note, the postgraduate population increased over the five year period by 3% to 10,300. Whilst the focus for concern in this subject area should be the falling numbers of undergraduate students, of equal concern is the high proportion of foreign students which increased by 135% over the five year period with nearly 65% of students being from outside the UK.

3.86 General Engineering

There is anecdotal evidence that the uptake of general engineering courses in the UK is increasing. This has been reflected by the fact that over the last five years, home acceptances have increased by 15%, to over 2,200.

General engineering	2004-2005	Annual Change	5 Year Change %
Home acceptances	2,245	11.4	14.8
Undergraduate population	14,295	-2.5	10.5
Postgraduate population	7,085	3.3	22.5
Percentage of female students	13.8	3.7	-3.4
Percentage of foreign students	37.8	63.2	80.7

Source: HESA, UCAS

The postgraduate population and percentage of foreign students studying general engineering has also increased by 23% and 81% respectively. Unfortunately the 4% increase in the percentage of female students last year was insufficient to off-set the five year declining trend. The current percentage of female students is at just under 14%.

3.87 Mechanical Engineering

Mechanical engineering has seen an 18% increase in home acceptances over the last five years to just over 3,500. However, this has had only a limited impact on the undergraduate population which has remained relatively static over the same period, at 17,300.

Mechanical engineering	2004-2005	Annual Change	5 Year Change %
Home acceptances	3,515	3.8	17.8
Undergraduate population	17,280	4.5	-0.1
Postgraduate population	3,935	2.0	-2.3
Percentage of female students	8.4	-1.4	0.6
Percentage of foreign students	34.3	40.8	59.1

Source: HESA, UCAS

The postgraduate population in mechanical engineering saw a slight reduction of 2.3% over the last five years to just under 4,000. Mechanical engineering saw a significant increase in the percentage of foreign students reaching 60% in 2005. It is worth noting that the proportion of female students at over 8% is the lowest female participation rate across the branches of engineering.

3.88 Production and Manufacturing Engineering

Production and manufacturing engineering has seen declining home acceptances, undergraduate and postgraduate populations. These have all fallen by 35%, 38% and 28% respectively.

Production & manufacturing engineering	2004-2005	Annual Change	5 Year Change %
Home acceptances	899	-8.3	-34.5
Undergraduate population	5,265	-14.0	-38.4
Postgraduate population	2,715	-13.5	-28.4
Percentage of female students	15.6	2.8	15.9
Percentage of foreign students	37.2	48.7	131.2

Source: HESA, UCAS

Over the same period the percentage of foreign students increased to nearly 16%. The picture painted here for this subject area is not too healthy; the statistics indicate a subject in decline perhaps reflecting the long term decline of the manufacturing industry in the UK.

3.9 Summary and Conclusions

> In 2005 there were over 330 institutions offering Higher Education courses in the UK with over 306,000 undergraduate degree awards being made during the year; 85,000 of these were awarded in the STEM subject areas.

> Nearly 120,000 postgraduate degrees were awarded at masters and doctoral level in 2005; 34,000 being awarded in STEM subjects.

> The last five years has seen an expansion in overall student numbers taking STEM subjects within the UK Higher Education system. STEM student numbers have increased by nearly 25% from 424,000 in 2001 to just under 529,000 in 2005.

> Engineering and technology as a whole has seen increases in home student numbers of 12% over the past five years, rising to 17,200 home acceptances in 2005.

4. Graduate Recruitment

The interface between the supply and demand of graduate engineers takes place when graduates enter the workplace. This section examines trends relating to engineering graduates after they leave Higher Education and enter the workforce. The analysis also looks at where graduates work and what salaries they are likely to earn.

4.1 Expansion in Higher Education

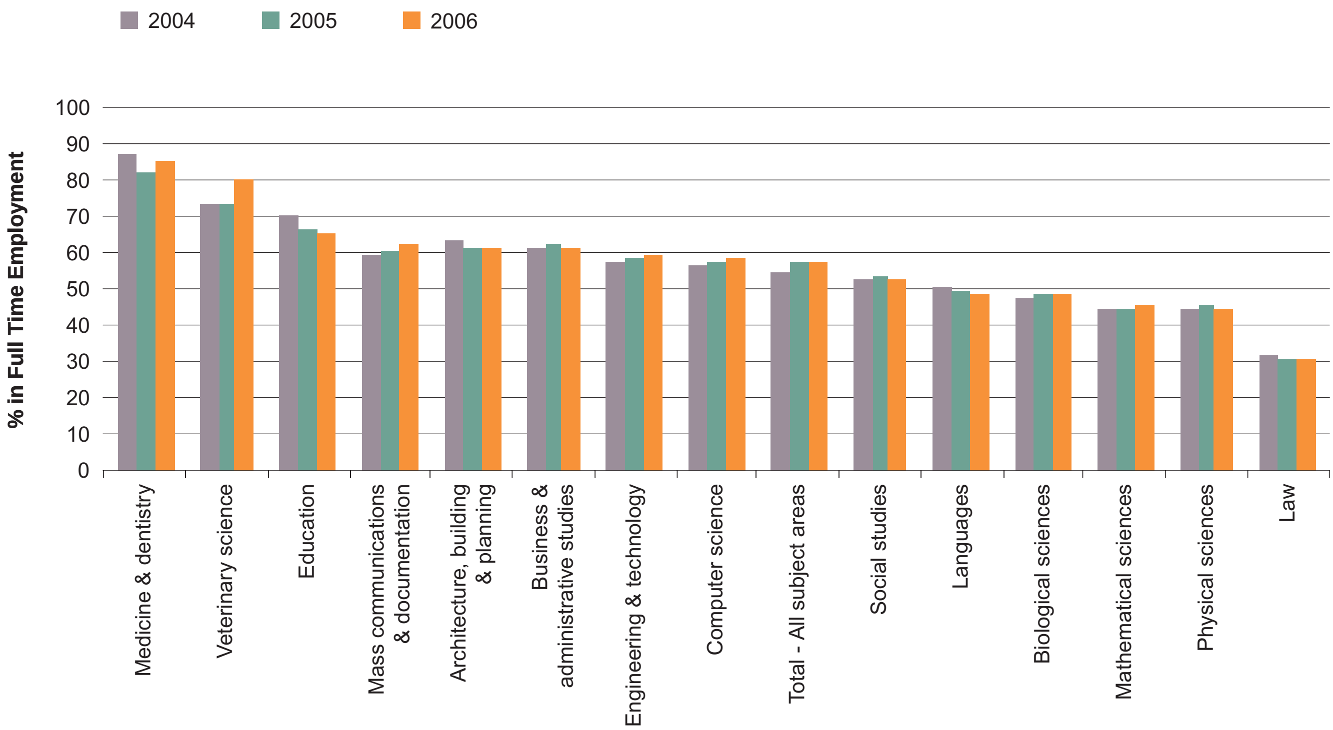
The rapid expansion in Higher Education during the last decade, together with a shift to a more open and diverse HE system has created a wide range of choice for potential students. It has also posed challenges to universities and colleges in their marketing and recruitment. Students are increasingly seen as customers with individual needs and preferences and there is consequently a competitive market for HE. Selection of a Higher Education institution to enhance future employment prospects is becoming a more important factor in applicants' minds, particularly as the perception, and frequently the reality, of student debt increases. The employment prospects of science, technology engineering and mathematics (STEM) students are an important issue for both HE and British industry. For the HE sector, the graduate employment market can be seen as an important performance indicator on its ability to supply talent for British industry; the role of universities is vital in providing sufficient numbers of appropriately trained graduates to meet the demand of the UK industry. It is important that the patterns of graduate recruitment facing STEM students are captured and recorded so that long term trends relating to graduate recruitment can be benchmarked.

This section provides a perspective on the demand-side of the STEM skills agenda by examining the trends facing graduates after they leave HE and enter the world of employment. The section begins by setting out some of the main findings from the latest version of the graduate "Destinations of Leavers from Higher Education" survey, published annually by the Higher Education Statistics Agency (HESA). This looks in particular at where STEM graduates work in the UK economy. The second half of the section examines some of the data published by HESA and the Association of Graduate Recruiters (AGR), on salaries and working conditions of STEM graduates.

4.2 Destination of Leavers from Higher Education Survey

Produced by HESA, the Destinations of Leavers from Higher Education (DLHE) survey looks at the employment status of graduates six months after the end of their studies. The study looks to sample both undergraduates and postgraduates. In the most recent study published in June 2006 the results from the 2004/05 cohort are presented; the study received over 250,000 responses from full time students, up 10,000 since 2003. This represented a response rate of over 80% from full time postgraduate and undergraduate students. The full time employment rate of the undergraduates in January 2006 for the cohorts of 2002/03, 2003/04 and 2004/05 are detailed in Chart 4.1. For the cohort of 2004/05, the highest employment rate is seen in medicine and dentistry (86%), a 3% improvement on the 2003/04 cohort. Veterinary science (80%) and education (66%) also saw high levels of employment which is not surprising due to the vocational nature of these courses. At the other end of the scale, law has the lowest employment ratio at 31% for the third consecutive year, with languages, biological sciences, mathematical sciences and physical sciences all with employment rates lower than 50%. It is worth noting that law is a special case in this analysis; many law graduates go directly onto low paid training contracts or take part in legal practice courses, lowering the employment levels for law students.

Chart 4.1: Percentage of Students in Full Time Employment by Subject 6 Months after Study

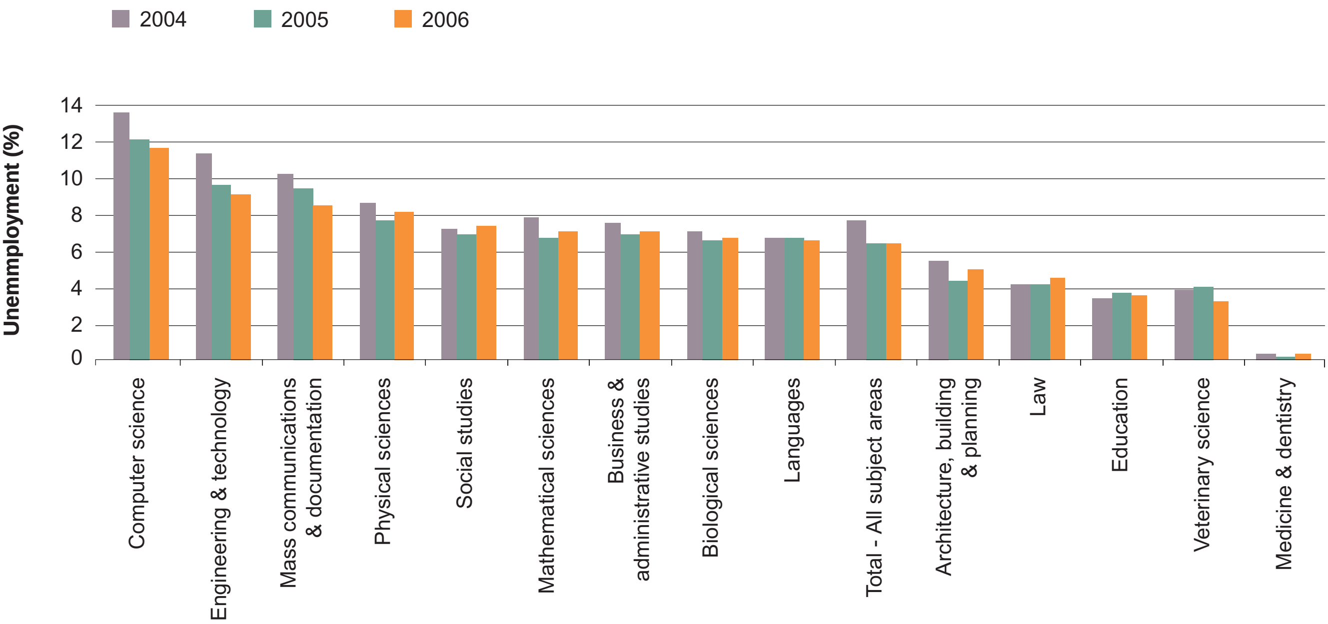


Source: HESA (2006)

With employment rates increasing annually for engineering and technology (60%) and computer science (58%), both of these applied subjects stand above average for all subject areas of 55%. However it must be stressed that these figures for full time education per subject do not take into account the number of students carrying on to full time study and those in voluntary / unpaid work. An alternative measure is to look at unemployment rates by subject. This is shown in Chart 4.2, here the picture is less positive for computer science (11%) and engineering and technology (9%), with both subjects having the highest levels of unemployment. Physical sciences still has an 8% level of unemployment despite improvements in 2004.

At the other end of the spectrum, medicine and dentistry have an unemployment level of 0.2% with veterinary science having a similarly low rate of below 3%. Generally, there is a trend of declining unemployment rates since 2003 in all subjects, with the exception of social studies and law. One would expect a positive relationship between high employment rates and low unemployment rates as seen in subjects like medicine. On the other hand, there are subjects like engineering and technology and computer science which have above average employment rates but a high unemployment rate. It is clear that the interaction between employment rates and unemployment rates require further study.

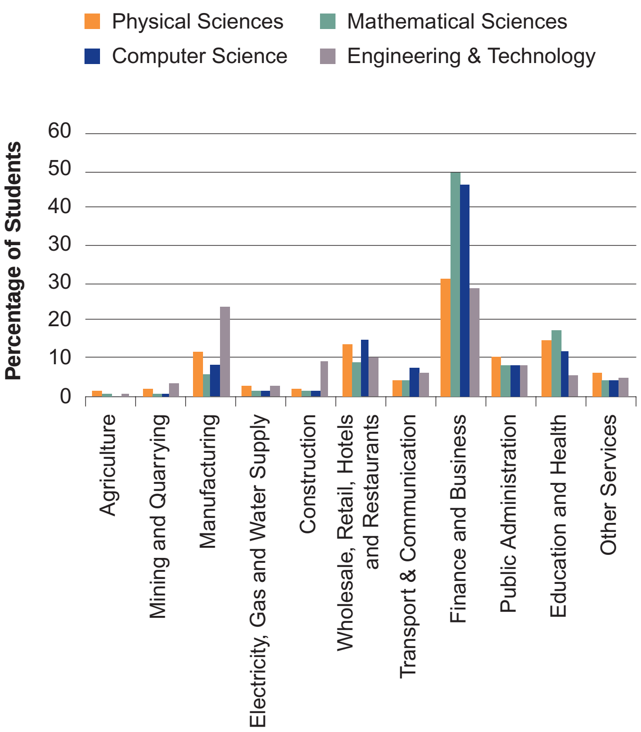
Chart 4.2: Unemployment Rate by Subject 6 Months after Study



Source: HESA (2006)

One type of analysis of the Destinations of Leavers from Higher Education data is to examine graduate destinations by subject in line with the Standard Industrial Classification (SIC) codes. This allows analysis of where in the economy graduates are working and we can compare the distribution of graduates from different subject areas. The breakdown of first degree completions by SIC code is outlined in Chart 4.3.

Chart 4.3: Destinations of First Degree Holders by Standard Industrial Classification (SIC) 6 Months after Study



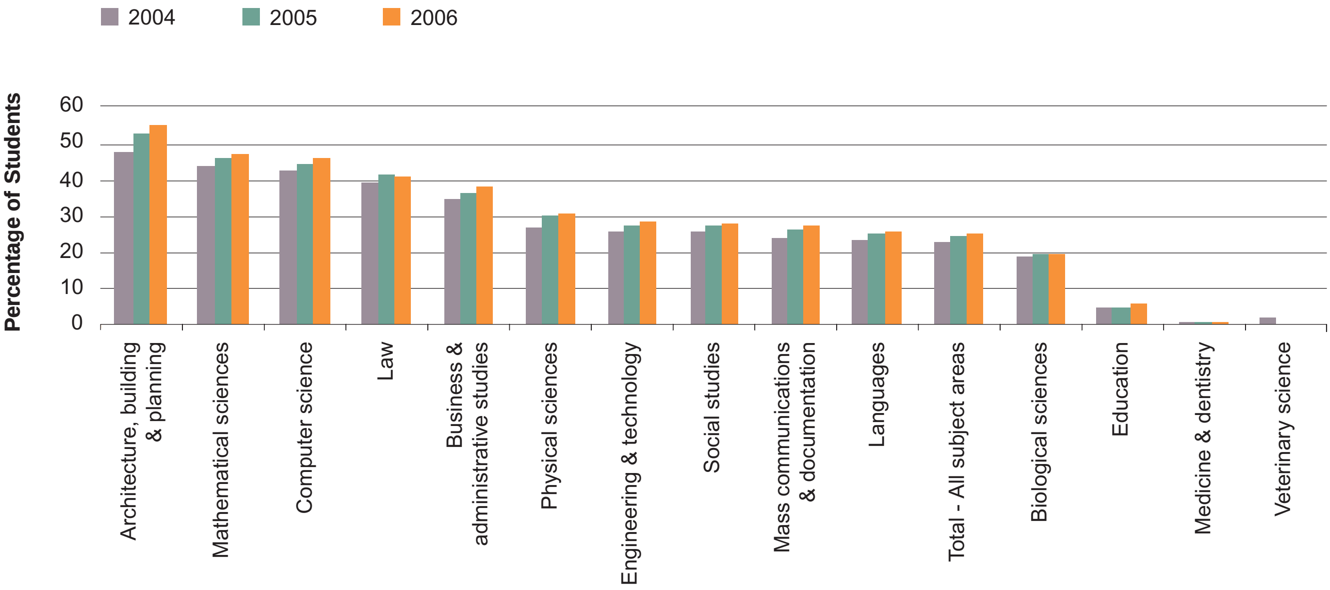
Source: HESA (2006)

The destinations breakdown for STEM subject areas shows a diverse picture across the subjects. Engineering and technology see the largest percentage of graduates working in finance and business (28%), with the second largest group working in manufacturing (24%). This compares to the situation for computer science where 46% of graduates work in finance and business. Physical sciences weigh in with 31% in the same part of the economy and mathematical sciences with over 50%.

The high percentage of STEM undergraduates entering finance and business is a major feature of our SIC analysis of the Destination of Leavers from Higher Education survey and is an issue which requires more investigation. Chart 4.4 looks at the percentage of students going into finance and business from various subject groupings over the last 3 years. Architecture, building and planning have the highest ratio of graduates working in finance and business with 55%. This is followed by mathematical sciences at 47% and computer science with 46% – all of these subjects have followed this trend for the past three consecutive years.

There has long been a view that there has been a drain on STEM graduates towards finance and business – a feature of the fact that finance and business firms value the analytical and mathematical skills inherent in STEM graduates. This trend is supported by the fact that a large proportion of mathematics and computer science graduates go into finance and business occupations. However a much lower percentage of graduates from physical sciences (31%) and engineering and technology (28%) go into finance and business. This is in the mid range of graduates entering finance and business, with the average for all subjects being at just under 25%. It should be noted that one feature of the uptake of work in finance and business is the fact that the sector employs people from all subject areas and this has been increasing since 2003. Whilst engineering and technology sees 28% of its graduates entering the field, it is similar for social studies students (28%) and mass communication and documentation students (27%); the drain to finance and business is not a phenomenon specific to engineering and technology.

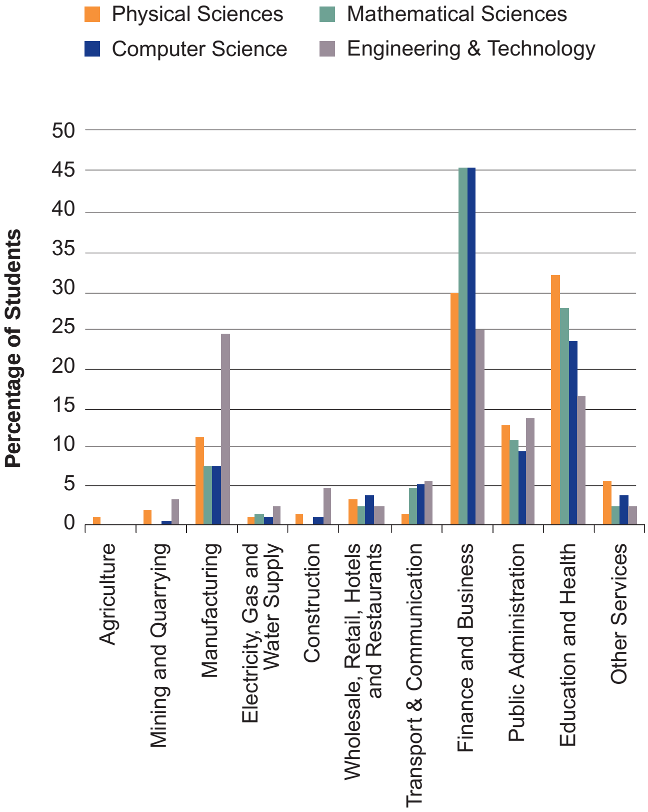
Chart 4.4: Percentage of All Students Going Into Finance and Business by University Subject 6 Months after Study



Source: HESA (2006)

Analysis of postgraduate destinations provides a similar story for engineering and technology, and is shown in Chart 4.5; with 25% of engineering and technology postgraduates going on to work in finance and business and 24% working in manufacturing, a situation not wholly dissimilar to that seen at undergraduate level.

Chart 4.5: Destinations of Postgraduate Degree Holders by Standard Industrial Classification (SIC) 6 Months after Study

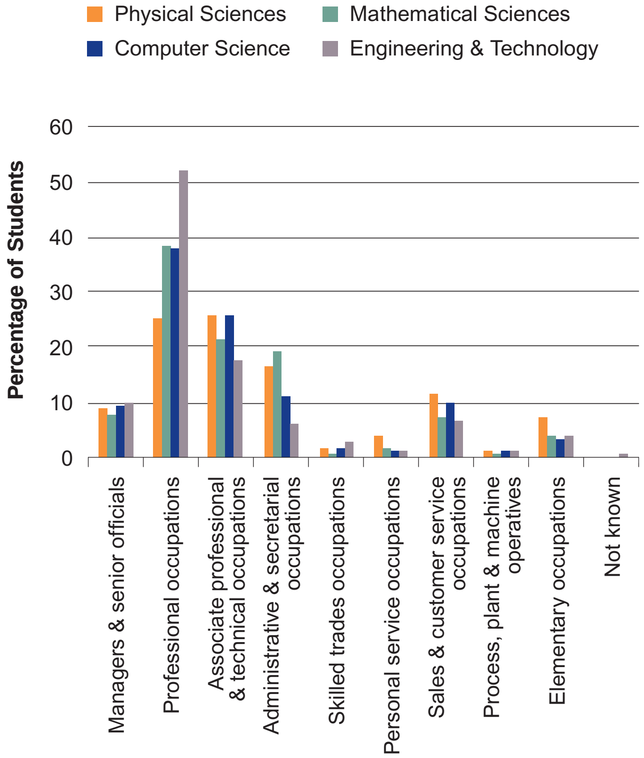


Source: HESA (2006)

It must be noted, however, that the situation is slightly different at postgraduate level for the physical and mathematical sciences. In both these cases there is still a heavy bias towards work in finance and business (physical sciences at 29% and mathematical sciences at 45%), but with a large percentage of postgraduates staying on in academia – this is reflected in the figures for education and health of 31% for physical sciences and 27% for mathematical sciences.

Our analysis of destination data needs to be put into more detailed context than that offered solely by SIC codes. Whilst SIC codes inform us of what type of industry an individual is working in, they tell us little about the type of role the individual plays within that industry. There may be, for example, engineers working in parts of the economy not readily associated with engineering, i.e. SIC code analysis would always classify an engineer working at a retailer as working in retail. Further analysis through the use of Standard Occupational Codes (SOC), allows us to look at the same data from an occupational perspective. This permits an analysis of the extent to which graduates are employed as engineers. The SOC breakdown for first degree STEM students is outlined in Chart 4.6.

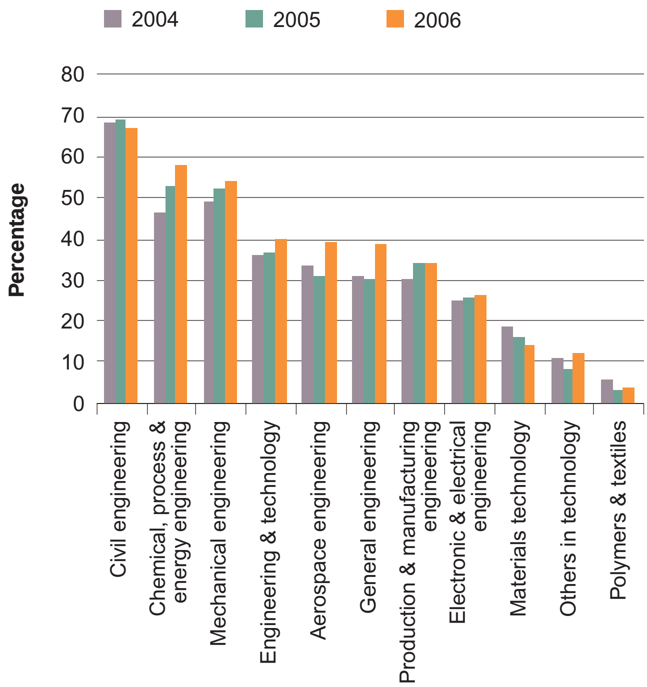
Chart 4.6: Destinations of First Degree Holders by Standard Occupational Classification (SOC) 6 Months after Study



Source: HESA (2006)

It is obvious from the SOC code analysis that professional occupations are the primary destination for STEM students – it is not surprising to see that engineering and technology has just fewer than 52% of its students going into professional occupations. Computer science and mathematical sciences also have a heavy bias into the professional occupations with both registering around 38%. It is interesting that physical sciences have a three way split between professional, associate and administrative occupations. Further analysis of SOC codes for engineering and technology can tell us about differences in the separate branches of engineering. This is displayed in Chart 4.7, which outlines the percentage of students from each branch of engineering who go on to become professional engineers.

Chart 4.7: Percentage of Engineering Graduates Who Move Into Professional Engineering by Discipline 6 Months after Study



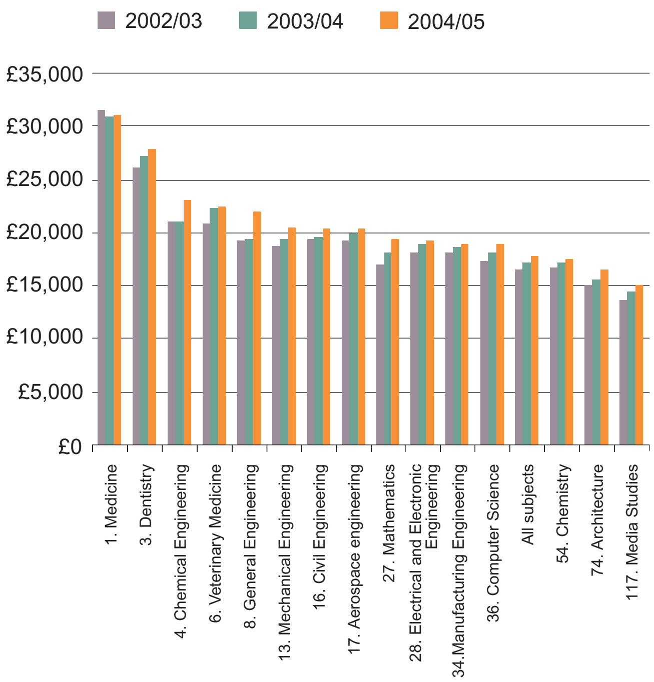
Source: HESA (2006)

The propensity of graduates to enter professional engineering differs across the engineering world. Civil engineering, for instance, has an extremely high rate of career progression with nearly 70% of civil engineering graduates working as professional engineers 6 months after graduation. Chemical engineering with 58% and mechanical engineering with 54% also see over 50% of their graduates going into the profession. It is a concern, however, that electronic and electrical engineering sees only a quarter of its graduates moving onto professional engineering careers. The interaction of graduates and industry demand requires further work as the level of progression from graduate to professional engineer is dependant upon industry demand for graduates. It is likely that the low percentage of electronic and electrical engineers who work as professional engineers is a function of low demand for graduates from electronics firms. In addition, the already low proportions of materials technology students (14%) and polymers and textiles students (4%) in professional engineering careers have further decreased.

4.3 Graduate Starting Salaries

One of the main drivers behind graduate recruitment trends are initial starting salaries. Chart 4.8 outlines the starting salaries of graduates from different university courses from 2002/03 to 2004/05. This data shows what salaries graduates are earning on average, regardless of where in the economy they are working.

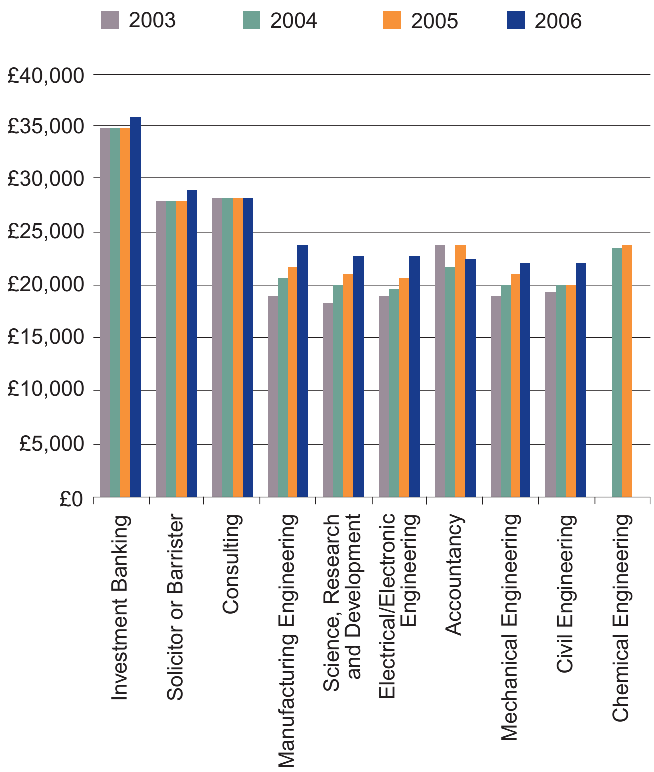
Chart 4.8: What Do Graduates Earn? By Subject 6 Months after Study



Source: HESA Higher Education Institutions' Survey 2002/03 to 2004/05

Medicine and dentistry topped the group for yet another year, with starting salaries of £31,000 and £28,000 respectively. A striking feature of the data is the fact that 5 out of the top 17 salaries are attributed to engineering courses, with chemical engineering leading the way in fourth place with an average salary of just below £23,000, up £1000 from 2003/04. General, mechanical, civil and aerospace engineering starting salaries also rose to a level above £20,000. Thus, they stand well above the average graduate starting salary of £17,700. This graphic contains data from all students who finished each degree – it may well be the case that some of the engineering graduates are working in other areas. Data published by the AGR is useful in that it gives us an indication of the starting salaries of different professions within larger graduate employers. This is outlined in Chart 4.9.

Chart 4.9: Median Graduate Starting Salaries



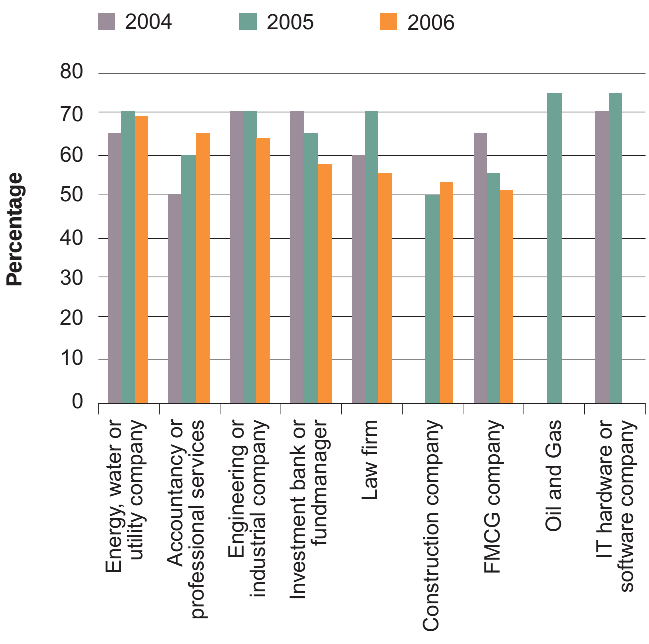
Source: Association of Graduate Recruiters 2006

In the AGR analysis of graduate starting salaries, engineering does not perform as well compared to the HESA data. In 2006, manufacturing engineering leads the engineering disciplines with salaries at £24,000, but this is well below the starting salaries of investment banking at £36,000 and solicitors or consulting salaries at £29,000. In fact the lowest salaries offered by engineering firms are for civil engineering graduates, earning an average of £22,000. Nevertheless, all engineering starting salaries appear to be increasing annually.

4.4 Graduate Retention Rates

The AGR also look at the issue of graduate retention rates and salary levels five years after initial recruitment. These are outlined in Charts 4.10 and 4.11. Their data on retention rates for 2006 puts engineering at 64%, only slightly lower than the best levels of 69% retention seen in energy, water or utility companies and 65% in accountancy firms. The lowest retention rates are within FMCG companies at 51% and construction companies at 53% (it must be noted that the job market for construction graduates is particularly fluid, so it is not surprising that they have a low level of graduate retention).

Chart 4.10: Retention Rates for Graduates 5 Years after Recruitment

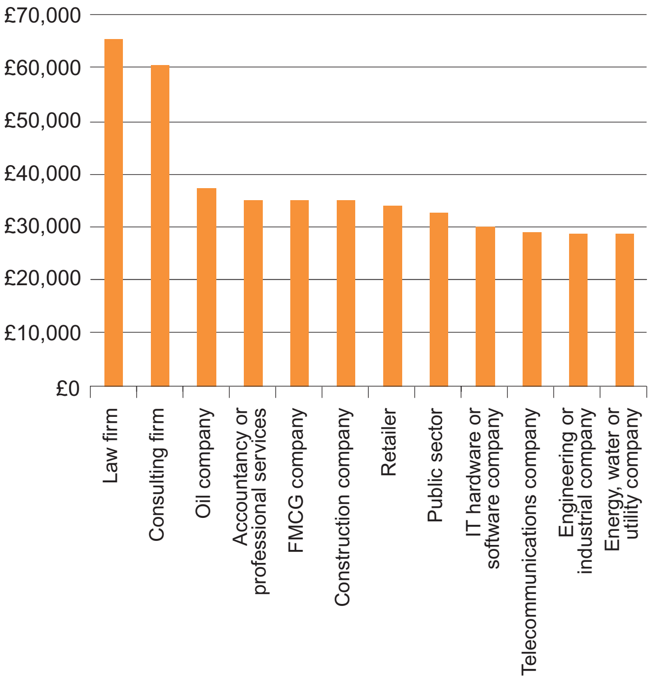


Source: Association of Graduate Recruiters 2006

4.5 Long Term Graduate Salary Levels

The salary rates of those recruited for five years do not appear to show engineering salaries to be catching up with other graduate salaries. Whilst engineering salaries have increased to an average of £28,500 over this period, this is well below salary levels for those working in law firms and consulting firms (over £60,000) and below the £35,000 level for salaries in the oil, professional services and construction sectors.

Chart 4.11: Current Salaries Paid To Graduates Employed 5 Years Ago



Source: Association of Graduate Recruiters 2005

4.6 Summary and Conclusions

> The destination breakdown for SET shows a diverse picture across the subjects. Engineering and technology see the largest percentage of graduates working in finance and business (28%), with the second largest group working in manufacturing (24%).

> Whilst engineering and technology sees 28% of its graduates entering the finance and business field, it is similar for social studies graduates (28%) and mass communication and documentation graduates (27%); the drain to finance and business is not a phenomenon specific to engineering and technology.

> The propensity of graduates to enter careers in professional engineering differs across the engineering disciplines.

> A striking feature of the data is the fact that 5 out of the top 17 graduate salaries are attributed to engineering disciplines, with chemical engineering leading the way in third place with an average salary of just below £23,000.

> Analysis of graduate starting salaries from the AGR shows that engineering does not perform as well as other graduate professions, amongst the membership of the AGR.

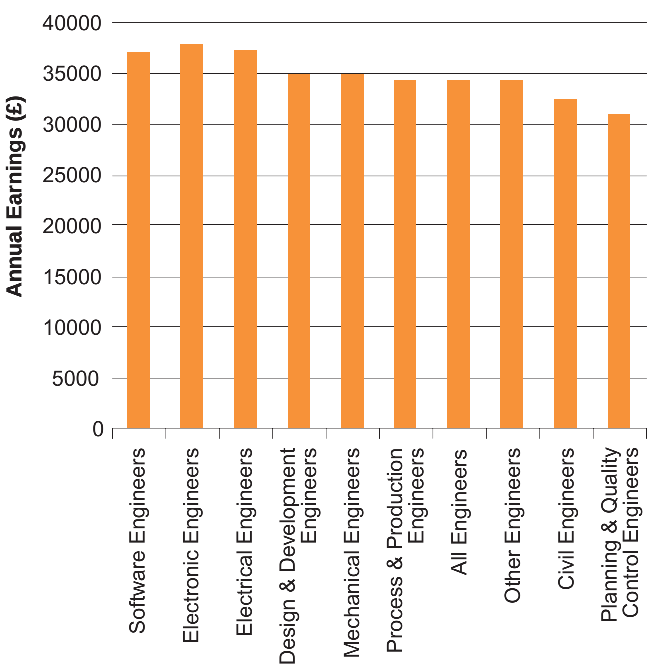
5. Engineering Salary Levels

The subject of salary levels is a topic close to the heart of all within the engineering profession and is often the cause of much debate. Traditionally there has been a widely held view that engineers are underpaid and this section attempts to assess whether this is the case.

5.1 New Earnings Survey

Information on the earnings of the UK workforce was collected in the UK in the New Earnings Survey (NES), published by the Office for National Statistics (ONS) in 2003. The published details from the January 2003 New Earnings Survey are given in Chart 5.1 and Chart 5.2.

Chart 5.1: Engineering Salaries from the New Earnings Survey

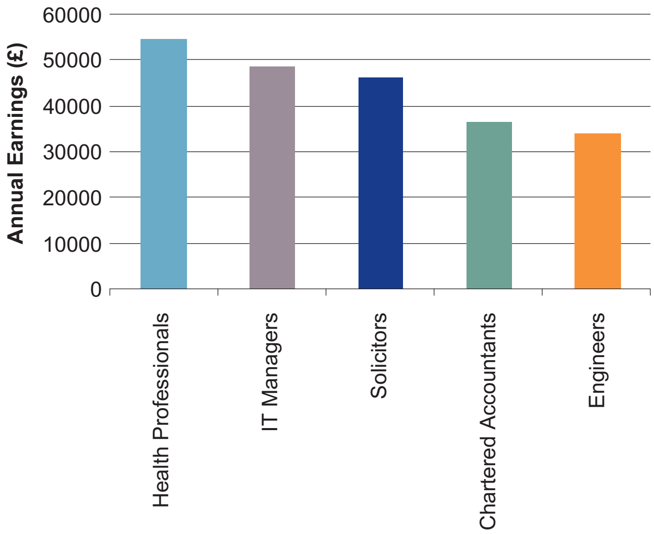


Source: New Earning Survey, ONS (2002)

According to the data presented in Chart 5.1 the average annual gross earnings of professional engineers was £33,300 at the end of 2002. For the purposes of the exercise the data collected focused on the salaries of “professional engineers” – graduates working with skills they have acquired whilst at university.

It is worth noting that there was a spread in the earnings of engineers from software engineers (£37,100) to planning and quality control engineers (£29,100). Chart 5.2 compares the aggregate salary for professional engineers against a number of other professions. Health professionals head the list with average salaries of £54,000, solicitors come in with £45,600, and chartered accountants come in at £36,200. In comparison, engineering salaries average at £33,300.

Chart 5.2: New Earnings Survey – Comparison of Salaries of Main Professions

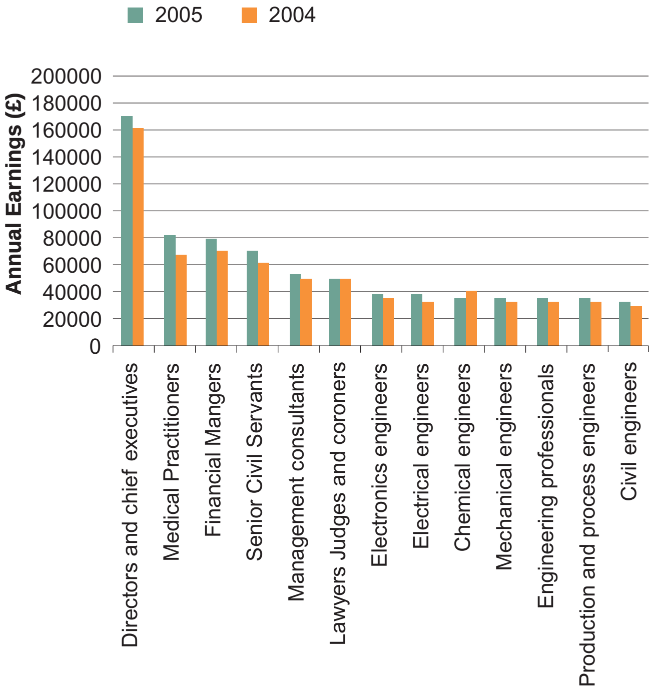


Source: New Earning Survey, ONS (2002)

5.2 More Recent Data from ONS

More recent data on salaries has been published by ONS in 2006. This data follows on from work on the New Earnings Survey and provides a snapshot of salary levels across the UK economy. Chart 5.3 details the average annual earnings of the main branches of engineering in comparison with the main professions.

Chart 5.3: Median Annual Earnings of Main Professions



Source: ETB analysis of ONS (2006)

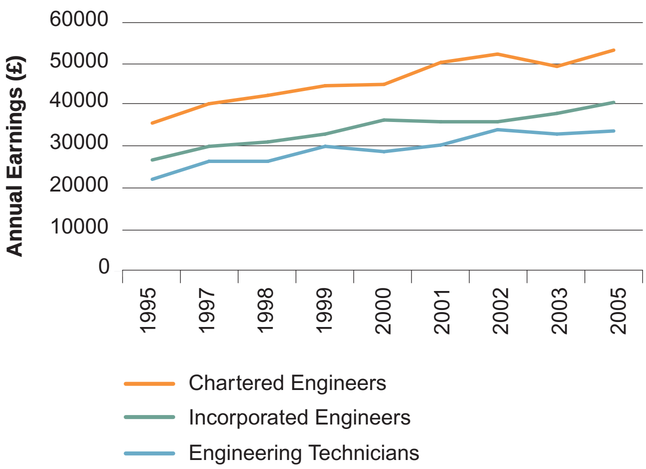
The data illustrates the fact that engineering salaries fall behind the other main professions. Leading the way are directors and chief executives with median salaries of nearly £172,000, medical practitioners at £82,000, financial managers at £80,000 and management consultants at £53,000. Engineering in comparison has much lower salaries with electronics engineers featuring at £38,000, chemical engineers at £36,000 and mechanical engineers at £36,000. Civil engineers rank as the lowest paid engineering profession with median salaries in 2005 of just under £33,000.

5.3 ETB Survey of Registered Engineers

The engineering salary level of £33,300 outlined in the NES does not present the most positive picture of salary levels for professional engineers. The more recent data published by ONS goes some of the way to creating a better understanding of current salary levels, however, both ONS pieces of data contrast with that presented in the Engineering and Technology Board 2005 Survey of Registered Engineers, which shows the average annual gross earnings for registered Chartered Engineers in 2005 at £53,100 (this has risen from £49,100 for 2003). This rather large difference between the new earnings survey national data and the survey response from the profession could stem from a number of causes. One primary cause could relate to the age profile of those surveyed by the ETB – registration as a professional engineer can happen at a later stage in a person's career. The data contained in the NES includes newly qualified engineers who are years away from professional registration. However, it is clear that whatever the cause, registered engineers earn considerably more than the national average for the engineering profession. The full salary data from the ETB 2005 Survey of Registered Engineers builds upon salary surveys that were carried out by the Engineering Council UK.

The headline salary figures for average and median earnings of registered engineers and technicians, over the period 1995-2005 are shown graphically in Charts 5.4 and 5.5. The average (mean) Chartered Engineer salary was £53,100 (up from £49,100 in 2003), while for Incorporated Engineers it was £40,500 up from £37,800 in 2003. Engineering Technicians' average salary is now £33,800 an increase from the 2003 figure of £33,000.

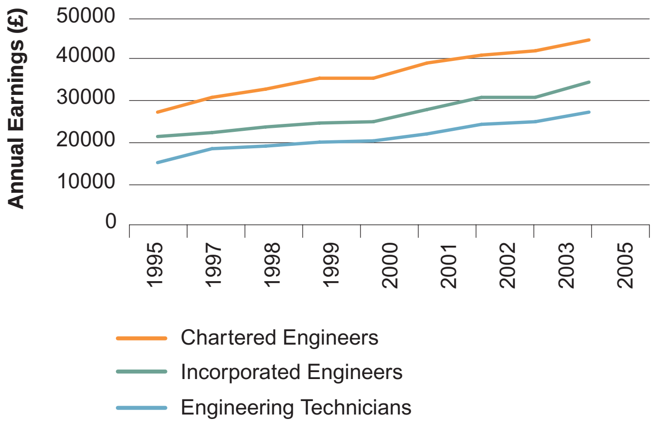
Chart 5.4: Average Annual Earnings of Registered Engineers and Technicians



Source: The Engineering and Technology Board (2005)

The figure for 2005 for Chartered Engineer salaries is a reversal of the trend in 2003 where the survey noted that salaries had actually fallen in real terms. Median salary levels are included in Chart 5.5. As such they provide a better measure on salary levels as they are not subject to salary increases at the extremes of the salary scales.

Chart 5.5: Median Annual Earnings of Registered Engineers and Technicians



Source: The Engineering and Technology Board (2005)

The median Chartered Engineer salary in 2005 was £45,500 (up from £43,500 in 2003), while for Incorporated Engineers it was £37,000 up from £34,000 in 2003. Engineering Technicians' average salary is now £31,000 an increase from the 2003 figure of £29,000. Salary figures published in the 2005 survey of registered engineers compare favourably with some other professions such as architecture. Figures published by the Royal Institute of British Architects (RIBA) show that over the year to April 2003, its members had median earnings of £35,000. This compares directly to the Chartered Engineer median salary of £43,500 for the same time period.

5.4 Summary and Conclusions

> According to ONS data the average annual gross earnings of professional engineers was £33,300 at the end of 2002.

> More recent ONS salary data shows that the engineering profession are paid significantly lower salaries than other professions.

> The negative salary situation contrasts to data presented in the Engineering and Technology Board 2005 Survey of Registered Engineers, which put the average annual gross earnings for registered Chartered Engineers in 2005 at £53,100.

> The median Chartered Engineer salary in 2005 was £45,500 (up from £43,500 in 2003).

> Figures published by the Royal Institute of British Architects (RIBA) show that over the year to April 2003, its members had median earnings of £35,000. This compares directly to the Chartered Engineer median salary of £43,500 for the same time period.

6. Professional Registration

Registration of professional engineers and technicians in the UK is an important market-clearing mechanism, enabling employers to identify competent professional engineers and distinguishing those who meet nationally agreed standards. Registration contributes to maintaining and advancing the status and prestige of UK engineering. This section looks at trends in the uptake of professional registration. The material is sourced from the Engineering Council UK (EC^{UK}) register of professional engineers and engineering technicians.

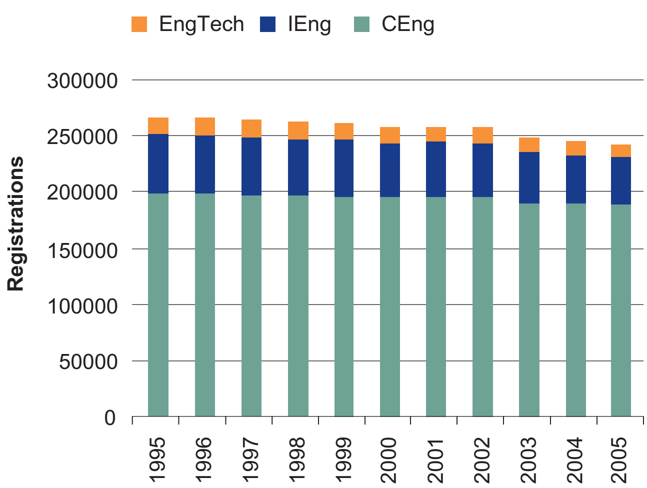
6.1 The EC^{UK} Register of Engineers

The Engineering Council UK (EC^{UK}) maintains the UK national register of professional engineers and technicians. By 31 December 2005 there were 36 professional engineering institutions licensed by EC^{UK} to submit for registration those of their members who met the UK standard. To gain registration, individuals must demonstrate competence underwritten by education, training and responsible experience, as set out in UK Standard for Professional Engineering Competence (UK-SPEC). Subject to licence, institution members can be entered in one of three categories on the register: Chartered Engineer, Incorporated Engineer and Engineering Technician.

6.2 Registered Engineers

The total number of registered engineers and technicians for each of the last ten years is outlined in Chart 6.1. The total number of registrations has declined from just over 267,100 in 1995 to just over 243,000 in 2005, representing a fall of 9.0% over the decade.

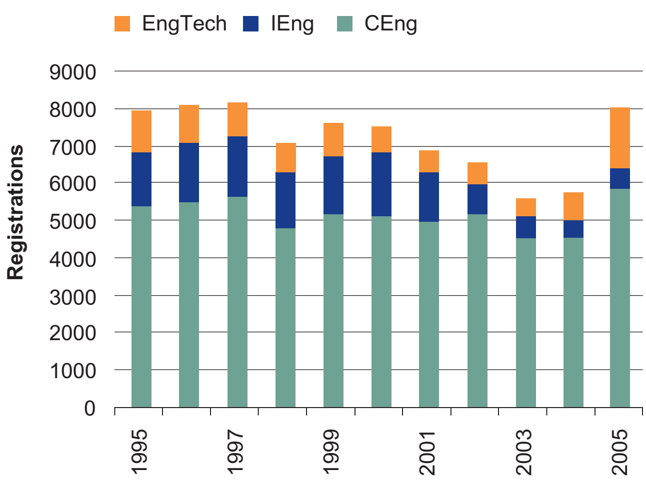
Chart 6.1: Total Registrations



Source: EC[UK]

Chart 6.1 also details the breakdown between the three categories of registration. The majority of those registered with EC[UK] are Chartered Engineers. Over the last ten years, the numbers registered have fallen from 198,100 to 188,400 by the end of 2005, representing a fall of 4.9% over the last ten years. Larger declines have been recorded on the other two categories of registrant. At the end of 1995 there were 53,300 Incorporated Engineers but by the end of 2005 there were 41,600. This represents a fall of 21.9%. At the end of 1994 there were 15,800 Engineering Technicians but by the end of 2005 there were 3,100, a fall of 17.0% over ten years. Chart 6.2 shows the numbers of new additions to the Register annually for the last decade.

Chart 6.2: New Registrations



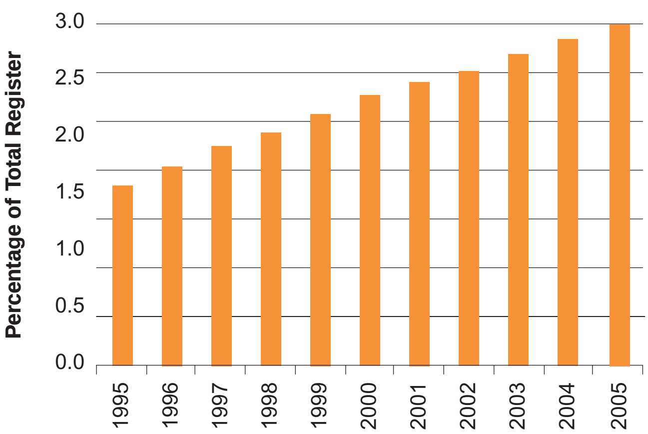
Source: EC[UK]

The picture outlined is one of falling new registrations in the last decade amongst all three categories of registration. However, the last two years have seen increases in new registrations to just under 5,800 in 2004 and just over 8,000 in 2005. Whilst 2 years of growth is not the basis for long-term predictions for an expanding market in new registrations, it is a welcome development and a halt in the 4 year decline in new registrations seen in between 1999 and 2003.

6.3 Female Registrations

Chart 6.3 shows the percentage of female registrants over the last decade.

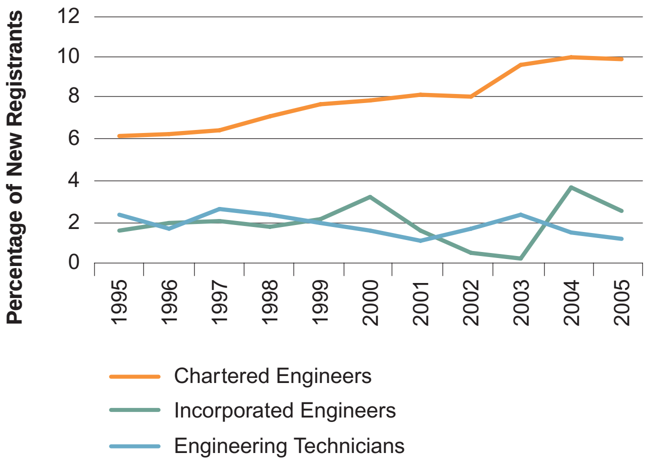
Chart 6.3: Number of Female Registered Engineers



Source: ECUK

Encouragingly, the trend is a positive one with an increase from 1.6% in 1995 to 3.0% in 2005, although it must be stressed that this increase must be put into perspective; female registrations are starting from an extremely low base. Chart 6.4 looks at the percentage of females as a percentage of new registrations. Here the trend is more positive with increasing numbers of women choosing to seek professional registration, particularly at Chartered level.

Chart 6.4: Percentage of New Registrants Who Are Women



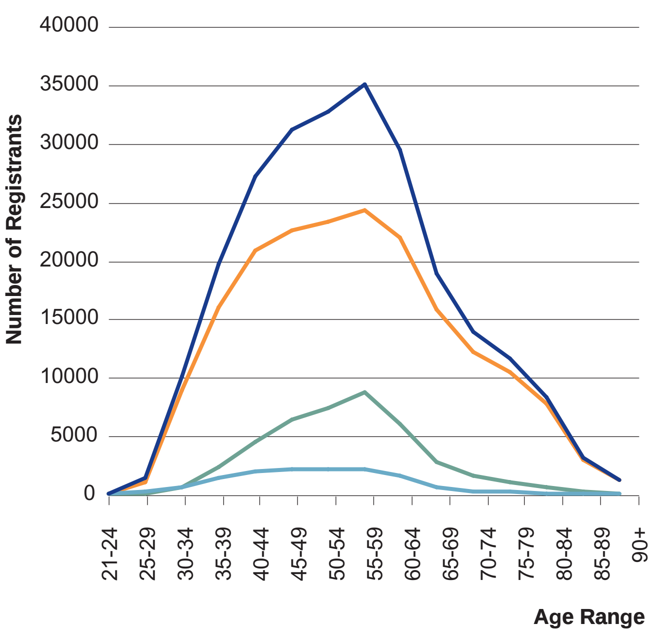
Source: ECUK

Chartered Engineer registration saw a positive increase with over 10% of new registrants being female in 2005. Given time this trend should assert itself into the total registration figures, with an increasing percentage of women on the register. However, this increase in the percentage of new registrants must also be put into the context of a long term decline in total numbers of new registrants.

6.4 Age Profile

The age profile of those registered as engineers and technicians in 2004 is shown in Chart 6.5.

Chart 6.5: Registrants Age Profile 2005

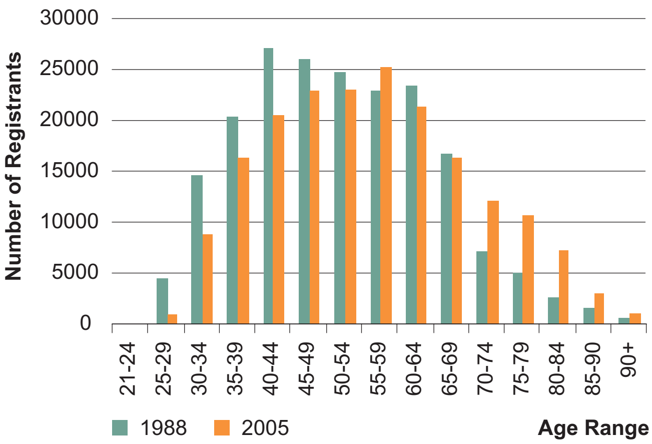


Source: EC[UK]

The overall age profile of registered engineers in 2004 has a median age of over 55. Comparing the age profile of registered engineers in 2005 to that of 1988 provides a picture of the changing age profile over time. Age profiles for the three categories of registration are shown in Charts 6.6, 6.7 and 6.8.

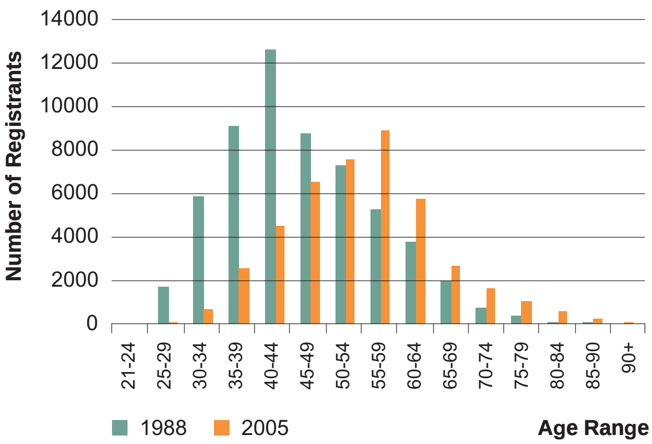
These three age profiles clearly demonstrate that the average age of registered engineers is increasing. This is obviously related to the long term decline in new registrations (see Chart 6.2), however, the recent upturn in new registrations will have to continue for some time if a more evenly distributed age profile is to be achieved.

Chart 6.6: Chartered Engineer – Age Profile 1988/2005



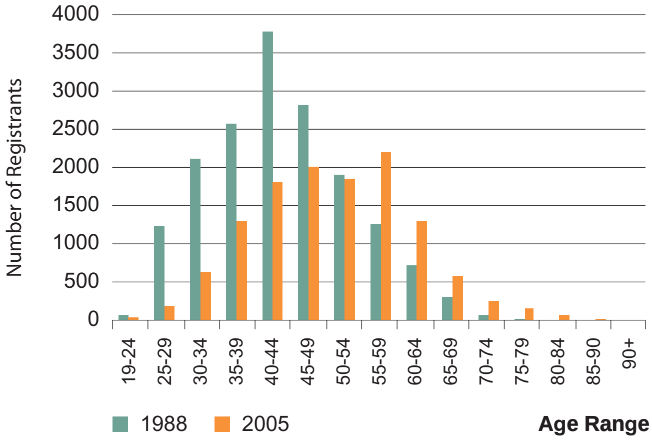
Source: EC[UK]

Chart 6.7: Incorporated Engineer – Age Profile 1988/2005



Source: EC[UK]

Chart 6.8: Engineering Technician – Age Profile 1988/2005



Source: EC[UK]

6.5 Summary and Conclusions

- The total number of registrations has declined from just over 267,100 in 1995 to just under 243,000 in 2005, representing a fall of 9.0% over the decade.
- New registrations have seen positive growth over the last two years, reversing the declining trend in new registrations seen over the last decade.
- The overall age profile of registered engineers in 2005 reflects their median age of over 55.
- The average age of registered engineers is increasing.

7. Engineers in the Economy

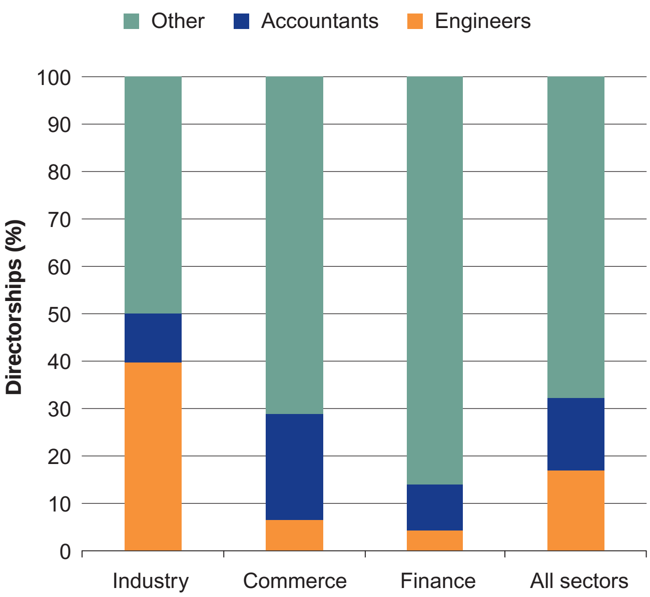
Engineers have a great deal to offer UK industry; they operate in all parts of the economy and at all levels of decision making. This section examines the role of engineers in the economy, their position at senior management level in large companies, their distribution amongst UK industry and the impact of engineering on the UK economy.

7.1 Engineers Heading the FTSE 100 Companies

Research jointly commissioned by the Engineering Council UK and the Royal Academy of Engineering in 1997 examined the academic and professional qualifications of the directors and top executives (CEO, Executive Chairman or equivalent) of those companies listed on the FTSE 100 at 1 December 1997. The findings indicated that 16% of directors of FTSE 100 companies with a first degree had studied engineering.

This was marginally higher than the proportions who had studied science subjects or economics. When professional qualifications were considered, professionally qualified accountants outnumbered professionally qualified engineers 3:2 on all FTSE 100 boards, though within the industry sector 17% of directorships were held by engineers compared with only 15% by accountants. This data is presented graphically in Chart 7.1.

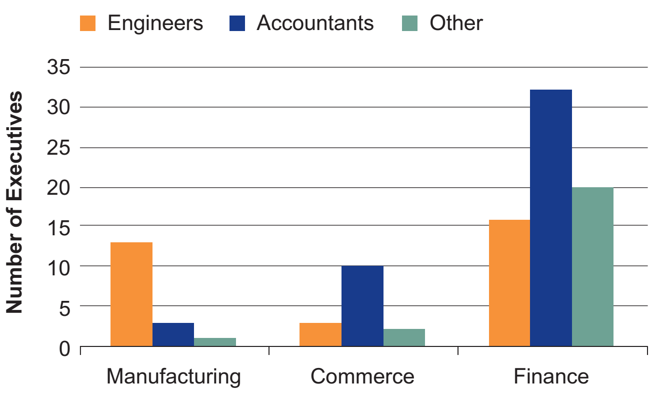
Chart 7.1: Directorships of FTSE 100 Companies by Subject of Director's Qualification



Source: Engineering Council UK / Royal Academy of Engineering (1997) IER: Engineers in Top Management

When the sample was narrowed to the top or chief executives, qualified engineers outnumbered qualified accountants. Of the one hundred top executives, 17 held engineering qualifications, as opposed to 15 with accountancy qualifications. Within the manufacturing sector, the proportion of the top executives who were qualified engineers was as high as 41% (accountants made up only 9%), and even within the finance sector, where only one top executive was an engineer, no more than two were accountants (see Chart 7.2 for further details).

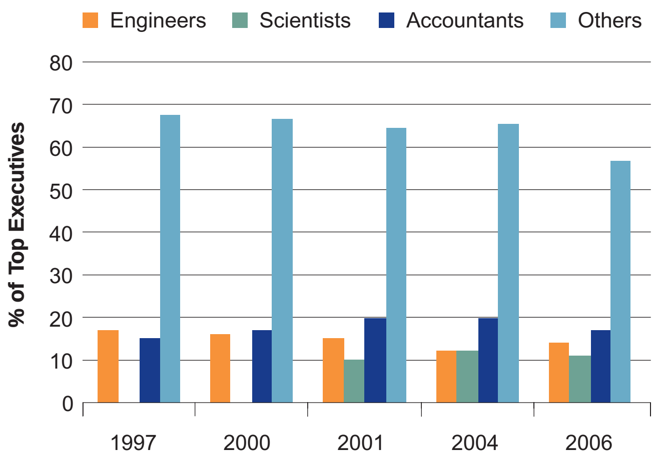
Chart 7.2: Top Executives of FTSE 100 Companies by Discipline



Source: Engineering Council UK /Royal Academy of Engineers/IER 1997

The Engineering Council UK and the ETB updated the FTSE 100 top executives study in 2000, 2001, 2004 and 2006. The results of these studies are included in Chart 7.3. The trend suggests a falling number of top executives with engineering qualifications, from 17 in 1997 to 12 in 2004. However, the number with engineering qualifications rose to 14 in 2006. In comparison the number of accountants has increased slightly over the same period from 15 to 17.

Chart 7.3: Top Executives of FTSE 100 Companies



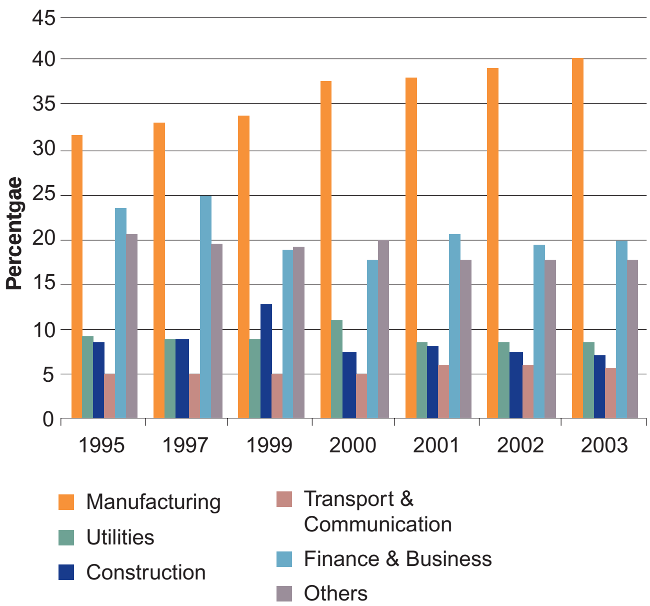
Source: Engineering Council UK/Royal Academy of Engineers/IER 1997, 2000, Engineering Council UK 2001, Engineering and Technology Board 2004, 2006

It must be stressed that this analysis was based on the university qualifications of the companies top executives – many of whom specialised in different subjects after entering the workforce – for example many of those with non-accountancy degree qualifications may well have followed the accountancy route after entering the workforce as part of their company's training programmes. Conversely it is unlikely that non-engineering graduates would move into the management of technical engineering disciplines.

7.2 Distribution of Engineers throughout the Economy

Gratifying as it is to find engineers and scientists reasonably well represented at the top of the business world, it is still true to say that, until recently, it is in manufacturing companies that engineers are most likely to have achieved a very senior position. It is important to note that the overall employment of engineering professionals differs markedly from this pattern. The employment by industrial sector of those professional engineers who are registered with the Engineering Council UK was collected as part of the Engineering Council Surveys of Professional Engineers and Technicians and the Engineering and Technology Board Survey of Registered Engineers, carried out between 1995 and 2003. This data is summarised in Chart 7.4.

Chart 7.4: Professional Engineers by Industrial Sector



Source: Engineering Council UK and the Engineering and Technology Board (1995-2003)

The most striking feature from the surveys is that the manufacturing sector still dominates the employment of registered engineers. The spread of employment in manufacturing ranges from 32% in 1995 to 40% of employment in 2003. For 2003 the remaining 60% are spread throughout all other sectors of the economy. Notably, finance and business services (which includes engineering consultancy) accounts for the employment of 20% of registered engineers, a figure which has remained steady since 1999. This chart, more than any other information available at present, clearly demonstrates the influence of the engineering profession on all aspects of our daily life, and, indeed, its importance in the future development and growth of our economy.

7.3 National Statistics and the Engineering Profession

Formal professional registration of all appropriately qualified engineers, which is voluntary in the UK, will remain an objective for the profession but is unlikely ever to be achieved in the current policy environment. For example, registered Chartered Engineers and Incorporated Engineers may only represent about 25% to 40% of those likely to be eligible. This estimate is based on a calculation of all the professional engineers found in the Labour Force Survey in 2001; a net total of 425,000. The total number of UK based Chartered Engineers and Incorporated Engineers working in the UK in 2001 was 158,000. If we assume that the Labour Force Survey figures include 5% non-UK nationals (in line with the 5% of registered engineers who are not from the UK) then we arrive at a ratio of 158,000 over 404,000 which suggests that only 39% of UK engineers are registered. Efforts are being made by the Engineering and Technology Board, the Engineering Council UK and the professional engineering institutions to promote registration and increase the number of registered engineers.

In 2001, the Engineering Council UK obtained a large matrix of data analysing specific jobs by the Standard Occupational Classification (SOC) and by Standard Industrial Classification (SIC). This data was provided by the Office of National Statistics Labour Force Survey. The analysis suggested that 2.4 million people work in the engineering sector in the UK, however the Engineering Council UK went onto say that "There are no reliable figures to estimate the numbers of people whose title does not include engineering but who practice engineering in the course of their work, such as scientists, technologists, metallurgists, computer programmers, and many more". Although likely to exaggerate total numbers, there are undoubtedly difficulties using official UK Labour Force Survey data. However, a wider analysis of the Labour Force Survey data using an expanded list of roles based on the Standard Occupational Classifications may permit future Labour Force Surveys to reflect the full universe of engineering roles.

7.4 Summary and Conclusions

- The number of top business executives with engineering qualifications in FTSE 100 companies fell from 17 in 1997 to 12 in 2004. However, the number with engineering qualifications rose to 14 in 2006.
- The manufacturing sector still dominates the employment of registered engineers. The proportion of employment in manufacturing rose from 32% in 1995 to 40% of employment in 2003. In 2003 the remaining 60% are found throughout all other sectors of the economy.
- Estimates suggest that only 39% of UK engineers are registered with the Engineering Council UK.

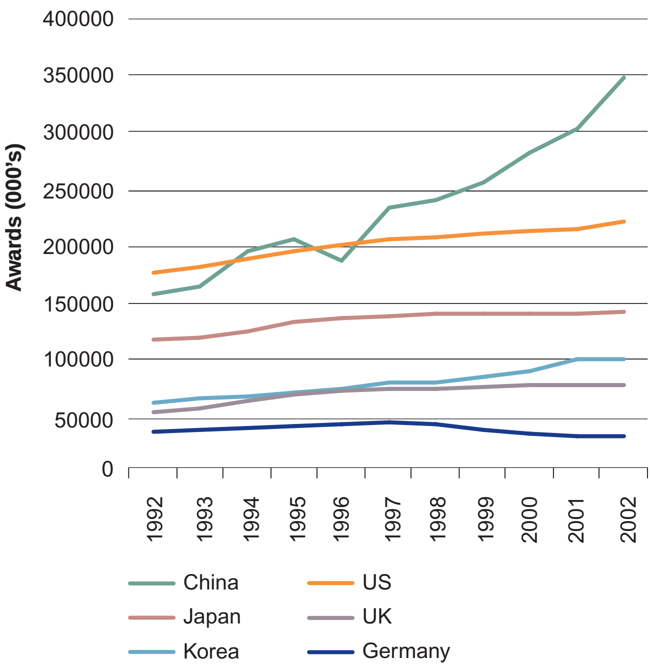
8. International Dimensions of STEM Higher Education

In order for the UK, within an extremely competitive global marketplace for STEM skills, to compete successfully in products and services requiring technical innovation, it is crucial that the UK continues to produce high quality engineers and scientists in sufficient quantity to supply the needs of industry. This section examines the international aspects of STEM Higher Education.

8.1 STEM Degree Output

It is important that the UK is able to produce enough STEM graduates within the context of an extremely competitive global market place for STEM Higher Education. It is therefore important to understand how STEM Higher Education in the UK compares with other countries. Chart 8.1 is based on data published by the United Nations and describes awards of STEM degrees by country over the period 1992-2002.

Chart 8.1: STEM Degree Awards by Country 1992-2002



Source: ETB analysis of NSF 2006

Of the 9 million first degrees awarded internationally in 2002, about 2.3 million were in STEM fields (National Science Foundation (NSF), 2005). These worldwide totals include only countries for which recent data is readily available (primarily countries in the Asian, American and European regions). Asian universities from Japan, South Korea, China and India accounted for over a million (43%) of the world's STEM degrees in 2002 with close to 600,000 of them in engineering. Students across Europe were awarded 930,000 STEM degrees, and students in North and Central America gained almost 600,000 STEM degrees in 2002.

The most striking feature of Chart 8.1 is the massive increase in output of STEM degrees in China. Over the past decade China has seen a 124% increase in STEM student degrees, to just under 350,000 per year in 2002. It must be stressed that as the latest figures are as of 2002, anecdotal feedback indicates that the growth in STEM numbers within China and India has continued apace to the present day. Over the same period the UK also experienced strong growth with nearly 75,000 degrees and a 53% increase over the decade. The US also performs well with nearly 220,000 graduates, a 27% increase over the decade. Interestingly, Germany, traditionally strong in STEM subjects, has, according to this data, seen a 9% decline over the decade to just under 29,000 degrees.

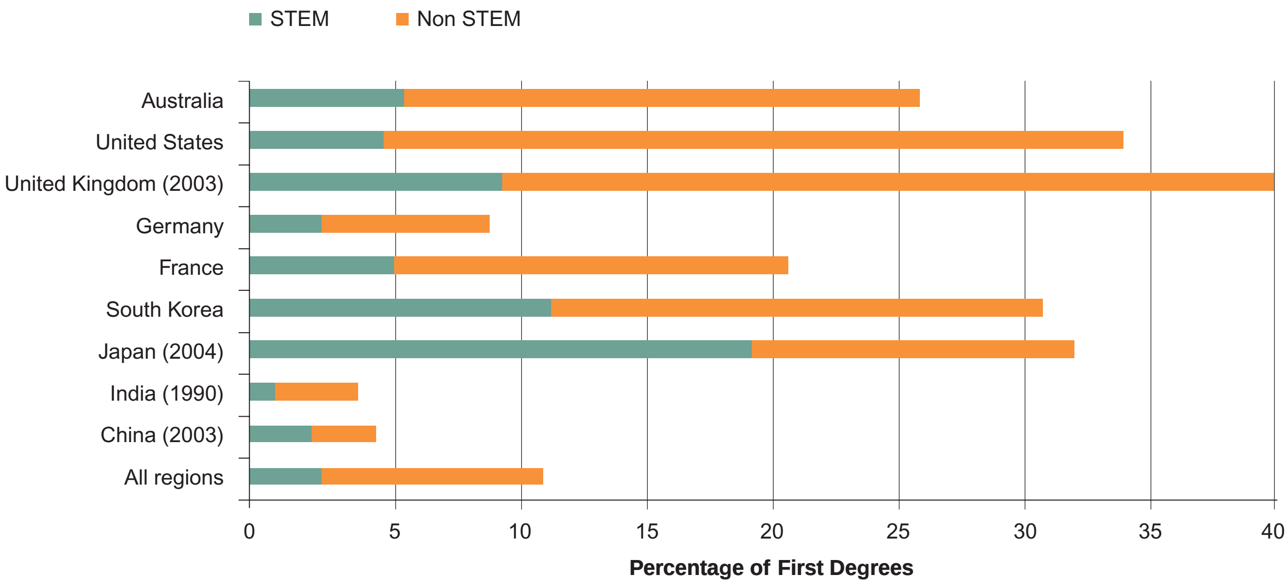
8.2 Overall Access to Higher Education

The UK has remained a world leader in providing broad access to Higher Education. The ratio of bachelors degrees earned in the UK compared to the population of the college-age cohort was high at 40% in 2002. Chart 8.2 compares the performance of the UK with other large or fast growing economies.

On analysis, the UK still remains at the top of the group with a 40% participation rate for first degrees and 10% for STEM first degrees (although the UK lags behind South Korea and Japan for the overall percentage of STEM degrees). The figure of 40% for the UK from the NSF data validates the UK Government's claim of a 42% participation rate in Higher Education. The Higher Education sector also appears to be dynamic in a number of other economies. The United States (34%), Japan (32%) and South Korea (31%) all have overall participation levels above 30%, with Australia only slightly below. Despite the prospect of a more educated global workforce, these figures suggest a possible future diversion of demand for Higher Education away from the UK to other economies overseas.

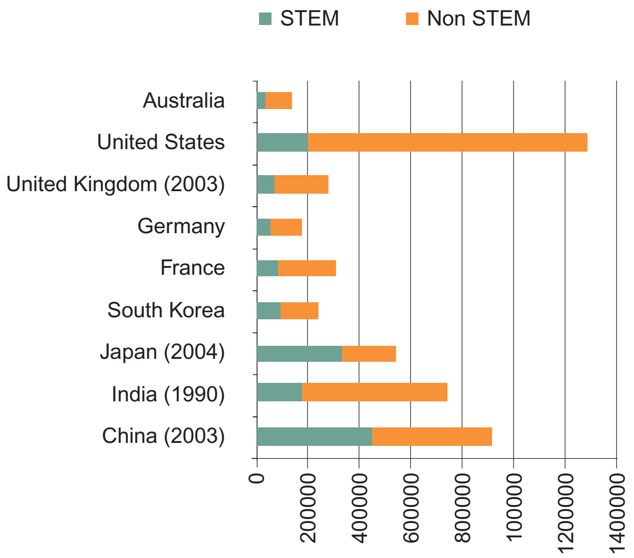
However, Chart 8.2 fails to take into account the population size of the various economies, and might therefore give a false impression of the performance of the Asian giants, China and India. Chart 8.3 compares the actual number of first degrees in the individual nations of the group and indicates how many of these are in the STEM fields.

Chart 8.2: Ratio of STEM First Degrees to 24 Year Old Population of Various Regions



Source: ETB analysis of NSF 2006

Chart 8.3: Recent STEM Degree Production

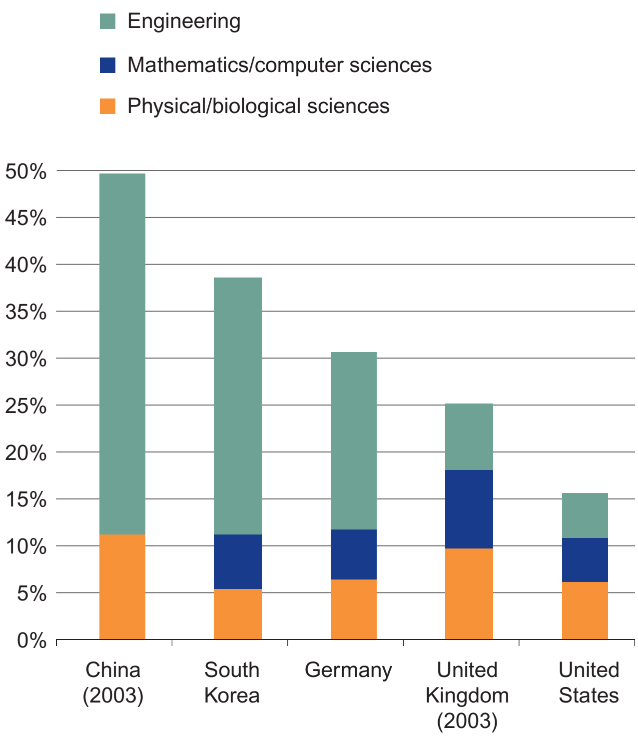


Source: ETB analysis of NSF 2006

From the above chart, the US has the highest number of first degree holders, with over 1.3 million, with a sixth of these degrees in STEM fields. These figures are approximately 4 times greater than those of the UK, which indicates an output of 70,000 STEM degrees in 2003. Other top performers include China and India with 930,000 and 750,000 first degrees respectively. However, this constitutes only a small proportion of their college-age cohort, with the ratio of first degrees for the 24 year old population standing low at 5% for China and 4% for India.

Of equal importance is the proportion of first degrees awarded in the individual STEM fields. Chart 8.4 compares the distribution of first degrees in the UK with four other developed and fast developing nations.

Chart 8.4: The Distribution of First Degrees in the United Kingdom, the United States, Germany, South Korea and China



Source: ETB Analysis of NSF/OECD 2006

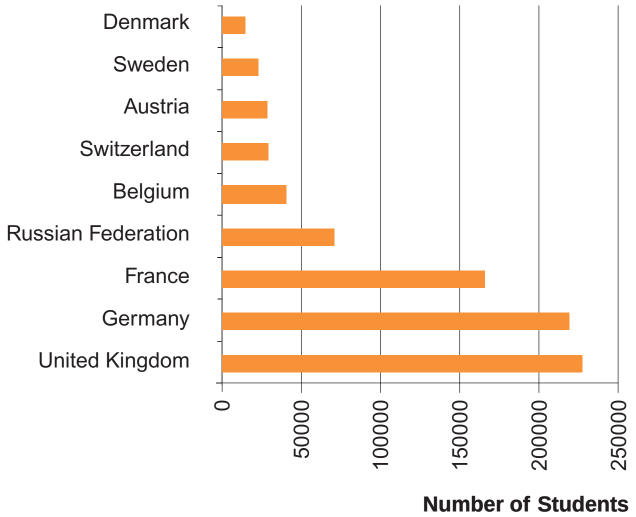
According to the OECD data, the 70,000 UK STEM first degrees account for 25% of the UK first degrees (this compares to a HESA figure of 85,000 and 28% used in section three of this report). Of the 70,000 degree awards, physical and biological sciences are the most dominant with 27,000 first degrees. Mathematics and computer science follows with 23,000 first degrees. When compared with the UK, the United States performs poorly, with only 16% of the first degrees awarded in STEM fields. In the US the smaller fields of mathematics, computer sciences and engineering only account for 5% of first degree output. However the scale of the US HE sector is such that this 5% equates to over 60,000 degree awards, almost equal to the sum of all STEM degrees in the United Kingdom.

Germany has a similar proportion of their first degrees in STEM fields as the UK. However, 19% of the first degrees are in engineering, which is almost three times the percentage witnessed in the United Kingdom. The performance of China and South Korea varies greatly from the UK, US and Germany. In China, for example, first degrees in STEM fields constitute a greater proportion of all first degrees. With just under a million first degrees awarded in 2003, China achieved 49% of these in STEM fields, with engineering accounting for 38%. It is clear from this data that China is ahead of the UK when it comes to the production of STEM first degrees, both by proportion and actual number of degrees.

8.3 Foreign Student Participation in UK STEM

The competitive nature of the global HE sector is reflected in the number of students attracted to study in other countries. The UK leads the way in the European HE market for foreign students (see Chart 8.5).

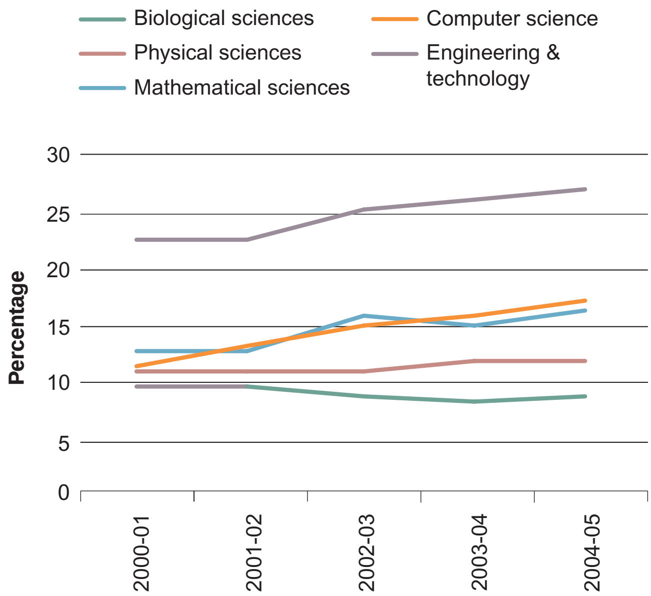
Chart 8.5: Foreign Students Enrolled in Tertiary Education



Source: ETB analysis of NSF/OECD 2006

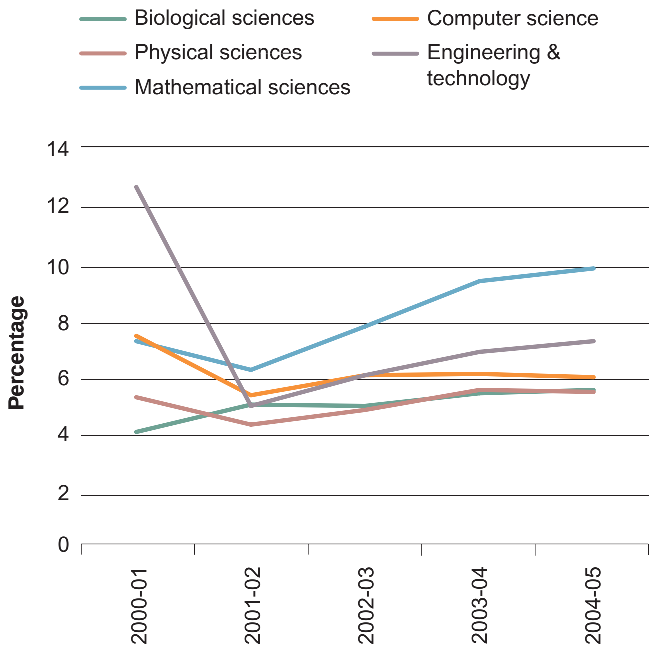
The internationalisation of the Higher Education system has had a major impact on foreign student participation levels within STEM subjects in the UK. It is worth putting the previous analysis of the internationalisation of STEM Higher Education into the context of data sets from the UK, most notably from those supplied by HESA. The percentage number of foreign students by STEM subjects is detailed in Chart 8.6.

Chart 8.6: Percentage of Non-UK Students by STEM Subject in UK HE (all degrees)



Source: HESA 2005

Chart 8.7: Percentage of Non-EU Foreign Students by STEM Subject in UK HE



Source: HESA 2006

Engineering and technology has a far higher proportion of foreign students compared to all other STEM subjects with nearly 27% of students coming from outside the UK. This has been a steady growth rate from 22% in 2001. The rest of the STEM subjects are much more typical of the university population as a whole, with 13% foreign student participation. Biological sciences and physical sciences both appear to have a steady number of non-UK students at 9% and 12% respectively in 2005. Both computer science and mathematical sciences have seen an increase in the proportion of foreign students over the five year period reaching 17% and 16% respectively.

Foreign student figures alone do not tell the whole story. At present foreign students from the EU pay the same fees as UK students. Therefore it is necessary to separate them from the lucrative non-EU students who often pay substantially more fees than UK and EU students. Chart 8.7 details the percentage participation of non-EU foreign students on UK STEM courses in the UK.

The most striking feature of Chart 8.7 is the rapid fall in percentage of non-EU students in engineering and technology between 2001 and 2002 where the number fell from under 13% to 5% in a single year. This highlights the highly elastic nature of demand for UK STEM provision from the non-EU student market. The fall was compensated for by an increase in the demand for UK STEM provision by EU students. Since 2002 all the STEM subjects have seen an increase in the percentage of non-EU students with participation ranging from just under 10% in mathematical sciences to 6% in computer science.

Further analysis on this issue will be required to understand the financial implications for STEM university departments who may use these high fee paying students to subsidise financial shortcomings of existing funding for teaching programmes. Future analysis should also examine the differences in fee levels paid by non-EU undergraduate and postgraduate students.

8.4 Global Comparison of STEM Doctoral Degrees

In 2002, 96,000 STEM degrees were awarded at doctoral level, globally. This accounts for 53% of all doctoral degrees awarded in 2002. As shown in Table 8.1, more than 18,000 of these STEM doctoral degrees were awarded in the United States, where there is also the highest number of doctoral degrees overall (about 41,000). Germany also outperformed the UK, awarding 23,000 doctoral degrees, with more than 8,000 in STEM fields.

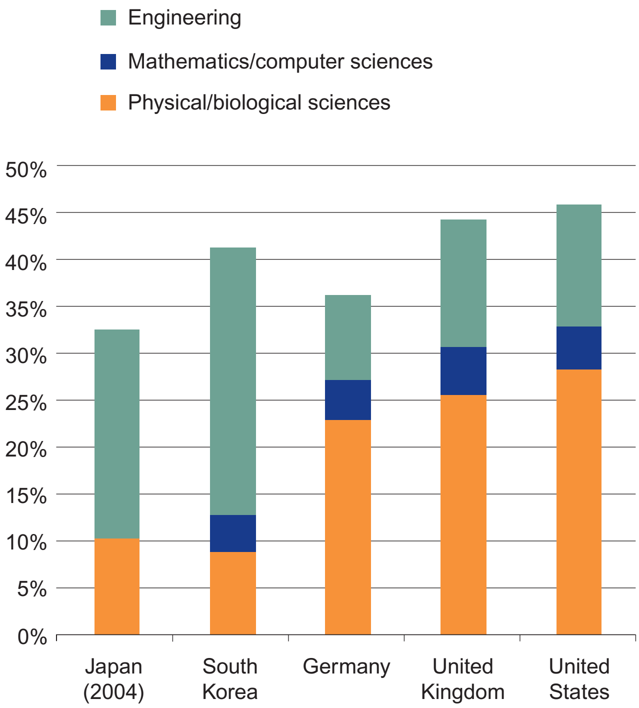
Table 8.1: Numbers of STEM Doctoral Degrees in Selected Countries (2002 or most recent year)

Country	All fields	All S&E fields	Physical/ biological sciences	Mathematics/ computer sciences	Engineering	Non-S&E
Japan (2004)	15,200	5,000	1,600	0	3,400	10,300
South Korea	6,700	2,800	600	300	1,900	4,000
France	10,500	6,000	4,200	900	1,000	4,500
Germany	23,100	8,300	5,300	1,000	2,100	14,800
United Kingdom	14,900	6,600	3,800	800	2,100	8,400
United States	40,600	18,500	11,400	1,900	5,300	22,100
Australia	4,000	1,600	1,000	200	500	2,400

Source: NSF/OECD 2006

Both Japan and the UK awarded about 15,000 doctoral degrees each. In the UK 44% of these were in STEM fields (10% more than those awarded in Japan). Chart 8.8 shows the distribution of doctoral degrees in the UK, the US, Germany, South Korea and China.

Chart 8.8: The Distribution of Doctoral Degrees in the UK, the US, Germany, South Korea and China



Source: NSF/OECD 2006

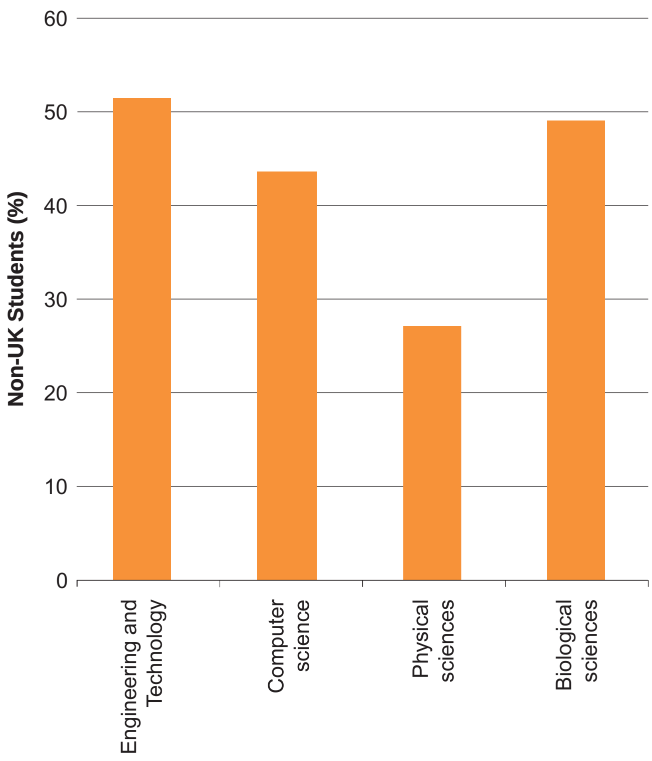
Once again, physical and biological sciences are the most dominant STEM field in the UK, with almost 4,000 doctoral degrees (25%). Engineering performs better than mathematics and computer sciences, with 14% of all UK doctoral degrees; but this only amounts to 2,000 doctoral degrees. Mathematics and computer sciences performed poorly with only 5% of all UK doctoral degrees. However, this is not peculiar to the UK, as there are even fewer proportions of mathematics and computer sciences doctoral degrees in other countries. In Japan, this figure is too small to be recorded. The US performed slightly better than the UK with 46% of the doctoral degrees in STEM fields. They had over three times more physical and biological sciences doctoral degrees (11,000) than the UK, but could only produce a similar proportion of their doctoral degrees in engineering (13%) as the UK.

In comparison to the UK, Germany performed poorly at doctoral level. Of the 23,000 doctoral degrees awarded in 2002, 23% were in physical and biological sciences. Engineering accounted for 9%, while the number of mathematics and computer sciences doctoral degrees was just below 1,000.

South Korea and Japan produced the largest proportions of engineering doctoral degrees (28% and 22% respectively). This indicates the emphasis being placed on the study of engineering and other STEM related fields in Asian countries.

It is clear that many post-graduate students are from outside the UK. This is particularly the case at doctoral level (Chart 8.9). The chart details the fact that the number of non-UK students on doctoral programmes is as high as 50% in engineering and technology. Whilst this data is slightly out of date, current anecdotal evidence suggests that the situation is at least equal to or worse than that described in this data.

Chart 8.9: Percentage of Non-UK Students Following Doctoral Programmes



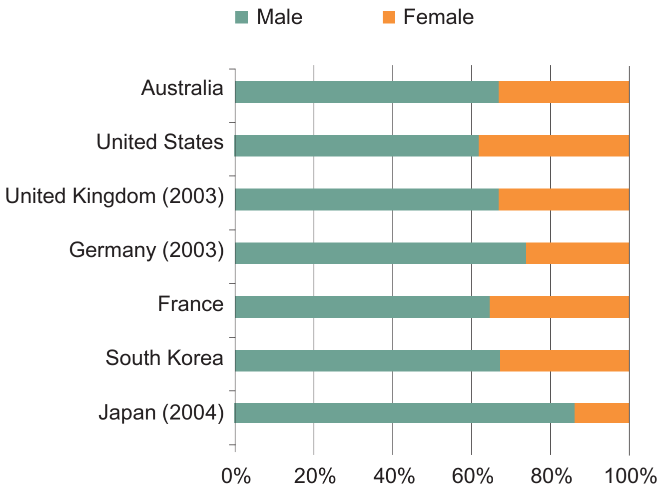
Source: NSF (2004)

Further work is required in this area to determine the impact of foreign students on doctoral programmes. Of particular interest is the percentage of these students who leave the UK at the end of their studies; an issue which is influenced by the UK Government's attitude to allowing post-graduates to obtain visas and remain in the UK after the end of their study. This will have a major impact upon knowledge transfer and the ability of the UK economy to produce the high level skills needed to compete in the 21st century.

8.5 Gender Participation in STEM Subjects

When considering the distribution of STEM degrees in various nations around the globe, there appears to be a defined pattern of far higher participation rates of male than female students in the STEM subjects. Chart 8.10 helps illustrate this point by showing the distribution of STEM degrees by gender in various selected nations.

Chart 8.10: Distribution of STEM First Degrees by Gender in Various Countries

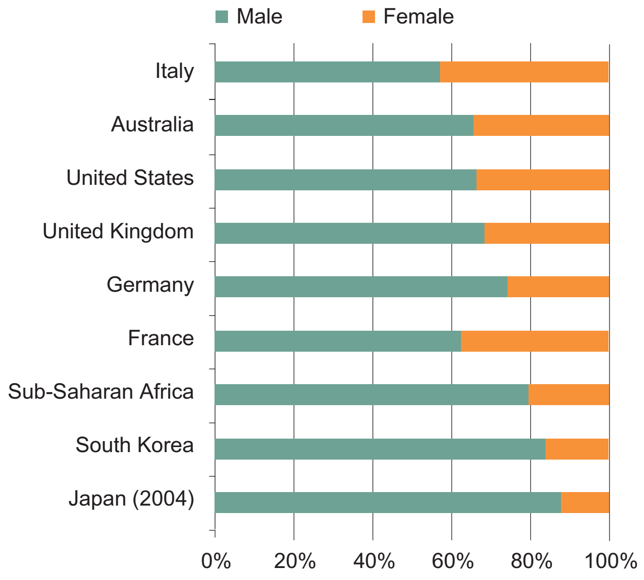


Source: ETB analysis of NSF/OECD 2006

From the above chart, male student participation on STEM degrees accounts for a minimum of 60% of the degrees undertaken in any of the selected countries. Japan appears to be faring particularly badly with a female student ratio of less than 20%. However, in Japan, as in the United States, a large proportion of the female students with degrees in science related fields are awarded in agricultural and social sciences, as opposed to the core STEM fields.

In 2003, female students were awarded approximately 35% of STEM doctoral degrees in the UK. The percentage of STEM doctoral degrees awarded to female students in other countries and areas of the world varied widely. In Western Europe, the percentage of doctoral degrees awarded to female students varied from 27% in Germany to 45% in Italy. In Asia, female students were awarded roughly one-fifth of all STEM doctoral degrees as shown in Chart 8.11 below.

Chart 8.11: Distribution of STEM Doctoral Degrees by Gender in Various Countries



Source: ETB analysis of NSF/OECD 2006

8.6 Summary and Conclusions

- China has seen a massive increase in output of STEM degrees over the past decade. This accounts for a 124% increase in STEM student degrees production of just under 350,000 per year.
- Over the last decade the UK also saw a 53% growth in STEM degree output to nearly 75,000 degrees.
- There has been a fall in percentage of non-EU students in engineering and technology studying in the UK between 2001 and 2002 where the number fell from under 13% to 5% in a single year. This highlights the highly elastic nature of demand for UK STEM provision from the non-EU student market.
- It is clear that many post graduate students are from outside the UK. This is particularly the case at doctoral level with student numbers from abroad at 50% in engineering and technology.
- The gender imbalance on STEM degree courses is very high – all countries studied had at least 60% male student participation rates.

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Progress through partnerships

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