Engineering UK
December 2008

etb
Progress through partnerships

Engineering UK 2008

We gratefully acknowledge contributions from:

cogent | ecuk | energy&utilityskills | ice Institution of Civil Engineers | semta | Summit SKILLS | Warwick Institute for Employment Research IER

Authors

The lead author and publisher of *Engineering UK 2008* was Robert Spano, with the grateful assistance of Anil Kumar, Emma Buglass, Georgina Goodman and other colleagues at the Engineering and Technology Board (ETB). The ETB would also like to thank the following partner contributors:

Bob Windmill
Head of Research – Energy & Utility Skills

Lauren Sadler
Research Advisor – Cogent SSC

Maciej Zwierzanski
Group Market Analyst – Institution of Civil Engineers

Matthew Dixon
Semta Visiting Research Fellow at SKOPE

Mike Hammond
Head of Research – SummitSkills

Rob Wilson
University of Warwick – Institute for Employment Research

Engineering UK 2008 – Report
Table of Contents

Engineering UK 2008 – Report
Table of Figures

Engineering UK 2008 – Report
Table of Tables

A Prologue
1 Foreword

Welcome to the 2008 edition of **Engineering UK**, the Engineering and Technology Board's (ETB) annual report on the state of Engineers, Technicians and Engineering and Technology (E&T).

For the past 10 years *Engineering UK* has provided policy-makers with an evidence base across the Science, Technology, Engineering and Mathematics (STEM) continuum. This 2008 edition is more comprehensive than the 2007 edition, built upon feedback from our stakeholders, and now contains more extensive supply trends, greater discussion of demand-side issues, as well as benefiting from expert external case study contributions from various organisations.

The environment for Engineers and Engineering has altered significantly this year, with many changes in the skills policy landscape across the UK that will have important consequences. Notable changes are as follows: In April, the establishment of the UK Commission for Employment and Skills[1] (UKCES) was a significant step towards improving employment and skills systems in order to help the UK become a world-class leader in productivity and employment in the context of a fast-changing global economy. In England, the decision within the Education and Skills Bill to raise the school-leaving age to 18 by 2015 was another important policy change. In Scotland, plans were announced to simplify the range of Standard Grades and Intermediates with a new general qualification; in Wales, a £70 million three-year Modern Apprenticeship World Class Skills project was announced to raise the skills of the workforce in Wales' most deprived areas; and in Northern Ireland the six new large-area colleges were bedded in. Also, crucially, the Sector Skills Councils began their re-licensing process. We believe that these changes and policy drivers will, over time, support the ETB goal of improving the supply of Engineers.

1 http://www.ukces.org.uk/

In terms of vocational engineering, September 2008 saw the commencement of the first 14-19 Diplomas in England, with both the Engineering Diploma[2] and the Construction and the Built Environment Diploma[3] being included in the first five available. In Wales, the provision of the Welsh Baccalaureate Qualification at Advanced and Intermediate levels in post-16 learning was extended, adding a further 4,900 learners in September 2008. It was also announced that a new qualification, the Scottish Science Baccalaureate, is to be introduced for S5 and S6 pupils in Scotland's schools with the first awards due in 2010. 2008 also saw the establishment of Skills Development Scotland,[4] a new non-departmental public body, which brought together Careers Scotland, Learndirect Scotland and ILA Scotland into an integrated organisation.

These important initiatives are designed to help young people make the transition from school through Further and/or Higher Education into employment and develop exciting careers within the sector. The ETB's aim is to promote the vital role of Engineers, engineering and technology in our society and to inspire people to pursue careers at all levels in this sector.

Events of the last few months have been particularly challenging for the world economy, with a significant reduction in economic growth and widespread financial shocks. However, we feel that the prospects for engineering are better than other sectors due to its extensive coverage and diverse nature, which spans the public and private sectors. This means that for both businesses and careers, engineering will continue to offer a steady future to Engineers and Technicians in the long term.

The two key planks supporting this are two of the ETB's strategic goals of improving the supply of Engineers and improving the perception of Engineers and Engineering among key audiences.

The ETB's Engineering Campaign,[5] *Engineers Make It Happen*,™ launched in October 2008, is specifically designed to inspire students in Further Education to pursue careers in Engineering. This involves a range of initiatives designed to give students more experience of the actual workplace in order to help inspire them to work-in what is an enjoyable and rewarding environment.

The campaign has been launched in five key regions and nations of the UK, including Wales and Northern Ireland, where the ETB is working with lecturers, national, regional and local small businesses and public-sector policy-makers to help meet the demand of business and industry for more skilled Engineers and Technicians.

The year ahead promises to offer new challenges to Engineering and Engineers, which I'm sure that everyone with an interest in the future success of E&T will rise to.

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

2 http://www.engineeringdiploma.com/

3 http://www.cbediploma.co.uk/

4 http://www.skillsdevelopmentscotland.co.uk/

5 http://www.engineersmakeithappen.co.uk

A Prologue
2 Introduction

Engineering UK 2008 is the 11th edition in the series of annual publications compiled by the ETB and its predecessor, the Engineering Council. Its purpose is to provide information on the past, present and future supply of and demand for Engineers and Engineering in the UK, for those interested in the state of the sector.

This edition is the most comprehensive yet, building on previous success and user research and including more information, data, analysis and interpretation than ever before.

The ETB works in collaboration with a wide range of organisations with an interest in the success of E&T and has drawn upon a considerable range of reliable, robust sources for inclusion in this report. The ETB is pleased to have received considerable support in the preparation of this year's edition from a number of other organisations and would like to extend its thanks to them.

Engineering UK 2008 is intended to be both relevant and stimulating. The narrative may provide surprises as well as confirming what challenges face the sector. The ETB would especially welcome feedback from as many readers as possible because it is only with your input that we can continue to improve *Engineering UK*. Please send any comments you may have to feedback@etechb.co.uk, stating '*Engineering UK 2008*' in the subject line.

Further copies of this report can be downloaded from the ETB's website **www.etechb.co.uk**

Robert Spano
Head of Research
rspano@etechb.co.uk
The Engineering and Technology Board (ETB)

Emma Buglass
Research Executive
ebuglass@etechb.co.uk
The Engineering and Technology Board (ETB)

A Prologue
3 Executive Summary

"Death and taxes are unsolved engineering problems."

Machado, Romana

> The central remit of *Engineering UK 2008* is to provide a narrative on the current state of the supply of and demand for Engineers and Technicians in the UK. This year's edition is designed to tell this story as robustly, objectively and insightfully as possible.

> **Who wants to be an Engineer?**

- According to the Relevance of Science Education (ROSE) research, evidence suggests that the developmental state of a nation, and its consequent cultural norms and values, has a significant impact upon the decision-making of individuals in relation to education and careers. The more developed the nation, the less relevant E&T careers are seen to be. This goes some way towards explaining the relative perceived unattractiveness of engineering for many young people, when compared to a wide choice of other careers.
- In 2007, joint research by the ETB and Royal Academy of Engineering (RAEng) showed the lack of understanding among young adults of what Engineers actually do. So, how have we arrived at a situation where teenagers have these perceptions of Engineering? Europe-wide research indicates that children appear to form strong attitudes towards occupations at an early age. The evidence suggests that pre-school (<5) intervention, such as that undertaken by Siemens, is critical in creating more positive attitudes towards Science and Technology.

> **Where have they all come from, and where are they going to?**

- Over the next decade there will be a substantial 16% decline in the UK annual school-leaver cohort, which will present specific challenges to E&T as it competes with a widening choice of alternative career options. As well as constantly striving to make Engineering a more attractive occupation, employers and stakeholders will increasingly need to look towards career-changers as a source for new Engineers and Technicians.
- Pass rates and grade levels for secondary education qualifications across the UK are, on the whole, improving – although certain subjects are becoming less popular. The introduction of the new 14–19 Diplomas in Engineering, IT, and in Construction and the Built Environment in England from September 2008 is a positive step in enabling young people to follow a clear route into Engineering that allows both Further Education (FE) and Higher Education (HE) progression.
- Although there has much despondency spread by those bemoaning a 'fall' in the number of Engineering graduates, in reality there has been a 7% increase in E&T HE applications in the last five years. Over the same period, the number of E&T graduates has grown by more than 2%; although this may not be a huge rise, it provides an encouraging foundation on which to build.
- There has also been much debate about the proportion of E&T graduates entering employment as Engineers. The data indicate that just under two-thirds of E&T graduates enter employment of some kind six months after graduation.
- Further analysis of HESA destination data using SOC codes shows that 9-out-of-10 E&T subject graduates who enter employment six months after graduation, take up Engineering and related occupations. Three quarters of these E&T subject graduates take up employment with an Engineering employer.
- Just 3.1% of E&T subject graduates entering employment have gone to work for Financial Services employer. This rate is less than half that for all HE subject graduates.
- These data are very encouraging and suggest that concerns about Engineering graduates pursuing non-engineering careers have been significantly over-stated.
- Of those who took up Engineering occupations the majority studied some sort of HE STEM-related subject, although some come from a business and administration subject background. Those employed in ICT studied a wider variety of subjects.

> Where are they needed?

- So where do shortages lie? Among Engineering employers, around 1-job-in-50 is vacant. Just 0.7% of jobs were described as Hard-to-Fill Vacancies (HTFVs), with 0.6% of jobs being described as Skills Shortage Vacancies (SSVs). These figures indicate that skills shortages are not significant in the round; however, there are specific occupations where problems do exist. These are most prevalent in Skilled Trades Occupations (Standard Occupational Classification (SOC) 5) and in Plant, Process and Machine Operatives (SOC 8). These two largest groups, combined with Associate Professional and Technical Occupations (e.g. Engineering Technicians, Architectural Technologists, and Laboratory Technicians) account for 61% of SSVs, but only 21% of first-degree HE E&T leaver occupations.
- This clearly indicates that where SSVs exist, they are in occupations where an HE qualification is not necessarily a requirement and for which an FE route is more likely to be the avenue into employment. Consequently, far from there being a shortage of graduates, there is, instead, a significant shortage of Technician-level Engineers in more junior occupational groups. These occupations are the very bedrock upon which Engineering depends.
- The Migration Advisory Committee (MAC) Tier 2 Shortage Occupation List for non-EEA domiciled highly-skilled workers gives further insight into where real shortages exist. It is notable that all Civil Engineer occupations (SOC 2121) and Chemical Engineer occupations (SOC 2125) are included in this list, as are specific Physicists, Geologists and Meteorologists (SOC 2113).

- On the demand side, the impact of the economic downturn on employment and unemployment levels is well correlated. The slowdown in economic growth accompanying rising commodity and input prices, rising output prices, rising inflation, falling property asset values and associated financial shocks in the UK and elsewhere is bound to have an affect upon the demand for all occupations, including Engineers. Experts appear to agree that any upturn will not show signs of taking place until 2010, and thereafter the demand for skilled Engineers across a range of disciplines – especially in relation to UK infrastructure projects – is expected to remain high.
- It is also significant that while a lack of proficiency (Skills Gaps) relating to technical skills is of significance, the data show that other, more generic, skills – such as team-working, problem-solving and communications – pose a significant problem for Engineering employers.

> What sort of Engineers?

- In the UK, Engineering has always been, and remains, a largely male-dominated occupation. It is accepted that for the sake of greater inclusivity and to increase the relevance of Engineering to the wider population, it must be beneficial to step up efforts to increase the number of female Engineers. This opinion is supported by observations that the financial performance of companies with a diverse workforce is better than those without.
- Although Engineering reflects the nature and diversity of the UK working population and presents equal opportunities to all, the ETB is concerned that despite more women joining the sector, the rate of increase is slow. The proportion of female registered Engineers remains in the low single figures, and although new registrants are currently about one in six (17%), this proportion is too low and growing far too slowly.
- The gender imbalance in FE Engineering is even more pronounced right across the wide range of frameworks – perhaps with the exception of Pharmacy Technicians.
- Since FE-qualified Engineers are in particularly short supply, this is an issue that needs far greater attention.

> What does the Engineering sector look like?

- A brief examination of the make-up of the UK Engineering sector shows that seven out of eight VAT-registered Engineering enterprises across the UK employ less than 10 people. Those in London, the South East and East of England are even more likely to be micro-businesses. The latter two regions have a particularly high proportion of such Engineering enterprises compared to the overall business stock, and all three combined account for half of all turnover in the Engineering sector.
- Most employees of VAT-registered companies (56%) work for SMEs (enterprises employing <250 people). This proportion is highest in Northern Ireland (72%). So, it is not just the larger employers who are critical to the success of Engineering in the UK – micro-businesses cannot be ignored.
- Analysis of the key sub-sectors of Engineering shows that while the number of enterprises and the volume of employees in more traditional areas of Engineering have declined steadily over the last decade, a number of other sub-sectors have seen a significant increase in Gross Value Added (GVA) and employment volumes.
- While the Construction sector has grown significantly, it is expected to remain subdued during the economic downturn. On the other hand, more specialist areas such as R&D, Engineering Activities and Related Technical Consultancy, and Technical Testing and Analysis have seen significant growth.
- The reduction in the proportion of the UK economy accounted for by Production Industries, Construction, R&D, Engineering Activities and Related Technical Consultancy, Technical Testing and Analysis reflects even faster growth than in, for example, the Service sector. It is not unreasonable to suppose that this reduction will stop or even reverse as the UK economy reacts to shifts in the global economy resulting from the credit crunch.

- Vacancy rates in the Energy and Water sectors in particular have held up during the downturn, so far.
- Registered Engineers (i.e. those with CEng, IEng and EngTech accreditations) account for a small proportion of all Engineers – anything between 5% and 10%, depending on which definition of an Engineer is used.
- A review of Registered Engineer statistics indicates a continuation in the long-term decline in overall volumes, ageing profiles, and a slow rise in the proportion who are female.
- National employers' skills surveys carried out across the UK home nations show that there is considerable variation in the extent of skills difficulties across the sub-sectors. It is worth observing that Skills Shortages and Skills Gaps afflict a small minority of employers and a tiny minority of occupations. Where they do exist they are largely confined to Skilled Trade occupations and Operatives, and rather more so than at Professional or Associate Professional level. Once again, this indicates that the greatest problems lie with those following the FE route into employment.

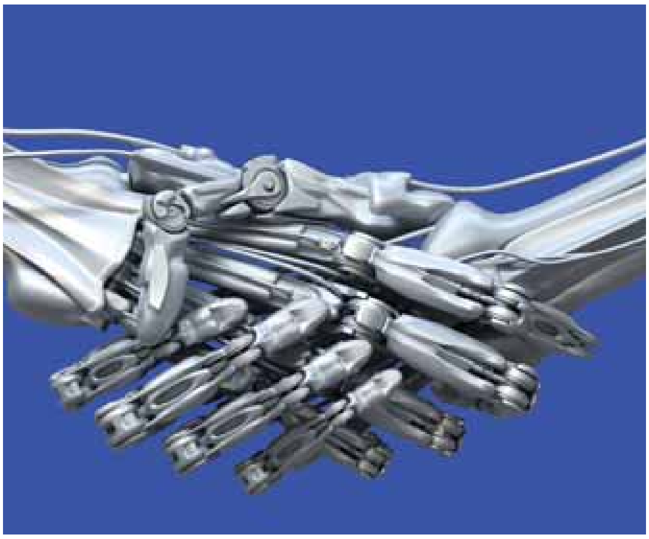
> **What do the ETB's partners think?**

- A number of partner organisations have contributed case studies to this year's *Engineering UK* covering the Electricity Industry, the Chemical, Pharmaceutical, Nuclear, Oil and Gas, and Process Industries, Engineering and Manufacturing Technologies, and Nuclear Engineering. These give specific perspectives on sub- engineering discipline issues. Some highlights from these case studies are as follows:
- Cogent SSC describes a shortfall of over 40,000 in the number of Core Workers (Technicians and Operators) in its footprint. It notes a particular problem with insufficient numbers of apprentices coming through in order to meet replacement demand.
- The importance of the contribution that National Skills Academies can and will make to addressing this need is highlighted, as is the need for the up-skilling of the existing workforce.
- Likewise, Semta has undertaken modelling exercises in developing future demand measures in the context of STEM qualifications.
- The work carried out by SummitSkills indicates that the Building Services Engineering sector may not be able to respond to any sudden or significant increase in the demand for Micro-generation Engineers. Urgent action needs to be taken to develop training courses to address this.
- EUSkills carried out research into the public perception of the Electricity sector. It found that adult up-skilling would be a significant element of any organisation's skills strategy, and because respondents were exposed to increasing amounts of information about the Electricity industry, they became increasingly engaged with the idea of pursuing a career in it.
- Furthermore, it found that a genuine green agenda would make the sector more attractive as a potential career choice. Opportunities clearly exist for utilities to raise their game in recruitment.
- The research carried out by Warwick IER suggests that in the future demand for STEM graduates will exceed supply.

> **And what are the ETB's conclusions?**

- If we are to increase interest in E&T as a career in the long term, the government, employers, institutions, policy-makers, funders and other stakeholders need a greater recognition of the need for interventions designed to interest and enthuse young people – especially females – in Engineering at a much younger age.
- Contrary to popular belief, the vast majority of those obtaining HE qualifications in E&T who enter employment, go to work in Engineering and related occupations. Just 3.1% go to work for Financial Services employers, of whom only 2.6% have studied E&T subjects. Rather than being seen as a job, greater focus must be placed on building careers in Engineering.
- The focus for increasing the supply of Engineers needs to be upon those following the FE route into employment – where the greatest shortage exists – both in terms of start volumes and completion rates.
- The gender imbalance at FE level is even more pronounced than in HE. This imbalance has significant cultural and practical implications for the sector and the rate of change is such that far more needs to be done to present Engineering as an inclusive and relevant occupation for women.
- Skills Shortages and Skills Gaps are not as generally widespread as is sometimes imagined, but they are nonetheless important – particularly in specific roles and occupations – highlighted by the MAC Shortage Occupation List and in the case studies.
- Importing skills cannot be a substitute for up-skilling the UK's workforce through training, development and lifelong learning. The importance of this cannot be underestimated. Employers have a key role in developing their employees and employees must take every opportunity to develop themselves professionally.
- The shortage of particular types of Engineers in specific roles is also tied in closely to FE learners – a point supported by the case studies.
- The supply of, and demand for, Engineers will always be a balance reflecting a functional labour market (dynamics and economics). Relevant evidence demonstrates significant opportunities covering knowledge sectors to create a positive career-pull through FE and HE.
- Despite current UK economic problems, the future opportunities to develop a career as an Engineer remain highly attractive.
- Those in the Engineering community with an interest in the success of Engineering need to address the wider imperatives facing Engineering and work together in a genuine spirit of co-operation to achieve positive, solution-oriented outcomes based on robust, objective evidence. Knowing the extent of the issues is one thing; understanding why is essential if these issues are to be successfully addressed.

B Supply Side
1 Image and Reputation



"A good scientist is a person with original ideas. A good engineer is a person who makes a design that works with as few original ideas as possible. There are no prima donnas in engineering."

Freeman John Dyson FRS

1a. Overview

Opinions and attitudes towards Engineering and Technology (E&T) are a vital component in determining the extent to which individuals are engaged by, and interested in, E&T – whether as a career or in advising or influencing others.

In 2007 the ETB and Royal Academy of Engineering (RAEng)[6] decided to carry out jointly-funded research into the general public's view of Engineers and Engineering.

The research was carried out by BMRB[7] and found that more than twice as many people knew little about Engineering as a profession (44%) than those who knew a lot (22%). Women and young adults (16-19-year-olds) were particularly unaware.

Furthermore, well over half (57%) of the public thought they were either not very well informed or not at all informed about the work of Engineers. Just 5% of women and the same proportion of 16-19-year-olds considered themselves to be very well informed about the work of Engineers.

Overall, the lower the social grade of the respondent, the less likely it was that they would know anything about Engineering as a profession or about the work of Engineers.

Similarly, more than half of the respondents agreed with the statement that 'hardly anyone knows what Engineers do', and four out of five adults agree that there are 'so many types of Engineer, it is confusing for the average person to understand'.

6 http://www.raeng.org.uk/

7 http://www.bmrb.co.uk/

Around five out of six adults agreed with the statement that 'Engineering is essential for all human development' and that 'Engineering is a well-respected profession'. However, a far lower proportion of 16-19-year-olds agreed with the former (68%), which suggests that the contribution of Engineering to human development is not as widely recognised among young adults.

The lower recognition by 16-19-year-olds of the contribution that Engineers make to solving key issues facing mankind is clear. However, a high proportion of all adults do recognise this contribution, particularly in the disposal of nuclear waste, improving sewage and sanitation and drinking water quality, and issues surrounding pollution and climate change.

It was found that communication with the public in order to generate a more positive image and reputation for the sector, as well as increasing awareness and knowledge, needs to be focused upon:

> Issues relevant to their interests and concerns

> Being as straightforward as possible and

> The benefits of solving problems

As a result of this research, the ETB and a number of partners have established an Engineers and Engineering Brand Monitor (EEBM) research project, which is being piloted in 2008 and will run regularly with the first main wave of the research taking place in 2009. The aim of the research is to establish the extent to which the opinions of not only adults, but also children, are changing in response to initiatives from the Engineering 'community' and are elsewhere designed to improve the image and reputation of Engineers and Engineering both as a contributor to modern living and as a career.

1b. Definitions, Cues, Semiotics, and the ROSE

So, what is Engineering? The concise OED[8] definitions of an Engineer and Engineering are grounded in the history of the subject.

1. engineer

• **noun**
1 a person qualified in engineering.
2 a person who maintains or controls an engine or machine.
3 a person who skilfully originates something.

2. engineering

• **noun** the branch of science and technology concerned with the design, building, and use of engines, machines, and structures.

Source: OED

While the ETB is not suggesting that these definitions are in any way an adequate summation of what Engineering is or Engineers are there is currently no generally agreed definition of engineering or engineers. However, the ETB has undertaken a comprehensive and thorough exercise in defining the scope of Engineering and Engineers using Standard Industry Classification (SIC) and Standard Occupation Classification (SOC) codes (see Appendices E3aii and E3b). These definitions are being used by the ETB to provide a consistent understanding of the scope of Engineering and Engineers for research purposes.

Ask most members of the UK general public to name a famous Engineer and the names of long-dead pioneers of Heavy Engineering dominate the list; Brunel, Stephenson, Telford, Watt and so on. These leaders of the Industrial Revolution were the celebrities of their day, when becoming an Engineer was a meritocratic way to achieve success and be respected and admired by your peers and all sectors of society.

8 http://www.oed.com/

Perhaps it's not surprising that these figures have entered into the folklore of Britain. When thinking of Engineering, many think of the products of these great historical figures, so many of which survive to this day – a testament to their skill and capability in a time before CAD and hydraulic building equipment. So, to many, Engineering conjures up images of magnificent bridges and viaducts, railway lines, canal lifts, huge ships, Concorde and such like – hard, strong, mighty and imposing. Yet thoughts rarely seem to extend beyond 'traditional' Engineering to include modern, hi-tech communications equipment or micro-power generation technology and such like.

There are many positive things to say about Engineering and being an Engineer, but there is also qualitative evidence that suggests that Engineering is often seen as a 'dirty' sector and that becoming an Engineer means getting 'covered in oil' or wearing a hard hat. The words are also often associated with negative scenarios such as 'over-running engineering works' or 'engineers have been called in to examine the problem'. The effect of such images and language at a subconscious (or even conscious) level on the attitudes or motivation towards Engineers and Engineering at all levels is complex, multi-layered and not well understood.

Its history hangs heavy over Engineering, which is probably as much a function of how the general public classifies 'Engineering' based on cultural norms and values, at least to an extent. The UK's historical place as the 'workshop of the world' plays a part in this, as does its subsequent economic development and the increasing diversity of occupations associated with this development. What was simple is now complex and the human condition tends towards simplification – a short-hand for 'Engineering', if you like.

As yet, the ETB has not carried out research into the cultural semiotics of Engineers, Technicians and E&T, but the findings of the Relevance of Science Education (ROSE)[9] project indicates that a better understanding of people's motivations could provide information on how to improve the attractiveness of the sector as a place to work.

ROSE is an international comparative research project designed to identify factors of importance to the learning of Science and Technology (S&T) – as perceived by the learners themselves. It is supported by the Research Council of Norway,[10] the Ministry of Education and Research in Norway,[11] the University of Oslo,[12] and the Norwegian Centre for Science Education.[13] The findings stem from the work of key international research institutions and individuals working collaboratively on the development of theoretical perspectives, research instruments, data collection and analysis, and its work on understanding the attitudes and motivations of 15-year-olds towards S&T in 40 countries around the world.

9 http://www.ils.uio.no/english/rose/index.html

10 http://www.forskningsradet.no/

11 http://www.regjeringen.no/

12 http://www.uio.no/

13 http://www.naturfagsenteret.no/

This research has shown that the greater the Human Development Index (HDI) – an index developed by the United Nations Development Programme,[14] that combines measures of life expectancy, literacy, educational attainment, and GDP per capita – the lower the interest that students express in S&T-related topics. There is a very strong inverse relationship. Apparently, this is true of career choices as well.

In Sjøberg's and Schreiner's (2005)[15] analysis for the ROSE findings they noted that young people's desire to choose a career in S&T is closely related to that country's HDI. They suggested that the challenge of improving the material conditions, health and wellfare, and economic growth in 'poor' countries made such development a key political and public issue, with S&T as a key driving force, and with such occupations being meaningful for both the individual and society.

They contrasted this with developed nations in which industrialisation was similarly directed at achieving 'progress', but found that now the work of Engineers and others is no longer as crucial for people's very existence. Other research indicates that young people in poorer countries have a rather heroic perception of scientists *et al.*, which is not the case in highly-developed nations (Sjøberg, 2002)

Clearly, cultural norms and values play a vital role in determining the image and reputation of S&T-related occupations, such as in Engineering, and in the career decision-making process of young people. Such norms and values that pervade society can and do change, but often very slowly and imperceptibly.

Seeking to change these opinions is no small task, and in order to do so there needs to be a more thorough and specific understanding of young people's decision-making processes in terms of education and careers. What and who are the influences and at what age? How young do interventions need to start? How can behaviour be altered in order to change cultural norms and values?

Kotter and Cohen (2002) asserted that behaviour must change and culture will surely follow. This is a challenge that all employers, employees, stakeholders and every other body and person with an interest in the success of E&T in the UK must work together to achieve.

14 http://www.undp.org/

15 http://www.ils.uio.no/english/rose/network/countries/norway/eng/nor-sjoberg-apfslt2005.pdf

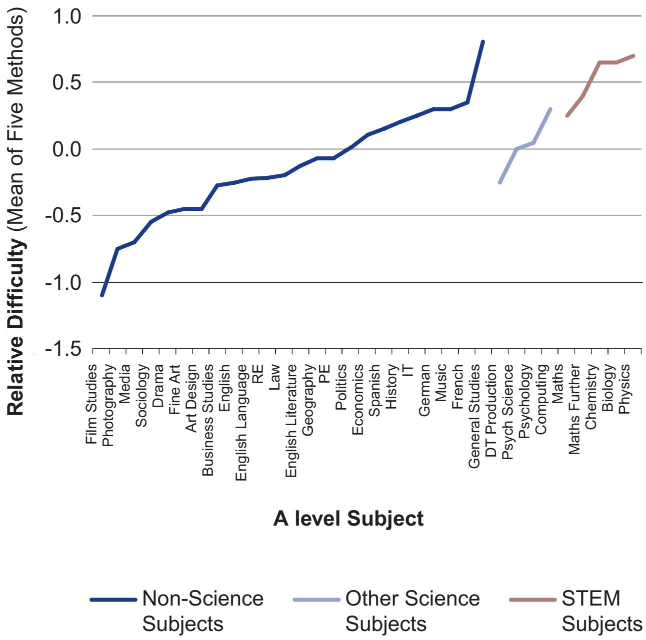
1c. Subject Choice

One issue that is often raised is the relative difficulty of studying STEM subjects and the impact that this may have on the future of the learner. It is often suggested that many young people are dissuaded from studying STEM subjects because they are widely perceived to be more difficult to study and to achieve a high grade in, and therefore may disadvantage the student as they progress through education into employment.

In July 2008 the CEM Centre[16] at Durham University[17] published its report *Relative Difficulty of Examinations in Different Subjects*, which reviewed the evidence regarding whether examinations in some subjects can be described as 'harder' than those in other subjects, and, if so, whether STEM subjects (those that form a foundation for further study in Science, Technology, Engineering and Mathematics) are generally more difficult than others.

The CEM research reported that there was a clear indication that STEM subjects are generally harder than other subjects. Comparing the difficulties of 33 A level subjects (250,000 candidates) and 34 subjects at GCSE (635,000 candidates), the findings of which are summarised in Figure B1.1.

Figure B1.1: Relative Difficulty of STEM and Non-STEM Subjects at A level



Source: CEM Centre – Durham University

The CEM research found that Physics, Chemistry and Biology A levels were a whole grade more difficult than Drama, Sociology or Media Studies, and three-quarters of a grade more difficult than English or Business Studies.

Ofsted's[18] report *Success in Science*, published in June 2008, evaluated the strengths and weaknesses of Science teaching in primary and secondary schools between 2004 and 2007, and pointed out that where the numbers recruited to A level Sciences were low, the students often talked about how it is more difficult to attain higher grades for entry to university in Sciences (particularly Physics and Chemistry) than in other subjects. Where the numbers recruited to post-16 Science courses were increasing, several factors came into play, the most frequently mentioned being the enjoyment gained from the subject and the enthusiasm of particular teachers.

16 http://www.cemcentre.org/

17 http://www.dur.ac.uk/

18 http://www.ofsted.gov.uk/

The evidence therefore points to STEM subjects being perceived as, and actually, more 'difficult', which indicates unfairness and implies an impact upon learning pathway choice. However, as the CEM Centre report points out:

"What is not clear, however, is whether such unfairness actually changes people's behaviour. A student who wants to take sciences may well do so in spite of incentives to do otherwise; a school that believes in offering a balanced programme of subjects to meet its students' educational needs will continue to support the more difficult subjects, despite any impact on its league table position. Does difficulty really make a difference to people's choices? More importantly, would addressing the problem of difficulty actually encourage more people to take the STEM subjects?"

This evidence only goes to support the need for a stronger, robust, objective evidence base in order to better understand how and why individuals choose the learning pathways and careers that they do.

1d. Early-age Interventions

i. Child of Our Time

Many of the myriad interventions and activities that the Engineering 'community' undertakes are aimed at certain points in curricula; for example Key Stage 3. There is qualitative evidence that children develop associations and opinions about STEM subjects and associated work and occupations from a very early age.

In the Open University[19] and BBC co-production documentary series *Child of Our Time,*[20] Dr Robin Banerjee, Senior Lecturer in Psychology at the University of Sussex, notes that:

"…children begin to label themselves and others as male or female accurately from around two years of age, and soon after this begin to form clear links between these labels and different activities, toys, behaviours, and even adult occupations (e.g. girls/women play with dolls and can be nurses; boys/men play with cars and can be firefighters). In fact, the beliefs of children in these early years of childhood can be much more strongly stereotyped than the beliefs of most adults – parents often find that their children have more stereotyped attitudes about gender than they do themselves."

"…researchers have shown that children actively begin to seek out information about what it means to be a boy or girl as soon as they are able to label themselves and others as male or female accurately. In other words, from around three years of age, children are themselves motivated to find out about masculine vs. feminine toys, activities, behaviours, and occupations."

It is the opinions about and attitudes towards occupations that are of most interest in the context of this publication. If children begin to form such views so early in life, attempting to influence them at the age of 14 may be 'missing the boat', both in terms of gender stereotypes and the kinds of careers they may be interested in.

19 http://www.open.ac.uk/

20 http://www.open2.net/childofourtime/2008/index.html

ii. Siemens AG Generation 21

It is not only in the UK that these issues are faced – as highlighted by the ROSE research, developed countries face similar challenges in making careers in E&T attractive – or that it is believed early-age intervention might be beneficial.

The *Siemens' Generation 21*[21] programme is an international series of interventions comprising a comprehensive long-term education programme designed to lead children through a learning journey starting at pre-school level, following through to post-secondary education.

This initiative, which has attracted recent interest from the media (Financial Times,[22] 17/06/08), expanded into the pre-school age group in Germany in 2005. Siemens identified that there was a serious lack of S&T-related teaching materials designed specifically for this age group and that teachers had neither experience of such materials, nor were they able to use them effectively. In a relatively short time, the teaching of science-related subjects to pre-school children has become commonplace in Germany.

Siemens based its interventions through research carried out by the Institute of Economic Policy at the University of Cologne[23] and the work of Professor Dr W. E. Fthenakis at the Free University of Bozen-Bolzano,[24] a leading expert in Developmental Psychology and Anthropology at the Faculty of Education.

The premise that underlies its approach is that children learn faster than adults, and do so fastest of all in their pre-school years. Siemens believes that the sooner children learn about all things technical and develop an understanding of the Natural Sciences in a playful way, the more readily they'll learn about them later.

Siemens offers materials for pre-schools that aim to cover a wide range of subjects because it believes that much of what is learnt at this age will shape their entire lives. Therefore, the foundation for later professional development should be laid as early as possible in order to enable children to get hooked on Technology and the Natural Sciences. In order to target this very young age group effectively, special methods are required because children at this age learn by observing and imitating, by trial and error.

As part of the Siemens Generation 21 programme, a 'Discovery Box' has been developed to stimulate the interest of pre-school children in S&T and to provide their teachers with a teaching resource.

The contents of the Discovery Box enable children and their teachers to conduct a wide range of scientific experiments to illustrate energy, electricity, the environment and health matters. The contents include light bulbs, batteries, electric motors, thermometers, and large diagrams of the human body.

In collaboration with other employers, Siemens also supports the 'Haus der Kleinen Forscher', or the 'House of Little Researchers'. This programme assists teachers with their work at day care centres and pre-school facilities. The interventions included in this German educational initiative have been designed to provide early enrichment activities in the Natural Sciences and Technology.

"We're helping pre-school children satisfy their curiosity, experience the fun of discovery and explore the fascinating world of Science and Technology in ways that are fun and geared to their capabilities."

Mrs Angela Clerc, Siemens AG, München.

The impact of these and other activities will, of course, have a time-lag, so it may be many years before evidence will emerge of the specific effectiveness of such positive initiatives. In the meantime, the evidence suggests that a closer inspection of the significance of early-age interventions should take place.

21 http://www.generation21.siemens.de/

22 http://www.ft.com/

23 http://www.iwp.uni-koeln.de/

24 http://www.unibz.it/

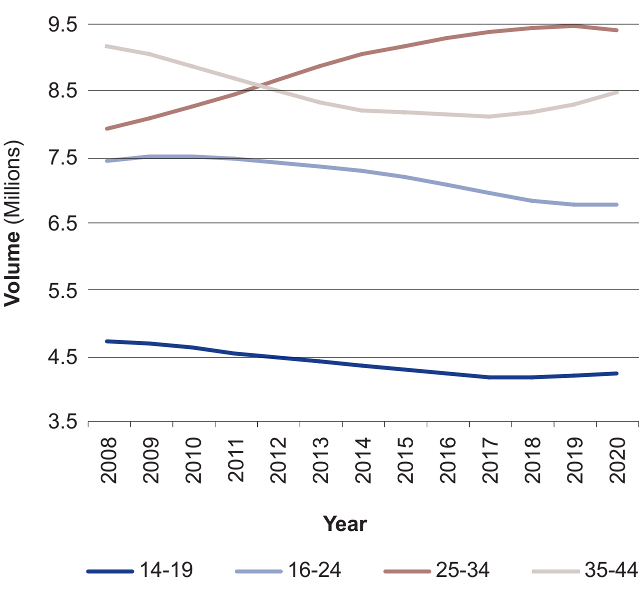
B Supply Side
2 Demographics

Vital to the future of the UK economy, and that of the Engineering sector, is an understanding of demographic change and how this could impact upon the pool from which the supply of Engineers and Technicians may be drawn in years to come.

The Government Actuary's Department[25] publishes population data based on the 2006 principal projections of persons. As can be seen in Figure B2.1, the most significant change is that by 2020 the number of 16-24-year-olds in the population will have fallen by 10% from 7.5 million to 6.75 million. Volumes in this key group are significantly below those of 25-34 and 35-44-year-olds, with the position against 25-34-year-olds worsening significantly so that there will be seven 16-24-year-olds for every 10 of the older age group.

The extent of the problem is illustrated in the number of 14-19-year-olds being about half that of 35-44-year-olds and even allowing for the shorter age band (seven and 10 years respectively) this disparity is significant. Indeed, the cohort of 14-19-year-olds in the UK will fall by 11.6% by 2018 before beginning to rise again.

Figure B2.1: **Projected UK Populations at Mid-Years by Age Last Birthday Band – 2006 Projections**



Source: Government Actuary's Department/ONS

At the same time the number of 35-44 year olds will fall 11.4% to 8,120,245 by 2017, thereafter experiencing a notable upturn.

The most significant increase in the period is for 25-34 year olds which will rise by 19.1% from just under 8 million to nearly 9.5 million. In view of the projected declines in other age groups, 25-34-year-olds must be a key target pool for future Engineers and Technicians. Many of these may be career changers whose training and education may not align with traditional Engineering career pathways. Ways will need to be found in order to draw upon this valuable pool of potential employees by up-skilling them to meet the needs of employers.

25 http://www.gad.gov.uk/

B Supply Side
3 Secondary Education: 14–19

3a. Overview

Given the projected fall in the number of young people of school-leaving age over the next decade, and the increasing competition that will arise for motivated youngsters keen to work for forward-thinking employers offering exciting careers, a review of the 14–19 secondary education is particularly important. This section looks at changes to the school-leaving age and secondary qualifications across the UK.

3b. School-leaving Age

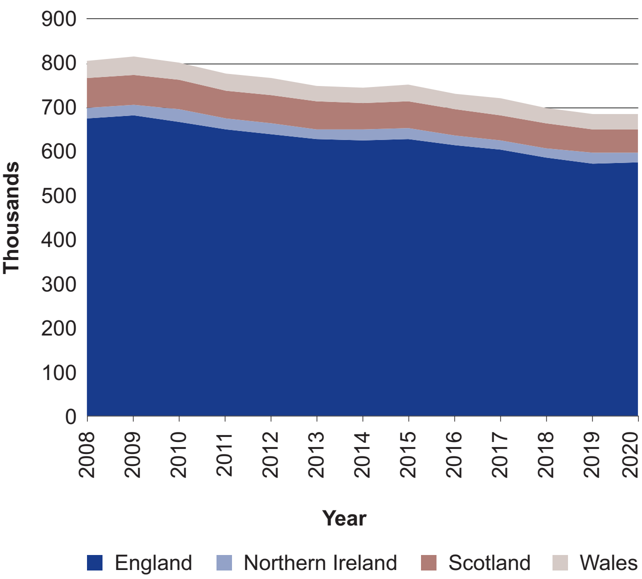
In England the government will raise the new school-leaving age limit to 17 from 2013 and 18 from 2015, which means that those children starting secondary school in September 2008 will be the first to be compelled to stay 'in education' until 18. The main reason for this change is to tackle the substantial group of 16-18-year-olds not in education, employment or training (the so-called NEET[26] group), which official estimates set at around 10% of the 16–18 cohort.

Under the plans 16-18-year-olds can choose to either stay on at school or undertake some form of training in a college or workplace environment. Those wanting to enter work at 16 will have to spend at least one day a week in training.

Population estimates and projections for the numbers of 18-year-olds living in the UK are shown in Figure B3.1. From 2009 onwards, estimates suggest that the population of 18-year-olds will decline fairly steadily until 2020. This decrease in the annual UK cohort will equate to 133,000, or 16.5% by 2020. Equivalent falls in Scotland and Wales are forecast to be over 20% in the same period.

26 Not in Employment, Education or Training (NEET)

Figure B3.1: Projected Populations at Mid-years by Age 18 Last Birthday



Source: Government Actuaries Department/ONS

These declines will pose particular challenges for educationalists, employers and policy-makers in the face of the need for developing an increasingly skilled workforce. It is, however, apparent that it will not be possible to simply to rely upon the conveyor belt of young people to fill new positions, but it will be necessary to engage with older, enthusiastic career changers and to find ways to empower them to bring their skills and experience into the world of Engineering.

3c. School-leaving Qualifications

i. Scottish National Qualifications

In early August 2008, the Scottish Qualifications Authority (SQA)[27] – the national body in Scotland responsible for the development, accreditation, assessment and certification of qualifications (other than degrees) – published the 2008 national results for courses graded by Scottish Curriculum and Qualification Framework (SCQF)[28] level (see Appendix E3d for details). Table B3.1 summarises the pre-appeal figures for passes in STEM subjects.

What is particularly noticeable is that nearly half of all pass awards at Advanced Higher level (SCQF Level 7) are in STEM subjects.

27 http://www.sqa.org.uk/

28 http://www.scqf.org.uk/

Table B3.1: **Scottish National Pre-appeal Selected STEM Course Awards 2008 – Passes**

	Access 2 (SCQF Level 2)	Access 3 (SCQF Level 3)	Standard Grade (SCQF Level 3-5)	Inter-mediate 1 (SCQF Level 4)	Inter-mediate 2 (SCQF Level 5)	Higher (SCQF Level 6)	Advanced Higher (SCQF Level 7)
Applied Mathematics	n/a	n/a	n/a	n/a	n/a	n/a	230
Applied Practical Electronics	n/a	n/a	n/a	145	n/a	n/a	n/a
Architectural Technology	n/a	n/a	n/a	n/a	n/a	35	n/a
Biology	n/a	2,409	21,983	3,685	4,585	6,417	1,454
Biotechnology	n/a	n/a	n/a	n/a	67	23	n/a
Chemistry	n/a	1,470	19,613	2,187	3,257	7,347	1,615
Computing	34	1,470	15,092	2,057	2,165	2,848	271
Craft and Design	n/a	n/a	12,585	n/a	n/a	n/a	n/a
Electronic, Electrical Fundamentals*	n/a	n/a	n/a	n/a	100	n/a	n/a
Engineering Craft/ Skills/Welding*	n/a	n/a	n/a	159	510	8	n/a
Human Biology	n/a	n/a	n/a	n/a	n/a	2,550	n/a
Information System	n/a	n/a	n/a	n/a	1,410	1,053	27
Mathematics	328	9,639	50,301	7,291	14,015	14,063	1,898
Physics	n/a	815	15,087	1,684	2,736	6,496	1,080
Product Design	n/a	n/a	n/a	n/a	715	1,452	25
Science	115	n/a	3,228	n/a	n/a	n/a	n/a
Technological Studies	n/a	n/a	1,385	n/a	99	463	66
Total of Above	**477**	**15,843**	**139,274**	**17,208**	**29,659**	**42,755**	**6,666**
STEM share of total all-subject passes	23%	59%	37%	39%	33%	36%	47%

* Some low-volume awards combined

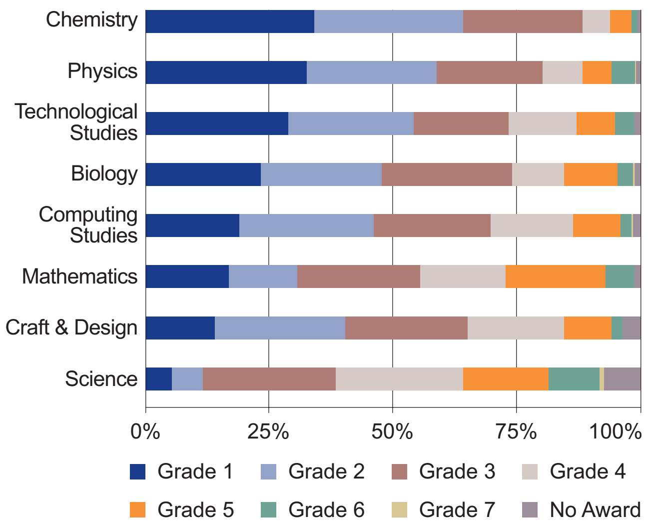
Source: Scottish Qualifications Authority (SQA)/SCQF

Mathematics remains an especially popular subject at Higher level (Level 6), with over 14,000 passes in 2008, while Chemistry is the next most popular STEM subject with around half the number of passes (7,347), with Biology and Physics both close behind.

When looking specifically at Standard Grade awards, over half of those taking Chemistry, Physics and Technological Studies achieved grades 1 or 2 (see Figure B3.2).

There is considerable variation in STEM subject grade awards at Standard Grade level; over one third (34%) of Chemistry awards are at Grade 1, whereas for Science the figure is just over 5%.

Figure B3.2: Scottish Standard Grade STEM Course Awards 2008 – by Grade



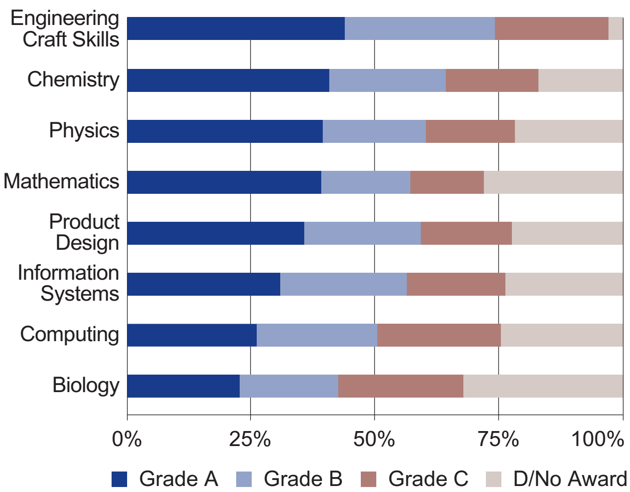
Source: Scottish Qualifications Authority (SQA)/SCQF

The grade levels for Mathematics at Standard Grade are notably poorer than for most other STEM subjects, perhaps reflecting the greater breadth of entrant capabilities for this subject.

Scottish Intermediate 2 STEM courses offer a wider range of STEM subjects, including those that are practically oriented. A very high proportion of those taking Engineering Craft Skills are achieving Grade A – more than for any other STEM subject.

It is disappointing to see well over a quarter of Mathematics and Biology candidates are receiving a Grade D or no award.

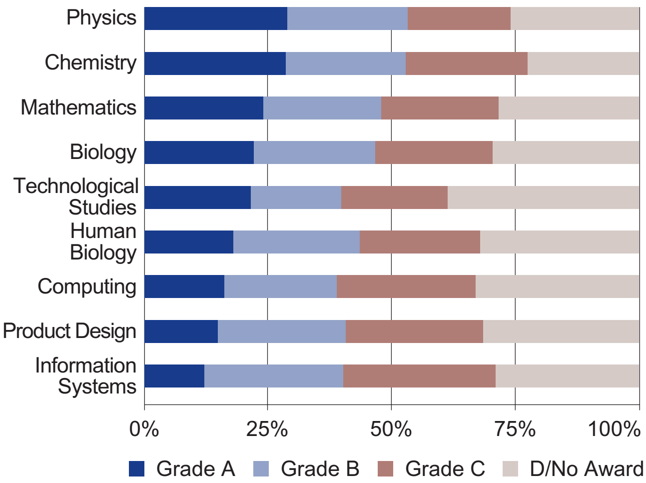
Figure B3.3: Scottish 'Intermediate 2' STEM Course Awards 2008



Source: Scottish Qualifications Authority (SQA)/SCQF

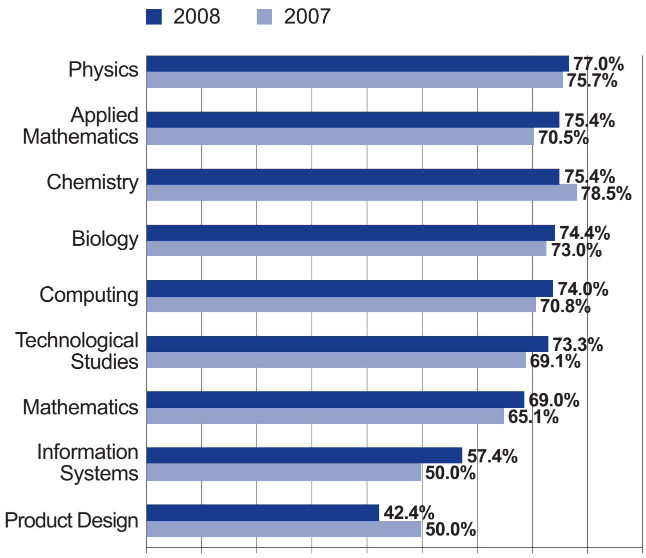
At Higher level the proportion of Physics and Chemistry candidates achieving A and B pass grades is well over 50%.

Figure B3.4: **Scottish Higher STEM Course Awards 2008**



Source: Scottish Qualifications Authority (SQA)/SCQF

Figure B3.5: **Scottish Advanced Higher STEM Course Pass Rates 2007 vs 2008**



Source: Scottish Qualifications Authority (SQA)/SCQF

When looking at Advanced Higher STEM subject pass rates in 2008 compared to 2007 (Figure B3.5), most subjects have seen a notable improvement over the previous year. Those sitting Applied Mathematics (+4.9% points), Technology Studies (+4.2% points), Mathematics (+3.9% points) and Information Systems (+7.4% points) have seen a particularly large rise in pass rates. It is not clear why the pass rate of Chemistry candidates has fallen slightly.

Science Baccalaureate

In June 2008 it was announced that a new qualification in Science is to be introduced for S5 and S6 pupils in Scotland's schools. The Baccalaureate will include existing qualifications in Science at Higher and Advanced Higher level. The new element of the award will be an interdisciplinary project to be taken in S6.

The proposed structure of the Scottish Science Baccalaureate comprises:

> Interdisciplinary project at Advanced Higher
> Maths at Higher
> 2 sciences at Higher
> 1 science at Advanced Higher

A range of STEM subjects are planned to be included, which may be added to or removed:

> Biology*
> Biotechnology
> Chemistry*
> Computing*
> Geology
> Human Biology
> Information Systems*
> Managing Environmental Resources
> Mechatronics
> Physics*
> Technological Studies*
> Building Construction
> Fabrication and Welding Engineering
> Graphic Communication
> Product Design**

* Currently available at Advanced Higher level
** Will become available at Advanced Higher level from session 2009-10.

An example of a topic that could be studied within the interdisciplinary element of the Science Baccalaureate is how the life sciences are used in industry, the Engineering industry, and ethical issues in Science. The first Baccalaureates will be awarded in August 2010.

3d. 14-19 Diplomas in England

Positioned as a new, alternative route through secondary education into HE and FE, the first 14-19 Diplomas were introduced in England in September 2008 covering five employment sectors:

> Construction and the Built Environment
> Creative and Media
> Engineering
> Information Technology
> Society, Health and Development

An additional suite of qualifications will be offered in a further five sectors from September 2009, and a total of 17 14-19 Diplomas are planned to be available across England by 2011.

There are three levels of 14-19 Diploma:

> The Foundation Diploma is a Level 1 qualification, equivalent to five GCSEs grades D-G.
> The Higher Diploma is a Level 2 qualification, equivalent to seven GCSEs grades A* to C.
> The Advanced Diploma, aimed at those over 16 is a Level 3 qualification, equivalent to three-and-a-half A levels.

A Progression Diploma (also Level 3) will also be available and is equivalent to two-and-a-half A levels. This will suit students who may not wish to complete a whole Diploma.

The Diplomas have a number of components :

> **Principal Learning:** The main compulsory course in the Diploma.
> **Project:** To be completed during the Diploma.
> **Personal Learning and Thinking Skills:** Including team working, communication and self-management.
> **Generic Learning:** English, Mathematics and ICT.
> **Additional and Specialist Learning:** A series of optional components.

From 2011, an Extended Diploma will also be available for study, comprising extra Mathematics, English and ICT, plus extra Additional and Specialist Learning.

Anyone will be able to study for an Extended Diploma in any subject on offer; the Extended Diploma will be available on all 17 Diploma courses, and at every level – whatever year the learner is in.

Dr Geoff Park, the University of Cambridge's (UoC)[29] Admissions Director, was quoted in *The Independent*[30] on 29th July 2008 as saying that Cambridge was impressed by the Engineering Diploma[31] and by the Environmental and Land-based Studies Diploma due to be offered in the second phase from September 2009. However, he did think that the remaining Diplomas being launched in the first three years would not be considered for admission by the UoC.

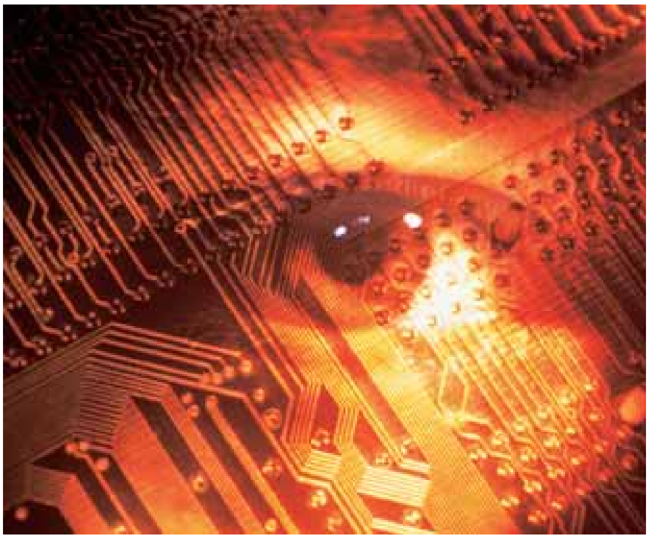
Along with many other professional Engineering organisations, the ETB strongly supports the Diploma in Engineering[32] because the ETB believes that it will enable young people to learn about Engineering and develop the skills and competences that will relate directly to developing a career in Engineering. Being delivered in local partnerships between schools, colleges, training providers and businesses will increase the relevance of the Diploma to both pupils and employers especially because the Engineering Diploma will enable pupils to follow either the FE or HE route.

Its Principal Learning element includes:

> The Engineered World: the importance and impact of Engineering on our lives.

> Discovering Engineering Technology: basic Engineering principles.

> Engineering the Future: what makes innovations succeed, how new materials contribute to design, and how to develop and launch new ideas.



Students also do a minimum of 10 days' Engineering work experience and get the chance to learn from professionals.

The Maths for Engineering unit has been shaped, reviewed and assessed by a specialist team from the Higher Education Academy's Engineering Subject Centre, the Engineering Professors' Council, the Royal Academy of Engineering, the Engineering Council UK, the Engineering Diploma Development Partnership, and the Institute of Mathematics and its Applications.

29 http://www.cam.ac.uk/

30 http://www.independent.co.uk/

31 http://www.engineeringdiploma.com/

32 http://www.engineeringdiploma.com/

3e. England, Wales and Northern Ireland

i. GCSE

The General Certificate of Secondary Education (GCSE) is the primary qualification taken by secondary school pupils aged 14-16 in England, Wales and Northern Ireland. GCSEs can be taken with other awards, such as General National Vocational Qualifications (GNVQs).

There are alternative qualifications gaining currency in some schools, including the International GCSE (or IGCSE), originally developed by CIE[33] 20 years ago and also offered by Edexcel.[34] One of the reasons that the IGCSE is gaining in popularity is because it is perceived to offer the greater academic rigour of the former GCE O level, abolished in the late 1980s.

GCSE candidate numbers have fluctuated across the STEM subjects over recent years. The Double Science Award has remained by far the most popular of the GCSE Science subjects, with around half-a-million candidates taking this exam 'pairing' each year, over the last eight years. This reached a peak in 2004 with a 9% decline to 2007 (Figure B3.6). However, this appears to be increasing again in 2008. This year the Double Science Award was effectively replaced by 'Additional Science'. The three science subjects are covered and two GCSEs are achieved, as with the Double Award. There is a slight change in that the curriculum incorporates areas of Science previously not taught. There has been a significant shift away from the 'Single Science' GCSE, with only 4,500 entrants in 2008, down from 98,500 in 2007.

Design and Technology (D&T) has seen a fall in candidate numbers since it ceased to be a statutory subject at Key Stage 4 (ages 14-16) in the National Curriculum (England) in 2004. However, it still had around 333,000 UK candidates in 2008. Since 2005 the volume of entrants has dropped from 397,000, this downward trend continues in 2008 with 6% fewer entrants than in 2007. On a more positive note, A*-C pass rates in D&T continue to improve, as shown in Figure B3.6, with a rise of 1.4 percentage points from 2007, to 61.2% in 2008 (provisional).

33 http://www.cie.org.uk/

34 http://www.edexcel.org.uk/

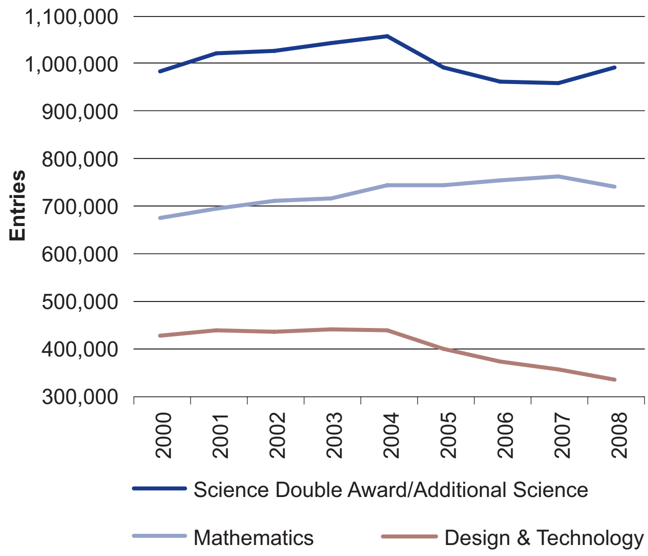
The number of GCSE Mathematics entries has risen steadily, up 9% over nine years to 738,000 in 2007, and it is the most popular single subject; however as Mathematics is compulsory this could simply reflect demographic change. The 2007/08 academic year saw a change in the curriculum resulting in the Science Double Award being replaced by Additional Science. All students study a general 'Science' qualification and the majority then take 'Additional Science', as with the Double Science Award, two GCSEs are achieved that cover the three subjects. In 2008, around 538,000 students were entered for Science and more than 433,000 took Additional Science.

There have been recent policy moves to encourage more candidates to take the 'single sciences' – Physics, Chemistry and Biology GCSEs – as separate subjects. This is reflected in the increased popularity of the single subjects, as illustrated in Figure B3.7. In 2008 in particular, entrant numbers in Biology rose by 35% and Chemistry and Physics rose by 29% in one year alone.

Also, Figure B3.7 shows the significant rises in the numbers of students opting to study Statistics and Additional Mathematics, with entrant numbers of 86,224 and 16,973 respectively in 2008.

The popularity of Statistics continues to rise steadily; there has been a 117% rise in entrant numbers since the subject was introduced in 2004, and the subject will become more popular than Biology and ICT if the trend continues. Additional Mathematics saw a particular surge in entrants this year; the volume increased 73% from 2007 to 2008 alone.

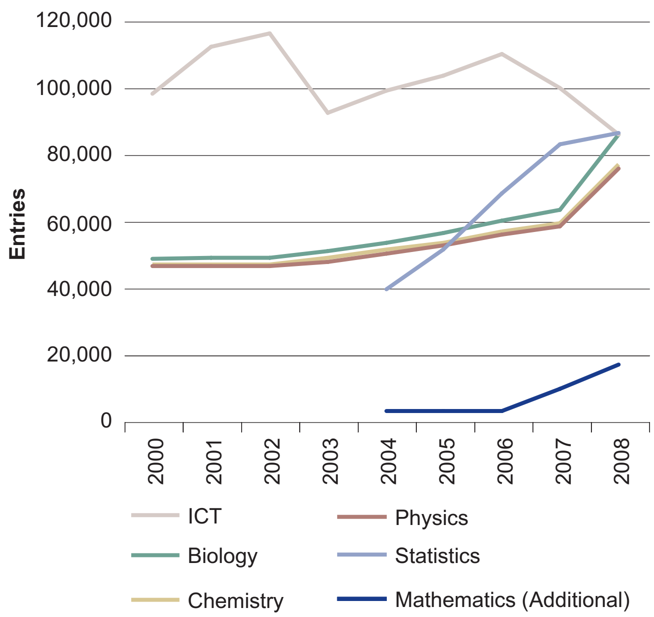
Figure B3.6: **GCSE Full Courses Entries – All UK Candidates 2008 (Provisional)**



Source: Joint Council for Qualifications (JCQ) 2001-2008

NB - Science Double Award candidate numbers are counted twice. 2008 candidate numbers were around 433,000.

Figure B3.7: **GCSE Full Courses Entries – All UK Candidates 2008 (Provisional)**



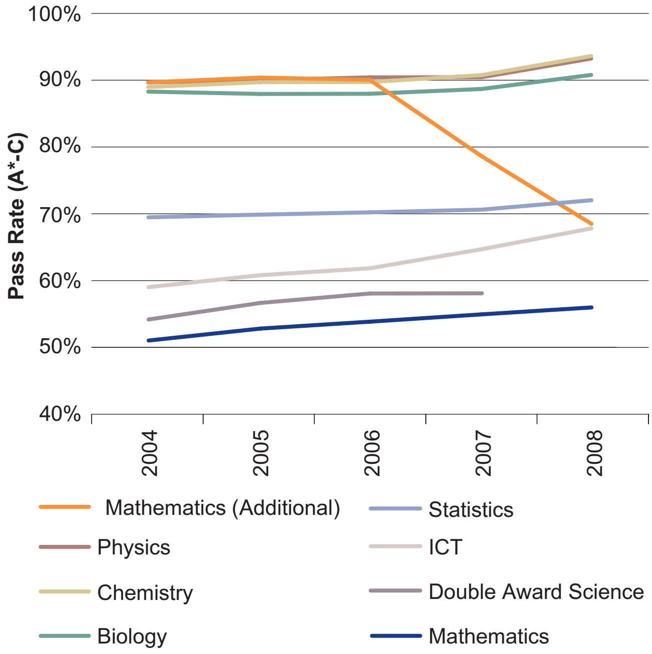
Source: Joint Council for Qualifications (JCQ) 2001-2008

Much media attention has been paid to the continuing improvement of pass rates amid speculation as to whether the qualifications are becoming 'easier' (an analysis of this with regard to Mathematics is given elsewhere in *Engineering UK*). Figure B3.8 shows that the pass rate trend holds true for STEM subjects, with the notable exception of Additional Mathematics. Having previously hovered at around 90%, the fall to 68% in 2008, although not proven, probably reflects an increase in candidate numbers, which perhaps in previous years was restricted only to the most able students. In absolute volume terms the picture is still a positive one, with 11,694 students achieving grades A*-C in 2008 compared with 2,891 in 2004.

Pass rates for Biology (91%), Chemistry (94%) and Physics (94%) remain very high and continue to grow; in 2008 there were not only significant increases in entrant numbers, but also the greatest rise in pass rates within the five-year period.

The A*-C pass rate for Statistics has risen slightly to 73% (provisional), despite the increase in candidates. With respect to the Single Science Award, only a quarter of the 100,000 entries attained a pass grade (A*-C), which may indicate that this subject is seen as something of a second choice.

Figure B3.8: **GCSE Pass Rates (Grades A*-C) over a Five-year Period**



Source: Joint Council for Qualifications 2001-2008

ii. GCE AS levels

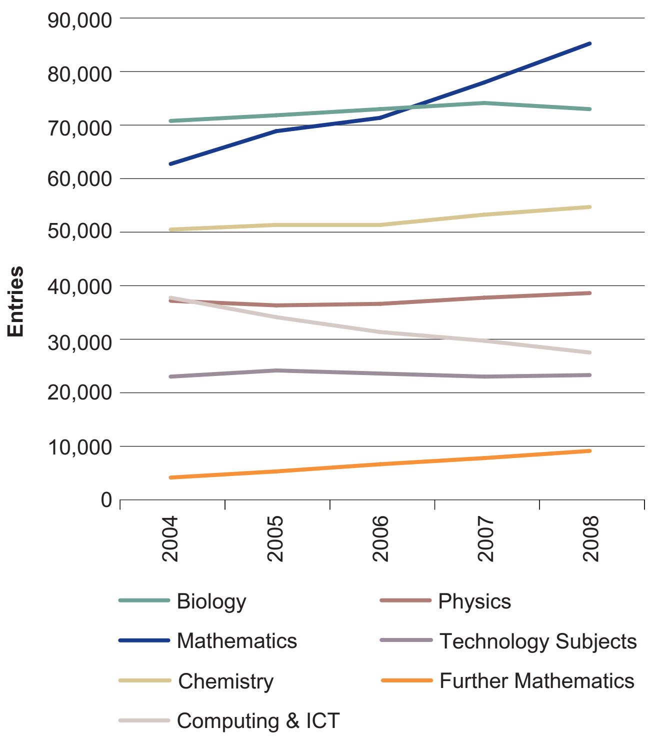
The General Certificate of Education Advanced Level (GCE A level) is the primary post-GCSE qualification taken in the last two years of secondary school, sixth-form college or further education college in England, Wales and Northern Ireland. The Advanced Supplementary (AS) Level examinations were first introduced in 1987, and since 2000 have represented a milestone examination at the end of Year 12 (Year 13 in Northern Ireland). The equivalent qualifications in Scotland are the Higher Grade or Advanced Higher Grade, usually known as 'Highers' which are set at SCQF Level 6, roughly equivalent to NQF Level 3.

All STEM AS levels, with the exception of Computing and ICT, have enjoyed a continued increase in entrant numbers over the five-year period, as shown in Figure B3.9. Mathematics is the most popular STEM subject at AS level, having overtaken Biology in 2007, and since 2004 there has been a strong 36% rise in entrant numbers. Further Mathematics has seen entrant numbers more than double over the five-year period, though they are still are relatively low.

There has been gradual growth in candidate numbers at AS level for Biology (3%), Chemistry (8%) and Physics (4%) since 2004, and these subjects remain the most popular STEM subjects after Mathematics.

ICT and Computing entrant numbers continue to fall, dropping 27% over the period. The continuing fall in Computing/ICT may reflect a return to a more stable long-term level following a surge in entries around 2002. The number of students choosing Technology subjects at AS level has remained fairly static, with a 1% rise since 2004.

Figure B3.9: GCE AS level STEM Subjects Entrant Volumes 2004-2008



Source: Joint Council for Qualifications (JCQ) 2001-2008

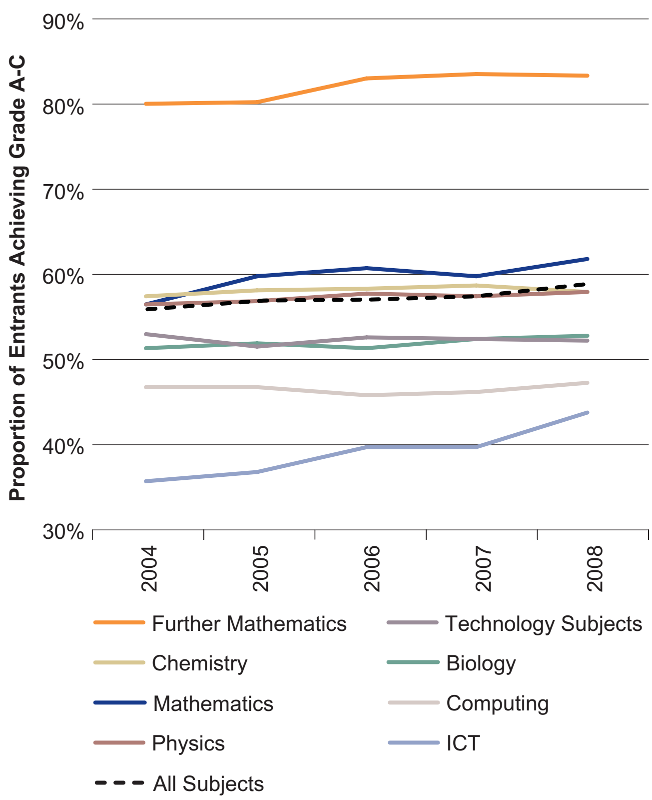
The majority of STEM AS levels saw between 50% and 60% of entrants achieving grades A-C. As with Additional Mathematics at GCSE level, the majority of students of Further Mathematics achieve good grades (83% graded A-C in 2008). This is no doubt due to the selection process for entry to the course – only the most able Mathematics students are encouraged to study to this level.

After Further Mathematics, AS level Mathematics enjoys the highest success rate, with 62% of entrants achieving grades A-C in 2008; this is an increase of 6% since 2004.

The proportion of entrants achieving grades A-C at AS level in Biology (53%), Chemistry (58%) and Physics (58%) has seen slight increases over the five-year period, as illustrated in Figure B3.10. Since 2004, Biology has increased two percentage points from 51%, Chemistry one percentage point from 57%, and Physics two percentage points from 56%.

Computing and ICT have the smallest proportion of students achieving grades A-C within STEM, with less than half the entrants achieving these grades. ICT has seen considerable improvement, though in 2004 only 36% of students achieved grade C or above. The difficulty in achieving good grades in these subjects could contribute to the declining entrant numbers as schools and sixth-form colleges feel the pressure of competing in league tables. Contrary to popular belief, Physics AS level has a similar proportion of students achieving grades A-C as the overall average, and Mathematics and Chemistry both have a higher achievement rate than that for 'all subjects'.

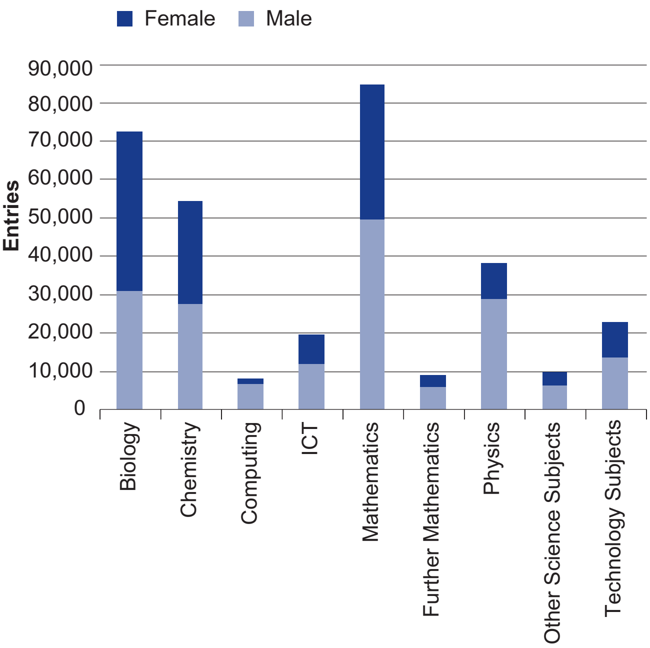
Figure B3.10: GCE AS level Grade A-C Achievement Rates 2004-2008



Source: Joint Council for Qualifications (JCQ) 2001-2008

A breakdown of each subject by gender, as illustrated in Figure B3.11, shows that the ratio between male and female students varies greatly within STEM. Biology enjoys a female-biased profile (58%), and Chemistry is almost exactly in gender balance. Both Mathematics and Technology Subjects have a male to female ratio of about 3:2, with Further Mathematics and Other Science Subjects running at 2:1. There has been little change in these ratios between 2007 and 2008.

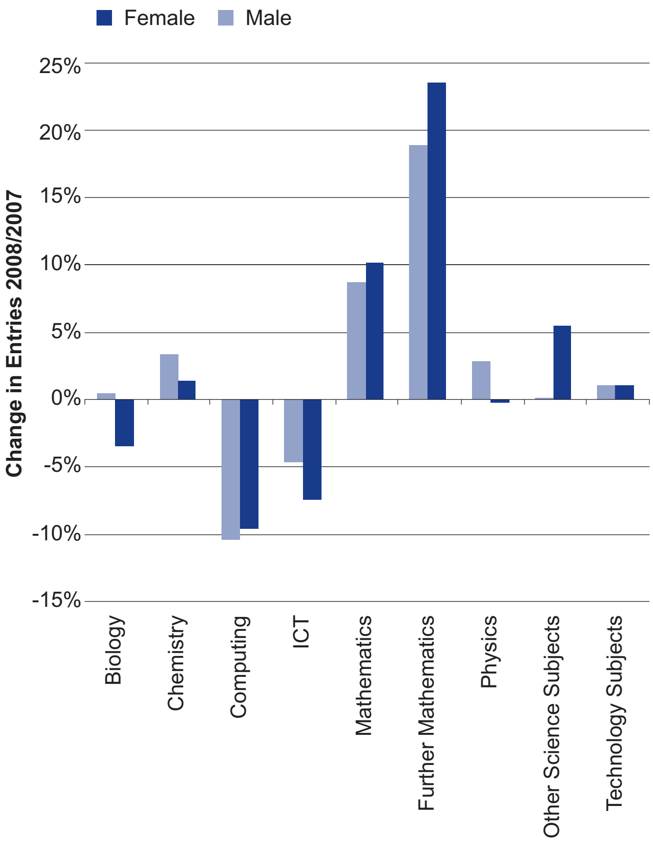
Figure B3.11: GCE AS level Entrant Volumes by Gender 2008



Source: Joint Council for Qualifications (JCQ) 2008

As can be seen in Figure B3.12, Mathematics and Further Mathematics enjoyed a healthy rise in entry volumes in 2008 compared to the previous year, whereas entry volumes for Computing and ICT have witnessed declines on the 2007 levels. There has been a small decline in the volume of female entrants for Biology this year. Physics and Chemistry experienced small rises in the volume of male students. Other Science Subjects saw a rise in the number of female entrants but little change in male student numbers.

Figure B3.12: Change in GCE AS level Entry Volumes by Gender 2008 vs 2007



Source: Joint Council for Qualifications (JCQ) 2008

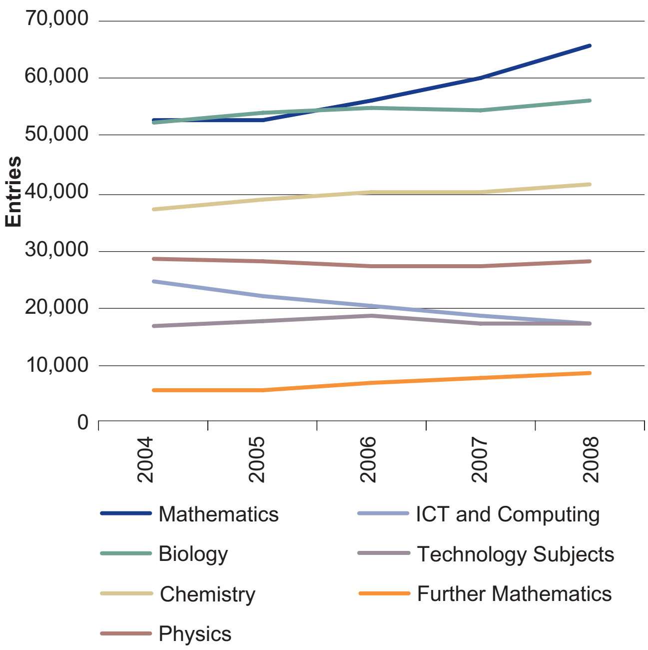
iii. GCE A levels

In 2008 there were 240,000 pupils taking the full A level STEM courses compared with 318,000 entrants for AS level. The trends seen at AS level are mirrored at A level, as shown in Figure B3.13, with Mathematics being the most popular STEM A level subject, having experienced a rise in entrant numbers of 24% over the five-year period. Further Mathematics has seen a staggering 59% increase over the same period, though the numbers are still fairly low.

Biology and Chemistry entrant numbers have seen healthy rises of 12% and 9% respectively whereas Physics has remained fairly static and actually experienced a 2% fall in entries since 2004.

Once again, ICT and Computing entrant numbers have fallen, from 24,600 in 2004 to 17,345 in 2008.

Figure B3.13: **GCE A-Level STEM Subject Entrant Numbers 2004-2008**



Source: Joint Council for Qualifications (JCQ) 2008

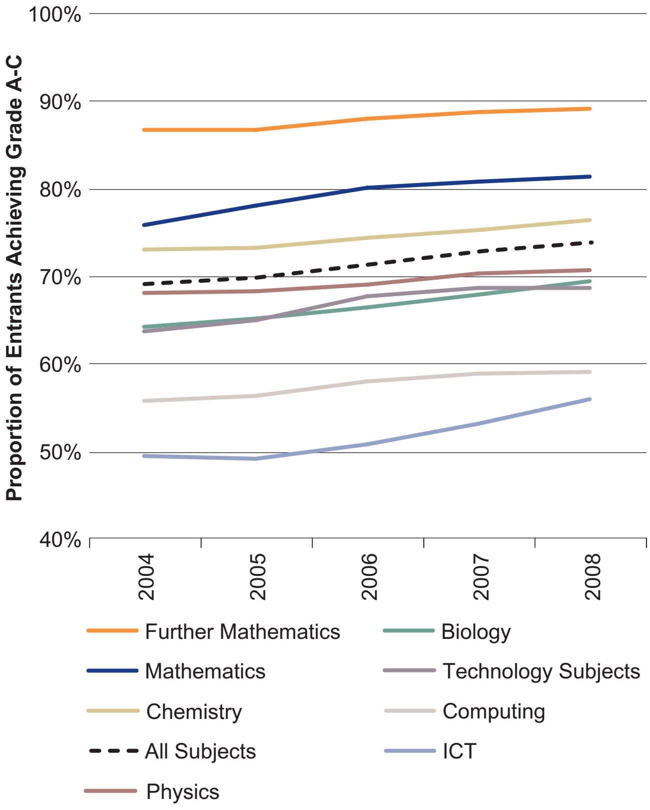
Figure B3.14 shows that the proportion of students achieving grades A-C at A level is considerably higher than at AS level, the overall average being 74% in 2008. Further Mathematics, Mathematics and Chemistry achievement rates sit comfortably above those for All Subjects. As discussed previously, the achievement rate for Further Mathematics is far higher than other STEM subjects. In 2008, 57% of Further Mathematics entrants achieved a grade A.

The proportion of entrants achieving grades A-C at A level is rising for all STEM subjects. Mathematics has seen this rate rise from 56% in 2004 to 62% in 2008, consistently above the average.

Biology, Chemistry and Physics have only seen very slight increases in students attaining a grade C or above, with rises of 2%, 1% and 2% respectively.

The subjects with the lowest level of entrants achieving grades A-C, again, are Computing and ICT (47% and 44% in 2008).

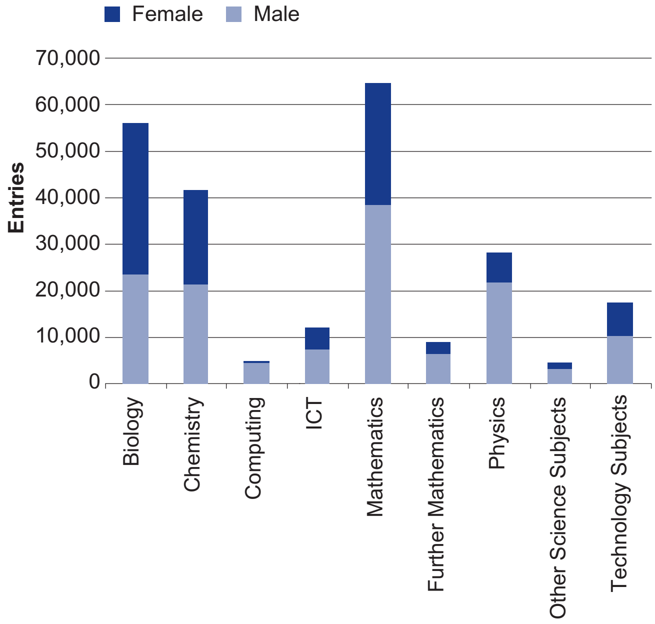
Figure B3.14: **Proportion Achieving Grades A-C at GCE A level 2004-2008**



Source: Joint Council for Qualifications (JCQ) 2008

Analysis of the selected STEM subjects shown in Figure B3.15 shows that the total number of candidate entries for these GCE A level subjects is provisionally 4% higher in 2008 than in 2007. Mathematics remains the most popular of these subjects, with Biology close behind enjoying a higher proportion of female candidates with a male to female ratio of 2:3. Chemistry is firmly in third place.

Figure B3.15: **GCE A level Entry Volumes by Gender 2008**

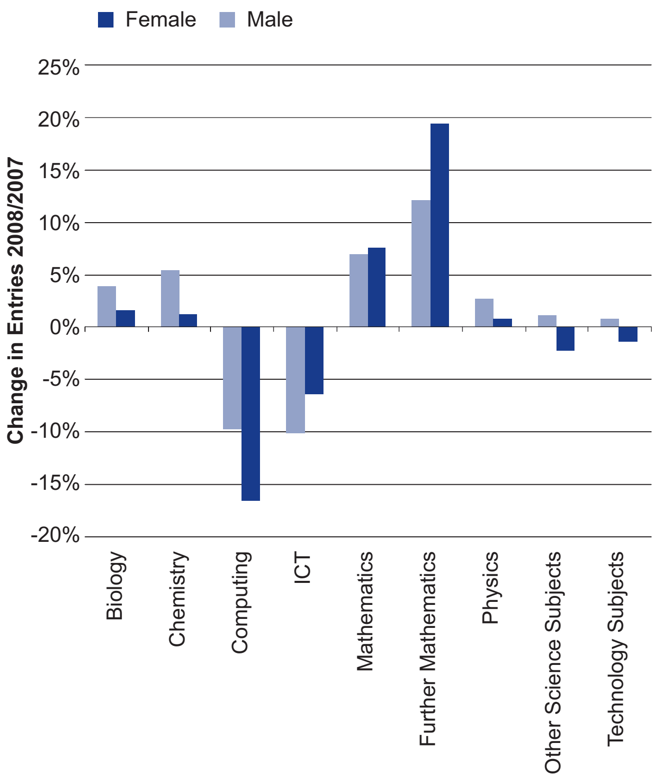


Source: Joint Council for Qualifications (JCQ) 2008

As shown in Figure B3.15 the ratio of male to female candidates varies somewhat from subject to subject. Taking these selected subjects as a whole, the proportion of males is 58% and females 42%. However, within this there are stark differences in, for example, Physics, and Computing, where the gender ratios remain very unbalanced.

Figure B3.16 shows significant increases in GCE A level candidate volumes for Mathematics and Further Mathematics in the provisional 2008 data compared to 2007 and small increases in candidate numbers in Biology, Chemistry and Physics. Computing and ICT have experienced a further reduction in entrant numbers in 2008. Even considering the small drop in female Technology Subjects entrants in 2008, the volume has risen by a healthy 11% over the five-year period.

Figure B3.16: **Change in GCE A level Entry Volumes by Gender 2008**



Source: Joint Council for Qualifications (JCQ) 2008

3f. 14-16 Young Apprenticeships in England

The Young Apprenticeship (YA) was introduced in England (only) by the former Department for Education and Skills (DfES) on a trial basis in September 2004 as a new option at Key Stage 4. It enables 14-16-year-olds with average or above results from the national tests in Mathematics, English and Science to study for vocational qualifications, not just in the classroom but in college, with training providers, and in the workplace as well. Pupils are based in school and follow the core National Curriculum subjects, but for the equivalent of two days a week they also work towards nationally recognised vocational qualifications delivered by their local Partnership. The programme includes a requirement of 50 days' work experience. The first cohort of around 1,000 pupils embarked upon YAs in specially selected partnerships across a small range of sectors, including Engineering. The cohort and range of sectors has increased year on year so that cohort five for 2008 includes around 9,000 new learners.

B Supply Side
4 Further Education and Vocational Education and Training (including some sub-disciplines)

4a. Overview

The success of Engineers and Engineering across the UK economy is dependent not only upon those following the most highly academic routes to employment, but also on those pursuing vocational routes to becoming an Engineer or Technician. These learners form the bedrock upon which all Engineering depends. Without them, leading-edge R&D and indeed much incremental innovation would never ultimately lead to full production and the delivery of products and services. This section looks at the significant FE landscape across the UK.

4b. England

There are dozens of work-based learning (WBL) frameworks – a definition of the components, structure and content of the skills and competences required by the individual learner – covering all industrial and business sectors in England. Even though framework 106 'Engineering' is the core Engineering framework in England, there are 28 other frameworks that fall within the Engineering footprint. Table B4.1 lists these 29 frameworks.

Table B4.1: **Work-based Learning Engineering Sector Frameworks – England**

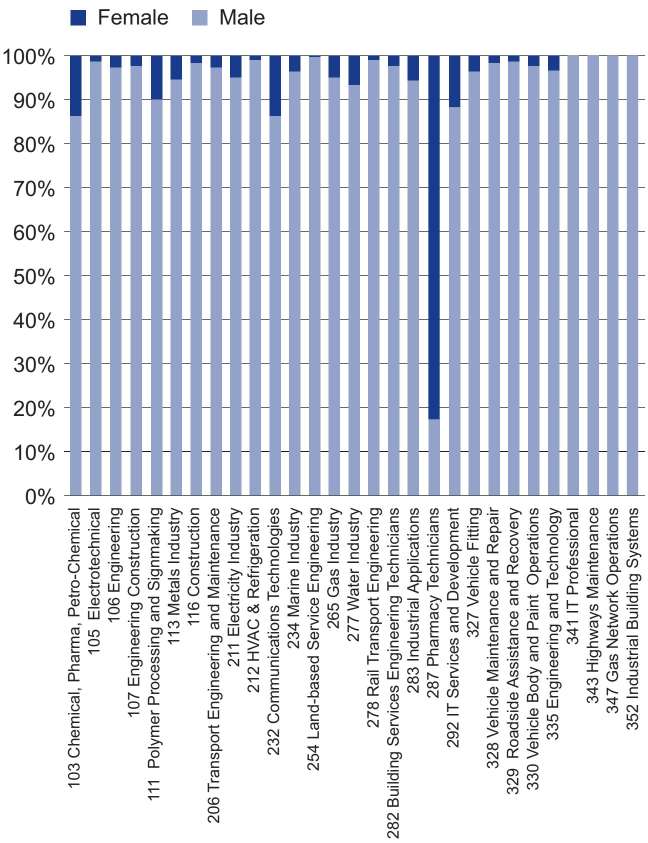
103	Chemical, Pharma, Petro-Chemical
105	Electro-technical
106	Engineering
107	Engineering Construction
111	Polymer Processing and Sign-making
113	Metals Industry
116	Construction
206	Transport Engineering and Maintenance
211	Electricity Industry
212	HVAC & Refrigeration
232	Communications Technologies
234	Marine Industry
254	Land-based Service Engineering
265	Gas Industry
277	Water Industry
278	Rail Transport Engineering
282	Building Services Engineering Technicians
283	Industrial Applications
287	Pharmacy Technicians
292	IT Services and Development
327	Vehicle Fitting
328	Vehicle Maintenance and Repair
329	Roadside Assistance and Recovery
330	Vehicle Body and Paint Operations
335	Engineering Technology
341	IT Professional
343	Highways Maintenance
347	Gas Network Operations
352	Industrial Building Systems

Source LSC

Over one in five (21%) of all male Advanced Apprenticeship (Level 3) starts are in framework 106 Engineering alone and nearly three quarters (72%) of starts are in one of the 29 Engineering frameworks. This illustrates the importance of engineering disciplines to the FE sector. The equivalent figures for female Advanced Apprentices are just 1% and 3.3% respectively. This indicates that a phenomenal gender imbalance exists, which can be seen clearly in Figure B4.1 covering both levels of Apprenticeship by framework in England. Over all Engineering frameworks the female share of all Apprenticeships is just 2.7% (2.3% of Apprenticeships at Level 2 and 3.2% of Advanced Apprenticeships). Confining the analysis to framework 106 Engineering gives exactly the same female shares.

Of all Engineering frameworks, only framework 287 'Pharmacy Technicians' exhibits a predominantly female bias.

Figure B4.1: Gender Balance in Work-based Learning Frameworks Cumulative Starts up to Period 9 for 2007/08 in England



Source: LSC

The male domination of such frameworks was highlighted in a report published by the TUC[35] in July 2008: *Still More (Better Paid) Jobs for the Boys – Apprenticeships and Gender Segregation*. This illustrates that for 106 Engineering, the proportion of female starts has actually fallen in the last five years from 4.6% in 2003/04 to 2.7% in 2007/08. Even when looking at those employers contracting directly with the Learning and Skills Council's National Employer Service[36] (NES) – available to employers with over 5,000 employees – only a marginal improvement of around 3.5% is seen.

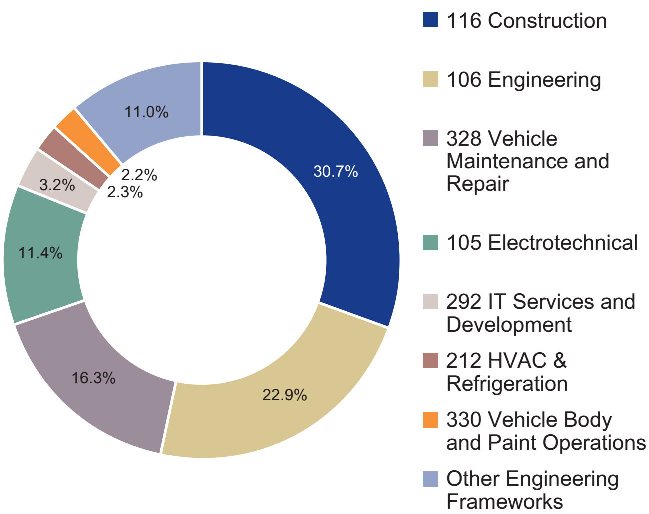
There are obvious benefits of improving the balance between the numbers of male and female apprentices in Engineering frameworks. Yet efforts to improve this balance to date have seemingly had little effect and, in the case of the 106 Engineering framework at least, the figures are heading in the opposite direction. Many of those with an interest in this area have opinions on what solutions will work, but unless we can reach a far better understanding of the reasons *why* individuals make the educational, training and career choices they do and how these are arrived at over time, any success in this area will be more by chance rather than by design. The influence of macro- and micro-cultural norms and values (and how these change over time) cannot be ignored from an analysis and understanding of decision-making.

As can be seen in Figure B4.2, framework 106 Engineering accounts for around two in nine of all 29 Engineering frameworks Apprenticeship starts. This illustrates that when considering Engineering apprentices there is a need to understand the level of choice open to candidates.

35 http://www.tuc.org.uk/

36 http://nes.lsc.gov.uk/

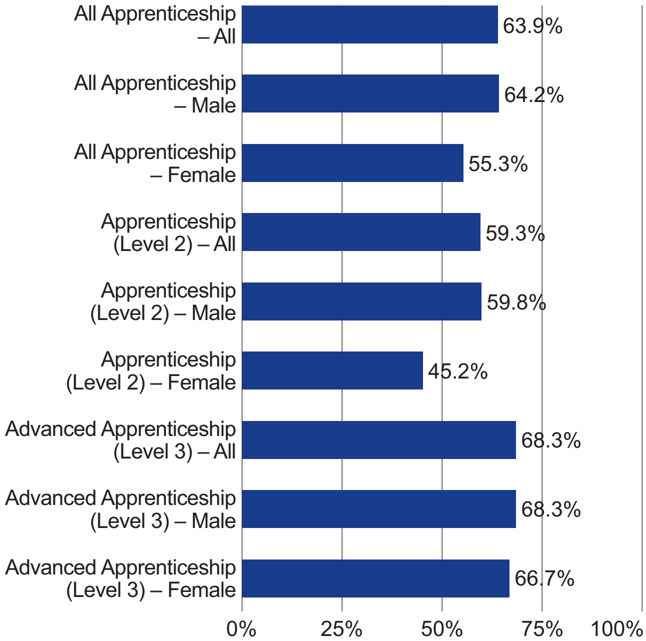
Figure B4.2: **Cumulative Apprentice Starts in Work-based Learning 'Engineering' Share by Framework up to Period 9 2007/8**



Source: LSC

Figure B4.3 examines the success rate for framework 106 Engineering by level and gender and finds that overall framework success rates hover at under two-thirds. What is noticeable is that the female framework success rates are significantly lower than those for male candidates: indeed those for Level 2 Apprenticeships are well below 50%.

Figure B4.3: **Work-based Learning Framework 106 Engineering Success Rates Sector up to Period 9 for 2007/08 in England**



Source: LSC

It is encouraging, and the ETB is pleased to note, that Level 3 Advanced Apprenticeship completion rates for framework 106 Engineering are now at over two-thirds.

Research into Expanding Apprenticeships

The Learning and Skills Council (LSC)[37] commissioned Ipsos MORI[38] and Cambridge Policy Consultants (CPC) to conduct research into how the Apprenticeship programme in England could be expanded to meet the recommendations of the Leitch report on skills.

The LSC wanted to understand employers' and learners' attitudes toward the Apprenticeship programme in order to better respond to the factors that lie behind the demand for Apprenticeships, and to consider how policy changes might help expand the programme. The research found that:

> Employers involved themselves with Apprenticeships in order to:
   - Develop their future workforce
   - Train recruits in the employers' way of doing things
   - Support their recruitment activity – mostly as an alternative to recruiting fully-skilled employees

> A quarter of the companies surveyed have increased the number of Apprenticeship places on offer.

> Business needs drive both increases and decreases in places. Changes in the local labour market – for example the limited availability of skilled workers – are seen as a push factor, which encourages participation.

> Employer satisfaction with the Apprenticeship programme is high among both participating employers and those that have lapsed.

> Three in five participating employers have been approached by their college or training provider to increase the number of Apprenticeships on offer.

Barriers to participation included:

> Some employers (10%) requested additional apprentices, but were told that this was not possible due to a variety of factors.

> Almost a third of non-participating employers had never heard of the Apprenticeship programme, and almost as many again were aware of it but knew no details. Moreover, two-thirds of non-participating employers said that they would not know where to go for advice about the programme. Fewer than 20% of non-participating employers had been directly contacted by a training provider about the Apprenticeship programme.

> There is a perception among many employers that young people are not always ready to settle down to work after leaving school. Three-quarters of employers that had recruited in the previous three years had not recruited a 16-17-year-old, and half had not recruited anyone under 25.

> Around a third of non-participating employers thought it was very likely or fairly likely that they would get involved if a training provider contacted them with a bespoke offer.

Demand-side issues were:

> Migrant workers are seen as a valued resource to enable employers to respond to short-term shifts in demand. Apprenticeships, on the other hand, are seen by employers as long-term and as providing skills for the future. There is no evidence to support the view that employers are hiring migrant workers instead of taking on apprentices.

> There is strong evidence of unmet demand for Apprenticeships from *individuals*, with 25% of learners not able to find an employer or provider. This is strongly supported by case study evidence from colleges and training providers.

> More support is needed for young people seeking a placement – most are currently left to find one on their own. Case studies suggest that some colleges and training providers are starting to address this, but resources are limited.

37 http://www.lsc.gov.uk/

38 http://www.ipsos-mori.com/

Perception findings were:

> Most apprentices feel that qualifications have an important role to play in securing a desired career or job. (This was also the case for FE learners.) The ability to work and train at the same time is also considered to be significant.

> There is a perception among FE learners that Apprenticeships can close off future career choices and academic progression. This contrasts with the majority of apprentices (particularly advanced apprentices), who said that they were focused on a particular career and had not considered any other options when choosing their course.

The research recommends that:

> Colleges and training providers are a key element in making the Apprenticeship market work. Case study discussions have highlighted the need for the LSC to communicate its vision for what the expanded programme should look like. This will help colleges and training providers to plan for the expansion.

> Colleges and training providers need to play a larger role in securing more employer engagement in the Apprenticeship programme, and in supporting interested young people to set up placements.

> Much more has to be done in order to coordinate the work of training organisations, so that they are responding to the varied needs of employers. This initiative will need resourcing (to underwrite the risks involved) – there are too few incentives in the current funding and inspection regime for providers to make the required shift.

4c. Scotland

Modern Apprenticeships (MAs) in Scotland, which are different from those offered in England, offer those aged over 16 paid employment combined with the opportunity to train for jobs at Craft, Technician and Management level, and are aimed at those capable of achieving a Scottish Vocational Qualification (SVQ) at Level 3 or above. Currently there are 84 frameworks of which 25 cover areas that can be included in the Engineering footprint, which are shown in Table B4.2.

Table B4.2: **List of Engineering-related Modern Apprenticeship Frameworks – Scotland**

Framework	Sponsor
Biotechnology	Semta
Chemicals Manufacturing and Petroleum Industries	Cogent
Construction	Construction Skills
Electricity Industry	EUSkills
Electro-technical	SummitSkills
Engineering	Semta
Engineering Construction	ECITB
Gas Industry	EUSkills
Glass Industry	Proskills
HVAC and Refrigeration	SummitSkills
ICT Professionals	e-skills
Jewellery, Silversmithing and Allied Trades	Semta
Laboratory Technicians	Semta
Land-based Service Engineering	Lantra
Metals Industry	MetSkill
Oil and Gas Extraction	OPITO
Pharmacy Technicians	Skills for Health
Polymer Processing	Cogent
Rail Transport Engineering	GoSkills
Sign-making	Cogent
Transport Engineering and Maintenance	GoSkills
Vehicle Body and Paint Operations	Automotive Skills
Vehicle Fitting Operations	Automotive Skills
Vehicle Maintenance and Repair	Automotive Skills
Water Industries	EUSkills

Source: Skills Development Scotland[39]

At present, each MA framework is specific to a particular industry or sector, and is made up of three parts:

1. SVQ Level 3: The occupational S/NVQs for the sector at Level 3 are the core of every framework. Some frameworks may specify progression routes, which allow apprentices to work towards a Level 2 initially, and then progress to the Level 3 and Level 4 SVQ.
2. Core Skills:
    a. Communications
    b. Working with others
    c. Numeracy
    d. Information Technology
    e. Problem-solving
3. Additional Components: These vary from sector to sector and may include additional SVQ units or industry-specific or academic qualifications such as HNCs or HNDs.

A review of the most up-to-date participation data currently available illustrates once again the significance of E&T-related frameworks within the MA system in Scotland. The total volumes are higher in the Scottish Enterprise (SE) area, compared with the Highland and Island Enterprise (HIE) area.

39 http://www.skillsdevelopmentscotland.co.uk/

Table B4.3: **Scottish Enterprise Modern Apprenticeship Selected Engineering and Engineering-related Frameworks Participation from Top 30 – 31st December 2006**

Ranking	Framework	Apprentices in Training
1	Construction	6,783
2	Engineering	2,579
3	Electrotechnical	2,433
4	Motor Vehicle	2,331
7	Plumbing	1,805
13	Vehicle Maintenance and Repair	411
15	Heating and Ventilation	374
17	Engineering Construction	281
24	Gas	142
26	Engineering (OPITO)	106
30	Agriculture and Garden Machinery	92
Total	Total from within Top 30	17,337

Source: SSAScot 2007

Furthermore, gender imbalance issues are similar to those found in England. SSAScot data show that the overall ratio of male to female Modern Apprentices is 72:28. This imbalance is significantly reduced when looking at those MAs over the age of 25, but volumes are also significantly lower. The overall ratio of male to female Modern Apprentices aged 25 and over is 45:55.

Table B4.4: **Scottish Enterprise Modern Apprenticeship Adults Aged 25+ Selected Engineering and Engineering-related Frameworks Participation from Top 10 – 31st December 2006**

Ranking	Framework	Apprentices in training
3	Construction	341
8	Electrotechnical	131
9	Engineering	113
10	Plumbing	104
Total	Total from within Top 10	689

Source: SSAScot 2007

In the HIE region, numbers of apprentices are lower, reflecting relative population levels, but the make-up of the top 30 frameworks is once again similar to that found in the SE regions, with a notable prevalence of E&T-related frameworks.

Table B4.5: **Highlands & Islands Enterprise Modern Apprenticeship Selected Engineering and Engineering-related Frameworks Participation from Top 30 – 31st December 2006**

Ranking	Framework	Apprentices in training
1	Construction	1,240
2	Plumbing	239
3	Electrotechnical	232
4	Engineering	226
5	Vehicle Maintenance and Repair	208
9	Motor Vehicle	65
15	Electricity	24
16	Heating and Ventilating	22
18	Engineering Construction	21
22	Vehicle Body and Paint Operations	15
26	Marine Engineering	9
27	Electronic Servicing	9
Total	Total from within Top 30	2,310

Source: SSAScot 2007

The gender imbalance is more marked with an overall ratio of male to female Modern Apprentices of 82:18 according to SSAScot data. Again when looking at those aged 25+, the difference is redressed, although volumes are significantly smaller.

Table B4.6: **Highlands & Islands Enterprise Modern Apprenticeship Adults Aged 25+ Selected Engineering and Engineering-related Frameworks Participation from Top 10 – 31st December 2006**

Ranking	Framework	Apprentices in training
2	Construction	68
6	Plumbing	24
7	Electrotechnical	22
Total	Total from within Top 10	114

Source: SSAScot 2007

The overall ratio of male to female Modern Apprentices aged 25 and over is 53:47.

4d. Wales

Statistics for Wales'[40] First Release of National Comparators for Further Education and Work-based Learning 2006/7 (SDR 106/2008) shows the following:

The success rates shown in Table B4.7 are calculated as the number of leavers that have attained the full framework by the total number of leavers. The subject areas (columns) are based on the first-tier areas of learning in the Qualifications and Curriculum Authority (QCA) sector subject framework.

The framework success rates for Foundation Modern Apprenticeships (FMAs) for Engineer and Manufacturing Technologies (E&MT) are nine percentage points higher (62%) than that for all subjects (53%). Similarly the same data for Modern Apprenticeships (MAs) are 11 percentage points higher for E&MT (54%) than for all subjects (43%). The figures for All Apprenticeships for E&MT are 10 percentage points higher (60%) than those for all subjects (50%).

Success rates for Construction, Planning and the Built Environment are disappointingly low (30% overall) and significantly less than those for all subjects (50%).

Data for ICT FMA and other WBL framework success rates are better than those for all subjects (although not as high as for E&MT), but the MA rate is poor (35%).

40 http://new.wales.gov.uk/

Table B4.7: Framework Success Rates for WBL Provision by Subject Area and Type of Programme-Wales 2006/7

	Framework	Engineering and Manufacturing Technologies	Construction, Planning and the Built Environment	Information and Communication Technology	All Subject Areas
Foundation Modern Apprenticeship	Leavers Attaining Full Framework	1,760	355	645	7,920
	Leavers	2,820	1,130	1,070	14,920
	Proportion	62%	32%	60%	53%
Modern Apprenticeship	Leavers Attaining Full Framework	780	100	190	3,320
	Leavers	1,435	385	530	7,690
	Proportion	54%	26%	35%	43%
All Apprenticeships	Leavers Attaining Full Framework	2,540	455	830	11,245
	Leavers	4,250	1,515	1,600	22,610
	Proportion	60%	30%	52%	50%

Source: Lifelong Learning Wales Record (LLWR) 2008

The success rates for E&MT in Wales are similar to those achieved elsewhere in the UK, but there is still room to raise these even further.

4e. Northern Ireland

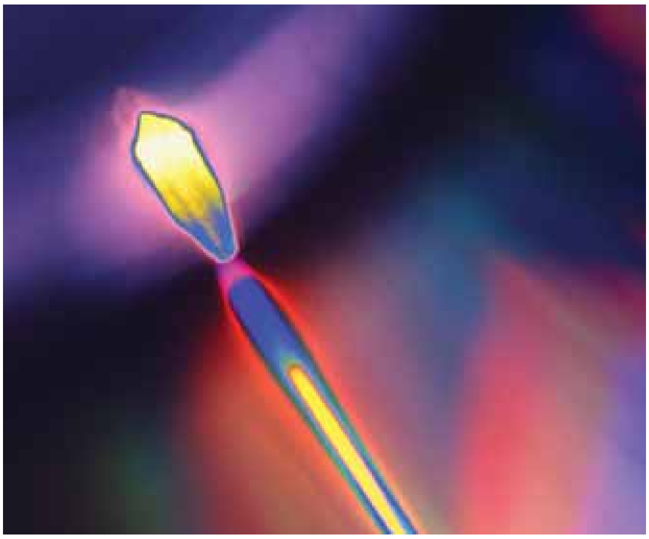
In August 2007, the 16 former FE colleges in Northern Ireland coalesced into six area-based colleges. The range of courses provided by the colleges spans across essential skills, a wide range of vocational and academic programmes at Levels 2 and 3, and Higher Education programmes.

Until that time, apprentices were enrolled under the *Jobskills* training programme, which paid a weekly training allowance, or wage, while the candidate gained skills, qualifications and experience. *Jobskills* consisted of Access, Traineeship and Modern Apprenticeship training. A new Professional and Technical Training provision programme replaced Jobskills in September 2007.

The new programme is called *Training for Success*[41] and is designed for young people aged 16-18 (or for those aged up to 24 if requiring additional support), and apprentices now enter though this provision.

According to the Department for Employment and Learning (DELNI)[42] as of 23rd July 2008, the number of Engineering apprentices engaged under the *Jobskills* provision is 581 and the number under *Training for Success* is 561, making a total of 1,142 in learning.

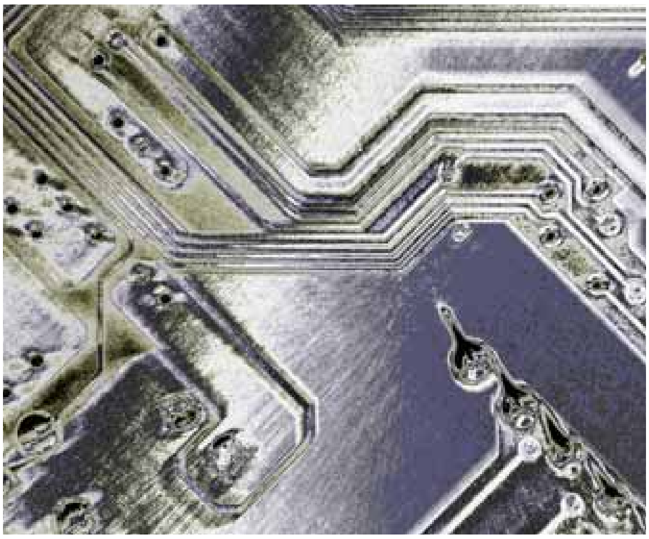
This volume is very respectable given that Northern Ireland accounts for around just 2% of the UK population.



41 http://www.delni.gov.uk/trainingforsuccess

42 http://www.delni.gov.uk/

B Supply Side
5 Higher Education (including some sub-disciplines)



"No student knows his subject: the most he knows is where and how to find out the things he does not know."

Thomas Woodrow Wilson, 28th President of the United States of America.

5a. Overview

In a Universities UK (UUK)[43] review entitled *'The Future Size and Shape of the Higher Education Sector in the UK: Threats and Opportunities'* a number of scenarios were developed. One such scenario assumes that a significant reduction in, and increased targeting of, public subsidies for full-time undergraduate provision, together with much more widespread use of digital technology to deliver and support learning, will lead to a sharp decline in full-time home and EU undergraduates over and above the projected demographic decline in volumes.

UUK believes that much HE provision would be protected from such changes, and particularly in subjects of strategic importance, such as Engineering and the Physical Sciences. However, under this scenario 20-25% of full-time undergraduate places might see a fall in demand given the increased requirement for individuals to meet the cost and the availability of part-time alternatives.

43 http://www.universitiesuk.ac.uk/

5b. Graduate Throughput

The government has set a target of 50% of young people going to university by the year 2010. Each year, the publication of progress against this target causes much comment and debate, particularly surrounding those subjects that are vital to our ambitions for a technology-driven, globally-competitive economy. However, the debate is often based on anecdote rather than hard data. Here we look at the annual data gathered by the Universities and Colleges Admissions Service (UCAS) and the Higher Education Statistics Agency (HESA) on student numbers in Science, Technology, Engineering and Mathematics (STEM) subjects, in order to provide an accurate picture of trends in these key disciplines. In line with the ETB's purpose, particular attention is given to detailed analyses of trends in E&T which, as this paper will show, is enjoying positive growth. The data are broken down in terms of applications (which provide an indication of popularity), admissions (which indicate the fitness of the candidate base) and degrees achieved (which indicate the health of the supply to the economy).

i. Applicants

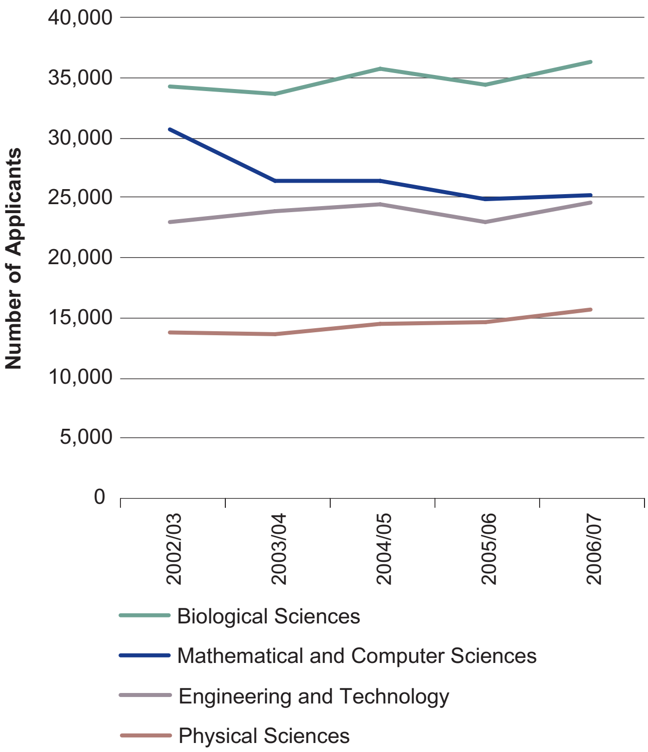
Since 2002, the total volume of all university applicants[44] has risen by 12.2%. To date, the government's aims for an increased student population are being achieved. The volumes of STEM subject applicants have, however, increased by only 0.08% during this period. Further scrutiny of the STEM data (Figure B5.1) shows that there are wide variations between the subject groups classified as "STEM". It should be noted that the reduction from six to five in the number of courses UCAS will allow in student applications (bought in for those applying for the 2008/09 academic year) will not affect future analyses.

44 Applicants that include HNDs are classified by the subject most listed on the UCAS application form. If the student shows equal preference for two or more subjects these are classified as "no preferred subject line".

45 2007/08 UCAS figures will be released in February 2009

46 This grouping is a UCAS definition

Figure B5.1: Applicants to UK STEM Higher Education Courses[45]

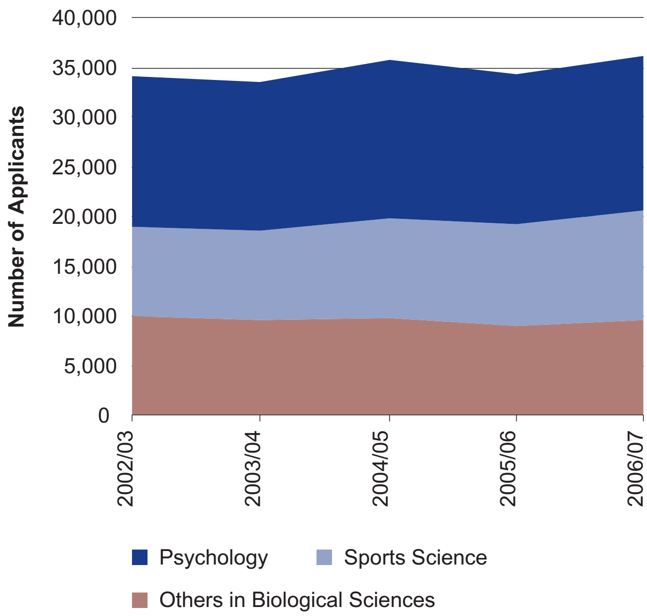


Source: UCAS

The Biological Sciences subject group, which has attracted the highest number of applicants within the main STEM disciplines, has seen a 6% rise over the past five years. This is often cited as being the most popular of all STEM disciplines. However, closer scrutiny of the UCAS figures reveals that over two thirds of the applicants classified within this grouping are actually choosing Psychology (the second most popular of all subjects after Law) and Sports Science, accounting for 43% and 25% of Biological Sciences applicants respectively.

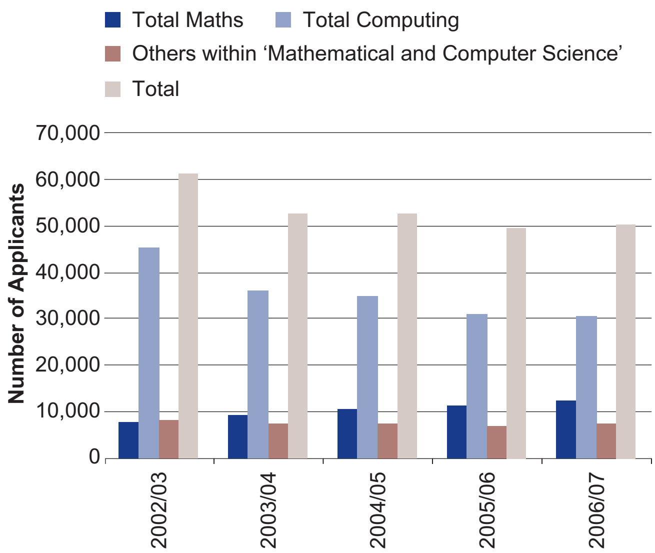
Mathematical and Computer Sciences,[46] as a group, has seen a dramatic drop in applicants of 18% since 2002. The combination of these subjects masks two very different trends. When this statistic is analysed it is apparent that the large fall in students applying to study Computer Science is bringing down the total applications for this category. In fact, Mathematics subjects have actually enjoyed a huge 61% rise in applicants in the same period. While this rise is very encouraging, in terms of total numbers – 6,165 in 2006/07 – these account for only 5% of all STEM degrees.

Figure B5.2: **Biological Sciences – Higher Education Applicants by Subject Area**



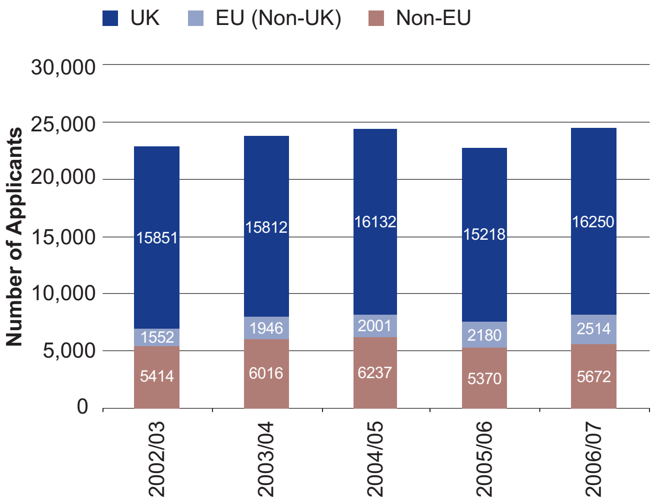
Source: UCAS

Figure B5.3: **Mathematical and Computer Sciences Higher Education Applicants by Subject Area**



Source: UCAS

Figure B5.4: **Applicants to Engineering and Technology Higher Education Courses by Domicile**



Source: UCAS

Physical Science group courses have seen a 14% rise in the total number of applicants. In this subject area, the volume of non-UK domiciled students has grown by two percentage points over the past five years, and the volume of UK domiciled applicants has increased by 12% over the five year period (2002-2007).

E&T subject group courses have also experienced an overall rise in applicant numbers of 7% since 2002. E&T subjects have the highest proportion of non-UK domiciled students, which has risen from 30.5% in 2002 to 33.5% in 2007. The volume of non-UK applicants has increased by 18% since 2002. Applications from UK-domiciled students have, however, risen by only 3% only, over this five year period.

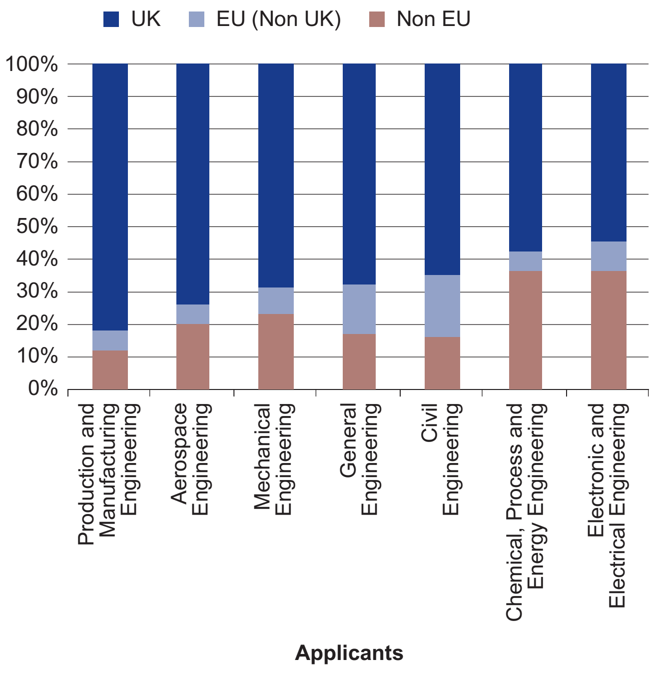
Further analysis of Engineering at a sub-discipline level shows that the proportion of non-EU students, while averaging 25%, varies considerably. Table B5.1 shows the numbers of applicants to the main Engineering disciplines and Figure B5.5 presents the breakdown by domicile. It should be noted that this is not a complete list of all subjects within E&T. More detailed five-year trends are provided in Appendix E3e.

Table B5.1: **Applicants to Higher Education Engineering Courses by Sub-discipline in 2006/07**

	Production and Manufacturing Engineering	Aerospace Engineering	General Engineering	Mechanical Engineering	Civil Engineering	Chemical, Process and Energy Engineering	Electronic and Electrical Engineering	Totals
UK	424	1,714	824	3,888	2,924	877	2,381	13,032
EU (excluding UK)	31	146	176	483	831	84	397	2,148
Non EU	65	465	215	1,307	760	553	1,621	4,986
Total Non UK	96	611	391	1,790	1,591	637	2,018	7,134
Total	**520**	**2,325**	**1,215**	**5,678**	**4,515**	**1,514**	**4,399**	**20,166**
Percentage of Non EU	12.50%	20.00%	17.70%	23.02%	16.83%	36.53%	36.85%	24.72%

Source: UCAS

Figure B5.5: **Proportion of Applicants to Higher Education Engineering Sub-disciplines by Domicile in 2006/07**



Source: UCAS

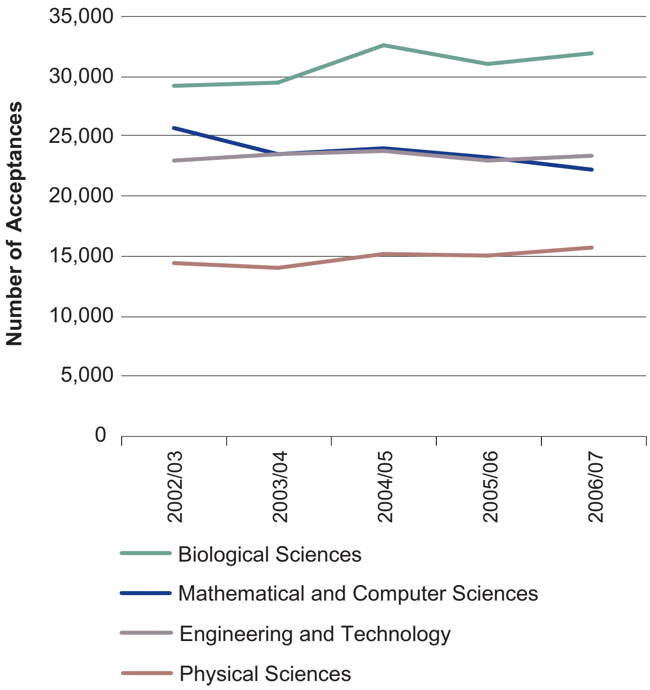
ii. Acceptances[47]

Accepted applicant numbers, or 'acceptances', are close to, although not necessarily identical to, those who actually enrol, because acceptances include accepted applicants that may not have applied through the main UCAS scheme.

Overall university acceptances have risen by 7.9% over the past five years, which contrasts with the 0.85% rise for STEM acceptances. Nevertheless, as with applicants, the Biological Sciences group (Figure B5.6) has the highest number of 'accepted applicants' of all STEM subject areas, with just under 31,800 in 2007. However, the majority of these are in Psychology (41%) and Sports Science (26%) subjects rather than the purer sciences.

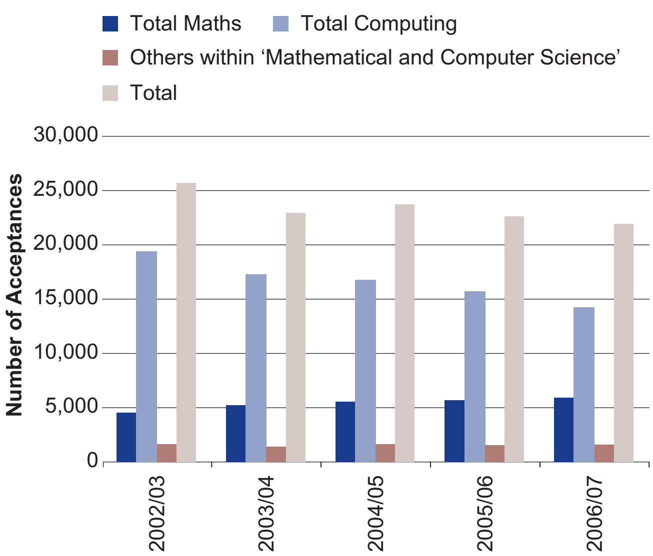
The Physical Sciences subject group has enjoyed a 9% rise overall, with an 8% rise in UK-domiciled students. Mathematical and Computer Sciences (Figure B5.6) has experienced a 14% fall in acceptances. As with applicants, when this number is broken down it becomes apparent that this reduction in acceptances is due to the large fall in applications and resultant acceptances for Computer Science. The actual picture shows that while the total number of acceptances in Mathematics subjects is reasonably low in comparison with other STEM subjects, the subject has actually experienced a 33% rise in acceptances since 2002/03, which was originally masked by the 27% fall in accepted Computing applicants.

Figure B5.6: **STEM Acceptances by Higher Education Subject Area**



Source: UCAS

Figure B5.7: **Mathematical and Computer Science Higher Education Acceptances**



Source: UCAS

47 'Acceptances' is the closest approximation UCAS has to starts. In addition, the number of accepted applicants may appear higher than the number of applicants. This is because acceptances include accepted applicants that may not have applied through the UCAS main scheme. Acceptance figures only include first Degrees, not Diplomas or HNDs.

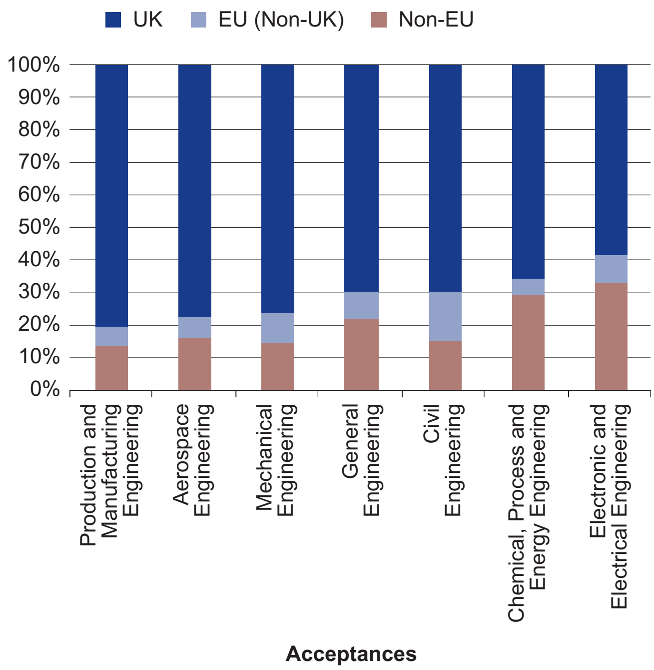
The E&T subject grouping enjoyed a 1.3% rise in acceptances, more or less in line with the 0.85% figure for STEM acceptances. Looking more closely within E&T, the five-year trend for accepted applicants is similar to applications, with around one-quarter of overall acceptances coming from non-EU domiciled students (Table B5.2 and Figures B5.8). More detailed five-year trends are provided in Appendix E3e.

Table B5.2: **Acceptances on Higher Education Engineering Courses by Sub-discipline in 2006/07**

	Production and Manufacturing Engineering	Aerospace Engineering	General Engineering	Mechanical Engineering	Civil Engineering	Chemical, Process and Energy Engineering	Electronic and Electrical Engineering	Totals
UK	618	1,289	2,269	3,193	2,607	953	2,699	13,628
EU (excluding UK)	49	99	272	383	583	80	389	1,855
Non EU	103	273	438	1,016	564	422	1,549	4,365
Total Non-UK	152	372	710	1,399	1,147	502	1,938	6,220
Total	**770**	**1,661**	**2,979**	**4,592**	**3,754**	**1,455**	**4,637**	**19,848**
Proportion Non-EU	13.38%	16.44%	14.70%	22.13%	15.02%	29.00%	33.41%	21.99%

Source: UCAS

Figure B5.8: **Proportion of Accepted Applicants to Higher Education Engineering Sub-disciplines by Domicile in 2006/07**



Source: UCAS

iii. Degrees Achieved

Having analysed the input into Higher Education, we now turn our attention to the number of degrees achieved, which provides an indication of the output. The total number of all first degrees achieved in 2007 was 319,260, a rise of 12.7% since 2002. Further analysis shows that STEM degree completions rose by nearly 6%, although this was less than the 15.4% increase in non-STEM first degrees. Contrary to popular belief, E&T degrees achieved also rose over the past five years by 2.29%, as shown in Table B5.3.

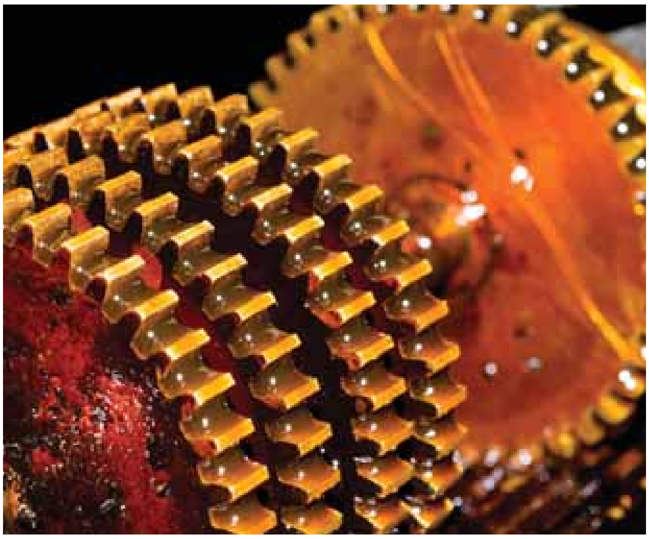
Table B5.3: **Numbers of First Degrees Achieved**

	2002/03	2003/04	2004/05	2005/06	2006/07	Percentage change
All	283,280	292,090	306,365	315,985	319,260	**12.70%**
Non-STEM	204,280	208,760	221,695	231,140	235,695	**15.38%**
STEM	79,000	83,330	84,670	84,845	83,565	**5.78%**
Engineering and Technology	19,455	19,780	19,575	19,765	19,900	**2.29%**

Source: Higher Education Statistics Agency (HESA) 2008

iv. Conclusions

The purpose of this breakdown of HE applications, acceptances and completions was to draw a line in the sand in relation to the clearly identified recent trends in annual student numbers from a STEM perspective, in order to portray the true position of these subjects. Additionally, as the ETB is particularly concerned with the supply of Engineers into and from university, which relates directly to one of our core objectives of improving the supply of Engineers, particular attention has been given to detailed analyses of Engineering trends.



v. General STEM Findings

University applicants overall have risen by 12.2% over the past five years, but STEM subjects have risen by just 0.08%. The rates of growth within these disciplines vary markedly; for example, Biological Sciences has grown the most at 6%, but primarily in Psychology and Sports Science. If these subjects were removed, the increase in Biological Sciences would become a fall of 1%. Similarly, Mathematical and Computer Sciences, taken as a group, has seen a dramatic 18% applicant drop over the past five years. However, removing the Computer Sciences data reveals Mathematics having actually enjoyed a major resurgence, with a 61% growth in applications. Yet, this improvement needs to be tempered by the fact that the Mathematics student numbers (at 6,165) still account for only 5% of all STEM applicants.

The trends for STEM acceptances are similar to those for STEM applications, with modest 0.85% STEM growth compared to the overall 7.9% growth of all first degrees.

Finally, it is very positive to see that the numbers of students actually graduating with STEM degrees has grown 5.78% over the past five years, even if this growth rate is one third that of non-STEM subjects.

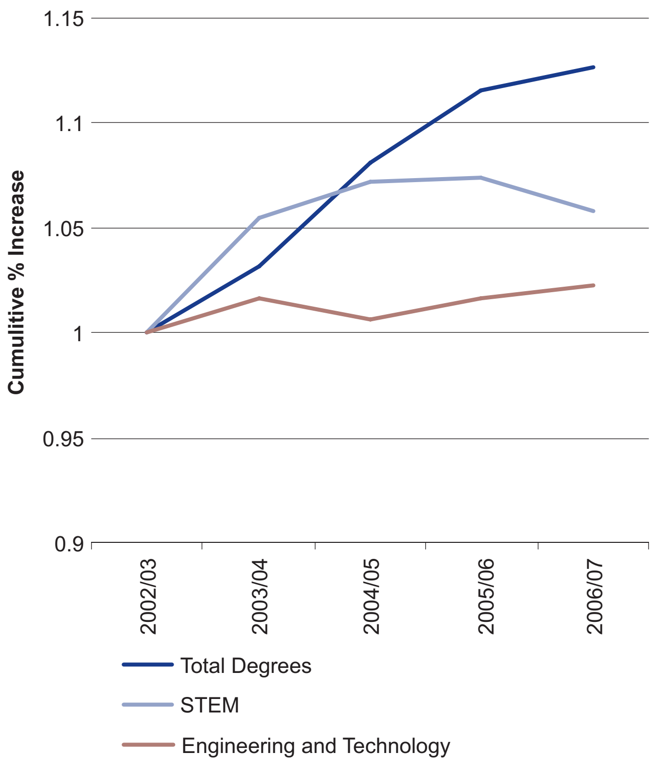
vi. Key Findings for Engineering

Set against the government-directed development which has resulted in a 12% overall increase in applications over the past five years, we are pleased to note the increasing popularity of E&T which has grown by 7%, substantially greater than the STEM application growth of 0.08%. This buoyant trend has continued into acceptances, where E&T has enjoyed a 1.3% five year growth.

In terms of E&T graduates, contrary to popular belief, numbers graduating have actually grown 2.29% over the past five years (Figure B5.9).

Taken as a whole, and while we should not be complacent, our analysis shows a positive underlying message for Engineering. Across all measures – applications, acceptances and degrees achieved – there are upward trends in the supply of Engineering students. This is especially positive given the increased competition to E&T from the rising level of subject choices available at first-degree level to prospective undergraduates. Moreover, the international attractiveness of UK Engineering courses is also evident: compared to all other subjects, it manages to attract a much higher proportion of non-EU applicants (25%).

Figure B5.9: **Percentage Year-on-year Growth in First Degrees Achieved 2002/03-06/07**



Source: Higher Education Statistics Agency Limited (HESA) 2008

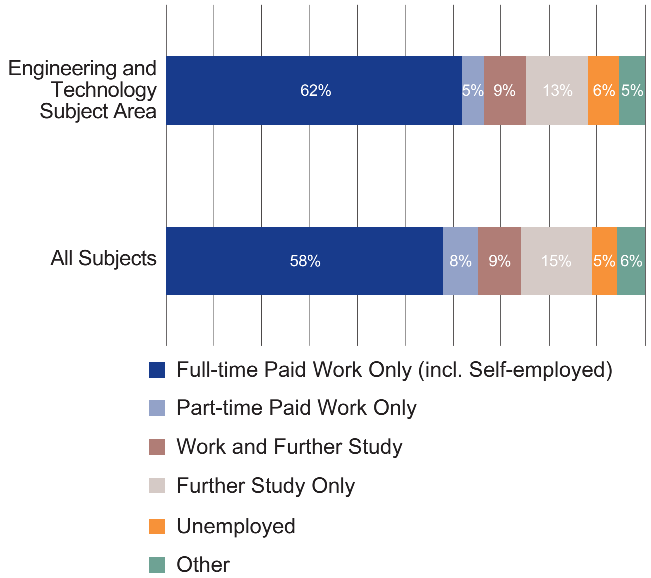
5c. Graduate Destinations

i. Graduate Destinations

Graduates leaving university have a number of options to choose from, including, but not exclusively, direct employment. The latest HESA data show that UK-domiciled E&T[48] subject area leavers have a higher employment conversion rate than all subject leavers with 62% entering full-time paid employment compared to 58% of all subject leavers. E&T graduates are also slightly less likely to engage in further study (13% vs 15%): Figure B5.10.

This suggests that there is a better push and/or pull effect to/from employment for E&T graduates than there is for all those graduates in other subject areas combined.

Figure B5.10: **Destinations of UK-domiciled All Subjects Versus Engineering and Technology Subject Area Leavers who Obtained All Qualifications Through Full-time Study 2006/07**



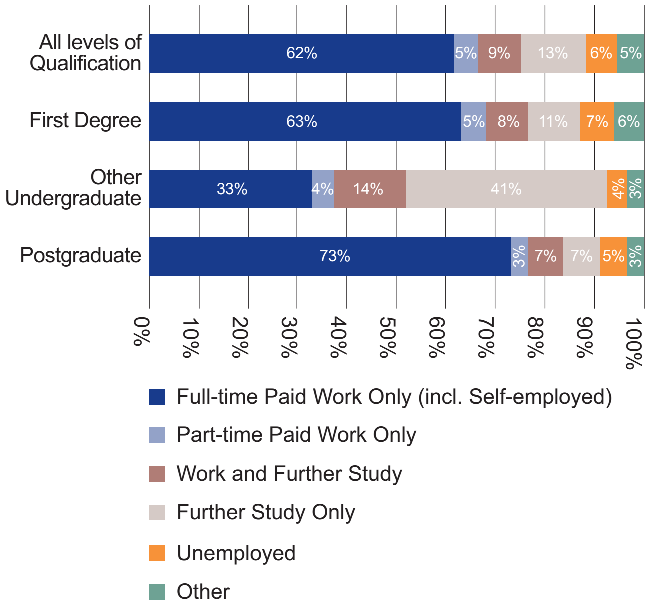
Source: Higher Education Statistics Agency Limited (HESA) 2008

48 'Engineering & Technology subject area is JACS codes 'H' and 'J'. Full details of JACS can be found at www.hesa.ac.uk/jacs.

A comparison of E&T leavers by level of study (Figure B5.11) shows that those with postgraduate qualifications are far more likely to enter full-time paid employment (73%) than those with first degrees (63%). Perhaps unsurprisingly, first-degree graduates are more likely to go on to further study (8%) or be without work (11%) than postgraduates (both 7%).

These findings make it clear that any expectation for substantially more than two-thirds of HE students to enter Engineering occupations will be limited by the students' own desire to engage in further learning or undertake some other form of activity (e.g., a gap year).

Figure B5.11: **Destinations of UK-domiciled Engineering and Technology Graduates who Obtained Qualifications Through Full-time Study 2006/07**



Source: Higher Education Statistics Agency Limited (HESA) 2008

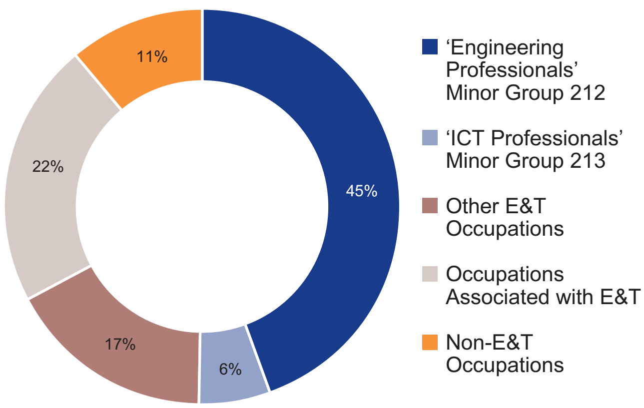
It has been widely suggested that a large proportion of E&T graduates entering employment do not work in Engineering occupations or for Engineering employers. In order to test this assumption a detailed analysis of HESA DLHE data was undertaken. The findings of this analysis are presented in two ways: as the occupations undertaken and as the type of employer.

ii. Occupations Undertaken

An analysis of E&T graduates entering employment by Standard Occupational Classification (SOC) codes gives an insight into the type of occupation that they are pursuing. This can be grouped according to whether the employee is definitely an Engineer or Technician, or in a role that may be associated therewith, or is in an occupation that is not related to Engineering or Technology.

By far the two largest occupational groups that graduates enter are 'Engineering Professionals' (SOC 2000 Major Group 212) and 'ICT Professionals' 213 (Figure B5.12), which combined account for over half (51%) of all those leavers entering employment. When combined with the other E&T occupations (17%) and occupations associated with Engineering (22%) categories, this makes up the vast majority of roles entered into (89%).

Figure B5.12: **Destination Occupations of All UK-domiciled Engineering and Technology Graduates who Obtained First Degrees and entered employment by Standard Occupational Classification (SOC) Codes 2006/07**



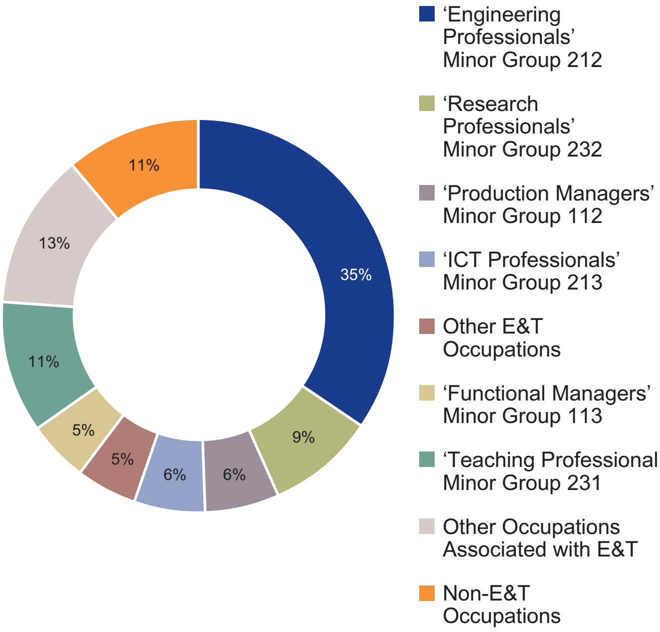
Source: Higher Education Statistics Agency Limited (HESA) 2008

Overall, nine out of 10 first-degree E&T graduates entering employment took up occupations that were E&T related. Contrary to popular opinion, only one tenth of E&T graduates entered roles that were non-E&T occupations. This further reduces to one in 15 graduates once those leavers who do not go into employment are taken into account.

An examination of postgraduate employment routes shows that the top six SOC 2000 Major Group destination occupations,[49] comprising 89% of postgraduate leavers, include significant E&T roles, senior management and educational occupations, which are very likely to be strongly Engineering-related (Figure B5.13).

Less than 11% of postgraduate leavers have entered occupations that are unrelated to Engineering.

Figure B5.13: Destination Occupations of All UK-domiciled Engineering and Technology Subject Area Leavers who Obtained Postgraduate Qualifications and Entered Employment by Standard Occupational Classification (SOC) Codes 2006/07



Source: Higher Education Statistics Agency Limited (HESA) 2008

Overall, the occupation destination data demonstrates a very high conversion rate of E&T leavers to E&T roles. Any desired increase in this proportion will be limited by this fact.

iii. Types of Employer

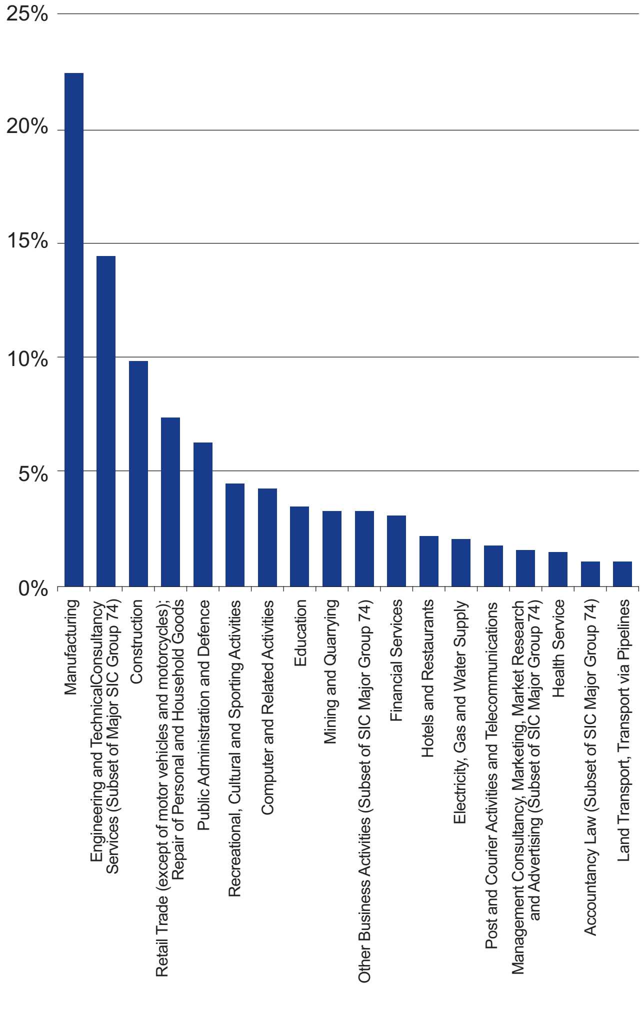
Another way to look at destinations is to examine the types of employers that E&T leavers have gone to work for. Employers' main economic activity can be classified by Standard Industrial Classification (SIC) codes and these are included in the HESA DLHE data. It should be noted that SIC codes reflect what employers consider to be their *main* economic activity, and this does not necessarily reflect what work is actually undertaken by the employer. In other words, Engineers or Technicians may work in an E&T role at an employer whose main activity may be categorised as something other than E&T.

It is often remarked that a large proportion of E&T HE leavers "go to work in the City". However, our analysis makes it clear (Figure B5.14) that of the 63% with a first degree in E&T who enter employment, just 3.1% go to work for an employer in Financial Services compared to 6.6% of all subject leavers who do so. Consequently E&T graduates are actually less than half as likely as all subject first-degree graduates to enter employment with a Financial Services employer.

Even if the scope is extended to encompass Business and Management Consultancy, Marketing, Market Research and Advertising, these together take just 1.6% of E&T first-degree leavers. Accountancy and Law employers combined employ only 1.1% of E&T leavers. The total 'City-type' non-E&T occupations right across the UK is just 5.8% of leavers.

49 SOC 2000 Codes 1 to 9

Figure B5.14: Employer Destinations for All UK-domiciled Engineering and Technology Subject Area Leavers who Obtained First Degrees and Entered Employment by Standard Industrial Classification (SIC) Code Primary Activity of Employer 2006/07

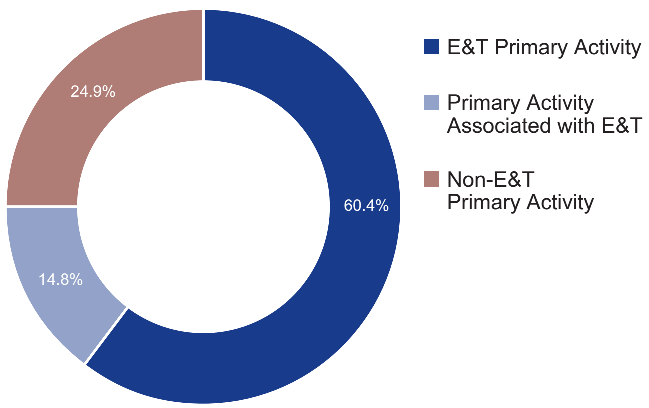


Source: Higher Education Statistics Agency Limited (HESA) 2008

Thus, the vast majority of leavers go to work for employers whose primary activity is in E&T. The two biggest categories are Manufacturing and Engineering Consultancy and Services. This latter group comprises a combination of four-digit SIC codes contained within the SIC Major Group 74 (usually labelled 'Other Business Activities'). This has perhaps led to a simple misinterpretation as representing non-E&T employers.

By categorising employers along similar lines to those used when reviewing occupations, it can be shown that three quarters (75.2%) of E&T leavers go to work for an employer whose primary activity is in, or directly related to, E&T (Figure B5.15).

Figure B5.15: Employer Destinations for All UK-domiciled Engineering and Technology Subject Area Leavers who obtained First Degrees and Entered Employment by Standard Industrial Classification (SIC) Code Primary Activity of Employer 2006/07



Source: Higher Education Statistics Agency Limited (HESA) 2008

These data differ from those for occupations (63%) because although the primary activity of an employer may not be in E&T, particular roles with that employer may well be in an E&T occupation.

This level of analysis therefore suggests that of the 24.9% E&T graduates working for employers whose primary activity is not E&T, a substantial proportion are, in fact, undertaking E&T occupations for those employers.

These data indicate a healthy conversion from HE into E&T-related occupations and employers. What is not yet explored is the extent to which there is a shortage of Engineers and Technicians, and what evidence there is that suggests there are problems in recruitment from HE. The next section looks at robust government-sponsored research into this area.

iv. Skills Shortages within E&T

The National Employers Skills Survey (NESS)[50] 2007, published in May 2008, was produced by the Learning and Skills Council (LSC)[51] in partnership with the Department for Innovation, Universities and Skills (DIUS)[52] and the UK Commission for Employment and Skills (UKCES)[53].

The findings provide some insight into the true extent of skills shortages across English businesses and industry, which can be analysed by sector. Examining employers that fall into the SIC footprint of Semta[54], (the Sector Skills Council for Science, Engineering and Manufacturing Technologies), we find that:

- Just under one in five employers (19%) said they had vacancies. However, these vacancies, however, account for 2.0% of employment (i.e. one in 50 roles are vacant).
- Less than one in 10 employers (9%) said they had hard-to-fill vacancies (HTFVs). These vacancies accounted for just over one third of vacancies (38%), but just 0.7% of employment.
- Around one in 12 employers (8%) said they had Skills Shortage Vacancies (SSVs). These vacancies accounted for just under one third of vacancies (31%) or just 0.6% of employment.

These data indicate that the vast majority of Engineering employers do not face significant skills recruitment problems, and that such problems exist in only a small proportion of roles.

So, why is there such a widely held perception that there is a major shortage of Engineers? Perhaps the answer lies in understanding what employers mean by a 'shortage of Engineers'.

50 Based on a total un-weighted sample of 79,018 employers in England

51 http://www.lsc.gov.uk/

52 http://www.dius.gov.uk/

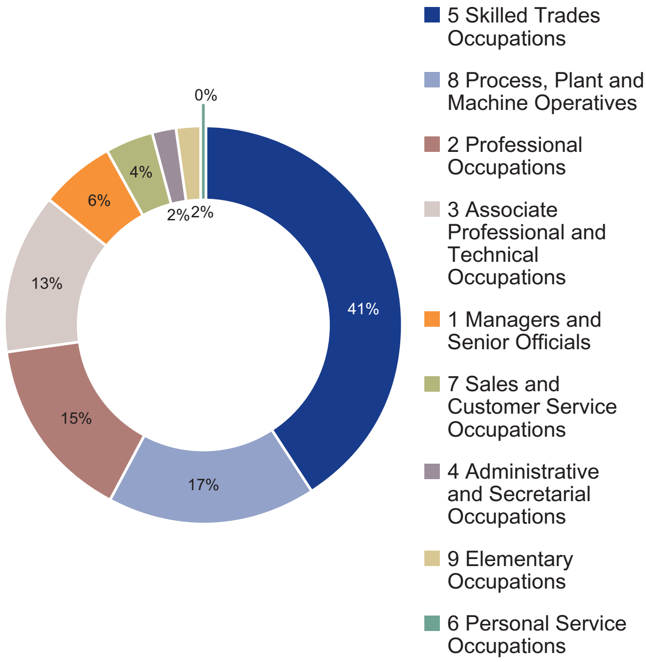
53 http://www.ukces.org.uk/

54 Based on 3,335 employer interviews with a *maximum* standard error of +/- 1.63% for findings of 50% at 95% confidence.

v. Occupational Skills Shortage Vacancies

Although the vast majority of E&T employers claim that they do not face skills shortages, an analysis of the SSVs by SOC Code provides an indication of where the major issues lie (Figure B5.16).

Figure B5.16: Share of Skills Shortage Vacancies at Employers Covered by the Semta Footprint by SOC Major Group Occupation Codes



Source: National Employers Skills Survey (England) 2007

The greatest area of skills shortage, accounting for just over two-fifths of SSVs, is in the Skilled Trades occupations. These include, for example, metal working production and maintenance fitters, motor mechanics, auto Engineers, electricians, electrical fitters and steel erectors.

The next largest category (17%) is Process, Plant and Machine Operatives, which includes, Chemical and Related Process Operatives, Quarry Workers, Energy Plant Operatives, Routine Laboratory Testers, and Rail Construction and Maintenance Operatives.

These two largest groups of skills shortage occupations, combined with the Associate Professional and Technical Occupations (e.g. Engineering Technicians, Architectural Technologists, and Laboratory Technicians), account for three fifths (61%) of SSVs, but only 21% of first-degree HE E&T leaver occupations.

The Professional Occupations (e.g. Chemical, Civil, Mechanical or Electrical Engineers, or ICT professionals) account for 55% of first-degree HE E&T leavers' employment, but only 15% of SSVs.

This clearly indicates that where SSVs exist they are in occupations where an HE qualification is not necessarily a requirement and for which a FE route is more likely to be the route into employment. Consequently, rather than confirm a shortage of graduates, we have instead highlighted the significant shortage of Technician-level Engineers in more junior occupational groups.

So, why do so many complain about a shortage of graduate Engineers? The answer may lie with what those asserting that this problem exists, actually mean. There is qualitative evidence[55] showing that finding young Engineers with the qualifications, experience, competences and skill sets required by the employer, plus being prepared to work for the level of salary of offer, may be difficult to find. Additionally, data from the NESS '07 survey indicate that:

- A quarter of Semta SIC footprint employers (24%) recruit under-24-year-olds straight from education, but just 7% specifically from HE.
- Of the 7% of employers who recruited from a university or HE institution, around one in six (17%) stated that these recruits were poorly or very poorly prepared for work – a figure which widely applies across other Engineering sub-sectors.

This evidence indicates that graduates with poor employment skills may be being interpreted by employers as a 'shortage' – that is, there is a mismatch between employer and HE leaver expectations.

55 Automotive Skills Sector Skills Agreement Skills Needs Analysis Focus Groups – Inverness and Glasgow 2006

vi. Conclusions

> Our analysis of the DLHE data provided by HESA[56] shows clearly that the substantial majority (about nine out of 10) of E&T students leaving HE and entering employment begin careers as Engineers and Technicians for employers whose main activities are in E&T.

> There is a widely-held perception that a large proportion of E&T HE leavers "go to work in the City". Our analysis of HESA and NESS data has shown that this is not the case; only 3.1% go to work for an employer in Financial Services, anywhere (not just the City of London), compared to 6.6% of all subject leavers. Destination data have been misinterpreted previously, with assumptions being made about what occupations and types of employers are included under the Business and Finance category, without an appreciation of its content.

> Generalisations have been made about E&T 'skills shortages', which require more detailed examination and understanding in order to fully comprehend the nature and extent of the problems encountered and why they exist. This area has been further compounded by the observation that the term 'skills shortages' may be used loosely to cover poor preparation for work or 'skills gaps' in the existing workforce.

> The greatest area of skills shortage, accounting for over 60% of SSVs is actually in the Skilled Trades, Associate Professional and Technical where an HE qualification is not necessarily a requirement.

> While there does appear to be something of a mismatch between specific employer requirements and graduate qualifications, competences, skills and experience, this is not related to HE leavers pursuing alternative sector careers. Rather, it is a function of the increasingly specialised and specific nature of individual E&T occupations. This has, to some extent, been recognised through the creation of employer-led National Skills Academies (NSAs)[57] now active in Construction, Food and Drink Manufacturing, Nuclear, Manufacturing, and Process Industries.

> It is clear that we need to improve our understanding of the personal attitudes and motivations of E&T leavers if we are to find ways to increase the proportion of such leavers entering employment overall and to identify where the skills shortages lie.

56 For further information, please contact HESA: http://www.hesa.ac.uk/ and the LSC: http://www.lsc.gov.uk/
Data analysed in this report are the copyright of Higher Education Statistics Agency Limited (HESA) © 2008 , and of the Learning and Skills Council (LSC) © 2008[56]. All data are subject to rounding and may not total exactly

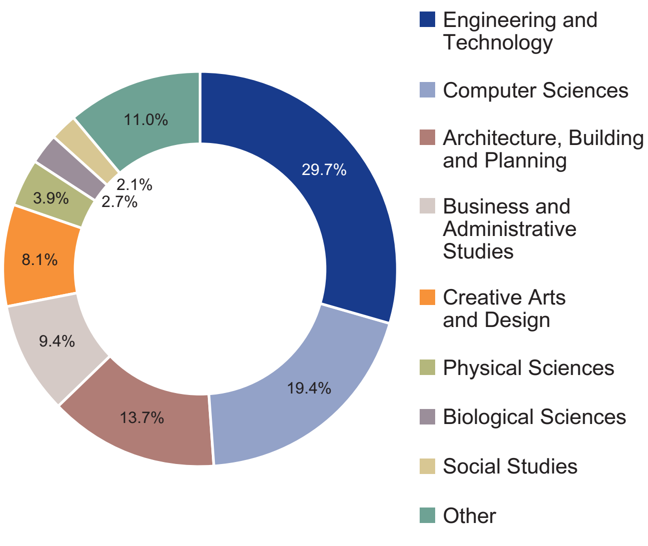
57 http://www.nationalskillsacademy.co.uk/

5d. Destinations – SIC and SOC Defined Analysis

The ETB commissioned HESA to undertake a special cut of its destination data categorised by SIC and SOC code to match the ETB's definition of Engineering establishments and Engineers and Technicians (see Appendix E3a/E3b).

Firstly, we looked at those who were employed as Engineers (as defined by SOC Code) (Figure B5.17) and the subjects they studied. Three out of 10 Engineers studied subjects in the E&T subject area with other subject areas reflecting sub-sectors of Engineering, although it is interesting that so many studied non- STEM subjects like Business (9.4%), Creative Art and Design (8.1%), and Social Studies (2.1%), which when combined to make up one in five of those employed as Engineers.

Figure B5.17: Subject Area Studied by Those Employed as Engineers Six Months after Graduation in 2006/7 Academic Year

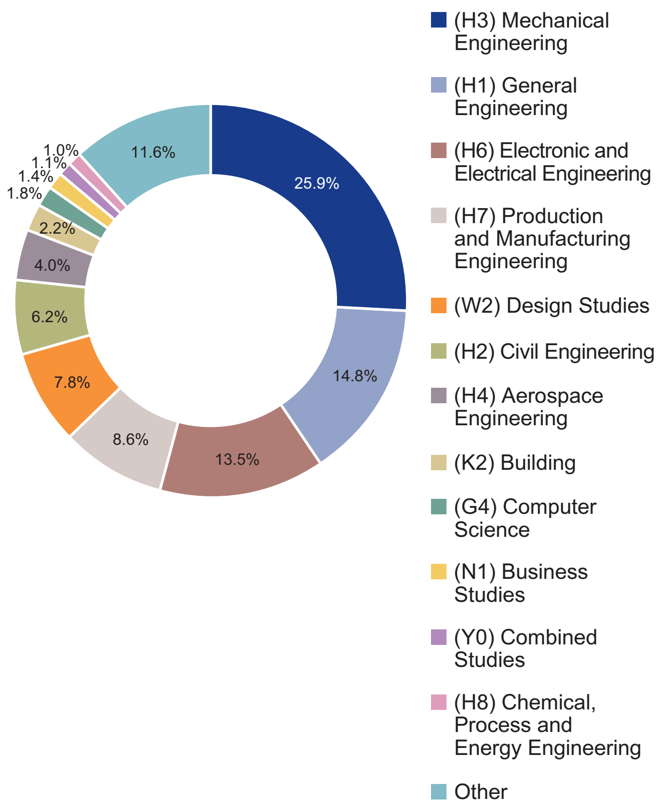


Source: HESA

A closer examination of individual occupations, defined by their four-digit SOC code, illustrates a more distinctive picture in terms of subjects studied at HE level.

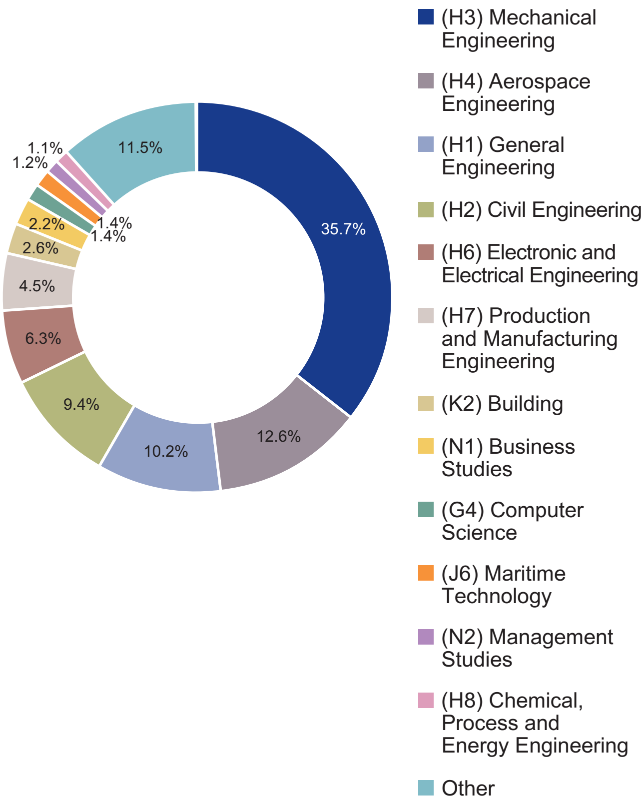
For example, we can see that those employed as Design and Development Engineers (SOC 2126) (Figure B5.18) studied a wide variety of Engineering disciplines and some non-engineering subjects as well. Mechanical Engineering accounts for the largest proportion of subjects studied at just over a quarter – which is also true of those employed as Mechanical Engineers (SOC 2122) at just over a third (Figure B5.19). This implies a considerable degree of flexibility among employers when considering candidates to fill these types of roles.

Figure B5.18: Principal Subject Studied by Those Employed as Design and Development Engineers (SOC 2126) Six Months after Graduation in 2006/7 Academic Year



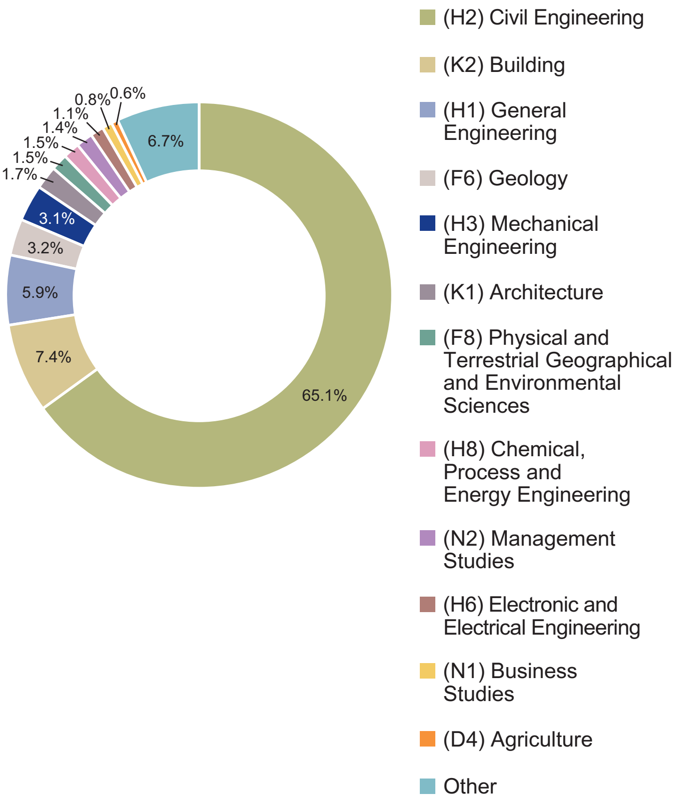
Source: HESA

Figure B5.19: **Principal Subject Studied by Those Employed as Mechanical Engineers (SOC 2122) Six Months after Graduation in 2006/7 Academic Year**



Source: HESA

Figure B5.20: **Principal Subject Studied by Those Employed as Civil Engineers (SOC 2121) Six Months after Graduation in 2006/7 Academic Year**



Source: HESA

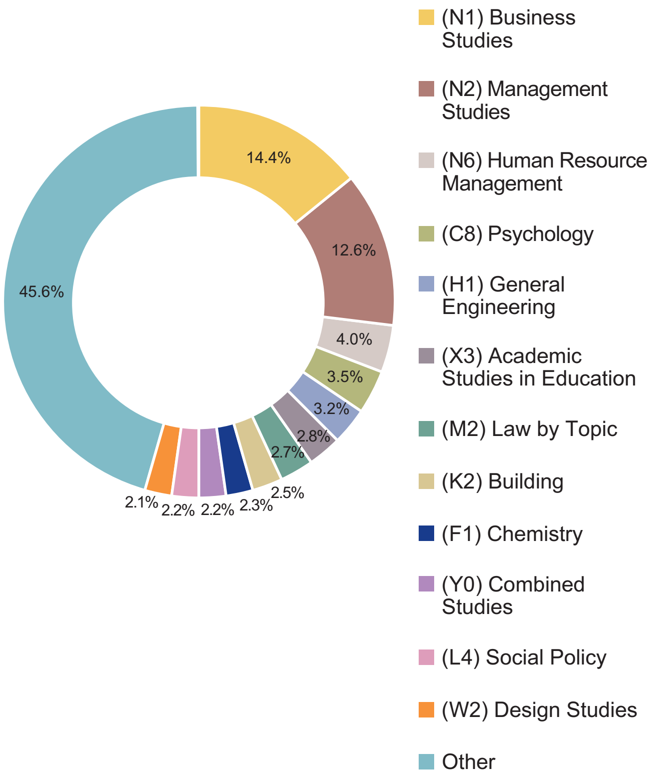
However, the same may not be true for all disciplines. If employed as Civil Engineers, the vast majority (two-thirds) of employees would have specifically studied Civil Engineering, with almost all of the remainder having followed courses in closely related subjects (Figure B5.20).

By contrast, Research and Development Managers (SOC 1137) (Figure B5.21) studied a very wide range of subjects,with E&T subjects notable by their lower profile.

Clearly, at this level, management training and education is seen as being at least as important as knowledge of Engineering matters.

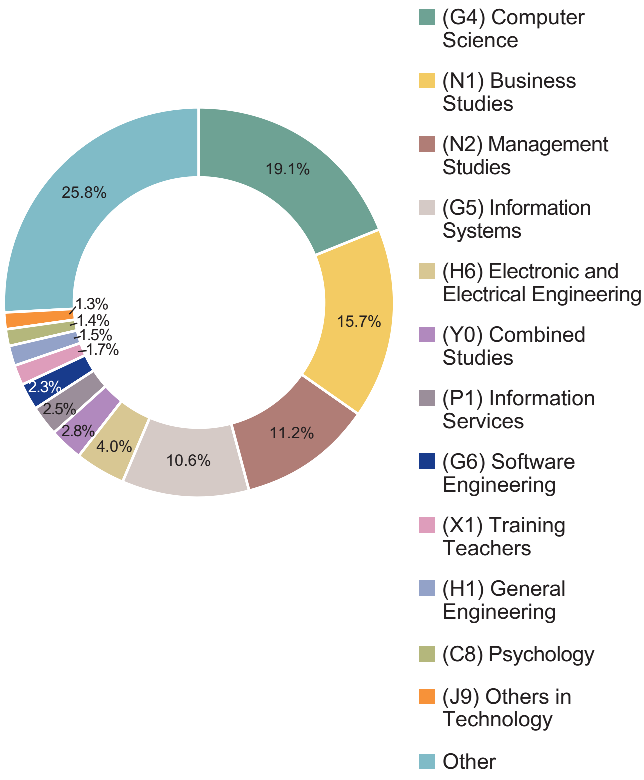
One branch of Engineering where an equally mixed array of subjects of study can be found is in the ICT area (SOC 1136) (Figure B5.22). This group is by no means confined to ICT-related subjects, but includes other Engineering and non-engineering disciplines.

Figure B5.21: Principal Subject Studied by Those Employed as Research and Development Managers (SOC 1137) Six Months after Graduation in 2006/7 Academic Year



Source: HESA

Figure B5.22: Principal Subject Studied by Those Employed as ICT Managers (SOC 1136) Six Months after Graduation in 2006/7 Academic Year



Source: HESA

5e. UCAS Points and Satisfaction

Each year, Unistats[58] surveys students across the UK to match UCAS points, graduate employment and student satisfaction with their courses. This gives an indication of the institutions that deliver for their students in terms of both teaching and employment.

The Higher Education Funding Council for England (HEFCE) acting on behalf of the Higher Education Funding Council for Wales (HEFCW), the Department for Employment and Learning Northern Ireland (DELNI) and the Scottish Funding Council (SFC), owns the Unistats websites and has contracted UCAS to manage the delivery and maintenance of these websites on its behalf. Table B5.4 illustrates Engineering courses ranked by mean UCAS points. It is clear that it is not just 'Oxbridge' and Imperial College that require high tariff scores from applicants.

58 http://www.unistats.com/

Table B5.4: **Top 20 UK Engineering First Degree Full-Time Courses Ranked by UCAS Tariff Score Points**

University	Subject	Average UCAS Points	Graduate Job After Six Months	Student Satisfaction
Cambridge	Engineering and Technology	540	93%	93%
Cambridge	General Engineering	540	93%	92%
Strathclyde	Chemical, Process and Energy Engineering.	540	90%	89%
Strathclyde	Mechanical, Production and Manufacturing Engineering	536	88%	78%
Strathclyde	Mechanically-based Engineering	528	84%	80%
Oxford	General Engineering	520	90%	89%
Strathclyde	Civil Engineering	514	95%	71%
Strathclyde	Electronic and Electrical Engineering	512	90%	85%
Dundee	Civil Engineering	500	100%	94%
Dundee	Civil, Chemical and Other Engineering	500	100%	94%
Dundee	Engineering and Technology	482	95%	92%
Edinburgh	Electronic and Electrical Engineering	480	95%	91%
Edinburgh	Civil, Chemical and Other Engineering	480	95%	90%
Imperial	Mechanical, Production and Manufacturing Engineering	480	90%	**
Imperial	Aerospace Engineering	480	80%	69%
Edinburgh	Civil Engineering	474	95%	90%
Bristol	Mechanical, Production and Manufacturing Engineering	471	95%	95%
Durham	General Engineering	470	96%	90%
Imperial	Chemical, Process and Energy Engineering	470	95%	94%
Imperial	Civil Engineering	460	100%	**

** Insufficient sample size

Source: Unistats

Table B5.5 shows all Engineering courses where 100% of graduates are in occupations after six months. What is very apparent is the dominance of Civil Engineering in this list, with Aerospace Engineering a notable second. These data mirror HESA's unemployment rates, which are particularly low for those who have studied Civil Engineering, and add to the body of evidence that there is a genuine and significant shortage of Civil Engineering graduates in the UK.

Table B5.5: **Top 10 UK Engineering First Degree Full-time Courses Ranked by Proportion with Graduate Jobs After Six Months**

University	Subject	Average UCAS Points	Graduate Job After Six Months	Student Satisfaction
Dundee	Civil Engineering	500	100%	94%
Dundee	Civil, Chemical and Other Engineering	500	100%	94%
Imperial	Civil Engineering	460	100%	**
Bristol	Aerospace Engineering	440	100%	97%
Bristol	Civil Engineering	440	100%	90%
Sheffield	Civil Engineering	420	100%	100%
Southampton	Mechanical, Production and Manufacturing Engineering	420	100%	94%
Manchester	Civil Engineering	400	100%	95%
Loughborough	Aerospace Engineering	400	100%	87%
Queens (NI)	Civil Engineering	360	100%	85%

Source: Unistats

In Table B5.6, where the top 10 Engineering courses are ranked by student satisfaction, Civil Engineering once again dominates the list, albeit across a somewhat different range of institutions.

Table B5.6: **Top 10 UK Engineering First Degree Full-time Courses Ranked by Student Satisfaction**

University	Subject	Average UCAS Points	Graduate Job After Six Months	Student Satisfaction
Sheffield	Civil Engineering	420	100%	100%
Southampton	Aerospace Engineering	455	75%	100%
Leicester	Civil Engineering	**	**	100%
Bristol	Civil, Chemical and other Engineering	440	100%	97%
Southampton	Civil Engineering	430	88%	96%
Aston	Civil Engineering	290	**	96%
City	Mechanical, Production and Manufacturing Engineering	250	**	96%
Manchester	Civil Engineering	400	100%	95%
Bristol	Aerospace Engineering	471	95%	95%
Loughborough	Civil Engineering	350	95%	95%

Source: Unistats

5f. Participation Rates – England

Rates of participation and social inclusion go hand-in-hand in the UK government's aim of increasing opportunity for all; however, education policy is largely a devolved matter across the four nations of the UK.

The DIUS issued the latest data on Participation Rates in HE Academic Years 1999/2000 to 2006/2007[59] in March 2008. They show that the overall HE Initial Participation Rate (HEIPR) fell from 42% in 2005/06 to 40% in 2006/07 (Figure B5.23). Roughly equivalent falls were found in the proportion of males and females participating in HE.

The fall in the HEIPR among English students is of concern given the increasing number of students achieving higher grades at GCSE and A level, and the seemingly growing demand for Engineering graduates. The HEIPR rate remains stubbornly below the government's target of 50% of those aged 18-30 by 2010. The HEIPR for females is notable and consistently higher than for males.

Figure B5.23: **Higher Education Initial Participation Rate (HEIPR) for English-domiciled, First-time Participants in HE Courses at UK HEIs and FE Colleges.**

Source: DIUS – DIUS SFR 02/2008

HEFCE[60] announced in August 2008 that it was consulting on changes to the way it funds teaching in HE in England. Its proposals are designed to improve support for teaching enhancement and widening participation.

The key elements of the proposals are to:

> Combine the funding for improving retention, learning, teaching and assessment strategies, and teaching informed and enriched by research, to create a new allocation to support teaching enhancement and student success.

> Increase the funding for widening access by transferring £30 million from the funding for improving retention.

> Make changes to the weightings used in the formula for calculating the funding for widening access in order to recognise the costs of working with schools and colleges in the most disadvantaged areas.

The consultation closed in November 2008.

59 DIUS SFR 02/2008

60 http://www.hefce.ac.uk/

5g. Participation Rates – Scotland

In June 2008, the Scottish Universities Taskforce and Joint Future Thinking Taskforce, working on behalf of the Scottish government, made a series of recommendations published in a draft report on proposed major modernisation of the relationship between the Scottish government, Scottish Funding Council and Scotland's universities. The key recommendations were:

> In return for the substantial public funding they receive, universities must clearly demonstrate that government-funded activities are aligned with the government's purpose of delivering higher levels of sustainable economic growth for the benefit of all.

> New criteria should be used to guide the Scottish government and the SFC through future Spending Reviews. One such criterion is targeted growth in postgraduate numbers.

> There should be a new funding system for universities, including a more flexible General Fund for mainstream activity and a Horizon Fund to provide new opportunities and incentives that support delivery of the government's priorities and each university's own mission and strengths.

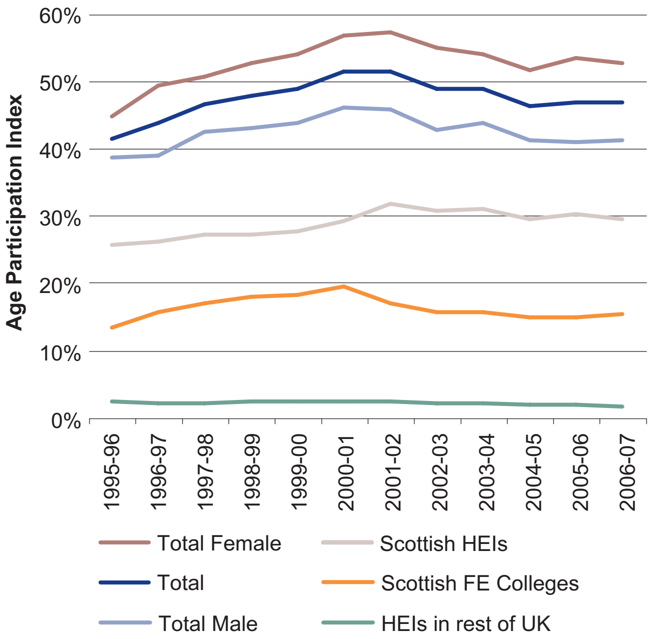
> All universities should undertake research as well as teaching with rejection of the 'teaching only' universities proposed in England.

> A new Tripartite Advisory Group should be established bringing together universities, the Scottish Funding Council and Scottish government, through which the sector will offer its views on how these new funding arrangements should and will continue to operate.

> SFC regulation should be significantly relaxed to give universities greater autonomy. This will free up the council to work on implementing key strategic initiatives in partnership with universities and government, such as improving the links between Scottish business and Scottish higher education.

The Age Participation Index rate in Scotland is somewhat higher, overall, than it is in England. In particular this reflects the high proportion of females engaging in HE, which in Scotland has been above 50% since the 1996/97 academic year. Rates peaked just after the start of this decade before declining slightly, but have remained stable over the last three years (Figure B5.24).

Figure B5.24: **Age Participation Index for Scotland by Gender and Type of Institution Components**



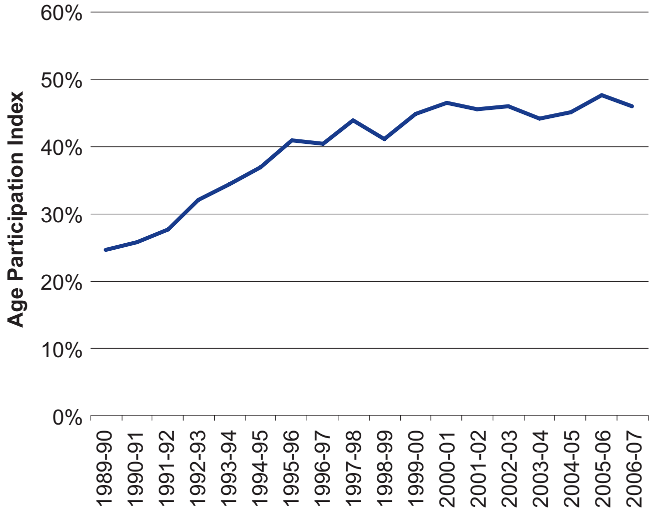
Sources: Higher Education Statistics Agency (HESA) / Scottish Funding Council (SFC)

5h. Participation Rates – Northern Ireland

In Northern Ireland the Age Participation Index is defined as the number of NI-domiciled young entrants (aged under 21) to full-time undergraduates in HE (in the UK or Republic of Ireland) as a percentage of the 18 year-old population of Northern Ireland.

The Index has risen steadily from the early 1990s, plateauing around 2000 and remaining fairly stable at just over 45% since that time, despite a small decline for 2006/07 (Figure B5.25).

Figure B5.25: Higher Education Age Participation Index for Northern Ireland



Source: DELNI

B Supply Side
6 Migrants

6a. Points-based System for Skilled Workers

i. Overview

Many Engineering employers across the whole range of sub-sectors have turned to foreign workers to fill Hard-to-fill and Skills Shortage Vacancies. The accession states of Eastern Europe provided (and still continue to provide) fruitful talent pools in this area. The current situation in the UK allows nationals from the European Economic Area (EEA) the right to work in the UK, however, the rules for hiring non-EEA citizens have changed.

From November 2008 anyone employing new and/or existing migrant workers must do so under the new Points-based System (PBS). There are a number of Tiers in the system, the most significant of which is Tier 2.

If an organisation or educational institution wishes to employ migrants (non-settled workers), they must apply for a license to sponsor skilled workers (Tier 2), temporary workers or students (Tier 5) under the new PBS. Unlicensed employment could result in two years' imprisonment, an unlimited fine or both.

Licences can be applied for to sponsor Tier 2 and Tier 5 workers. Tier 2 has four categories of workers:

- Skilled workers (general)
- Intra-company transfers
- Sports people
- Ministers of religion

Tier 5 has two categories of workers:

- Temporary workers
- Youth mobility scheme

Migrants were able to start applying under Tiers 2 and 5 from November 2008.

ii. Sponsorship

Any Tier 2 'Skilled Worker' will require a valid certificate of sponsorship, and an individual can score up to 50 points for their certificate of sponsorship. Those coming to the UK under Tier 2 can only do so with a certificate of sponsorship if the individual:

- Is filling a vacancy that requires a worker with skills at S/NVQ level 3 or above
- Complies with the conditions their permission to stay and leaves the UK when this expires

An individual with a certificate of sponsorship for a job on the Shortage Occupation List (SOL) will be awarded 50 points. If the job is not covered by the SOL and the job has passed the resident labour market test, 30 points will be awarded.

iii. Qualifications

Individuals can score up to 15 points for their qualifications for the highest qualification held, as follows:

Table B6.1

Qualifications	Points Awarded
No Qualifications	0
S/NVQ Level 3	5
Bachelors/Masters Degree	10
PhD	15

Source: Home Office/UK Border Agency

iv. Prospective Earnings

Up to 20 points can be scored for prospective earnings as follows:

Table B6.2

Prospective Earnings	Points Awarded
£17,000 - £19,999	5
£20,000 - £21,999	10
£22,000 - £23,999	15
£24,000+	20

Source: Home Office/UK Border Agency

v. Maintenance

Individuals must score 10 points in this category by showing that they are able to support themselves while in the UK by showing that they have £800 in savings.

vi. English Language Skills

Individuals must also score 10 points in this category by showing that they are able to speak English to a basic standard. This is a mandatory requirement. This will include an ability to understand and use familiar everyday expressions and basic phrases to be able to introduce yourself and others, and to be able to answer basic personal questions.

Individuals will need to show that they are competent in the English language by:

- Passing a test in English equivalent to the appropriate level
- Coming from a majority English-speaking country
- Having taken a degree taught in English (verified using national academic recognition information centre data)

vii. Intra-company Transfers

A worker transferred from outside the EEA to a UK branch of a company they work for can apply to work in the UK under the intra-company transfer category Tier 2, Skilled Worker. However, they must have worked overseas for the sponsoring organisation for at least six months and the UK job must be at S/NVQ Level 3 or above.

viii. Timetable

The timetable for the introduction of the new points-based migration system is presented in Table B6.3.

Table B6.3: Timetable for Introduction of Points-based Migration System

Tier	Applications Open for Sponsors	Applications Opened for Migrants
Tier 1: Highly-skilled workers	No sponsor needed	29 February 2008
Tier 1: Investors, entrepreneurs and post-study workers	No sponsor needed	30 June 2008
Tier 2: Skilled workers with a job offer to fill gaps in United Kingdom labour force	28 February 2008	November 2008
Tier 3: Limited numbers of low-skilled workers needed to fill temporary labour shortages	This tier is currently suspended	This tier is currently suspended
Tier 4: Students	28 July 2008	Details published in October 2008
Tier 5: Temporary workers and youth mobility scheme: people allowed to work in the UK for a limited period of time to satisfy primarily non-economic objectives	28 July 2008	November 2008

Source: Home Office/UK Border Agency

Those seeking further information should contact the UK Border Agency.[61]

61 http://www.bia.homeoffice.gov.uk/

6b. MAC Shortage Occupations List

New recommended lists of occupations for which there is a shortage of skilled workers in the UK and Scotland alone were published on 9th September 2008 by the Migration Advisory Committee (MAC) and apply to Tier 2 of the new PBS, which relates to the immigration of skilled workers from outside the European Economic Area (EEA).

Under Tier 2, as well having as a certificate of sponsorship from a sponsoring employer and satisfying English language and maintenance requirements, migrants have to satisfy points criteria based on their expected contribution to the UK economy. Under the shortage occupation route, employers who are licensed sponsors can bring in migrant workers from outside the EEA to fill vacancies in those occupations.

There are two lists, one for the UK as a whole and another for Scotland alone. These consist of skilled occupations and job titles that the MAC has assessed as being both skilled and in shortage, and where it has concluded that it is sensible to fill these shortages, at least in the short-term, through immigration.

The Committee's lists are recommendations to the government and then it is up to the government to accept them or not. Professor David Metcalf, Chair of the MAC, said that the report represented…

"…a landmark in the provision of evidence-based advice to government. It breaks new ground in combining detailed data analysis with evidence from employers within a consistent and robust economic framework. This is the most comprehensive such analysis ever undertaken anywhere in the world."

Table B6.4 shows those engineering occupations recommended by the MAC for inclusion in the lists. One aspect of the selection process that is of particular interest is the emphasis upon alternative solutions to migration to fulfilling skills shortages. The MAC did evaluate the opportunity to up-skill and train those with skills gaps (existing workforce) to fill skills shortages (new recruits to positions).

Table B6.4: **Recommended UK Shortage Occupation List for Tier 2 of the Points-based System – Engineers – September 2008**

Related Occupation Title and SOC Code	Job Titles Included on the Shortage Occupation List
Managers in Construction (1122)	ONLY the following job title within this occupation: • Project Manager for Property Development and Construction[62]
Civil Engineers (2121)	• ALL job titles within this occupation, including the following: Public Health Engineer, Rail Engineer, Drainage Engineer, Structural Engineer, Water Engineer, Geotechnical Engineer, Geotechnical Design Engineer, Geotechnical Specialist, Tunnelling Engineer, Marine Engineer, Mining Engineer, Mining Geotechnical Engineer, Petroleum Engineer
Physicists, Geologists and Meteorologists (2113)	ONLY the following job titles within this occupation: • Geologist • Geological Engineer • Hydrogeologist • Geophysical Specialist • Geological Advisor • Geological Analyst • Geological Associate • Geophysicist • Geoscientist • Geosupport Engineer • Contaminated Land Engineer • Geoenvironmental Engineer • Reservoir panel Engineer • Rock mechanics Engineer • Soil mechanics Engineer • Geomechanics Engineer • Landfill Engineer • Contaminated Land Specialist • Geoenvironmentalist
Chemical Engineers (2125)	• ALL job titles within this occupation, including the following: Chemical Engineer, Petrophysicist
Quantity Surveyors (2433)	• ALL job titles within this occupation
Engineering Technicians (3113)	ONLY the following job title within this occupation: • Aircraft Component Manufacturing Engineer
Pipe Fitters (5216)	ONLY the following job title within this occupation: • High Integrity Pipe Welder[63]
Lines Repairers and Cable Jointers (5243)	ONLY the following job title within this occupation: • Electricity Transmission Overhead Lines Worker.

Source: UK Migration Advisory Committee – September 2008

The UK and Scotland-only lists of Engineering occupations identified are identical.

What the list of Engineering occupations illustrates is the highly specific nature of skills shortages that have been identified as meeting the criteria followed by the MAC. Member of the MAC, Dr Diane Coyle, described those occupations listed as being; "only those job titles which are skilled, in shortage and for which is it sensible to use immigrant workers to fill the shortages."

The occupations are spread across different levels, which shows that these kinds of shortages apply to skilled trade occupations as much as professional ones. The specific nature of the occupations list backs up the ETB's assertion that skills shortages are not general, but tied to very specific Engineering roles and the needs that employers have for specific qualifications, skills, competences, and experience for the job.

62 The individual must lead on a project or combination of projects that would amount to a large financial responsibility (at least several £million).

63 The individual must have three or more years' documented evidence of related on-the-job experience.

6c. Students and Post-qualification Working

Much has been made of the high volumes of overseas students but the question remains as to whether these students constitute a useable pool of potential labour for UK employers.

The new points-based immigration system puts forward requirements for acceptance into the post-study worker category (Tier 1 Post-study Work). Candidates must pass a points-based assessment.

Candidates must score the following:

> 75 points for attributes
  - A United Kingdom qualification
  - Study at a United Kingdom institution
  - Immigration status during United Kingdom study and/or research
  - The date of award of the qualification

> 10 points for English language; and

> 10 points for available maintenance (funds)

If candidates do not score a minimum of 75 points for their attributes, 10 points for English language and 10 points for available maintenance (funds), their application will be refused.

The requirements to score points are different depending on whether the candidate is:

> Switching from student status (which includes students, student nurses, students re-sitting examinations, and students writing up a thesis) and applying for permission to enter or stay in the UK under the Post-study Worker category (initial applications); or

> Currently has leave under the Science and Engineering Graduates Scheme (SEGS), the International Graduates Scheme (IGS) or the Fresh Talent: Working in Scotland Scheme (FT:WISS), and is applying to stay in the UK under the Post-study Worker category (transitional arrangements).

At the end of July 2008, Diana Warwick, Chief Executive of Universities UK (UUK),[64] said:

"We also welcome the introduction of the new Post-study Work arrangements. These arrangements will allow international graduates to apply to stay in the UK to work for up to two years after graduation. We know international students are keen to build on their academic qualification with a period of work experience in the UK and Post-study Work will ensure the UK remains an attractive destination for international students."[65]

64 http://www.universitiesuk.ac.uk/

65 http://www.universitiesuk.ac.uk/Newsroom/Media-releases/Pages/

B Supply Side
7 The European Qualifications Framework

7a. The EQF: Its Aspirations and Challenges

The European Qualifications Framework for Lifelong Learning (EQF) is a common European reference framework, which aims to link countries' qualifications systems together, acting as a translation device to make qualifications more readable and understandable across European borders and systems.

The EQF has two principal aims: firstly to promote citizens' mobility between countries, and secondly to facilitate their lifelong learning. The European Commission's[66] EQF recommendations formally entered into force in April 2008. These set 2010 as the target date for countries to relate their national qualifications systems to the EQF, and 2012 as the date for those countries to ensure that individual qualification certificates bear a reference to the appropriate EQF level.

Undoubtedly, when initiated, the EQF will have notable implications for UK qualifications and recruitment practises. Matthew Dixon, Semta's[67] Visiting Research Fellow at SKOPE,[68] provides a note of caution for the UK:

The intention is that the EQF will relate different countries' national qualifications systems to a common European reference framework. Individuals and employers will (in principle) be able to use the EQF to better understand and compare the qualifications levels of different countries and different education and training systems.

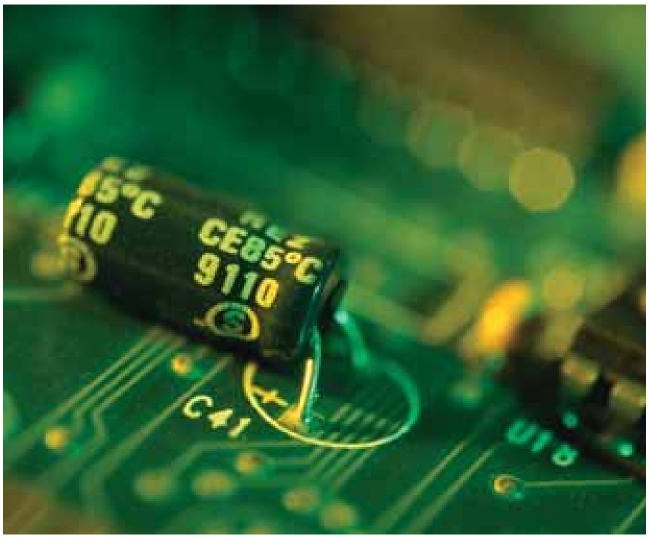
The Framework is in essence a set of definitions of 8 levels, specified in terms of Knowledge, Skills and Competence, to one of which each existing qualification (of any kind) can be assigned: in most cases this allocation is expected to take place by a 'mapping' of levels between the qualifications framework (or 'system') of the country of origin and the EQF. Agreement has, in principle, been reach on the mapping of the EQF to the 'Dublin Descriptors' of the European Higher Education Framework that has been developed through the Bologna process (not entirely surprisingly, the top three EQF levels are viewed as aligning with the qualifications arising from the first, second and third Bologna cycles).

In principle this Framework is a major part of the European Commission's efforts to deliver something substantive from the aspirations of the 2000 Lisbon objectives, to make Europe, by 2010, "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth, with more and better jobs and greater social cohesion."

66 http://ec.europa.eu/education/

67 http://www.semta.org.uk/

68 http://www.skope.ox.ac.uk/



In principle, bringing a little more transparency to the wide range of qualifications awarded within Europe sounds a helpful idea. However, the qualifications that exist in Europe reflect the wide diversity of education and training traditions within our global region, and some of the fundamental concepts on which the EQF is built (in particular skills and competence) are seen rather differently in the different cultures. Worse, assigning levels to qualifications is not a million miles from assigning levels (and so status) to people, and is difficult to do, both in terms of the process of assessing level and of the 'politics' of the 'qualification owners', and what about qualifications that have been developed beyond national boundaries (e.g. the European Engineer – EurIng)? Qualifications frameworks are problematical enough within each nation (indeed the UK does not have a single framework), but the meaning and validity of mapping between national frameworks is deeply problematical.

In addition, there are a range of very serious practical problems of implementation, and the aspiration that employers will quickly and validly assess the appropriate value to a qualification simply by virtue of the certificate being stamped as, say, EQF Level 4 will not be realised quickly. In addition, it is not clear how real the barriers are, to which the EQF level stamp will make any difference… Is the whole exercise then a waste of Eurotaxpayers money? Not necessarily…

C Demand Side
1 Demand Analysis

"It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts".[69]

Sir Arthur Ignatius Conan Doyle DL.

The most important driver of demand for Engineers and Technicians over time is the rate of growth (or otherwise) of the UK (and global) economy. We begin this section with a review of the current state of the UK economy.

1a. Overview of the Economy

The Organisation for Economic Co-operation and Development (OECD)[70] published its interim assessment in early September 2008. It believes that financial market turmoil, housing market downturns and high commodity prices will continue to bear down on global growth while at the same time evolving rapidly. Table C1.1 shows the OECD forecasting recession in the UK in Q3 and Q4 2008.

Table C1.1: **GDP Growth**

	Q3 2007	Q4 2007	Q1 2008	Q2 2008	Q3 2008*	Q4 2008*
UK	2.3	2.2	1.1	0.2	-0.3 +/-1.2	-0.4 +/-1.2

* Forecast

Source: OECD – September 2008

The OECD notes that its UK model has been revised to include the impact of residential property prices, which are believed to play an important role at the current juncture. The OECD also forecasts that unemployment in the UK will rise by 100,000 over the next couple of years to reach 5.8% of the UK workforce by 2009, although this remains below the 7% average across the OECD's European members.

At the *Die Zeit* Conference in Frankfurt, Germany, in September 2008, the International Monetary Fund's (IMF)[71] first Deputy Managing Director, John Lipsky, noted that "High oil and food prices have cut into real disposable incomes, while financial strains and declining housing markets are increasingly a drag on domestic demand in several countries – including Spain, the United Kingdom, and Ireland."

69 *A Scandal in Bohemia, the Adventures of Sherlock Holmes* (1891)

70 http://www.oecd.org/

71 http://www.imf.org/

The European Commission[72] published its Interim Economic Forecast[73] in September 2008, which illustrated what it described as a sharper-than-expected slowdown. Table C1.2 illustrates comparative GDP growth/decline and inflation figures across the EU.

Table C1.2: **EU Real GDP Growth and Consumer Price Inflation 2008**

	Quarterly GDP Out-turn and Forecast				Quarterly HICP[74] Out-turn and Forecast			
	Q1 2008	Q2 2008	Q3 2008	Q4 2008	Q1 2008	Q2 2008	Q3 2008	Q4 2008
UK	+0.3%	0.0%	-0.2%	-0.2%	+2.4%	+3.4%	+4.4%	+4.3%
Germany	+1.3%	-0.5%	-0.2%	+0.2%	+3.1%	+3.0%	+3.3%	+2.7%
Spain	+0.3%	+0.1%	-0.1%	-0.3%	+4.5%	+4.7%	+5.0%	+4.0%
France	+0.4%	-0.3%	0.0%	+0.1%	+3.3%	+3.7%	+3.8%	+3.3%
Italy	+0.5%	-0.3%	0.0%	+0.1%	+3.3%	+3.8%	+4.1%	+3.6%
Netherlands	+0.4%	0.0%	+0.3%	+0.4%	+1.9%	+2.0%	+3.6%	+3.5%
Poland	+1.4%	+1.5%	+0.7%	+0.6%	+4.5%	+4.3%	+4.8%	+4.4%
EURO Zone	+0.7%	-0.2%	0.0%	+0.1%	+3.4%	+3.6%	+3.9%	+3.4%
EU 27 Members	+0.6%	-0.1%	0.0%	+0.1%	+3.6%	+3.9%	+4.2%	+3.7%

Source: European Commission EU interim forecasts – September 2008

This shows the UK and Spain to be in recession in the second half of 2008 and performing less well than the Euro Zone and all 27 EU states as a whole which at 0.1% forecasted Q4 growth is virtually stagnant.

72 http://europa.eu/

73 EC press release IP/08/1305

74 Harmonised Index of Consumer Prices

The United Kingdom – domestic demand contracts as economy comes to a standstill

In the first half of 2008 economic activity in the UK slowed rapidly. In the first quarter growth of real GDP halved to 0.3% quarter-on-quarter and in the second came to a standstill; after annual growth of 3.1% in 2007, this amounted to a slowdown in year-on-year growth from 2.3% in the first quarter to 1.4% in the second. In both quarters domestic demand contracted, subtracting 0.3% points respectively from quarterly growth.

Consumer spending remained robust in the first quarter but dipped slightly in the second. Fixed investment contracted markedly in both quarters, particularly in the second, thereby substantially dampening growth. A sizeable rebound in inventories compensated for the investment weakness in the second quarter.

Imports fell appreciably throughout the first half, against the background of broadly stable exports. The labour market began to turn: overall employment fell marginally and unemployment increased somewhat in the second quarter.

Emerging perceptions of the UK's sharply weaker performance, given its greater exposure to the ongoing weakness in both credit and equity markets, contributed to a further depreciation of the pound sterling. Between February and September this was around 7% on a nominal effective exchange rate basis, bringing total sterling depreciation to 15% since July 2007. UK policy rates were cut by a cumulative 50 basis points in February and April, but not further, given the sharply worsened inflation performance.

GDP growth in the second half of 2008 is expected to turn negative, with output contracting slightly in each quarter, driven by a continued weakening of domestic demand. Private consumption is likely to fall somewhat due to the combined impact of tighter credit conditions for household borrowing, weakening housing and labour markets and inflation-induced stagnation in real disposable income.

Investment levels are expected to weaken further on account of still-tight credit conditions, an uncertain business environment, both domestic and external, as well as a negative housing market outlook. While the lower exchange rate is likely to support export growth in the medium term, in the short-term weakness in overseas markets will constrain output gains from this source.

Overall, GDP growth for the entire year is forecast to fall to 1.1%, well under half that of the preceding year and more than ½% point weaker than expected in the Commission services' spring 2008 forecast.

The year-on-year HICP inflation rate in July 2008 rose sharply to 4.4%, up from 3.8% in June. Inflation is expected to peak in the third quarter 2008 due to higher gas and electricity prices, and will be lifted by base effects from the previous year.

These inflationary pressures are also evident in high producer price inflation, which reached 10.2% in July 2008, the highest rate in over 25 years. Average HICP inflation in 2008 is expected to be 3.5%, somewhat higher than forecast in the spring, although inflationary pressures are expected to be progressively mitigated by demand weakness.

Source: European Commission EU interim forecasts – September 2008

The consensus is that the UK economy is facing significant challenges, will remain subdued until 2010, and that the impact on skills shortages may be significant in the short term. This may result in increased lay-off and redundancies and make employers less likely to recruit, at least in the short-term.

In his speech to the Trades Union Congress annual conference in September 2008, John Denham, the Secretary of State for Innovation, Universities and Skills, announced a package of measures designed to help the Construction sector meet the skills needs of the present and future.

Sticking to the need to train 40,000 apprentices by 2012, Mr Denham announced that Construction Skills would establish a 'clearing house' for apprentices suffering from redundancy.

He promised to use government contracts to support trained employees and that he would work with the DWP and DEFRA on a new 'Energy Efficiency Employment' (EEE) initiative to match redundant construction workers with vacancies in energy efficient Construction projects.

Mr Denham insisted that there would continue to be a need for

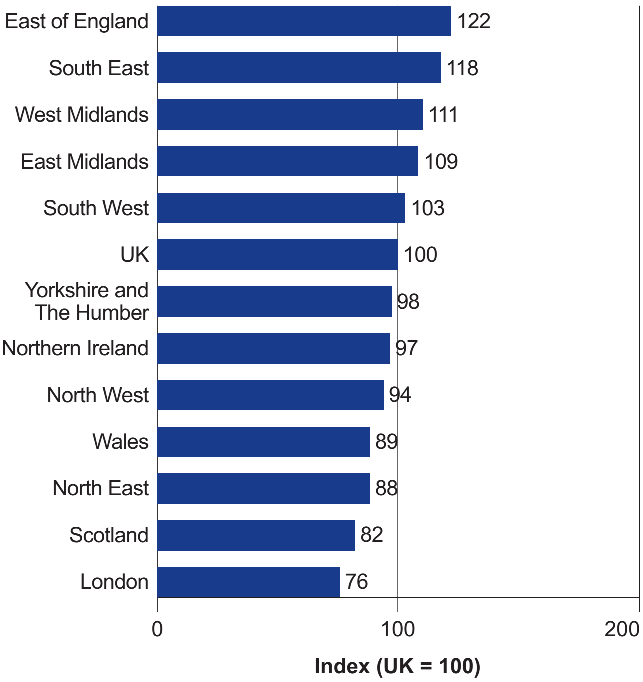
"many more skilled people working in Construction than we have today. In part this is because of government investment. In the Olympics, in Crossrail, in housing as well as in new schools, colleges and hospitals. And in part, as the government sets the framework for new jobs in energy; from nuclear to renewable. All of this will demand more, not fewer, skilled people."

Whether the depressed UK economy will substantiate his beliefs is yet to be seen.

1b. Engineering in the Nations and Regions

Using the ETB inclusive SIC 2003[75] code definition of Engineering enterprises, IDBR[76] data shows that there are 382,000 such businesses in the UK. 330,000, or 86.4%, of these are based in England, with Scotland accounting for 6.4%, Wales 4.1%, and Northern Ireland 3.1%. Figure C1.1 compares the share of all IBDR enterprises accounted for by Engineering concerns across the UK compared to the overall UK share. The higher the index figure, the more important Engineering is to the business stock of the nation/region in question.

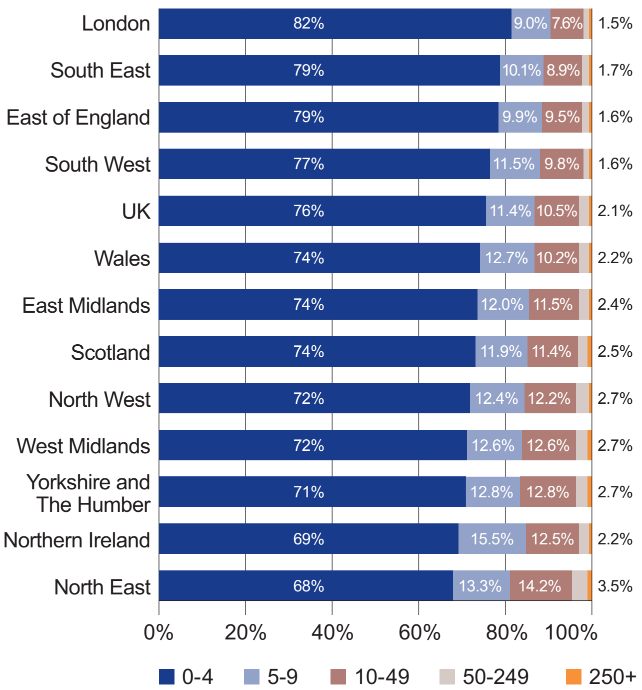
Figure C1.1: Index of Share of all VAT-registered Businesses Accounted for by Engineering Enterprises in Home Nations and English Regions



Source: ONS/IDBR 2007

When looking at the Engineering enterprises by number of employees (Figure C1.2) it is clear that businesses in London and the South East employ fewer people than those in the North of England, the West Midlands and Northern Ireland. It is also evident that micro-businesses[77] are the dominant form of enterprise, even if they don't account for the majority of employment.

Figure C1.2: Share of VAT-registered Engineering Enterprises by Number of Employees in Home Nations and English Regions



Source: ONS/IDBR 2007

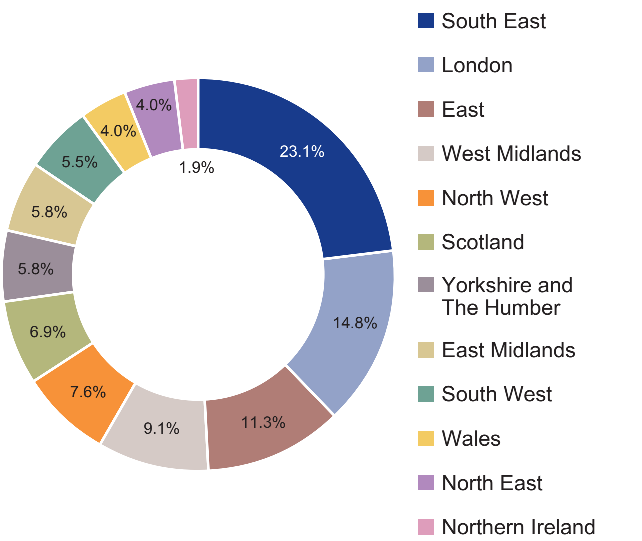
The IDBR data shows that the total turnover of all VAT-registered Engineering enterprises (defined by SIC 2003 Codes) in the UK in 2007 was £716 billion and these enterprises employed 4.3 million people (although by no means all of these are Engineers or Technicians, of course). Figure C1.3 shows this figure by home nation, with figures for England broken down by Government Office Region.

75 See Appendix E3

76 Inter-Departmental Business Register

77 The European Commission defines a micro-business as one which has fewer than 10 employees and a turnover or balance sheet total of less than €2 million.

Figure C1.3: Share of Turnover of VAT-registered Engineering Enterprises by Home Nation and English Region

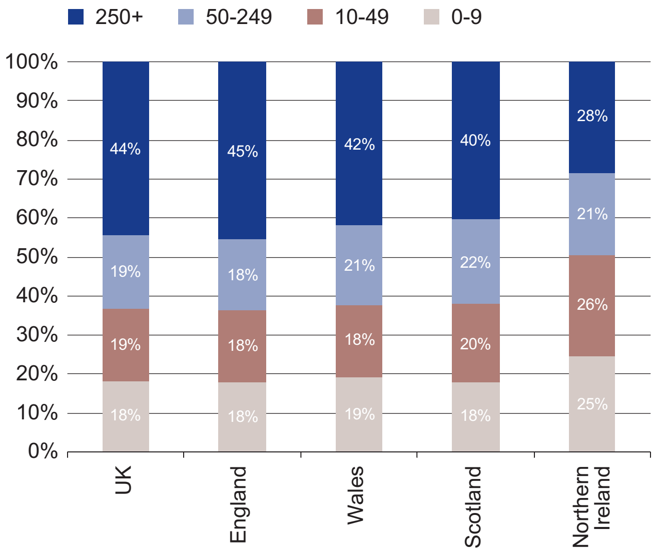


Source: ONS/IDBR 2007

Figure C1.4 shows that 44% of those employed in enterprises whose primary activity is engineering-related are employed in businesses of over 250 employees. The remaining 56% is shared roughly equally between those employing 0-9, 1-49 and 50-249 employees, equating to about 19% each. This dispels another myth that the vast majority of those employed are employed in companies with >250 employees.

Given that these data represent those enterprises that are VAT registered, and that the smallest businesses will not be VAT registered, and are therefore excluded (including the self-employed), the true proportion of employees accounted for by micro-businesses will be far higher.

Figure C1.4: Share of Employment of VAT-registered Engineering Enterprises by Size Home Nation and English Region



Source: ONS/IDBR 2007

The data in Figure C1.4 show that the majority (56%) of employees work in SMEs, which employ <250 people. This share is notably higher (72%) in Northern Ireland. The true share, including those micro-businesses not registered for VAT, will be considerably higher. This corrects the myth that the vast majority of employees in Engineering are based in large organisations employing >250 people. This emphasises the importance of engaging regionally and nationally with a wide range of employers of all sizes, if engagement is to be truly representative of, and effective for, the Engineering 'community'.

1c. UK Engineering Business

This section of *Engineering UK 2008* looks at the state of selected sub-sectors of Engineering in the UK economy, based on the Annual Business Inquiry (ABI), over the period from 1998 to 2006. It should be remembered that the data included in this section are based on Standard Industrial Classification (SIC 2003) codes and are subject to the data collection peculiarities of the ABI.

The data in Table C1.3 show that Turnover and GVA[78] in the Production Industries reached a low of £527 billion and £176 billion respectively in 2003 and climbed 15.1% and 14.1% respectively to 2006, even though the number of enterprises fell by 4.1% and the number of employees fell by 10.2% over the same period. Since 1999 the number of Production Industry enterprises has fallen 11.1% to 153,000 from 165,000.

In the nine years covered by the table the average turnover per enterprise has risen from £3.1m to £4.0m, while employment per enterprise has fallen from 27.1 to 21.8. Given that the turnover per employee had jumped 59% from £114,000 in 1998 to £181,000 by 2006, there is a clear indication of increased efficiency in these industries.

Table C1.3: **Annual Business Inquiry – UK Production Industries – Mining, Quarrying, Manufacturing, Electricity, Gas and Water Supply (SIC 2003 Code Sections C to E)**

Year	Number of Enterprises	Total Turnover £m	Approximate Gross Value Added (GVA) at Basic Prices £m	Total Employment - Average During the Year	Total Employment Costs £m
1998	171,316	528,819	178,459	4,637,000	93,692
1999	172,196	533,384	181,189	4,480,000	93,774
2000	169,217	553,601	185,886	4,355,000	94,209
2001	166,730	544,210	182,243	4,172,000	93,993
2002	164,364	529,380	178,828	3,965,000	93,098
2003	159,738	527,180	175,826	3,724,000	91,317
2004	156,613	546,426	187,199	3,608,000	92,423
2005	155,002	577,426	192,666	3,447,000	93,364
2006	153,165	606,630	200,705	3,343,000	95,393

Source: ONS/Annual Business Inquiry – June 2008

78 The difference between output and intermediate consumption for any given sector/industry: the difference between the value of goods and services produced and the cost of raw materials and other inputs that are used in production.

GVA in the Construction sector has virtually doubled (+95%) between 1998 and 2006, with turnover rising 71% in the same period (Table C1.4), although the overall increase in employment was a more modest 9.6%. This is truly phenomenal growth, which reflects the speculative property market that became established during the first term of the current Labour government.

The turnover per Construction enterprise rose by one-third between 1998 (£570,000) and 2006 (£764,000), while the number of employees per enterprise fell from just over seven to just over six. Turnover per employee also rose significantly from just over £80,000 in 1998 to just over £125,000 by 2006. These data illustrate the relatively small size of these businesses reflecting the business paradigm of the Construction industry.

Table C1.4: **Annual Business Inquiry – Construction (SIC 2003 Code Section F)**

Year	Number of Enterprises	Total Turnover £m	Approximate Gross Value Added (GVA) at Basic Prices £m	Total Employment - Average During the Year	Total Employment Costs £m
1998	179,868	£102,446	£34,474	1,271,000	£18,634
1999	188,304	£111,365	£39,150	1,313,000	£20,810
2000	190,550	£121,549	£42,275	1,340,000	£21,734
2001	192,960	£130,064	£47,530	1,323,000	£23,567
2002	195,595	£140,475	£49,785	1,307,000	£25,939
2003	200,546	£150,892	£53,150	1,329,000	£27,223
2004	209,172	£158,025	£55,636	1,347,000	£28,088
2005	220,666	£166,312	£63,308	1,393,000	£29,946
2006	229,181	£174,984	£67,129	1,393,000	£32,411

Source: ONS/Annual Business Inquiry – June 2008

If we now look at SIC 2003 Division 73 'R&D' (part of Section K – Business Activities, which is often incorrectly assumed to be entirely non-engineering in nature) we can see that the number of enterprises involved in R&D has fluctuated a little over recent years, but has seen an overall increase of 14.5% to 2006. Turnover has shot up by 118% to £11.2 billion and GVA by 89% £4.4 billion in the same period. Turnover per enterprise leapt 90% to an average of £3.6 million in 2006, although average employment stayed around the mid-30s level throughout the period, so turnover per employee rose in line from £59,000 in 1998 to £109,000 in 2006 (+84%).

These are significant rises indicating a healthy and vibrant R&D sector in the UK.

Table C1.5: **Annual Business Inquiry – R&D (SIC 2003 Code Division 73)**

Year	Number of Enterprises	Total Turnover £m	Approximate Gross Value Added (GVA) at Basic Prices £m	Total Employment - Average During the Year	Total Employment Costs £m
1998	2,716	£5,141	£2,315	87,000	£2,242
1999	2,835	£5,450	£2,363	85,000	£2,494
2000	2,797	£4,773	£1,691	86,000	£2,600
2001	2,765	£7,066	£2,753	98,000	£3,039
2002	2,788	£8,015	£3,116	106,000	£3,686
2003	2,778	£7,952	£3,431	97,000	£3,801
2004	2,876	£8,951	£4,038	101,000	£4,271
2005	3,006	£10,044	£4,700	102,000	£4,247
2006	3,109	£11,207	£4,369	103,000	£4,453

Source: ONS/Annual Business Inquiry – June 2008

Analysing SIC 2003 Group 74.2 'Engineering Activities and Related Technical Consultancy', another Section K 'Business Activity', shows that turnover jumped 50% from £24.2 billion in 1998 to £36.3 billion in 2006. GVA grew nearly as fast at 46% over the same time span.

Interestingly, total employment costs rose 61% between 1998 and 2006 – a notably larger rise than that for turnover or GVA – with average employment cost per employee rising 7.6% in just one year from £28,019 in 2005 to £30,155 in 2006.

Role of Technology Strategy Board in Promoting R&D/Innovation

The DIUS white paper 'Innovation Nation', published in March 2008, highlighted the core role that the Technology Strategy Board will play in driving innovation in the UK. In their strategic plan they have outlined how funding of £1bn for the years 2008-2011 (with partner contributions), together with matching funds from business, will provide a total investment of at least £2 billion in innovation over the next three years.

In terms of Engineering we are pleased to note that they are developing strategies in a number of broad areas representing major societal challenges or associated with the challenge of maintaining a world-leading position, all of which will have key innovative Engineering components within them.

Currently, they include:

> Medicines and healthcare
> Energy generation and supply
> Transport
> Environmental sustainability
> Built environment
> Creative industries
> High-value services

Table C1.6: **Annual Business Inquiry – Engineering Activities and Related Technical Consultancy (SIC 2003 Code Group 74.2)**

Year	Number of Enterprises	Total Turnover £m	Approximate Gross Value Added (GVA) at Basic Prices £m	Total Employment - Average During the Year	Total Employment Costs £m
1998	52,490	£24,231	£12,925	327,000	£7,000
1999	55,981	£23,584	£12,634	334,000	£7,054
2000	56,024	£24,072	£13,811	340,000	£7,480
2001	55,428	£25,968	£14,535	349,000	£8,089
2002	55,531	£25,171	£13,645	345,000	£8,635
2003	55,642	£28,143	£15,871	342,000	£8,958
2004	56,416	£29,926	£16,424	354,000	£9,536
2005	57,498	£33,404	£18,749	373,000	£10,451
2006	59,775	£36,278	£18,913	373,000	£11,248

Source: ONS/Annual Business Inquiry – June 2008

Finally, analysing SIC 2003 Group 74.3 'Technical Testing and Analysis', another Section K 'Business Activity', we can observe a 110% jump in turnover to nearly £3.5 billion and a 116% leap in GVA to over £2 billion, in the nine years covered by the data. This reflects a 76% increase in the number of enterprises and a similar rise (77%) in turnover per employee, with the average number of employees per business falling from over 17 to less than 12 over the period.

Table C1.7: **Annual Business Inquiry – Technical Testing and Analysis (SIC 2003 Code Group 74.3)**

Year	Number of Enterprises	Total Turnover £m	Approximate Gross Value Added (GVA) at Basic Prices £m	Total Employment - Average During the Year	Total Employment Costs £m
1998	1,810	£1,663	£937	32,000	£730
1999	2,080	£1,553	£887	30,000	£705
2000	2,131	£1,510	£880	29,000	£708
2001	2,180	£1,556	£853	30,000	£747
2002	2,251	£1,859	£975	30,000	£907
2003	2,361	£2,266	£1,324	30,000	£1,028
2004	2,663	£2,343	£1,385	31,000	£1,031
2005	2,959	£3,121	£1,622	41,000	£1,258
2006	3,193	£3,498	£2,022	38,000	£1,345

Source: ONS/Annual Business Inquiry – June 2008

These data show that in many areas of Engineering – even those that may be categorised as 'Other Business Activities' – business has been thriving.

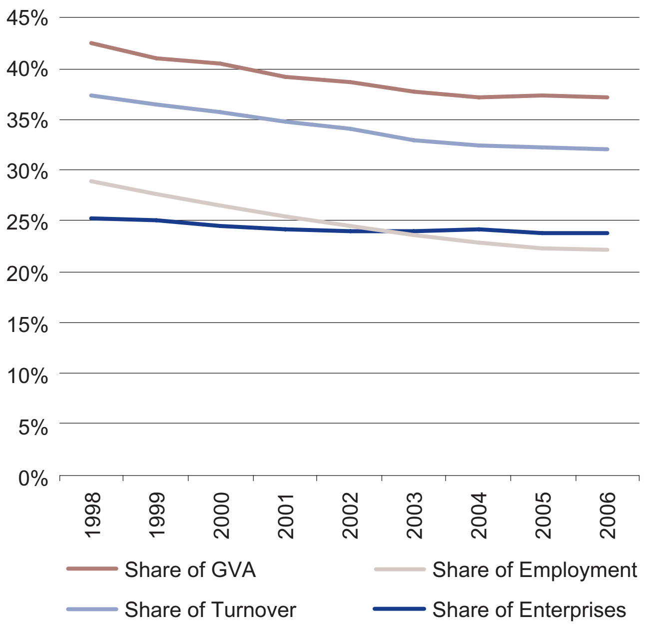
There is a common perception that Engineering continues to be in rapid decline in the UK. However, if all the data shown in the preceding tables are combined and compared with the whole UK economy, we see that the shares (Figure C1.5) of all enterprises, total turnover, total GVA and total employment, although declining, are still significant. There is even some indication of a levelling off in the rate of decline over the last three years.

Table C1.8: Annual Business Inquiry – Combination of UK Production Industries, Construction, R&D, Engineering Activities and Related Technical Consultancy, Technical Testing and Analysis (SIC 2003 Codes)

Year	Number of Enterprises	Total Turnover £m	Approximate Gross Value Added (GVA) at Basic Prices £m	Total Employment - Average During the Year	Total Employment Costs £m
1998	408,200	£662,300	£229,110	6,354,000	£122,298
1999	421,396	£675,336	£236,223	6,242,000	£124,837
2000	420,719	£705,505	£244,543	6,150,000	£126,731
2001	420,063	£708,864	£247,914	5,972,000	£129,435
2002	420,529	£704,900	£246,349	5,753,000	£132,265
2003	421,065	£716,433	£249,602	5,522,000	£132,327
2004	427,740	£745,671	£264,682	5,441,000	£135,349
2005	439,131	£790,307	£281,045	5,356,000	£139,266
2006	448,423	£832,597	£293,138	5,250,000	£144,850

Source: ONS/Annual Business Inquiry – June 2008

Figure C1.5: **The Combined Shares of UK Production Industries, Construction, R&D, Engineering Activities and Related Technical Consultancy, Technical Testing and Analysis of the Whole Economy.**



Source: ONS/Annual Business Inquiry – June 2008

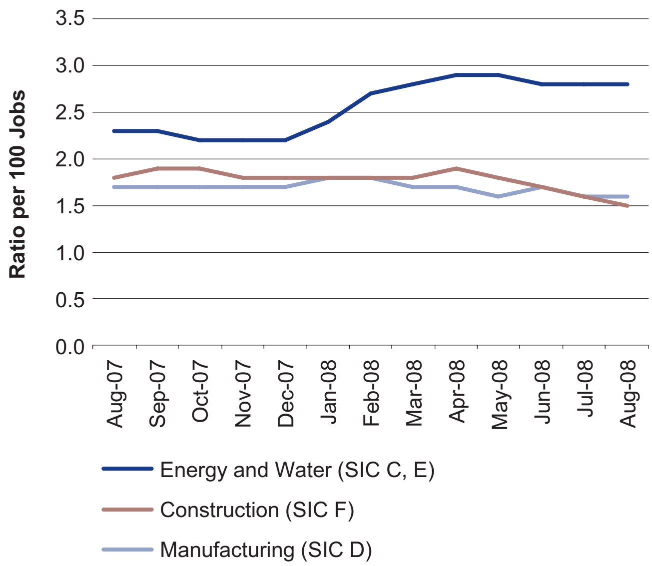
Because it is derived from a SIC 2003 code-based analysis, these data by no means cover all Engineering occupations, and indeed not all Engineering enterprises. For example, we have not looked at ICT and other Computing-related activities within this analysis. Nonetheless, Engineering-related activities remain an important part of the UK economy.

1d. Workforce Vacancies

September 2008 Labour Market Statistics published by the ONS show that in August 2008 there were 4,900 vacancies in the Energy and Water sector (SIC Sections C and E; not seasonally adjusted) a year-on-year change of 900; 51,000 vacancies in Manufacturing (SIC Section D), a year-on-year change of -4,100; and 19,000 vacancies in Construction (SIC Section F), a year-on-year change of -4,300.

The ratio of vacancies per 100 employee jobs (Figure C1.6) has fallen in the Construction sector since April. The rate for the Energy and Water sector increased between December 2007 and May 2008 after which it has remained fairly stable, but significantly higher than for Construction or Manufacturing. Manufacturing vacancy rates have remained stable throughout the period.

Figure C1.6: **Ratio of Vacancies Per Hundred Employee Jobs by SIC Sector – Averages for Three Months**



Source: Vacancy Survey – ONS First Release, Labour Market Statistics, September 2008

C Demand Side
2 Engineers; Registered and Others

2a. Overview

During evidence presented to the Parliamentary Innovation, Universities, Science and Skills Committee,[79] established in a 2007-08 session, there was some debate about restricting the ability of individuals to call themselves Engineers, but the word is in such common parlance that any such action would be extremely difficult to carry out with considerable qualification of the term.

There is the option of becoming a Registered Engineer based on an assessment against appropriate competences and commitment, taking into account educational achievement and professional development. In common with most countries, there is no licence to practise Engineering or restriction on the use of 'Engineer' or 'Technician' as occupations. Third-party assessment of competence is often valuable to employers, clients or service users, and Engineers and Technicians who aspire to be recognised as professional often seek registration irrespective of their employer's needs.

2b. Registered Engineers

Under its Royal Charter, the Engineering Council UK (EC^{UK})[80] grants licences to engineering institutions, allowing them to assess candidates for inclusion on its Register of Professional Engineers and Technicians, and to accredit academic programmes and professional development schemes. The Royal Charter also empowers EC^{UK} to give formal recognition to those Engineering-related professional bodies that satisfy criteria set down in bye-laws. Currently, It is estimated that, based on the broadest definitions, 5% of all Engineers and Technicians in the UK are registered with EC^{UK}.

In practice, a Licensed Member (institution) acts as the awarding body for registration. Licensed Members (institutions) may be further licensed to undertake a range of tasks associated with the assessment of candidates for registration, concurrently with assessment for Institution membership. Currently there are 36 Engineering institutions licensed by EC^{UK}.

Institutions use the UK Standard for Professional Engineering Competence (UK-SPEC) Regulations for Registration to assess applications or registration. Therefore Engineers are able to register with EC^{UK} as Chartered Engineers (CEng), Incorporated Engineers (IEng) or Engineering Technicians (EngTech). This section looks at the trends in Registered Engineer volumes over the last decade, up to 31st December 2007. Applicants must demonstrate that they possess a range of technical and personal competences and are also committed to keeping these up-to-date, and to behaving in a professionally and socially responsible manner.

79 http://www.parliament.uk/parliamentary_committees/ius.cfm

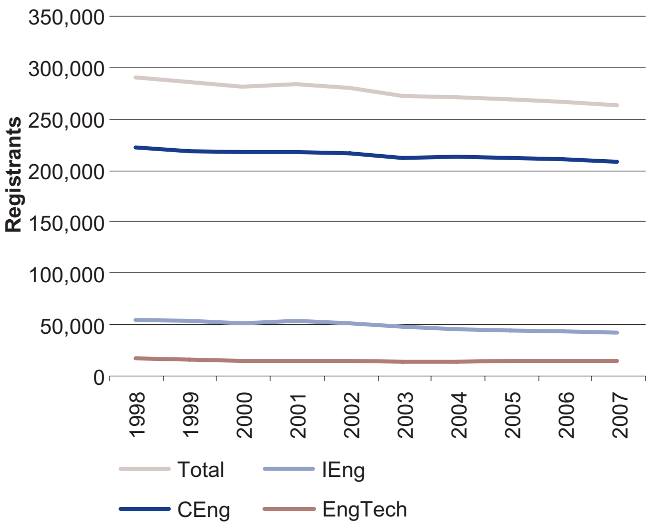
80 http://www.engc.org.uk/

Registration as a Chartered Engineer (CEng) is rarely achieved before the age of 30, and it is estimated by EC[UK] that around one quarter to one third of eligible Engineers have actually registered. A rather smaller proportion of eligible EngTechs have registered, although there is evidence that promotion of the grade by major Engineering bodies and some Sector Skills Councils is starting to increase interest. Registration of IEngs has fallen considerably in recent years, and the grade is currently being repositioned to reflect the nature of the market for this sector of professional Engineers.

2c. Overall Trends

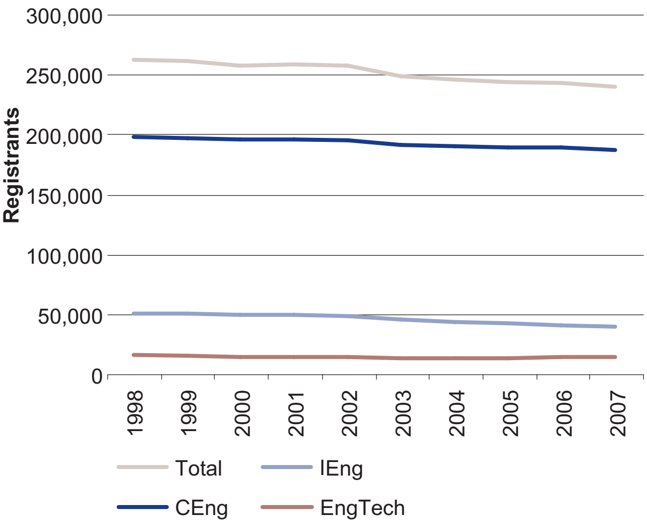
Over the last decade the total volume of registered Engineers and Technicians, by category, has fallen steadily as shown in Figure C2.1.

Figure C2.1: Total Volume of All Memberships of Registered Engineers by Grade 1998-2007



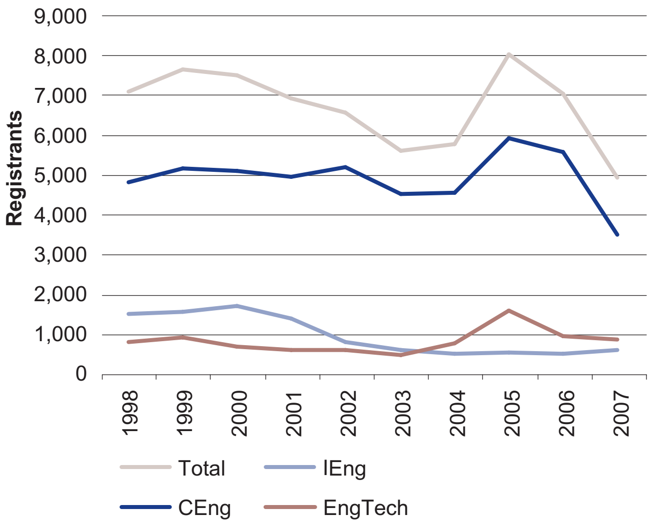
Source: EC[UK]

Figure C2.2: **Total Volume of Final-stage Registered Engineers by Grade 1998-2007**



Source: EC[UK]

Figure C2.3: **Total Volume of New Final Stage Registered Engineers by Grade 1998-2007**



Source: EC[UK]

The total number of final-stage registrants has dropped 8.7% from 262,190 in 1998 to 239,303 in 2007. In 2007, CEngs accounted for 78%, (75% in 1998), IEngs for 16% (19% in 1998), and EngTechs 6% (6% in 1998).

Therefore, the category of Registered Engineer that is declining the fastest in the last 10 years is IEng, down 22%. The volume of CEngs has dropped over 5% in the same period, while EngTechs are down 12%.

However, more recently, the number of EngTechs has risen steadily by over 7% in the three years to 2007 – perhaps partly due to increased promotion by a number of registered institutions – while the volume of CEngs has remained flat over the last three or four years.

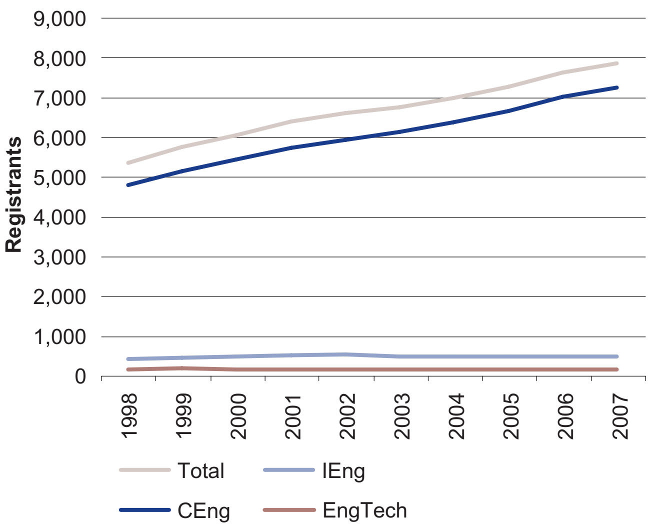
The number of new final-stage registrants has fluctuated erratically over many years (Figure C2.3), although total volumes are down 30% from 7,005 in 2006 to 4,914 in 2007, with CEngs accounting for 71% of the latter's total. In 2007 there were 43% more new final-stage EngTechs than IEngs. The popularity of IEng status appears to be significantly on the wane and the EngTech's star appears to be in the ascendancy.

Similarly, there has been some considerable fluctuation in the extent of losses of Registered Engineers over recent years. Over 9,500 Registered Engineers were lost in 2007, of which 18% were deceased. The majority of these were lost from the Institution of Engineering and Technology, which emerged from the merger of the former Institution of Electrical Engineers and the Institution of Incorporated Engineers.

2d. Female Registered Engineers

The total number of all female registrants is now 7,845, 92% of whom are CEngs. Figure C2.4 shows the change in volumes over the last decade, which illustrates the very steady growth in female CEngs. Both IEng and EngTech grades, stubbornly remain at very low levels indeed.

Figure C2.4: **Total Volume of Female Registered Engineers by Grade 1998-2007**

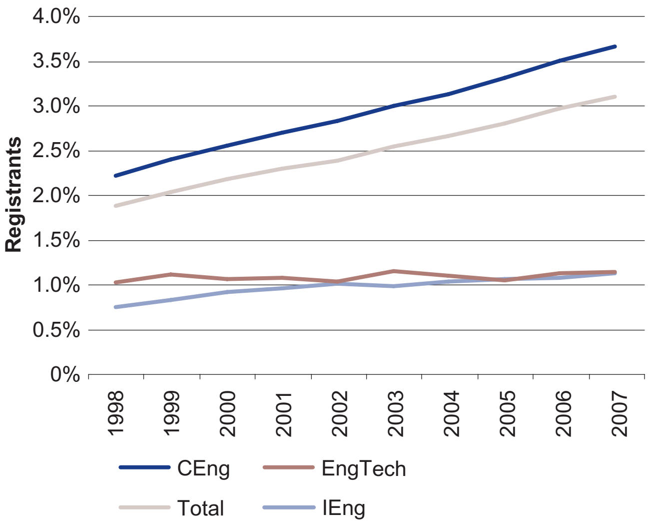


Source: EC[UK]

Although the proportion of interim and final stage Registered Engineers who are female has been climbing steadily, the rate of growth in the cohort of CEngs is approximately one percentage point every six years, as can be seen in Figure C2.5.

At this rate of increase it will take a staggering 278 years for the gender balance to become equal.

Figure C2.5: **Female Share of Total Registered Engineers by Grade 1998-2007**



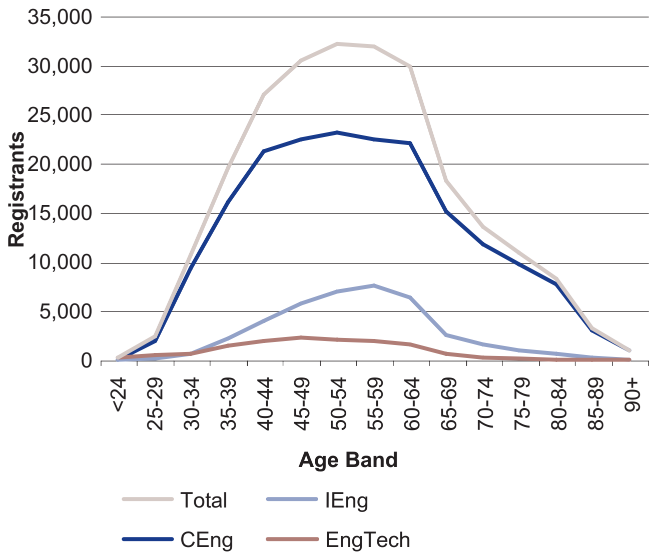
Source: EC[UK]

According to EC[UK]'s figures there were just 517 new female registrants in 2007, or 9.8% of all new registrants (5,300). While this is three times the proportion found among all registrants, it is still very low.

2e. Age

The age profile of Registered Engineers has been rising steadily for 20 years, such that the mode age band for CEngs has risen from 40-44 in 1988 to 50-54 in 2007. For IEngs it has risen from 40-44 in 1988 to 55-59 in 2007, and for EngTechs it has also risen from 40-44 in 1988 to 45-49 in 2007.

Figure C2.6: Age Profile of Registered Engineers by Grade as at 31/12/2007



Source: EC[UK]

Those aged 55-64 account for 24% of CEngs, 35% of IEngs and 26% of EngTechs, with an overall proportion of 26% of all Registered Engineers.

The overall proportion of Registered Engineers aged 65+ is 23%, which, by grade, equates to 26% of CEngs, 15% of IEngs and 8% of EngTechs respectively.

Therefore, approximately half of all Registered Engineers are either already past retirement age, or will reach legal retirement age within 10 years.

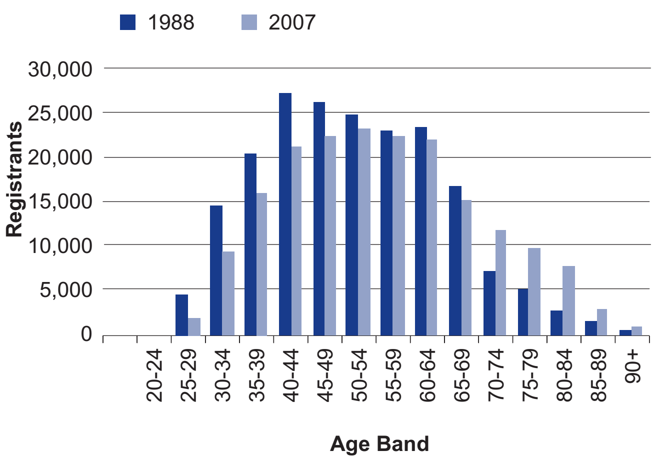
A comparison can be made between the current age profile by grade and that of 20 years ago.

The mean age of CEng and IEng members remains 55, while EngTechs' mean age also remains 50. Over a quarter (26%) of CEngs are aged over 65, while the proportion of IEngs is 16% and EngTechs is 9%.

Comparing the age profile of Registered Engineers in 2007 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 Figures C2.7, C2.8 and C2.9.

These three age profiles clearly demonstrate that the average age of Registered Engineers has increased. The mean age of a CEng in 2007 has risen four-and-a-half years from the 1988 level of 51.5 years of age. In the same period the mean age for IEng registrants have jumped a huge nine years from 46 years of age in 1988.

Figure C2.7: Age Profile of Chartered Engineers (CEng) 1988 vs 2007

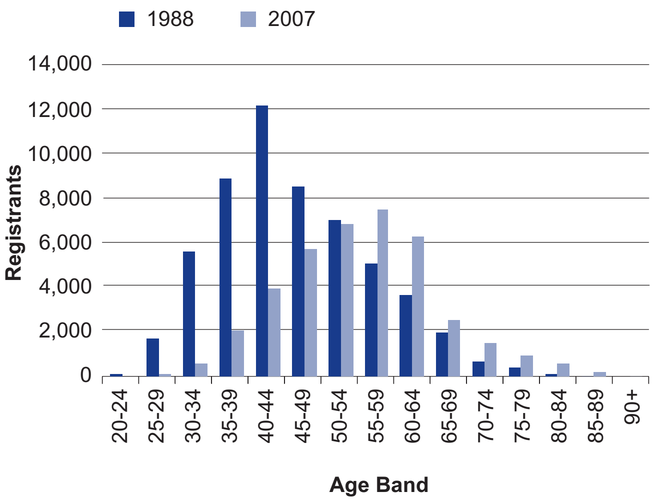


Source: EC[UK]

There has been a significant decline in the volumes of registered CEngs in all working age bands. The number of those aged under 55 has fallen by nearly a quarter, whereas those aged over 70 has doubled in 20 years. The ageing profile of CEngs over the last 20 years is of significant note.

An analysis of IEng age profiles (Table C2.8) illustrates an even more stark shift in the age profile and an accompanying decline in the volume of those aged <50, in the region of two-thirds in 20 years.

Figure C2.8: **Age Profile of Incorporated Engineers (IEng) 1988 vs 2007**

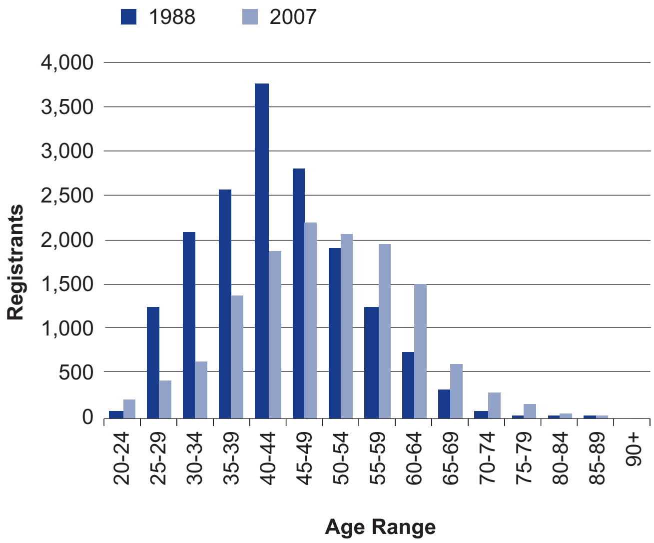


Source: EC[UK]

There has been a two-thirds decline in the volumes of registered IEngs in all age groups under 50 between 1988 and 2007. To a lesser extent this reflects an ageing profile of IEng registrants with a doubling in volumes of those aged over 65 in the period.

The group aged 55-64 alone has risen by two-thirds between 1998 and 2007. These IEng registrants will all reach retirement age within the next 10 years, which highlights a potential slump in working-age IEng registrants.

Figure C2.9: **Age Profile of 'Engineering Technicians' (EngTech) 1988 vs 2007**



Source: EC[UK]

Among EngTechs too there has been a near 50% decline in registration volumes in all age groups under 50 between 1988 and 2007. Once again this reflects to a lesser extent an ageing profile of registrants with a 60% increase in volumes of those aged over 50 in the period.

A similar demographic time bomb can be seen amongst EngTechs aged 55-64 whose volume has risen 75% between 1998 and 2007. The 3,500 such EngTech registrants in 2007 are all due to reach retirement age within the next 10 years.

ICT*Tech*

In June 2008, EC^{UK} announced its intention to offer individuals the opportunity to apply for registration as Information and Communications Technology Technicians. Those meeting the competence requirements for entry onto the new register will be granted the post-nominal title ICT*Tech*.

Assessment of the first applications for licences to award ICT*Tech* is due to begin by the end of 2008, and the ICT*Tech* register is planned to go live at the beginning of 2009.

A competence-based ICT*Tech* standard has been drafted in consultation with various interested parties, including the Sector Skills Council e-Skills UK.[81] It follows the same basic format as UK-SPEC used to assess those wishing to register as EngTechs.

81 http://www.e-skills.com/

C Demand Side
3 Labour Market Skills Data

The data included in the tables in this section relates to the Engineering footprints of Sector Skills Councils, which are largely or wholly responsible for UK industries that approximate to Engineering enterprises.

3a. England

The National Employers Skills Survey (NESS) 2007, published in England in May 2007, provides a considerable amount of data on vacancies, skill shortages and skills gaps. Table C3.1 summarises these data by selected Engineering Sector Skills Council (SSC) footprint.

These data illustrate that vacancies account for a very low proportion of employment across Engineering SSC footprints, ranging from just 1.5% to 3.6% of employment. It is these higher values for Construction Skills, e-skills and SummitSkills footprint employers that significantly exceed the average for all sectors.

Engineering employer Hard-to-fill Vacancies (HTFVs) are generally above the average for all sectors, with those for Construction Skills (Index 166) and Proskills (Index 146) particularly high.

Skills Shortage Vacancies (SSVs) are particularly prevalent in the footprints of Construction Skills, e-skills and Semta, albeit still representing a minority of vacancies.

The proportion of Engineering-related establishments with Skills Gaps is in the range of 13-19% across the SSC footprints, although the proportion of staff not fully proficient is actually in the range of 5-8%, thus 92-95% of employees are considered to be fully proficient.

Of those that have Skills Gaps, it is the Skilled Trades, Operatives and Elementary staff that have the greatest proportion of the problems. For e-skills and Cogent footprint employers, Sales occupations also stand out.

The proportion of employers providing off-the-job training is generally fairly low, in the range of 10-17%, although the share of SummitSkills employers (23%) is higher, showing that there is some room for improvement.

Those employers with a training plan also vary by sector somewhat. The amount spent on training is a matter of some debate – not least because of the difficulty of defining spend (especially where this may be incorporated into a larger contract) – but it is meant to be indicative and is clearly variable by sub-sector.

Table C3.1: Employment Skills Data for England – Selected SSC Footprints 2007

	Cogent	Construction Skills	e-skills	EUSkills	Semta	Proskills	Summit Skills
All employment	389,517	1,018,391	647,381	244,940	1,179,842	273,723	227,444
Vacancies	6,650	36,700	22,650	6,100	23,200	3,975	8,075
Vacancies as a Prop of Employment	1.7%	3.6%	3.5%	2.5%	2.0%	1.5%	3.6%
Index (100 = all sectors)	61	129	126	89	71	52	128
Skills Shortage Vacancies (SSVs)	1,400	14,625	6,275	500	7,150	950	2,000
SSVs as a Prop of Vacancies	21%	40%	28%	8%	31%	24%	25%
Index (100 = all sectors)	100	190	132	39	147	114	118
SSV per Thousand Employees	3.6	14.4	9.7	2.0	6.1	3.5	8.8
Hard-to-Fill Vacancies (HTFV)	842	9,319	2,995	**	4,446	886	1,483
HTFV as a Prop of Vacancies	13%	25%	13%	**	19%	22%	18%
Index (100 = all sectors)	83	166	87	**	126	146	120
Skills Gaps – Prop of Estabs with any	18%	14%	13%	16%	17%	15%	19%
Employees Not Fully Proficient	31,200	58,800	49,900	11,800	75,000	15,600	14,200
Skills Gaps – Prop of Staff with any	8%	6%	8%	5%	6%	6%	6%
Skills Gaps – Managers	10%	15%	11%	15%	11%	12%	9%
Skills Gaps – Professionals	1%	9%	11%	5%	7%	5%	1%
Skills Gaps – Skilled Trades	6%	29%	9%	16%	19%	13%	61%
Skills Gaps – Sales	21%	5%	48%	5%	4%	7%	6%
Skills Gaps – Operatives	22%	7%	1%	23%	26%	28%	1%
Skills Gaps – Elementary	29%	14%	1%	8%	13%	17%	7%
Skills Gaps – Other	11%	21%	19%	28%	20%	18%	15%
Prop of Employers Offering Apprenticeships	12%	19%	7%	13%	20%	12%	44%
Prop of Employers Training	69%	60%	66%	75%	64%	58%	69%
Prop of Employers Off-the-job Training	10%	17%	13%	16%	14%	11%	23%
Prop of Employers Without Training Plan	27%	43%	29%	26%	36%	40%	41%
Training Expenditure	£490m	£2,809m	£952m	£715m	£1,853m	£621m	£556m
Training Expenditure Per Employee	£1,250	£2,750	£1,475	£2,925	£1,575	£2,275	£2,450
Index (100 = all sectors)	72	159	86	170	91	132	142
Training Expenditure Per Trainee	£2,300	£5,100	£2,450	£4,325	£3,250	£5,650	£5,225
Index (100 = all sectors)	83	184	88	156	117	204	188

** Sample size too low for reliability.

Source: Learning & Skills Council (LSC) National Employers Skills Survey (NESS) 2007[82]

82 http://research.lsc.gov.uk/LSC+Research/published/ness/

3b. Scotland

Data from the Scottish sector profiles for a range of Engineering SSCs and Sector Skills Bodies compiled by Futureskills Scotland shows that a substantial number of people are employed in the sector in Scotland.

Vacancy levels as a proportion of employment are a little higher overall than they are in England, with Construction and ICT showing the highest proportions (both 7%). It is notable that labour turnover is very high at near half in the e-skills footprint, with Cogent, Construction Skills and ECITB footprints around the one-in-four mark.

Construction Skills employers suffer the highest levels of SSVs at 3.5% of employment. Overall, HTFVs as a proportion of vacancies are notably higher than average (indices ranging from 121 to 193, where 100 = all sectors).

Skills Gaps are also more prevalent overall, with 20-30% of establishments in Engineering footprints experiencing Skills Gaps, although as a proportion of employees, the figures are in the range of 6-12% - still higher than for all sectors. This means that the vast majority of employees are considered to be proficient in their roles, but there is an underlying lack of proficiency across a wide range of generic skills, as well as technical skills.

It appears that the proportion of employers investing in training is lower than average in a number of sub-sectors with e-skills, Semta and Proskills footprints are particularly notable. The proportion of employees receiving off-the-job training needs to be increased in order to take account of the changing technology and increasing competition experienced in Scotland and more widely elsewhere.

Table C3.2: **Employment Skills Data for Scotland – Selected SSC/SSB Footprints 2007**

	Cogent	Construction Skills	e-skills	ECITB	Semta	Proskills	Summit Skills
Employers	1,500	17,100	6,400	18,800	4,100	1,500	3,800
Employees	50,000	137,900	55,700	262,500	98,200	19,200	28,500
Self-employed (in addition to employees)	3,000	49,000	5,000	57,000	4,000	n/a	n/a
Prop Female Employees	21%	18%	39%	31%	19%	21%	15%
Female Employees	10,500	24,800	21,750	81,500	18,700	4,000	4,250
Vacancies	1,700	9,700	3,900	13,100	3,000	385	850
Vacancies as a Prop of Employment	3%	7%	7%	5%	3%	2%	3%
Index (100 = all)	75	233	233	125	75	50	75
Labour Turnover	24%	22%	47%	26%	13%	12%	19%
Index (100 = all)	109	100	313	118	59	55	86
Skills Shortages as a Prop of Employees	0.8%	3.5%	1.6%	2.2%	1.3%	0.6%	1.2%
Index (100 = all)	89	438	178	220	144	67	133
Prop of Workplaces with Skills Shortages	9%	10%	**	13%	12%	5%	4%
Index (100 = all)	150	167	**	186	200	83	67
Hard-to-fill Vacancies (HTFV)	900	6,900	1,000	9,000	2,000	200	700
HTFV as a Prop of Vacancies	53%	71%	**	69%	67%	52%	83%
Index (100 = all)	123	178	**	153	156	121	193
SSVs as a Prop of HTFV	51%	70%	**	60%	71%	59%	**
Index (100 = all)	84	121	**	95	118	98	**
Skills Gaps – Prop of Estabs with any	29%	23%	**	30%	26%	21%	27%
Index (100 = all)	132	105	**	136	118	95	123
Employees Not Fully Proficient	6,000	12,500	5,000	23,500	6,000	1,700	3,500
Skills Gaps – Prop of Staff with any	12%	9%	9%	9%	6%	9%	12%
Index (100 = all)	150	113	113	113	75	113	150
Technical/Practical Skills Lacking	44%	52%	n/a	45%	71%	42%	62%
Planning & Organisational Skills Lacking	62%	50%	68%	56%	53%	63%	43%
Team-working Skills Lacking	62%	40%	n/a	49%	48%	52%	43%
Problem-solving Skills Lacking	58%	41%	n/a	n/a	45%	n/a	48%
Customer-handling Skills Lacking	50%	38%	77%	44%	33%	n/a	56%
Oral Communications Skills Lacking	48%	n/a	67%	41%	32%	50%	45%
Prop of Employers Training	83%	65%	56%	74%	57%	55%	68%
Index (100 = all) 66%	126	98	85	116	86	83	103
Prop of Employers Off-the-job Training	**	24%	**	14%	20%	**	37%
Prop of Employees with Off-the-Job Training	31%	42%	57%	40%	35%	26%	48%

NB: Figures are subject to rounding. ** Sample size too low for reliability. n/a = Not Available

Source: Futureskills Scotland[83]

83 http://www.futureskillsscotland.org.uk/

3c. Wales

Among employers in the footprints of Engineering-oriented SSCs vacancy rates were generally lower than average – with the exception of those covered by e-skills. The proportion of vacancies as a proportion of employment is also far lower than for all sectors (except for e-skills).

The proportion of HTFVs varied considerably across the footprints with, once again, only those covered by e-skills showing an above-average rate. For the seven SSCs list, the total number of all HTFVs was 2,162 and SSVs was 1,375.

Skills Gaps are most prevalent in Skilled Trades and in Operatives occupations, which underlines the need for up-skilling at the Technician and more junior Engineer level. The proportion of employees with Skills Gaps is remarkably similar across sectors at around 6% - with only those in the footprints of Semta and SummitSkills being above average. In other words most employers believe that 94% of their employees are fully proficient in their roles.

Among those with Skills Gaps, it is the 'generic' cross-sectoral skills that dominate the list. Of these it is Problem-solving Skills that stands out as the most common. Unsurprisingly, Technical and Practical Skills also rate as an area of high gap prevalence. The low levels of Skills Gaps in the EUSkills footprint perhaps reflect the high proportion of establishments providing off-the-job training (70%).

Table C3.3: **Employment Skills Data for Wales – Selected SSC Footprints 2005**

	Cogent	Construction Skills	e-skills	EUSkills	Semta	Proskills	Summit Skills
All Employment							
Vacancies	302	1,731	665	257	965	439	147
Vacancies – Proportion of Estabs with any	15%	16%	22%	10%	21%	21%	15%
Index (100 = all sectors)	71	76	105	48	100	100	71
Vacancies as a Prop of Employment	1.1%	3.3%	3.9%	2.0%	1.2%	2.4%	1.4%
Index (100 = all sectors)	31	94	111	57	34	69	40
Skills Shortage Vacancies (SSVs)	45	712	246	16	260	30	66
SSVs as a Proportion of Employment	**	1.4%	1.4%	n/a	n/a	n/a	0.6%
SSVs – Proportion of Estabs with any	3%	6%	8%	1%	6%	2%	4%
Hard-to-Fill Vacancies (HTFV)	79	1,086	392	26	420	75	84
HTFVs – Proportion of Estabs with any	6%	10%	11%	2%	10%	5%	5%
Index (100 = all sectors)	60	100	110	20	100	50	50
HTFVs as a Prop of all Vacancies	26%	63%	59%	10%	44%	17%	57%
HTFVs as a Prop of Employment	n/a	2.1%	2.3%	n/a	0.5%	n/a	0.8%
Skills Gaps – Prop of Estabs with any	20%	14%	22%	19%	23%	16%	22%
Index (100 = all sectors)	111	78	122	106	128	89	122
Skills Gaps – Prop of Employees with any	6%	6%	6%	4%	9%	6%	10%
Skills Gaps – Managers	120	444	207	36	380	76	40
Skills Gaps – Professionals	72	193	255	13	133	30	67
Skills Gaps – Associate Professionals	30	121	229	69	282	7	42
Skills Gaps – Administrators	54	368	55	354	275	53	17
Skills Gaps – Skilled Trades	265	1,358	69	89	1,187	239	689
Skills Gaps – Sales	144	293	175	195	187	19	10
Skills Gaps – Operatives	936	165	0	93	4,230	546	144
Skills Gaps – Elementary	27	232	0	19	277	78	64
Of those with Skills Gaps:							
Problem-solving Skills	60%	69%	50%	n/a	56%	n/a	n/a
Customer-handling Skills	42%	31%	43%	n/a	47%	n/a	n/a
Technical and Practical Skills	59%	57%	57%	n/a	77%	n/a	n/a
Team-working Skills	46%	40%	30%	n/a	63%	n/a	n/a
Communications Skills	48%	41%	42%	n/a	55%	n/a	n/a
Management Skills	41%	30%	48%	n/a	51%	n/a	n/a
General IT User Skills	44%	28%	31%	n/a	47%	n/a	n/a
Prop of Estabs Providing Off-the-job Training	54%	58%	52%	70%	61%	45%	58%
Index (100 = all sectors)	93	100	90	121	105	78	100

Source: Future Skills Wales 2005[84]

84 http://www.learningobservatory.com/

3d. Northern Ireland

At the time of writing, there are nearly 8,000 apprentices in training in Northern Ireland and there are ambitions to significantly increase this number. In January 2008, Northern Ireland Employment and Learning Minister, Sir Reg Empey said:

"My department's training programmes help large numbers of young people move from education into the world of work. Last year alone the department spent £51m on vocational training, of which £12m was dedicated to apprenticeships. We are currently working towards a challenging target of 10,000 apprentices on departmental programmes by 2010.

In May 2008, Sir Reg announced the introduction of all-age Apprenticeships at Level 2 and Level 3, with the removal of the current upper age limit of 24. The new all-age provision will be separately branded as 'Apprenticeships NI'. Recruitment began in September 2008 following a commitment given by the Department of Employment and Learning (DELNI) under the Northern Ireland Skills Strategy to introduce mechanisms to up-skill adults who currently fall outside the current age range of 16-24 years.

At the time, Sir Reg commented:

"High-level skills are critical to adequately meet the needs of our economy and the enhancement of global competitiveness. I am confident that Apprenticeships NI, the new all-age apprenticeships provision, will be fully embraced by industry, Sector Skills Councils and existing or newly recruited employees."

The place of STEM within the education system in Northern Ireland is currently subject to a review, overseen by a steering group chaired by Dr Hugh Cormican and comprising representatives from business, government and academia. The review is due to report towards the end of 2008.

C Demand Side
4 Sub-sector Analysis and Case Studies

4a. Case Study: Electricity Industry

Energy & Utility Skills (EUSkills) is the Sector Skills Council (SSC) for the electricity, gas, waste management and water industries. As an employer-led organisation, its purpose is to help employers identify their skills needs and then provide effective solutions to improve their business performance. EUSkills is actively working to establish itself as a focal point for business and industry (large or small) and government, working together.

Utilities are often perceived as a Cinderella sector; taken for granted, but essential to the smooth running of the UK economy for enterprise and at home.

The utilities sector in the UK has come something of a full circle. Originally established as a large number of small, private companies subsequent tranches of legislation allowed, and then required, the formation of nationalised utility monopolies. Under the Conservative Governments of the 1980s and 1990s, the process was reversed with initially gas and then electricity and water utilities being privatised.

Post privatisation, the gas, electricity and water industries were required by their economic regulators to produce year-on-year efficiency savings, a challenge they met through a mix of genuine downsizing and outsourcing of activities to contractors. The outcome is that employment in these industries has fallen by about 50% in the last 20 years.

The resulting lack of turnover and workforce renewal left the utilities with a workforce significantly older than the UK average. A recruitment crunch point is looming around 2020 when the 60's 'baby boomers' come up to retirement age. This will be repeated in 2040 with the retirement of the 80's 'baby boomers'.

Against this background much of the UK's utility infrastructure is overdue for renewal. Major investment is being planned to replace some 18,800 km[85] of old cast iron water mains in the next five years and OFGEM[86] allowing an additional £1 billion in new investment in electricity distribution by 2010.

To deliver this programme will require a significant amount of skilled manpower. In 2006 EU Skills' research[87] noted the need for an additional 45,000 Level 3 technicians and 20,000 managers between 2006 and 2012 just to maintain the status quo.

A key barrier to recruitment is the near invisibility of the utility organisations to the public. This was identified in EU Skills' analysis of the National Employer Skills Survey (NESS) 2006 and in industry scenario planning workshops undertaken as part of the EU Skills Sector Skills Agreement (SSA) research in 2007.

85 OFWAT 2008 www.ofwat.gov.uk

86 OFGEM 2004 www.ofgem.gov.uk

87 EU Skills Sector Skills Agreement Stage 1 report 2006 www.euskills.co.uk

To investigate this further, in 2008 EU Skills commissioned a piece of research on behalf of the Power Sector Skills Strategy Group (PSSSG) into the perceptions of the public of the electricity industry. In a telephone survey of 1,000 respondents were asked to rate their knowledge of the electricity industry on a scale of one-to-ten (where ten was the greatest amount of knowledge and one the least) at between one and four. In their answers four out of five respondents rated their awareness at between one and four. Whilst not entirely unexpected, the findings highlighted the scale of the awareness problem.

This finding was echoed in the focus groups run as part of the research. Participants exhibited a limited awareness of electricity generation but had no clear idea of how it reached their homes and businesses. By contrast participants were able clearly identify the importance of electricity to modern life, one participant noting that '*life would be medieval without electricity*'.

In another part of the exercise the participants were asked to describe what they felt were typical roles in the electricity industry. Seven pen portraits of roles within the electricity industry emerged from the discussions. These comprised:

> The sparky (electricians);

> The boiler suited meter reader;

> The eccentric scientist;

> The grey executive;

> The salesman;

> The high risk engineer;

> The contact centre girl.

The roles were notably male dominated with the only female role being notably stereotypical. This perception of a male-dominated technical industry was a constant thread through the qualitative research. While this particular piece of research relates just to the electricity industry there is a belief within EU skills that a very similar picture would emerge for the gas and water industries.

This thinking is supported by the findings of the Relevance of Science Education (ROSE) project[88] run by Oslo University. This work examined the attitude of 15 year old students across 40 countries to science and technology, investigating a number of factors including gender and the state of development of the participants' country as measure by the Human Development Index[89].

The research identified a very strong inverse correlation between the state of development of a country and the attitude of its 15 year olds to science and technology with girls rating science and technology lower than boys. In short, the more developed a country, the less its 15 year olds are interested in science and technology, and it is worse for girls than boys. This suggests that the challenge of attracting new entrants into the Energy and Utility sector is much more than a UK problem and is actually global in nature.

Traditionally utility organisations have employed a higher proportion of graduates than the UK average, a reflection of the technical nature of these industries. Worryingly for the utility sector, graduate recruitment is expected to become increasing competitive. UK demographic data from the Office of National Statistics (ONS) shows a 9% reduction in the number of young people (18-25) in the population in 2030 compared to 1970. This suggests a corresponding reduction in the overall number of graduates, regardless of subject.

The situation among Engineering and Technology graduates may be proportionally less favourable. Whilst the number of graduates studying E&T subjects at UK HEIs has grown slightly over the last five years, increasing competition from a widening choice of university courses means that E&T student numbers are not growing as fast as the overall student population and will inevitably fall when the overall number of young people reduces.

88 http://www.ils.uio.no/english/rose/

89 The HDI combines three basic dimensions: **Life expectancy at birth**, as an index of population health and longevity; **Knowledge and education**, as measured by the adult literacy rate (with two-thirds weighting) and the combined primary, secondary, and tertiary gross enrollment ratio (with one-third weighting) and; **Standard of living**, as measured by the natural logarithm of gross domestic product (GDP) per capita at purchasing power parity (PPP) in United States dollars.

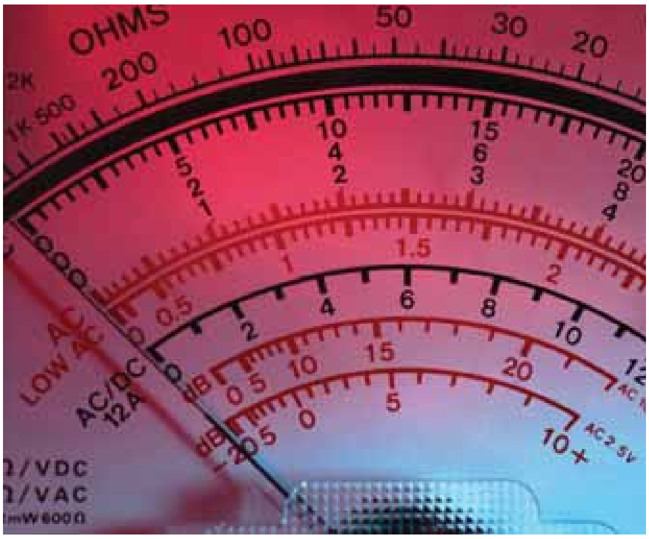
This reducing supply of appropriate graduates contrasts with anecdotal evidence highlighting increased competition for graduates China, while producing a large volume of home grown talent, is increasingly targeting graduates from European universities for its highest profile roles. Alongside this a recent article in the FT[90] noted that Germany is increasingly suffering a shortfall in graduate numbers. In response the German Government is considering relaxing its graduate residency rules, among other things halving the salary level required for a graduate to become a permanent resident.

With few counties being immune from issues of adverse demographics and the limited appeal of the utility sector as a career choice global competition for graduates is only likely to increase.

The reducing volume of potential and actual graduates contrasts with increases of 38%, 18% and 47% in the age bands 35-44, 45-50, and 50+ respectively. This shift in age profiles is reinforced by the ETB's finding that modal age band for Chartered Engineers in 2007 was 50-54, compared to 40-44 in 1988. To round out the picture data from the Government Actuary's Department shows that for the average UK business around 70% of its 2020 workforce has already left compulsory education. Whatever the skills issues of 2020 will turn out to be, the 30+ age group will need to be part of the solution.

One of the positive findings of the PSSSG research was that as participants were exposed to increasing amounts of information about the electricity industry they became increasingly engaged with the idea of pursuing a career in it.

Whilst considerable cynicism was exhibited about the current 'green' initiatives of the industry, regarding these as little more than 'green-washing', there was a consensus across many of the groups that a *genuine* green agenda would make the sector more attractive to them as a potential career choice.



While many of the pressures noted above have each been seen in some form before they are beginning to build up layer on layer in manner which suggests existing recruitment strategies will no longer be adequate. There is a clear requirement for the utilities sector to raise its game in recruitment so that it can put the sector forward as a well-paid, attractive, serious career proposition to compete with those sectors currently seen as being more dynamic and exciting.

90 FT.com 15th July 2008

4b. Case Study: Chemicals, Pharmaceuticals, Oil & Gas, Nuclear, Polymer and Petroleum Industries

i. Cogent SSC

Cogent is the expert, employer-led Sector Skills Council delivering strategic solutions to the skills needs of the chemicals, pharmaceuticals, oil & gas, nuclear, polymer and petroleum industries. Cogent is the essential partner in providing the tools its industries need to ensure they both get these skills and plan for future needs. It is working closely with its employers to support them on their journey towards higher value through skills.

The Cogent's industries include some of the UK's most strategic, wealth-creating and pioneering employers in the UK. They provide for our energy and our health care needs, as well as the chemicals and polymers that are in the everyday products around us. While the footprint comprises six distinct industries with individual skills needs, the sector overall is faced with a number of common challenges. Every employer's license to operate is dependent on its ability to manage complex business activities and understand science and technology. Ensuring the health and safety of employees and the local population as well as managing environmental impact are priority areas for companies. Across the sector there's also a demand for a greater understanding of innovation processes as well as future science, technology, engineering and management needs. Employers are clear they require highly capable people at all levels in their organisations; technology-literate individuals who can operate much more flexibly and across existing skills boundaries.

ii. National Skills Academy for Nuclear

The Skills Academy was established in November 2007, as a subsidiary of Cogent, to address the key skills and training challenges facing the Nuclear industry to ensure it has a skilled workforce that can operate safely and effectively and can also meet the future demands of this rapidly changing industry.

The employer led Skills Academy is structured around five main areas of Nuclear activity across the UK (Northwest/Northeast, Southeast/East, Southwest, Scotland and Wales), and a Regional Training Cluster (RTC) is being established in each region, developing quality training to be delivered by Skills Academy assured providers. Where possible, the Skills Academy will build on existing good provision in the region and will work with current providers to raise the standards and ensure they are responding to employer demand.

It is of fundamental importance to the Nuclear industry to increase flexibility and mobility of staff so that they can respond to the peaks and troughs of demand. To support this, the Skills Academy is developing a Nuclear Skills Passport that is underpinned by the Nuclear Industry Training Framework, this captures quality skills, education and training development that is recognized by employers across the sector. This has significant benefits for the sector by ensuring a skilled, qualified and competent workforce for the future; it will also enable significant savings in time and cost of repeat training as people/companies move from site to site.

iii. National Skills Academy for Process Industries

The Skills Academy was launched in January 2008 with the aim of developing an up-skilling structure and a network of employer-led, world-class centres of excellence delivering the skills required by each sector of the UK Process Industry. It will enable Process Industry employers to take control of the design and delivery of learning in their industry, working in partnership with the public and private sectors, from Government through to top training providers.

The Academy's central hub in the North East of England will steer the leadership and accreditation activities, and a network of public and private training centres around the UK will deliver the training. The Academy has established regional spokes, initially in the North East, North West, Yorkshire & Humber and the Midlands, each supported by a Regional Skills Manager with a Regional Skills Board comprising senior industrialists from the Process Industry, together with other key stakeholders. During the remainder of 2008 and throughout 2009 the next phase of expansion will see the Academy establish spokes throughout the rest of the UK & Ireland.

As part of the drive to help raise standards in the emerging workforce, the Academy is signing up Further Education colleges, Universities and other seats of learning to be accredited Skills Academy Centres of Excellence across the UK. A key project currently underway is establishing an 'Assessment System for Employer Training' (ASET) scheme which will assess and accredit employer training against the Gold Standard.

iv. OPITO

Launched in December 2007 to respond to the oil and gas industry's current and future requirements for a safe and effective workforce, the Oil & Gas Academy enjoys widespread employer support and engagement from all sectors of the industry. With employers at its centre, the Academy provides a focus for existing industry effort around skills, learning and workforce development, whilst also identifying where innovation and new investment are required.

The Academy's ethos is to work with the industry's employers to identify the issues and needs impacting on their business. This provides employers with a unique opportunity to help create, shape and skill their workforce. The Academy does this by engaging with employers in a variety of ways – from a strategic top-down approach liaising with industry CEOs and Oil & Gas UK's various forums; to a bottom-up approach involving communication across regional, sectoral, functional and technical specialisms. This enables the Academy to gain a holistic view of the industry's needs.

v. Nuclear Industries

The top priority in the nuclear industry is to reskill and upskill the workforce in response to the need for an increase in vocational and technical skills, up to and including Level 3. The sector needs to quadruple the number of apprentices over the next five years, and needs clear progression routes.

In the defence sector, a build programme of submarines continues alongside the question of whether to replace the national deterrent. This suggests the need for a steady flow of new entrants with the skills to undertake this work. In the civil sector, the decommissioning of legacy sites continues and as more nuclear power stations close down, the transition into refuelling, de-planting and decommissioning requires a major re-skilling of their workforce.

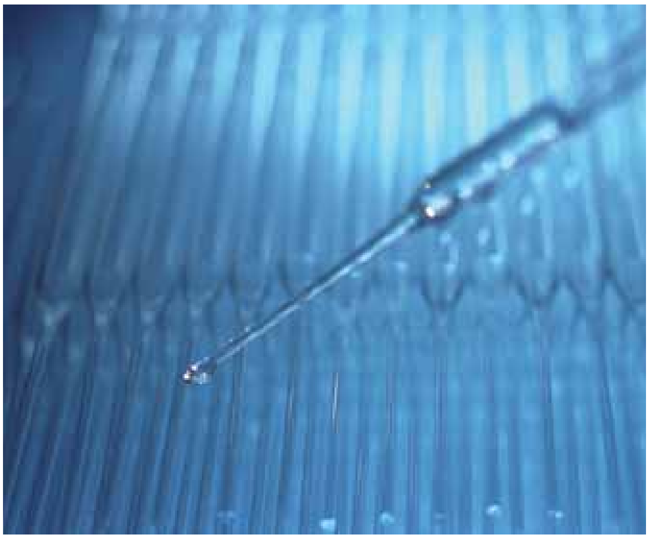
The prospect of new build will also require a new training and education programme. In the early years, many of the skills required will come from the engineering and construction industries, although some specific nuclear skills will be required to ensure safety of new designs. Once the new build programme is established, a new education and training programme will be required in the near future to ensure the supply of suitably qualified and experienced personnel to operate these new reactor plants.

vi. Oil & Gas Industry

New discoveries, ongoing operations, planned lifetime extensions for existing operations, decommissioning activities and retirement of the incumbent workforce, are all factors that mean the oil and gas industry has a sustained recruitment demand with a requirement for skills training and up-skilling of the incumbent workforce.

Keeping the UK Continental Shelf competitive will require exploration and production activities to be carried out, requiring a diversity of skilled people, including geoscientists, engineers, environmental scientists and electricians.

Competition from national and international projects could potentially lead to shortages in oil and gas specialists and for those with conventional skills required to support the UK. Skills developed in the UK are in demand globally, so the supply of skilled workforce for domestic and international activity requires industry management.



vii. Chemicals Industry

The UK Chemicals industry remains resilient in the face of high energy and raw materials costs and international competition. With a number of reorganisations, mergers and acquisitions the industry has achieved a high level of performance through lean manufacturing and process efficiencies and the move to higher added value products.

The industry invests significantly in training and up-skilling of its workforce. However, the workforce is getting older and there is a vital need to increase the supply of young people with the right skills and aptitude for the industry. Shortages of technical and engineering skills such as technicians, fitters, operators, and so on, remain a Europe-wide problem. These shortages are intensified by competition for skilled labour by the offshore oil & gas, and increasingly, the nuclear sectors.

The move to speciality products suggests a remaining major need to achieve a cultural step-change in appetite for innovative thinking at all levels from shop floor to senior management. There are opportunities for radical redesign in processes and products. Successful initiatives such as the Chemistry Innovation Knowledge Transfer Network and National Skills Academy for the Process Industries, plus the work of Cogent, are crucial for the continued prosperity of the Chemicals industry.

viii. Petroleum Industry

The UK oil refining industry encourages skills, knowledge and expertise in scientific, engineering and technical disciplines. The retention and development of this expertise is vital if the UK is to play a lead role in refining and emerging energy technologies. In addition to creating employment in its own right, the UK's domestic refining capability creates wealth and employment in related petrochemicals and manufacturing industries. Essential products include aviation and marine fuels; fuel oil for power generation; heating oil for homes, hospitals, factories and schools; petroleum gases, used mainly in industry but also as an alternative motor fuel; bitumen for roads and roofing; petroleum coke, used in steel making and aluminium smelting, and lubricants for all kinds of engines and machinery. The future direction of the petroleum industry remains stable, but a declining need for petrol coupled with a rising demand for diesel provides a challenge for the UK industry. One of the major challenges facing the sector relates to the uptake of qualifications and their use.

Petrochemicals are vital to products as diverse as carpets, fabrics and clothing; fertilisers; pharmaceuticals, cosmetics and medicines; plastics, paints and detergents; packaging, vehicle components and building materials. This strong local supply base is essential to retaining technical expertise, stimulating innovation within UK manufacturing and preventing its disappearance overseas. As in many other areas of UK manufacturing, this may not have an immediate impact. However, a cumulative effect will occur since skills, expertise and innovative new technologies would be lost to overseas competitors. The oil industry also underpins a number of service industries such as engineering contractors. In the absence of a UK refining industry these support services are likely to go overseas, while some smaller local subcontractors could be driven out of business.

ix. Pharmaceutical Industry

Research by the Association of the British Pharmaceutical Industry on over 100 UK Pharmaceutical companies has revealed that;

- More than a third of companies (35%) were expecting to reduce the level of investment in research and development over the next 12 months, currently standing at nearly £4 billion a year
- Investment in assets such as buildings and equipment, etc., is expected to decline by a similar amount (36%)
- 46% of companies are expected to reduce the number of UK clinical trials
- The level of manufacturing is forecast to drop by 42% among those surveyed

And almost all the companies surveyed (97%) said there is now an increasing level of uncertainty within the UK pharmaceutical market environment. The success of the industry in Britain, and the ability to retain world-class pharmaceutical company investment, are critically dependent on the willingness of the Government to support an environment in which the industry can conduct its research, manufacturing and marketing activities as effectively as in all the other countries that are competing for investment.

The UK's excellent research pedigree and strength in bio-pharmaceuticals are major assets in attracting and retaining a viable UK-based pharmaceutical industry. Recently, the Government has addressed a very broad range of issues relating to clinical research, licensing, intellectual property rights, the science base and the domestic market framework.

x. Polymer Industry

The polymer industry companies that prosper in the future will be lean and efficient in both manufacturing and administration. Innovative with both design and materials and will ally themselves to winning markets, customers and products. In the UK market, locally produced products will be smaller in quantity and higher quality with high volume to price ratio. As with other Cogent industries, there remain skills gaps at higher levels, and the polymer industry also requires people with good knowledge of competitive business techniques.

Recycling is an increasingly important factor in product design and 'cradle to grave' product management and provides significant opportunities in new areas of business with an associated need for skills development.

The cost of crude oil has a direct effect on the cost of all polymers and as such will cause an increase in plastic product prices affecting all other streams, from vegetable and fruit packaging to medical supplies and white goods.

Pressures from eastern economies, particularly China and India, which are often seen as an obstacle for the industry, but this may be overstated. A key difference is that these countries are investing more in automation and new technologies than the UK, with major implications for skills investment.

xi. The Future

The forecasts for the future of the sector are positive and consequently there will be the continued need to attract new workers into the sector. Re-skilling and up-skilling of the current workforce to meet industry demand will also remain a priority. The summary below indicates estimated employment gaps. Further analysis of this can be found in "Skills for Science Industries: Skills at Work" via www.cogent-ssc.com

> At present current forecasts for total employment in the Cogent sector by 2022 will be between approximately 401,000 and 523,000 employees.

NB: Industry estimates of total employment will increase these baseline figures and forecasts

Source: Cogent Forecasts based on ABI 2006 and Working Futures 2

DEMAND

- Total forecast future retirements are estimated to be 145,000 by 2022
- Estimated 72,000 Technicians and Operators needing to be replaced by 2022
- Estimated 55,000 Managers and Professionals needed by 2022

SUPPLY

- Total forecast supply of workers entering the Cogent sector 99,600
- Forecast of 31,600 apprentices entering the sector by 2022
- Forecast of 68,000 graduates entering the sector by 2022

- The numbers above suggest that the current inflow of non-graduates (this is entry via Apprenticeship routes and vocational qualification routes) is insufficient to meet replacement demand in processing and technician roles.
- This deficit will increase significantly in the five-year period to 2017, which coincides with the known lowest point in 16-18 year-olds in the general population, meaning that recruitment will be taking place within the most competitive marketplace.
- Alternative sources of skills to meet demand will be required, including a focus on up-skilling and re-skilling the current workforce, as well as initiatives to attract more entrants.
- The development of National Skills Academies will help to address this gap, by stimulating employer demand for, and supporting the delivery mechanism of, relevant vocational programmes and qualifications.
- At higher level, the current level of skills supply is likely to be sufficient overall, although of course further analysis will be needed to monitor the needs of individual industries and to avoid specific pinch-points.
- The forecasts illustrate the need for a concentration on the Technician and Operator workforce through the development of qualifications and vocational training at relevant levels, and through the up-skilling of the existing Cogent workforce.

Employee Group	Forecast Demand	Forecast Supply	Differential
Higher Level Workers (Managers and Professionals)	55,000	68,000	SURPLUS+ 13,000
Core Workers (Technicians and Operators)	72,000	31,600	SHORTFALL - 40,400

- Although there is already a range of initiatives to address skills shortages across the sector, the analysis suggests that the emphasis of these initiatives needs to focus on the skills levels of the core workforce , particularly around levels two and three, if Cogent are to meet the future needs of the sector.
- 45% of graduate destinations into the Cogent field are derived from STEM subjects. This remains a vital source of Cogent higher level skills for industries that rely on science and engineering at core. Cogent promotes more flexible and employment focussed provision in this regard.

The figures above do need to be treated with some caution, given the limitations of the available data. In particular, more sophisticated analysis of entry from FE, of age cohort changes and of expansion or contraction of individual industries would affect the estimates in various ways. However, the picture they paint reflects the substantial anecdotal evidence that Cogent regularly receives from employers and through its strategic Advisory Councils. Cogent is confident that the analysis forms a strong basis for action.

4c. Case Study: Engineering & Manufacturing Technologies

i. Semta

Semta is the Sector Skills Council for Science, Engineering & Manufacturing Technologies. Industry owned and led, Semta aims to increase the impact of skilled people throughout the science, engineering and manufacturing technologies sectors.

Semta works with the employers in its sectors to ascertain their current and future skills needs and to provide short and long term skills solutions, whether that be training and skills development, or campaigning with government and other organisations that can change things for the better. Through its labour market intelligence and insights from employers across our sectors, it identifies change needed in education and skills policy and practice and engages with key industry partners and partners in the education and training sector to help increase productivity at all levels in the workforce.

Semta is part of the Skills for Business network of 25 employer-led Sector Skills Councils and represents:

- Aerospace
- Automotive
- Bioscience
- Electrical
- Electronics
- Maintenance
- Marine
- Mathematics
- Mechanical
- Metals and Engineered Metal Products

ii. STEM qualifications

In terms of the employer view of STEM qualifications, the Sector Qualifications Strategy (SQS) development undertaken by Semta has analysed those qualifications which its employers believe are valuable and fit-for-purpose. From GCSEs in Mathematics to post-graduate qualifications in Microbiology, the SQS sets out those qualifications which employers in the sector have identified as key to their current and future success.

Semta gains its understanding of employer needs through two main approaches:

a) Direct engagement with key employers in each sector: Semta convenes six Sector Strategy Groups (SSGs), which cover each of the major sectors within Semta's scope. These actively engage senior people from a range of key employers (together with relevant stakeholders): Semta's Sector Strategy Groups address:

- Aerospace
- Automotive
- Bioscience
- Electronics
- Marine, and
- Metals, Mechanical and Electrical

SSG Members are consulted on all the main issues, and provide a powerful sounding Board for the development of Semta policies, initiatives and projects. Each Sector Skills Agreement comes within the purview of a Sector Strategy Group.

b) Comprehensive surveys of employers within Semta's sectors, carried out regularly. The most recent Semta Labour Market Survey was produced in 2007. It addressed the engineering sectors of its remit (a corresponding survey was carried out of Bioscience employers is reported in the Bioscience Sector Skills Agreement). Results were disaggregated at the level of the four UK home nations, and information was gathered on a wide range of issues including:

- Recruitment difficulties
- Skill gaps within the current workforce
- HR strategies, Training and Apprenticeships
- Experience with publicly-funded skills initiatives

c) Semta has undertaken extensive analysis of the qualifications needs of the sector through its Sectors Qualifications Strategy (SQS) process – documents which analyse the demand for qualifications at all levels, and drawn from employer discussion and the Sector Skills Agreements.

iii. Projections and Modelling Scenarios

Assessing future skill needs is a core activity of Sector Skills Councils and Semta's Sector Skills Agreements include such assessments. Quantitative estimates of future skill needs are also made, though these are subject to estimates and assumptions of many kinds, due to the considerable uncertainties in a wide range of factors that are likely to influence future development.

The Working Futures studies (Working Futures III was released in the Autumn of 2008) carried out over recent years by the Institute of Employment Research (IER) at the University of Warwick[91], provide ten-year estimates of future broad sectoral and occupational employment levels, and IER is playing a leading role in explorations of such forecasts at the European level[92].

It is generally recognised that the most effective way to gain a better understanding of the effect of key factors likely to influence future skills demand and supply is the use of scenarios. The development and consideration of *a set of alternative futures* reduces the risk of over-dependence on particular factors, and allows analysts and policy-makers to begin to get a feel for the 'space of possibilities'. There is growing interest in such foresight scenarios, and one of Semta's research team recently led a project that developed, after exploration of 90 independent change drivers, six scenarios for the European Commission[93] for Information and Communication Technology Practitioner skills for the ICT industry in Europe[94].

It should be noted that such work has so far tended to focus on possible future employment levels by sector and/or occupation, rather than the working prospects of those with particular types of qualification, although in principle this could be carried out with assumptions about the quantitative relationships between the sectoral and occupational development and the supply of those with particular qualifications – in this case STEM qualifications. The same principles would apply, although the additional 'mapping' would bring further uncertainty, thus increasing the need for scenarios to reduce the risk of errors.

Semta's work in this area so far has included collaboration with the IER to elaborate a more detailed forecasting model for Semta's sectors and occupations of interest than was possible with the Working Futures studies. This has provided valuable estimates of possible future employment levels, and so – in the light of the replacement demand expected arising from workforce attrition (retirements, deaths and net occupational or sectoral 'emigration') – the likely numbers of new people needed in the coming years.

There are no explicit assumptions in the model about the demand such requirements would put on the 'STEM qualification supply channels' (to which the requirements from all the other 'destination sectors' would need to be added), this model does provide useful input into the debate on future demand of STEM skills.

While forecasts must always be viewed with caution, Semta recognises the growing importance of more thorough and valid consideration of future developments to inform policy analysis.

91 http://www2.warwick.ac.uk/fac/soc/ier/research/current/wf/

92 http://www.trainingvillage.gr/etv/Projects_Networks/Skillsnet/forecasting.asp

93 Directorate-General Enterprise and Industry

94 see http://www.cepis.org/index.jsp?b=0-636&pID=648&nID=717

4d. Case Study: Zero Carbon Skills Policy

i. SummitSkills

SummitSkills is the Sector Skills Council for the building services engineering sector. It has been created by employers, for employers, to address five key objectives:

> Alleviate skills gaps
> Improve productivity
> Provide career progression
> Develop a competent workforce
> Champion the sector's skills agenda

The employer-led approach of SummitSkills gives businesses in the sector a key role in increasing their own and the country's productivity and profitability. Through the establishment of Sector Skills Councils, employers now have a direct route to influence strategic planning relating to skills and training.

ii. Hobson's Choice

In his paper *'Towards a 'Hobsonian' Nuclear Zero Carbon Energy Policy'? The Potential Training Gap in Renewables Technology'*[95], Dr Mike Hammond, Head of Research at SummitSkills[96], examines the options open to the sector.

In the play Hobson's Choice, the ultimate point is that Hobson, a robust Lancashire boot and shoe manufacturer had no choice but to accept ultimately the scenario given to him by his determined elder daughter and her lacklustre new husband. This paper suggests that ultimately the UK Government, regardless of political colour, is facing a similar 'Hobsonian choice' as the failure of the renewables market to develop may leave Nuclear power as the only viable zero carbon option. Current research that was undertaken by Dr Hammond on behalf of SummitSkills suggests that there is a significant training need within the Building Services Engineering Sector in relation to micro-generation of renewable 'green' energy particularly. Table C4.1 shows the potential training needs for the major renewables technologies that are likely to be fitted by the Building Services Engineering (BSE) Sector within the SummitSkills footprint (predominantly air conditioning and refrigeration engineers, electrotechnical engineers (electricians), heating and ventilation engineers and plumbers) for the UK.

95 A copy of the full report may be obtained from http://www.summitskills.org.uk/

96 The views expressed within this article are those of the author, and are not necessarily those of SummitSkills.

Table C4.1: **Potential Renewables Training Requirement for the BSE Sector in the UK by Technology and Industry**

Technology	UK Training Requirement
Solar Water and Heating	
Electrical Trades and Installation	91,471
Plumbing	41,404
Heating and Ventilation	25,480
Air Conditioning and Refrigeration	12,064
Photovoltaic	
Electrical Trades and Installation	43,404
Plumbing	28,326
Heating and Ventilation	12,882
Air Conditioning and Refrigeration	6,441
Combined Heating and Power Units	
Electrical Trades and Installation	78,336
Plumbing	34,224
Heating and Ventilation	23,382
Air Conditioning and Refrigeration	11,251
Micro Wind Energy	
Electrical Trades and Installation	39,175
Plumbing	18,360
Heating and Ventilation	11,297
Air Conditioning and Refrigeration	5,647
Ground Source Heat Pump	
Electrical Trades and Installation	74,081
Plumbing	32,996
Heating and Ventilation	21,383
Air Conditioning and Refrigeration	10,598
Air Source Heat Pump	
Electrical Trades and Installation	58,248
Plumbing	27,330
Heating and Ventilation	16,059
Air Conditioning and Refrigeration	8,409
Biomass	
Electrical Trades and Installation	36,876
Plumbing	17,134
Heating and Ventilation	10,545
Air Conditioning and Refrigeration	5,271
Bio Fuel (Liquid)	
Electrical Trades and Installation	35,286
Plumbing	16,463
Heating and Ventilation	10,310
Air Conditioning and Refrigeration	5,066
Micro Hydro Generation Systems	
Electrical Trades and Installation	27,618
Plumbing	12,821
Heating and Ventilation	7,890
Air Conditioning and Refrigeration	3,943
Fuel Cell Technology	
Electrical Trades and Installation	31,047
Plumbing	13,748
Heating and Ventilation	8,778
Air Conditioning and Refrigeration	4,344
Rainwater Harvesting[97]	
Electrical Trades and Installation	39,975
Plumbing	18,945
Heating and Ventilation	11,589
Air Conditioning and Refrigeration	5,793

Table C4.1 is based on the numbers of operatives who are currently working with the renewables technologies, but have received no formal training in their installation, plus the number of employees requiring training if the Government were to stimulate the renewables market, causing companies within the BSE sector currently not engaged in the installation of renewables products to enter the market.

97 Rainwater Harvesting is not a renewable energy generator per se, but is environmental as it saves clean water.

Table C4.1 shows that there are significant numbers of operatives in the BSE sector requiring training, and in the full report the figures are broken down by English region and devolved nation. What Table C4.1 does not show is that in some regions there is 'clustering' of companies engaged in particular renewables technologies. The demand therefore for training is not uniform across the UK, and providers would need to ensure that rather than offering a uniform suite of courses, the curriculum offer was related to regional/local demand taking into account potential specialisms emerging in certain regions indicated by the research.

A further conclusion that can be drawn from Table C4.1 (and particularly the nation/regional breakdown in the full report) is that if numbers of operatives of the magnitude contained in the table above were to require training at one time then the current supply network throughout the UK would be unable to cope with demand, and the potential for 'rogue providers' to enter the market should not be discounted.

In conclusion, therefore, it would appear that in micro-generation terms, the BSE sector is not in a position to be able to react positively to a sudden large surge in demand caused by market stimulation. The numbers of operatives needing training in Combined Heating and Power (CHP) Units, for example, suggests that the ability of the BSE sector to meet the Government's agenda as contained in the latest 'Energy' White Paper efficiently, and thus for CHP to play its part in a 'mixed zero carbon energy policy' is likely to be extremely challenging, which it is argued will inevitably lead more to a reliance on the Nuclear option.

To address this issue, urgent action needs to be taken to develop training courses in micro-generation renewables technologies, with a planned training approach, rather than a 'stampede' due to an uncoordinated stimulation of the market.

Reference

Hammond, M.J. (2008) Report on additional research into specific themes arising from the Sector Skills Agreement for building services engineering Milton Keynes, Summitskills.

D Interactivities

1 Labour Market Economics – The Rising Demand for STEM Graduates

1a. Overview[98]

Given the importance of Science, Technology, Engineering and Mathematics (STEM) to economic growth and technological change, the falling shares of young people choosing to study STEM subjects has become a major cause of concern in many countries, including the UK.[99 100] Participation rates in HE and FE have shown a rapidly rising trend in most countries. However, the numbers and quality of young people choosing to follow STEM educational routes through FE and HE, and following this up by entering occupations and careers in Science, Engineering and Technology, have shown static, and in some cases falling, in recent years. Such trends raise the question of whether or not the supply of STEM graduates is going to be adequate to meet the needs of a 21st-century economy.

This new study examines, in a systematic way, how changes in the economy and labour market, over the next decade, might affect the demand for STEM graduates at first degree and postgraduate level. It concludes that such trends appear to be moving in the opposite direction, with demand for many such skills rising, on average, faster than for other disciplines. This reinforces the case for measures to try to improve the supply side, and to encourage more and better students to follow STEM career paths.

98 This article is based on a report produced on behalf of ETB/CIHE/DIUS, (Wilson, R.A. (2008) "The Demand for STEM Graduates: Some benchmark projections". Institute for Employment Research, University of Warwick: Coventry.

99 Evolution of student interest in Science and Technology studies. Policy Report, OECD, May 2006: http://www.oecd.org/16/30/36645825.pdf

100 See the main report (Wilson (2008) for a more detailed review of relevant recent reports and papers.

1b. Approach

The project explores what the likely change in demand for STEM graduates might be, given a continuation of past trends in employment patterns (as observed using data taken from the officially collected Labour Force Survey (LFS)), and based on a detailed analysis of the longer-term prospects for the economy, using a well established multi-sectoral macroeconomic model. The analysis focuses primarily upon shares and numbers of people in employment holding different types of qualifications. The results provide some new insights into possible developments in this important part of the labour market, and contribute to a better understanding of the overall demand/supply relationship for STEM personnel, currently and over the coming decade.

It extends previous work on the levels of qualifications held by those in employment, as published in *Working Futures*.[101] Changes in shares of those in employment qualified in the various disciplines distinguished are examined (at a detailed industry and occupational level).

These results are then used to develop benchmark projections of likely future demand for STEM graduates by combining this information with a new medium- to long-term macroeconomic forecast.[102] The latter focuses upon likely changes in the Sectoral and Occupational structure of employment in the economy over the next 10 years, as a result of further technological change and the continued globalisation of economic activity.

1c. Results

i. Current Deployment of STEM Graduates

Graduates and postgraduates as a whole account for just over three in 10 jobs across all sectors, but this ranges from over one in two in Non-marketed Services (including Education, Health and Public Administration and Defence), to not much more than one in 10 for the Construction sector.

Across all industries, people qualified at post graduate level in STEM subjects accounted for just under 3% of total employment in 2007. Those with a first degree in STEM subjects account for just over 8% of employment.

Manufacturing is no longer the major area of employment for STEM graduates and postgraduates. There is now a much larger number and share of such people employed in other sectors. In total, people qualified at post-graduate level in STEM subjects accounted for just over 2% of total Manufacturing employment in 2007. Manufacturing now employs a smaller share of highly qualified people generally, although the patterns of change over time (in terms of the broad NQF categories) are very similar to those for all industries. However, the rate of growth of employment for STEM graduates is faster in Manufacturing than elsewhere, despite the fact that overall employment prospects are poorer in this sector than for all industries and services.

101 *Working Futures* is a set of detailed employment forecast produced on behalf of the LSC and UKCES. The present projections are linked to Working Futures 2007-17. The overall qualification patterns are based on an updated version of those produced for Working Futures 2004-2014, see *Working Futures Qualifications Report* at : http://www.ukces.org.uk/Default.aspx?page=28). The latest round of projections was completed without a full revision and reassessment of the qualification model developed in the 2004-2014 results. For further details of the results see the UKCSE website: http://www.ukces.org.uk/Default.aspx?page=28.

102 The projections are based on a *Working Futures* macroeconomic scenario which was developed in the first half of 2008 at a time of considerable economic uncertainty, with concerns about the impact on economic prospects of the “credit crunch” and rapidly rising commodity prices (especially for oil and food). Despite these uncertainties, and the likelihood of a recession in the short term, the medium to long-term employment prospects for the UK remain quite bullish, with substantial employment growth expected, driven by rising population.

Non-marketed Services (which does include many Engineering activities) is now the sector with the largest shares of people employed who are qualified in STEM subjects at first-degree level or above. A large proportion of these are qualified in medicine (doctors and nurses, etc). Excluding those qualified in Medicine, the Business and Other Services sector accounts for even greater numbers of STEM graduates and postgraduates than the public sector. Its share has also been growing at very rapid rates, especially for those qualified in subjects such as Mathematics and Computing. More than 300,000 STEM postgraduates were employed in these two sectors in 2007, while more than ¾ million STEM first-degree graduates were employed in Business and Other Services alone. However, it must be noted that great care must be taken in interpreting the inclusive nature of this category; a substantial proportion of employers included in this category would be considered to be Engineering organisations or those supplying Engineering-related activities.

Significant numbers are also employed in Distribution and Transport (including hotels and restaurants). Indeed for all categories, except those qualified in Engineering, the numbers employed in this sector are now much higher than in Manufacturing. Finally, the Primary sector (including utilities) and Construction both employ significant numbers of STEM graduates and postgraduates. However, these are small compared to the numbers in other sectors. The largest groups involved in both cases are first-degree graduates qualified in Engineering.

STEM graduates and postgraduates are most significantly represented amongst managerial, professional and associate professional occupations, although quite significant numbers are also employed in some lower level occupations.

ii. Supply of those with STEM Qualifications

At the broadest level, there is some evidence that the rapid increase observed in recent years in the supply of young people moving into HE as a whole may be slowing. The official measure (the HE Initial Participation Rate (HEIRP)) suggests that the proportion of may now have reached a plateau at around 40%. Unfortunately the HEIRP is not available for particular subject categories, (although in principle such measures could be calculated).

In 2007, just under one million people in the working age population had STEM qualifications at NQF Level 5, and just over 2½ million had STEM qualifications at NQF Level 4. Of such postgraduates and graduates, the vast majority were economically active and in employment, with only a small proportion unemployed. This reflects the patterns for those qualified in other subjects as well. In contrast, a much higher percentage of people with qualifications lower than NQF Level 4 are found to be economically inactive and/or unemployed. Those qualified in STEM subjects are marginally more likely to be economically active and in employment than graduates in other disciplines, although the differences are small.

iii. Projections of Numbers in Employment 2007-2017

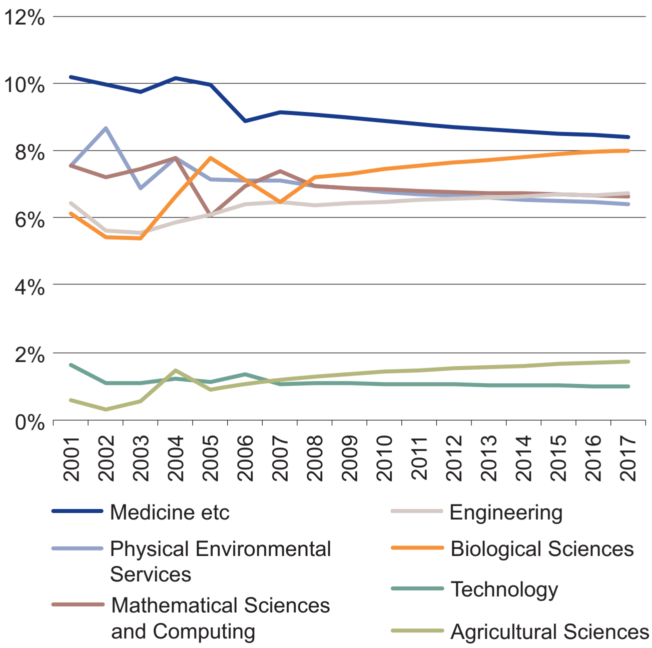
Generally, growth in employment is expected to be fastest for those qualified at the highest levels, while the number of those in employment with no or few formal qualifications is projected to decline. The results suggest that, with the main exception of Medicine, the demand for most STEM subjects is likely to grow faster than for other disciplines over the coming decade. Employment shares for most STEM categories have been on a slightly rising trend for the past few years. Some of the most rapid increases are observed for Biological Sciences at both graduate and postgraduate levels.

The focus here is on employment. The impact of both demand and supply factors is reflected in the historical and projected estimates of employment by qualification level. Such limitations should be considered when using such projections. Employment levels by qualification may be interpreted as representing the revealed preferences of employers for certain types of labour, as categorised by the qualifications they hold, but it is also clear that the changing patterns of supply, especially the strong trend towards undertaking and obtaining higher-level qualifications, has driven up the average qualification levels of those in employment. Having said that, evidence of rates of return to higher-level qualifications, as well as other evidence on the changing nature of jobs, suggests that overall demand has kept up with the supply of those with higher-level (NQF4+) qualifications. Many jobs are becoming more demanding in terms of the qualifications required.

The results generally suggest that the employment levels for those qualified in most STEM subjects will grow significantly.[103] Such changing structural demand is also only part of the picture. The age profile of the STEM population means that there will also be a significant need to replace those leaving the STEM workforce (as older workers reach retirement age in the coming decade). This need to refresh talent (replacement demand) is at least as important as so-called expansion demands arising from projected increases in employment levels for such workers. Together they lead to a substantial total requirement for almost all STEM categories over the coming decade.

The present analysis does not enable a direct comparison with likely supply. However, if recent trends continue, these results suggest that companies and organisations dependent upon high-quality STEM personnel will find it increasingly difficult to find the skills that they will need to operate and compete successfully.

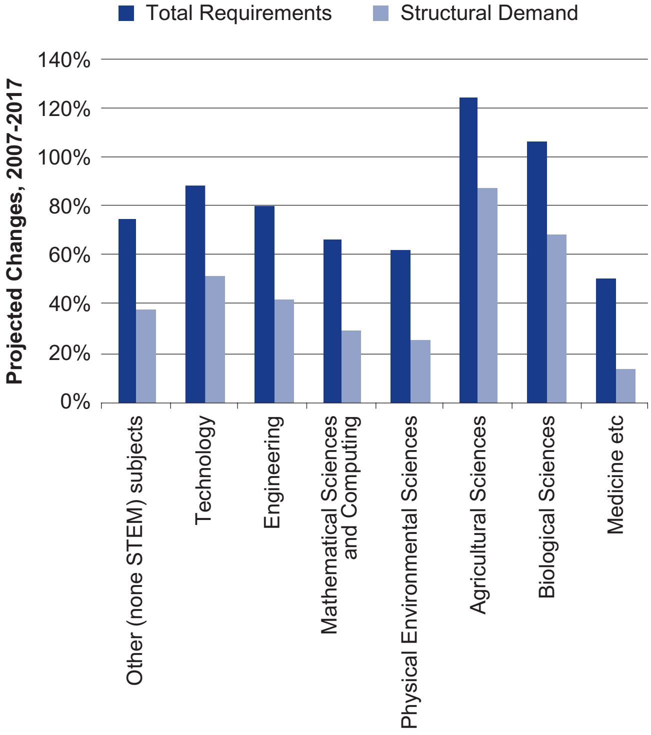
Figure D1.1: **Trends in STEM postgraduates (shares of total employment)**



Source: Warwick IER

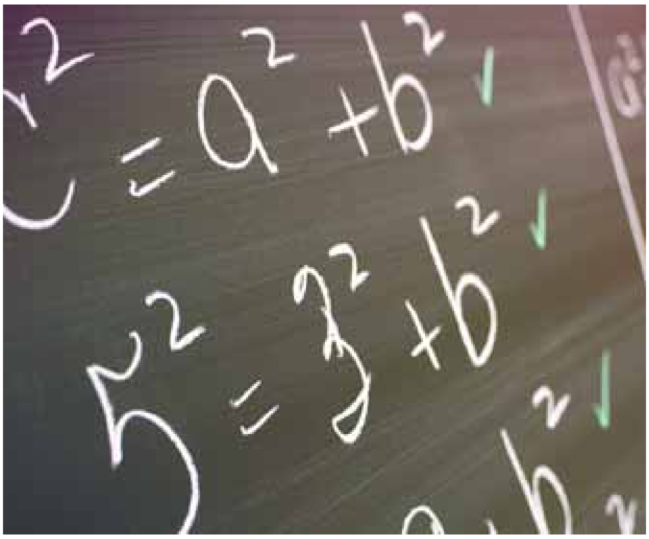
103 The projections of employment by discipline for various occupational and sectoral categories take no direct account of changes in the flows emerging from the educational system (i.e. the supply side). They therefore conflate both supply and demand influences. They indicate the numbers that might be expected if recent trends continue.

Figure D1.2: **Projected Changes in Employment, STEM postgraduates, 2007-2017**



Source: Warwick IER

D Interactivities
2 Recruitment in Engineering



2a. Importance of Mathematics

In a report on *The Value of Mathematics*, published by the Reform Research Trust[104] (RRT) (Kounine, Marks and Truss 2008), researchers set out a compelling analysis of O level and GCSE Mathematics examinations since 1951 and found that since the introduction of the GCSE in 1987, there has been a sharp decline in both the difficulty of the exams and the marks required to achieve a pass grade. Questions have become *"significantly shorter and simpler",* derived from a *"much broader and shallower curriculum"*.[105] They go on to note that *"it has become substantially easier to achieve a grade C since the inception of GCSEs in 1987"*.[106] This is illustrated by the fall in the percentage mark required for a grade C on the Higher Tier of GCSE falling from just over 50% in 1990 to about 20% in 2000 and 2006.

The authors suggest that the falling GCSE standards have had a knock-on effect on A level standards and undergraduate teaching in turn.

In the *Times Higher Education Supplement*[107] (10th January 2008), David Robb, Admissions Tutor in Mechanical Engineering and Chair of the Undergraduate Admissions Committee at Imperial College London, is quoted as being faced with the fact that students often lack the necessary knowledge of Mathematics to an extent that was unthinkable 25 years ago. This is one reason why eight years ago, Imperial replaced its three-year BEng with a four-year MEng because of the need for remedial teaching. This problem is not confined to Imperial and there is a widespread view among academics that they are having to *"pick up the pieces"* of a secondary education system that does not deliver university-ready students.

Robb said "You can look at A level exams of 20 years ago and today and they look fairly similar. But check the text and you can see that the older papers said "Here's a problem – solve it" while the new ones say "Do this calculation, do that, do the other and at the end announce that now you've solved the problem". Absolute standards are dropping; there is no doubt about that."

Alison Wolf, Professor of Public Sector Management at King's College London is quoted as saying "My impression is that for the sciences and languages and maths there is a growing problem. I do not think it is just people being hung up on the good old days, but there are real issues on abilities."

104 http://www.reform.co.uk/

105 Gardner, T. (2006), *Beyond the Soup Kitchen: Thoughts on revising the Mathematics Strategies/Frameworks for England*.

106 Coe, R. (1999), ***Changes in examination grades over time: Is the same worth less?***, Paper presented at the British Educational Research Association annual conference, Brighton, September; Coe, R. (2006), "Are A levels and GCSEs getting easier?", Presentation at "Alternatives to A level and GCSE" Conference, Wellington College, 7 June.

107 http://www.timeshighereducation.co.uk/

RRT's research shows that Financial Services institutions in the City of London want to recruit high-level mathematicians. Respondents indicated that of those recruited, only a very small proportion comprised UK-domiciled graduates. Indeed, one City institution noted that not one recruit was hired from the UK. Those City firms that *did* recruit from the UK tended to do so from Oxbridge only, with broader recruitment of German, French and Singaporean graduates in particular. The standards of these foreign students were felt to be higher overall.

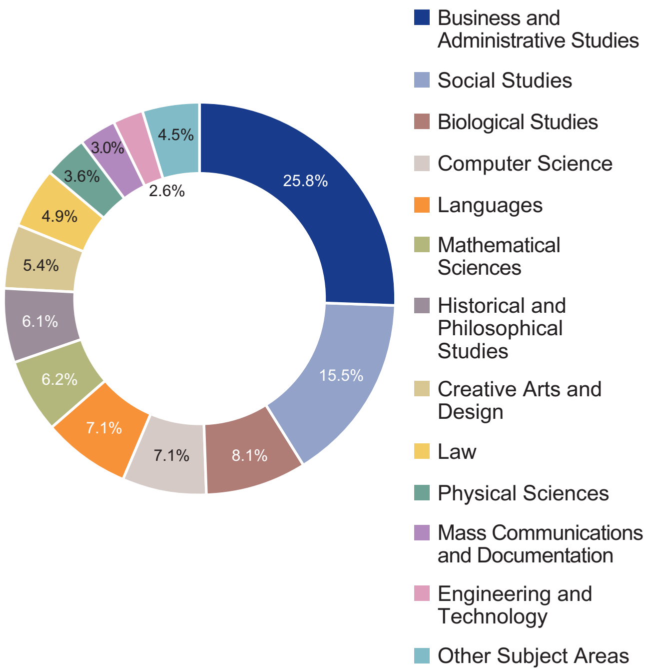
This evidence is supported by work carried out by London First,[108] which found a very strong opinion from banks that the UK-domiciled and educated graduates lacked numeracy skills, compared to their international equivalents. One of the banks with a graduate recruitment scheme told London First that although 70% of applicants for the 70 places on offer were UK domiciled, only three out of the 70 that actually offered positions were UK-domiciled.

This sits somewhat at odds with a widely-held perception in the Engineering world that E&T graduates are especially attractive to financial institutions because of their numeracy skills. The evidence indicates that high-end, high-value-added, specialist employers are looking for very specific, specialised high-end skills sets.

Figure D2.1 shows the share of first-degree HE leavers entering employment with all Financial Services employers (not just in the City of London) by the subject they studied. This clearly shows the wide variety of subject areas from which recruits were drawn and the dominance of Business and Social Studies graduates in this group.

Those who studied any subject within the subject area of Mathematical Sciences account for 6.2% of these recruits. Those who studied E&T accounted for just 2.6% of Financial Services recruits.

Figure D2.1: All UK-domiciled Leavers who Obtained First Degrees and Entered Employment with Financial Services Employers (SIC Code Divisions 65, 66 and 67) only, by Subject of Study – 2006/07



Source: Higher Education Statistics Agency (HESA) 2008

Insofar as numeracy is a vital skill in almost all occupations – right across UK business and industry – and that it forms a component of a great many degree courses out with core STEM subjects, it is not at all clear that numeracy skills gained in one subject are necessarily more valuable to a wider range of employers than those gained in any other subject.

Specialist mathematical modelling skills required by a small number of specialist, high-end financial employers will only ever represent a very small proportion of the employment pool.

108 http://www.london-first.co.uk/

Semta Employer views of the value of STEM skills, and how this varies across STEM disciplines and by level of qualification:

Mathematics skills in the general population

Semta's employers believe that mathematical competence and confidence are key for all UK employees, regardless of their role. The growing requirement of mathematics in enabling successful participation in society means that a sound grasp of both theory and application is needed. Those who lack the basics of mathematical understanding will find themselves increasingly isolated and with poorer chances in the UK labour market, particularly given employers' growing desire to recruit from an increasingly global talent pool, even for sub-degree level jobs.

In addition to this, confidence in using mathematics is essential – reducing trepidation and avoidance behaviour, and giving people an enthusiasm for using mathematics. The general attitude that mastery of mathematics is difficult, irrelevant, and no longer needed because of developments in IT must be challenged at all times.

Mathematics skills in STEM careers and sectors

For those working in STEM sectors and occupations, the mathematics requirements are naturally higher. Semta's employers particularly report a deficiency in the ability to estimate, a key skill when dealing with process which have some degree of automation. Too often, individuals are unable to identify errors and outriders in processing results, because they are unable to calculate a quick estimate of the expected outcome.

Employers are also concerned that the 'landscape' of mathematics education is becoming very complex. There is a lack of understanding of how the various options relate and concern that if a young person studies the wrong mathematics paper at GCSE or GCE A-Level (or 'Standards' or 'Highers' in Scotland), it could prevent their progression to a career which is dependent on mastery of additional areas. This has been particularly noted in the now-changed tri-partite mathematics papers in England, where some employers were forced to specify both grade and paper (Intermediate or Advanced) in recruitment – a B grade in the Intermediate paper meant that the individual had not covered the same syllabus as someone who had achieved a 'B' grade in the Advanced paper.

Source: Response to DIUS consultation: Analysis on Demand for STEM skills

D Interactivities
3 Earnings in Engineering

3a. Annual Survey of Hours and Earnings (ASHE)

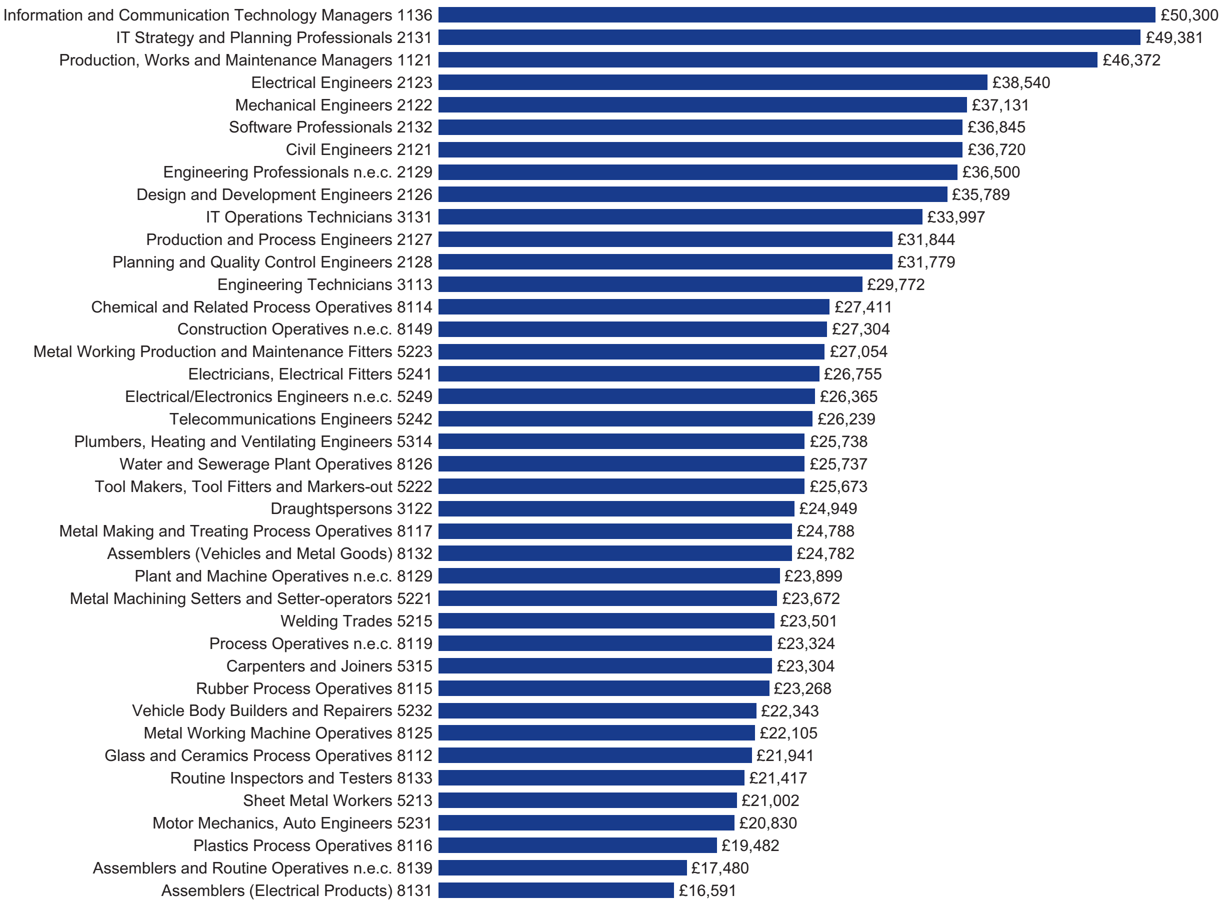
The Annual Survey of Hours and Earnings (ASHE), sponsored by the Office for National Statistics, provides information about the levels, distribution and make-up of earnings and hours paid to employees within industries, occupations and regions across the UK.

The ASHE replaced the New Earnings Survey (NES) in 2004 and included improvements to the coverage of employees, imputation for item non-response and the weighting of earnings estimates. The ASHE contains UK data on earnings for employees by sex and full-time/part-time workers. Further breakdowns include by region, occupation, industry, region by occupation and age groups.

These data can be broken down by four-digit SOC2000 code to provide figures for a range of occupations. Figure D3.1 provides mean annual salary data for a range of Engineering occupations ranging from the highest-paid ICT Professionals down to Assembly Operatives.

Unsurprisingly, those occupations included under Managers and Senior Officials (SOC 2000 Major Group 1) and Professionals (SOC 2000 Major Group 2) enjoy significantly higher pay levels than those under Skilled Trade Occupations (SOC 2000 Major Code 5) and Operatives (SOC 2000 Major Code 8).

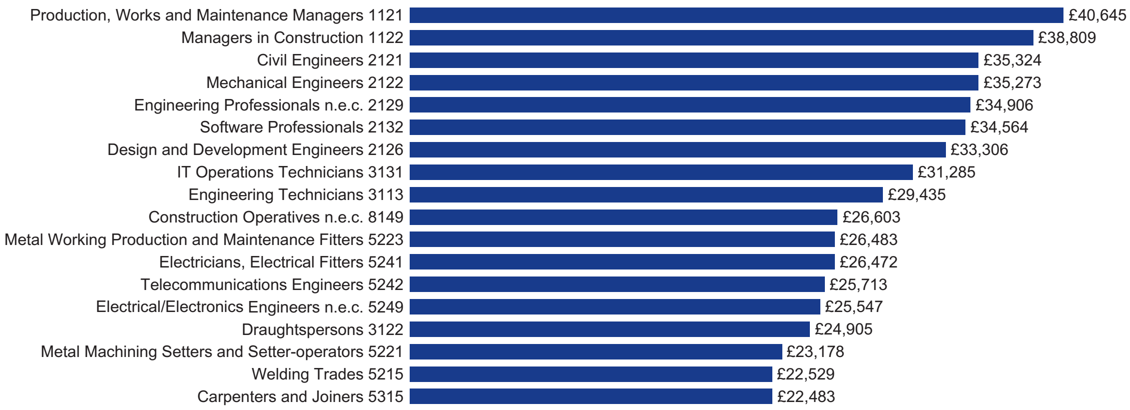
Figure D3.1: Mean Annual Gross (£) Pay – All Employee Jobs: United Kingdom, 2007, by Four-digit SOC 2000 Code



Source: Annual Survey of Hours and Earnings (ASHE), Office for National Statistics (ONS)

An examination of median pay data (Figure D3.2) for selected occupations, for which robust data are available shows a similar picture to that for the mean data.

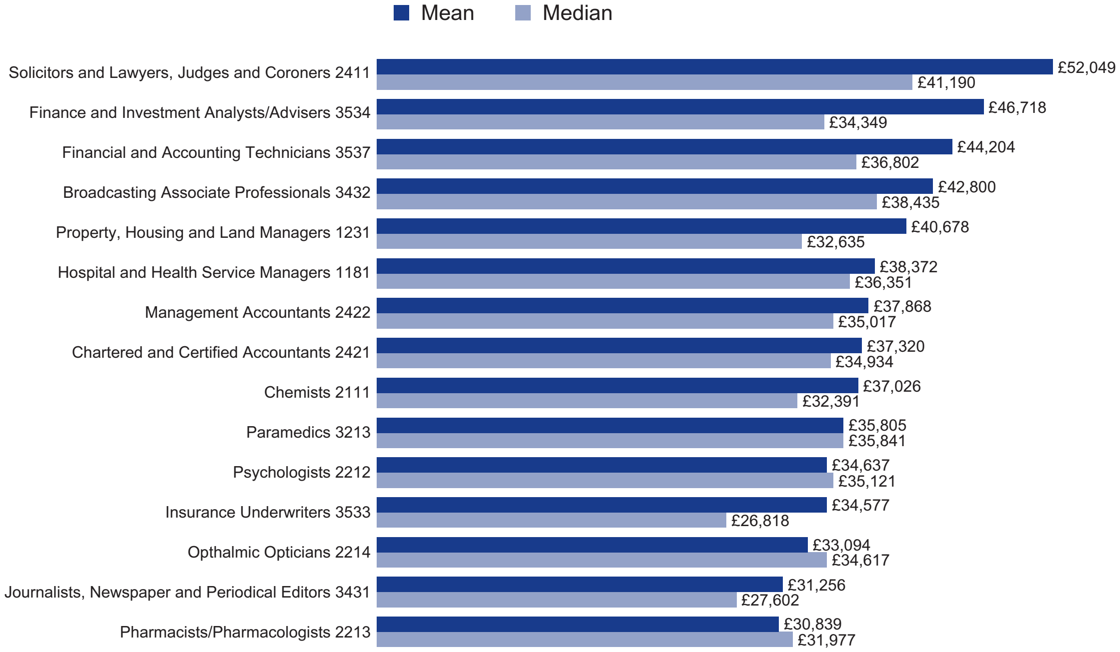
Figure D3.2: **Median Annual Gross (£) Pay – All Employee Jobs: United Kingdom, 2007, by Four-digit SOC 2000 Code**



Source: Annual Survey of Hours and Earnings (ASHE), Office for National Statistics (ONS)

Professional Engineering occupation pay levels compare very favourably with those of other professions (Figure D3.3). These data go some way towards countering the perception that Engineers are not well paid.

Figure D3.3: **Annual Gross (£) Pay – All Employee Jobs: United Kingdom, 2007, by Four-digit SOC 2000 Code – Comparative Non-engineering Occupations**



Source: Annual Survey of Hours and Earnings (ASHE), Office for National Statistics (ONS)

3b. Graduate Starting Salaries

According to the Prospects Directory, the median graduate starting salary for both all 2007 graduates and E&T subject graduates is £22,000. A review of starting salaries by type of employer shows that Engineering companies offer very excellent remuneration to the graduates they take on.

Table D3.1: Median Graduate Salary by Type of Employer

Computer Consultants	£28,500
Oil, Mining & Extractive Industries	£27,500
Chemical Manufacturers	£27,000
Energy & Natural Resources	£23,000
Engineering Products	£22,000
Construction Industries	£21,500

Source: Prospects Directory 2006/7

It is often the case in Engineering occupations that bonuses or other increments based on, for example, experience and postgraduate qualifications may be offered as well.

3c. Institution of Civil Engineers (ICE) Salary Survey 2007

i. Background

The Institution of Civil Engineers (ICE)[109] regularly conducts a Salary Survey of its members. The report on the 2007 survey published in May 2007 is probably the most complex and accurate employment survey in the Civil Engineering industry, and has become one of the ICE's most sought-after outputs.

Since the ICE's first Salary Survey in 1999, the size and scope of the research has progressed, particularly with regard to the sophistication of the methodology and the member response rate. In the 2007 survey over 9,500 UK working members shared with the ICE details of their remunerations, other benefits, holiday entitlements and job satisfaction, allowing it to draw some robust conclusions. For the first time the ICE also surveyed its Hong Kong (HK) based members in order to understand how their salaries compared to those of their colleagues in the UK, with over 250 members taking part.

109 http://www.ice.org.uk/

ii. Methodology

Conducting the survey is a complex process, demanding a great deal of preparation and intricate data extraction:

a. Representative findings: The sample structure of all respondents from both the UK and HK was representative of the ICE membership population, which means that the proportion between members of given grades and within certain age bands in the sample was the same as that of the whole UK/HK working membership.

b. Data weighting: All the responses collected were weighted according to the quotas established before the survey. This meant that the numbers of responses within some groups changed slightly in order to reflect the real proportions of the whole membership population.

c. Questionnaire design: Developing the final version of the survey questionnaire, including online testing, took around three weeks. A web survey was developed that enabled the ICE to accurately capture data on recent graduates,[110] a newly introduced category addressing the needs of both members and the Civil Engineering environment.

d. Respondents' database: A mailing list of 38,000 potential respondents was extracted from the membership database and used in the survey.

Before the bulk of the questionnaires were e-mailed, the survey was piloted with 5% of the mailing list in order to test it and spot any potential problems. After receiving feedback from the respondents and making the necessary minor adjustments, the remaining 95% of questionnaires were distributed.

The ICE employed an independent research agency to handle questionnaire distribution, response gathering, and analysis. The agency also prepared a draft report which was later developed by an external Copywriter. A design agency was employed to ensure that the final report looked good, was easy to read and was in compliance with ICE branding guidelines. The communications team handled the report launch as well as all the related communications with the media.

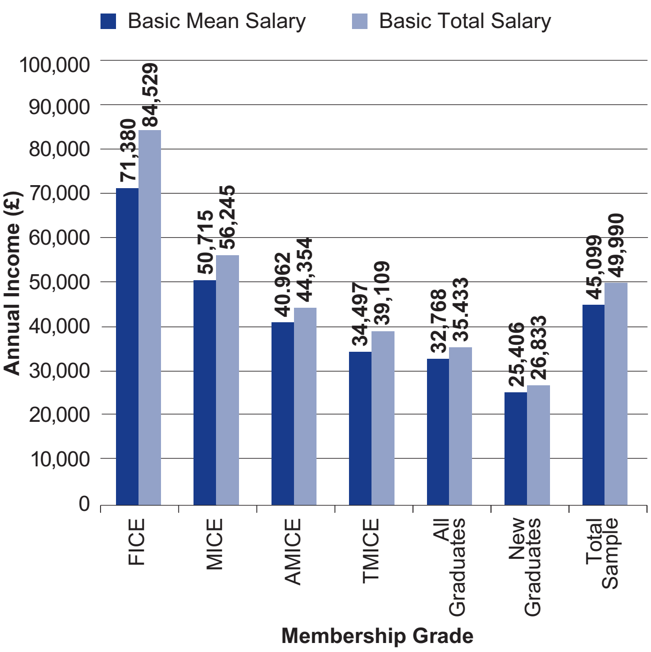
iii. Findings

ICE Members' Remuneration

Analysis showed that 82% of surveyed members were satisfied with their current role and almost three-quarters of ICE members (73%) said that they had no intention of moving positions within the next 12 months. This was a significant improvement in satisfaction levels compared to 2006 (74%) and a moderate increase in the number planning to stay in their current role (70%).

The average salary across the whole membership base showed a year-on-year difference of only +4% compared to +12% between the years 2004 and 2006. This indicates that the increase in ICE members' salaries is on par with the Retail Prices Index (RPI).[111] This finding was particularly confusing in light of the widely stated skills shortage issues, which create an expectation that Civil Engineering salaries would be increasing at a faster rate. Figure D3.4 shows 2006 salary levels by membership type.

Figure D3.4: ICE Member Remuneration



Source: ICE Members Survey (total sample 9,559)

110 Recent graduate – a graduate ICE member aged up to 34 with up to five years of experience in civil engineering. This category was developed with ICE's Graduate and Student Network to assess salary levels among those graduate members who graduated recently.

111 In 2007 the RPI was at the level of 4.3%

The most significant salary increase was observed amongst those aged between 35 and 49 who hold senior positions (Managers, Directors, CEOs, Partners). Those in junior positions, who between 2004 and 2006 experienced the highest salary increases, experienced a slight year-on-year salary decrease. This would support anecdotal information that those most in demand on the market are not fresh graduates but experienced Civil Engineers capable of managing large projects.

Despite the slight decrease in graduate salaries, current demographic trends indicate that a significant number of professionals will be retiring within the next 10-15 years, which could lead to a shortage of highly-qualified employees. This may accelerate the careers of those who are now in their early 30s and create a whirlpool effect for those who have just recently graduated, thus compensating for current lower salaries.

Gender Gap

Salary differences between female and male members of the ICE have always existed, and the 2007 survey illustrated that the overall difference in salary was a staggering 53% (an average female member salary of £33,700, versus one of £51,600 of an average male member). This discrepancy is not entirely surprising, taking into consideration that only just over 8% of all Civil Engineers in the UK are female and only 1% earn £100,000 or above compared to 5% of men.

The ICE undertook additional analysis in order to better understand this divergence. The conclusions confirmed the initial findings: the difference in remuneration between female and male ICE members was greatest for members occupying senior roles, and smallest for members in junior roles.

For junior roles the differences in basic salaries range from -0.5% (where female members earn more than their male colleagues) to approximately +5%, whereas for total salary (basic salary plus additional incomes, bonuses and overtime) it is between -1% (again, female members earning more) and +12%.

For Project Management roles (including Directors), male ICE members are paid between 9% and almost 20% more than female members, and for total salaries it is between 12% and 21%.

The most significant difference is at the most senior level, related to individuals managing the companies' operations. At this level the average basic difference in salary between female and male members is 37%, whereas for the total the difference is almost 50%.

In the next salary survey the ICE will endeavour to better understand the reasons for this discrepancy by asking questions related to possible career breaks caused by family responsibilities or other issues, and how employers have addressed these issues.

iv. Summary

The ICE believes that its Salary Survey not only adds value to membership, but also provides valuable information on salary levels in the industry. Analysis of the findings always raises new questions and issues to be investigated, meaning the project is constantly evolving and improving to gain new and interesting insights into the industry.

D Interactivities
4 Gender Issues in Engineering

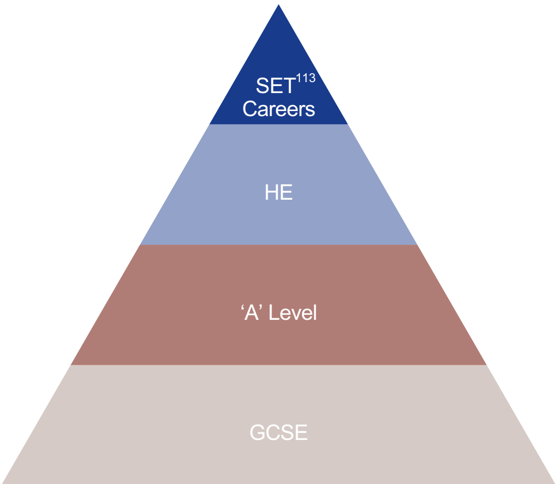
4a. Introduction

There is a growing demand for people with STEM skills in today's economy. It is widely acknowledged that to remain globally competitive the UK needs a workforce skilled in Science and Engineering. Moreover, this need must be set within the context of an overall decline in the proportion of students studying E&T and a generally poor perception[112] of E&T careers. There is also a challenge in that many STEM graduates move into unrelated occupations, where their analytical skills are sought after. This section looks at the potential pool of female employees as a key answer to the skills challenges that the UK faces. Women are one of the country's most under-utilised resources, and this is particularly prevalent in the Physical Sciences and Engineering sectors where only a minority choose a career.

As judged by the numbers achieving GSCE awards in STEM subjects, girls reach 16 on a fairly even footing with boys. However, only a minority of girls continue their education in STEM, with even fewer choosing a career in Science, Engineering and Technology. Nevertheless, girls who do continue with STEM subjects after the age of 16 actually achieve higher pass rates in nearly all STEM subjects compared to the boys. This includes vocational training in traditionally male dominated areas such as Engineering and Manufacturing.

112 Public Attitudes to and Perceptions of Engineering and Engineers 2007, September 2007 http://www.etechb.co.uk/_db/_documents/Public_Attitudes_to_and_Perceptions_of_Engineering_and_Engineers_2007.pdf

4b. Current Situation - Female Participation at Different Levels



Post-16,[114] when STEM subjects cease to be compulsory and despite good attainment, female levels of involvement begin to fall. This decrease in participation continues throughout the academic path, and into the workforce, particularly in Engineering; at the end of 2007 only 3% of all Registered Engineers were female.

4c. School

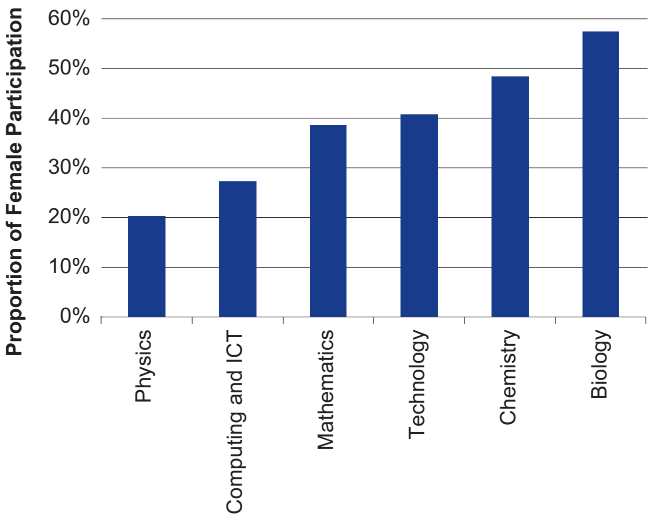
i. GCSE

At GCSE level, 51% of grade A*-C awards in Mathematics and Double-award Science were obtained by girls, showing that when STEM is compulsory, girls and boys are on an equal footing.

ii. A Level

In 2007, female students represented 59% of those taking A level Biology, 50% of those taking Chemistry, 40% of those taking A level Mathematics and 29% of those taking Computing/ICT. The lowest female STEM A level participation was in Physics at only 22%.

Figure D4.1: **Proportion of Female A level Students by Subject**



Source: Joint Council, AQA 2007/QCA

113 Science, Engineering and Technology. Before the drive for STEM, this area was referred to as SET. Where source data talks about SET, this has been reflected in the narrative. SET is still used when describing careers.

114 Post 14 in NI

Figure D4.1 shows a good level of female participation in Biology and Chemistry, but of major concern is the gender gap in Physics, with the proportion of female candidates remaining fairly static at a low 22%. This is significant because, historically, Engineering departments have sought Physics A level as a prerequisite subject. However, in recent years many universities have begun to accept Design & Technology (D&T) A level as (at least) a third offering with Mathematics. Since more female students are sitting D&T A level than Physics, this may be a route to improving the gender balance in Engineering courses at university, as females made up 42% of Technology subject A levels in 2007. However, it should be noted that the total number of students for Maths and Physics have been falling which further compounds the issue of numbers of females pursuing these subjects.

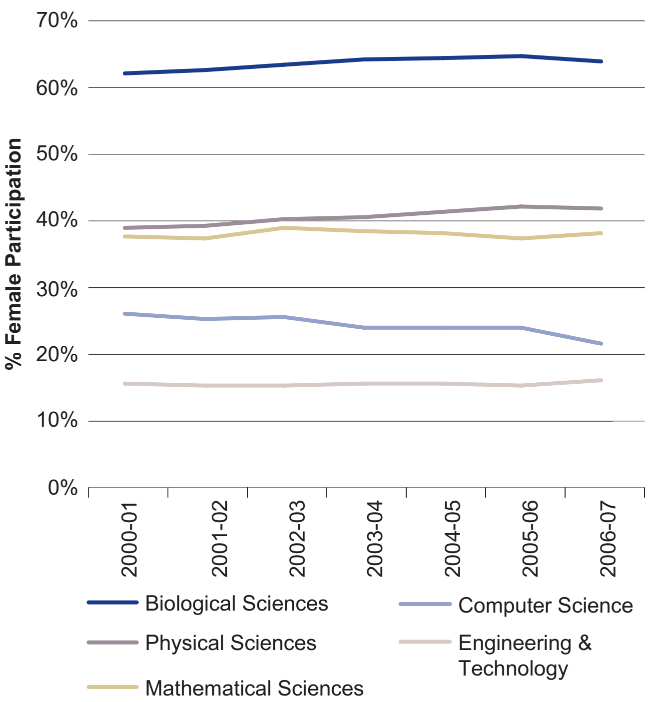
iii. Diplomas

In England, from September 2008, the new 14-19 specialised Diplomas have begun to be introduced. Among the first five of these is the Engineering Diploma. The concept behind the Diploma is to provide pupils with a range of knowledge and skills required by employers. The range of units being offered will provide an opportunity to encourage a high proportion of female pupils to participate in this Engineering Diploma and pursue Engineering through an alternative learning route.

iv. Higher Education

In some disciplines, increasing the number of female students will provide a key means of allowing HE teaching departments to expand the number of students studying STEM courses. Clearly STEM subjects have markedly different levels of female participation, as shown in Figure D4.2. Biological Sciences has 64% involvement whereas Physical Sciences and Mathematical Sciences have mid-levels of participation at 41% and 38% respectively, and within E&T female participation has remained at just above 15%. Hence, improving female participation in E&T is an obvious target for HE departments.

Figure D4.2: **Female Proportion of Undergraduates by Subject Group**

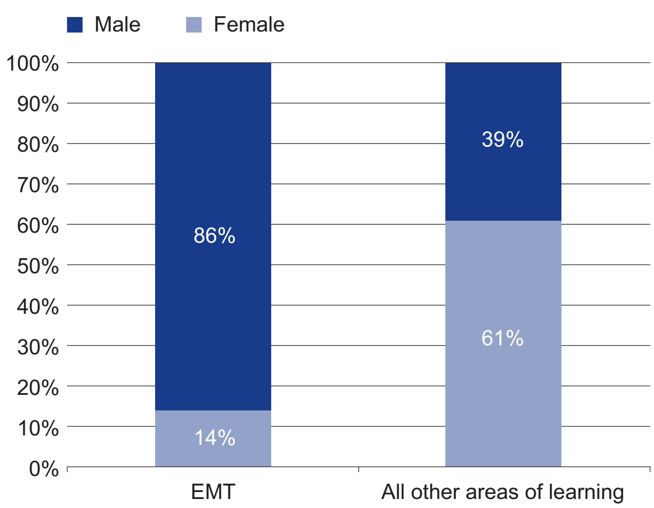


Source: HESA 2008

4d. Post-16 Vocational Education

Another increasingly important pathway to HE and/or employment is via vocational courses. However, even though in 2002, 62% of girls achieved GCSE grades A*-C in D&T subjects, they only represented 11% of students in Engineering, Manufacture and Technology (EMT) in FE, as illustrated in Figure D4.3. In 2004/05 this increased slightly to 14%, although the number still remains woefully low. Overall female participation in all other areas of learning in vocational post-16 education is 61%, and Table D4.1 shows that when females do participate in these areas they outperform the males.

Figure D4.3: Female Participation in FE



Source: ETB/York Consulting's 'Engineering, Manufacturing and Technology Provision within Further Education' 2007

Table D4.1: Completion Rate by Subject Sector Area

	2005/06 Success Rates (%)	
	Female	Male
Construction and the Built Environment	76	68
Engineering and Manufacturing Technologies	85	72
Information and Communication Technologies	69	67
Science and Mathematics	74	73
All Areas of Study	77	75

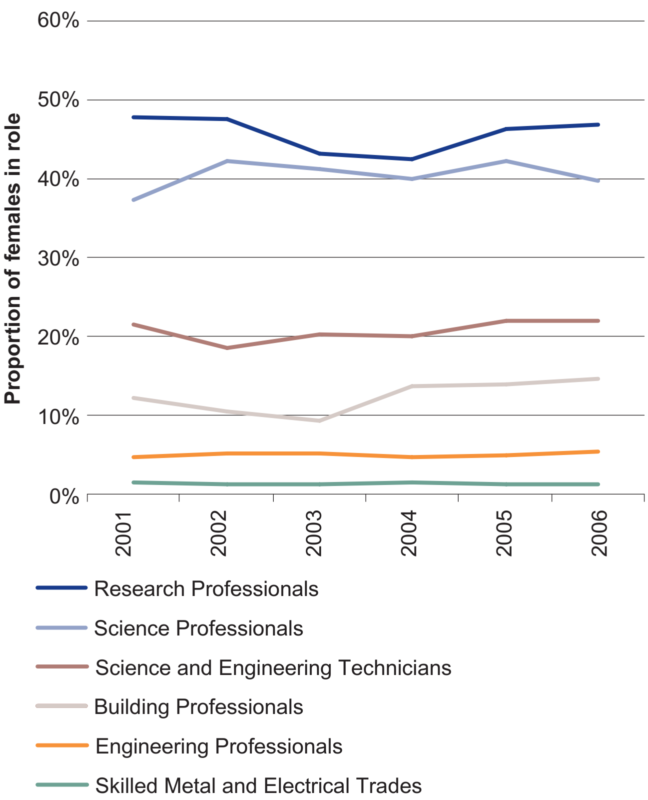
Source: Further Education and Work-based Learning for Young People Learner Outcomes in 2005/06 LSC Statistical first release 2007

These data for vocational education clearly show a huge potential for growth in female participation.

4e. Women in Science Engineering and Technology (SET) Careers

Of the women who do graduate with a SET first degree, only 27% actually pursue a SET career compared with 54% of men.[115] In 2007 only 13% of new Chartered Engineer registrants were women. However, the number of female registrations is gradually rising and given time this figure should be reflected in the total registration figures.

Figure D4.4: **Female Participation in SET Careers**



Source: Labour Force Survey (annualised – four quarters)

For those women who do pursue SET careers, the levels of female participation in different SET careers varies vastly, as shown in Figure D4.4. Science and Research roles enjoy the highest proportion of women workers (40%-47%) with only a minority of around 5% working as Engineering professionals. The lowest participation is within the Skilled Construction & Building Trades and Skilled Metal & Electrical Trades, where women account for only 1%. Figure D4.4 also shows that there has not been much improvement in female representation since 2001, suggesting that a different approach to recruitment and retention is required.

There is evidence to suggest that Engineering employers with a predominantly male workforce exhibit corporate cultural norms and values, which are often alien to female employees.[116] This factor alone dissuades many women from entering or remaining in Engineering occupations.

115 Secondary analysis by UK Women's Resource Centre of the HESA (2007) Destination of Leavers of Higher Education 2005/06 data

116 ASL Sector Skills Agreement employer research, Inverness, 2005/6

4f. Conclusion

If the UK is to compete in the knowledge and innovation-based economy it must have a good supply of well-trained, skilled people. This has to be addressed all the way through all of the key phases of education and training by means of concerted action from the government, training providers and employers in order to ensure the UK's future skills demands are met.

Our analysis clearly shows that in addressing the challenges of diversity and numbers of females pursing E&T, there remains much to be done; not only through government policy intervention but via the education and training sector and the ultimate end user, the employer.

It has been shown that female involvement in STEM varies widely between subjects, with the lowest participation being in Engineering. Indeed, after GCSEs few girls take this career path. There is a large gender imbalance in the take up of A level Physics, which is generally the prerequisite for HE Engineering. Within the FE vocational arena the figures are even more pronounced, with only a small fraction studying towards STEM vocational qualifications especially in E&T.

More targeted and bespoke promotion needs to be done to ensure girls, particularly in the 11-14-year-old age range, are well informed about what a SET career could offer and are encouraged to continue their education in the STEM disciplines, through both the graduate route and vocational progression pathways such as apprenticeships. The new Engineering Diploma is attractive in that it provides an alternative learning route.

Employers need to ensure that the jobs they offer women provide viable options for those who also choose to have children, which means that both industry and academia both have to acknowledge that the full-time working week is but one of a variety of options for employment in the future. We need to accept that while E&T roles are traditionally male centric future demand trends show that this state of affairs is clearly untenable for the UK's competitiveness; there are still difficult issues around masculine work place culture, discrimination and work-life balance to be addressed in order to make careers in E&T appealing to women.

We acknowledge the innovative work of agencies such as the UK Resource Centre for Women in Science, Engineering and Technology and WISE (Women into Science, Engineering and Construction) in targeting gender related issues. Nevertheless, this analysis highlights how the throughput and representation of women in E&T careers remains low, suggesting that government support of this area needs to be significantly increased in tandem with a requirement for employers to take a lead in addressing the under-representation of women and working together more closely to address their gender imbalance issues.

E Appendices
1 Bibliography

- *Age Participation Index for Scotland 2006-07*, Scottish Government: 5th August 2008.
- Banerjee, R. (2005). *Gender Identity and the Development of Gender Roles*. In S. Ding & K. Littleon (Eds.), Children's Personal and Social Development. Oxford, UK: Blackwell
- *City Research Focus*, Issue 1 2008, City of London Corporation: January 2008.
- Coe, R., Searle, J., Barmby, P., Jones, K., and Higgins, S. (2008). *Relative Difficulty of Examinations in Different Subjects*. CEM Centre – Durham University
- *Cogent Scottish Sector Profile 2007*. Futureskills Scotland: November 2007
- *Construction Scottish Sector Profile 2007*. Futureskills Scotland: November 2007
- *Destinations of leavers from Higher Education 2006/7*. Higher Education Statistics Agency Limited.
- *Destinations of leavers from Higher Education In the United Kingdom For The Academic Year 2006/07*. Higher Education Statistics Agency Limited – HESA SFR 124: July 2008.
- *e-skills Scottish Sector Profile 2007*. Futureskills Scotland: November 2007
- *Further Education, Work-Based Learning, Train to Gain and Adult Safeguarded Learning – Learner Numbers in England:* October 2007.
- *The Future Size and Shape of the Higher Education Sector in the UK: Threats and Opportunities*. Universities UK: July 2008
- Hammond, M. J. (2008) *Report on Additional Research into Specific Themes Arising from the Sector Skills Agreement for Building Services Engineering* Milton Keynes: SummitSkills.
- *Higher Education Statistics for the UK 2005/6*. Higher Education Statistics Agency Limited.
- Kotter, J., and Cohen, D; (2002) *Heart of Change, The: Real-life Stories of How People Change Their Organizations*. Harvard Business School Press.
- Kounine, L., Marks, J., and Truss, E. *The Value of Mathematics*. Reform research Trust. June 2008
- *National Comparators for Further Education and Work-Based Learning: 2006/07*. Statistics for Wales – First Release SDR 106/2008: 17th July 2008.
- *National Employers Skills Survey 2007*. Learning and Skills Council – National Office: May 2008
- *Proskills Scottish Sector Profile 2007*. Futureskills Scotland: November 2007
- *Public Attitudes to the Electricity Industry and the Careers it Offers*. BMRB/ Energy & Utility Skills: May 2008
- *Semta Scottish Sector Profile 2007*. Futureskills Scotland: November 2007
- *Still More (Better Paid) Jobs for the Boys – Apprenticeships and Gender Segregation*. Trades Union Congress (TUC): July 2008
- *Students in Higher Education Institutions 2006/7*. Higher Education Statistics Agency Limited.
- *Success in Science*. Ofsted: June 2008
- *SummitSkills Scottish Sector Profile 2007*. Futureskills Scotland: November 2007
- Sjøberg, S., and Schreiner, C. (2005) *How do Learners in Different Cultures Relate to Science and Technology? Asia-Pacific Forum on Science Learning and Teaching,* Volume 6, Issue 2, December 2005. University of Oslo.
- Wilson, R.A. (2008) "*The Demand for STEM Graduates: Some Benchmark Projections*". Institute for Employment Research, University of Warwick: Coventry.

E Appendices
2 Glossary of Terms

2a. Acronyms

Table E2.1: List of Acronyms

ABI	Annual Business Inquiry	http://www.statistics.gov.uk/abi/
ALP	Association of Learning Providers	http://www.learningproviders.org.uk/
API	Age Participation Index	
ASHE	Annual Survey of Hours and Earning	
ASSCs	Alliance of Sector Skills Councils	http://www.sscalliance.org/
BERR	Department for Business, Enterprise and Regulatory Reform (England)	http://www.berr.gov.uk/
CEM	Curriculum, Evaluation and Management	http://www.cemcentre.org/
CIE	Cambridge International Examinations	http://www.cie.org.uk/
DCELLS	Department for Children, Education, Lifelong Learning and Skills (Wales)	http://new.wales.gov.uk/
DCSF	Department for Children, Schools and Families (England)	http://www.dcsf.gov.uk/
DEFRA	Department for Environment, Food and Rural Affairs	http://www.defra.gov.uk/
DELNI	Department for Employment and Learning Northern Ireland	http://www.delni.gov.uk/
DENI	Department of Education Northern Ireland	
DIUS	Department for Innovation, Universities and Skills (England)	http://www.dius.gov.uk/
DWP	Department for Work and Pensions	http://www.dwp.gov.uk/
E&T	Engineering and Technology	
ECITB	Engineering Construction Industry Training Board	http://www.ecitb.org.uk/
ECUK	Engineering Council UK	http://www.engc.org.uk/
EEA	European Economic Area	
EEBM	Engineers and Engineering Brand Monitor	
EQF	European Qualifications Framework for Lifelong Learning	
FE	Further Education	
FMA	Foundation Modern Apprenticeship	
FSB	Federation of Small Businesses	http://www.fsb.org.uk/
FSS	Futureskills Scotland	http://www.futureskillsscotland.org.uk/
FSW	Futureskills Wales	http://www.learningobservatory.com/
GAD	Government Actuary's Department	http://www.gad.gov.uk/
GB	Great Britain (England, Wales and Scotland)	

GCSE	General Certificate of Secondary Education	
HE	Higher Education	
HEFCE	High Education Funding Council for England	http://www.hefce.ac.uk/
HEFCW	High Education Funding Council for Wales	http://www.hefcw.ac.uk/
HEI	Higher Education Institution	
HESA	Higher Education Statistics Authority	http://www.hesa.ac.uk/
HIE	Highland and Islands Enterprise	http://www.hie.co.uk/
HK	Hong Kong	
HTF(V)	Hard-to-fill Vacancy	
ICE	Institution of Civil Engineers	http://www.ice.org.uk/
IDBR	Inter-departmental Business Register	http://www.statistics.gov.uk/idbr/idbr.asp
IGCSE	International General Certificate of Secondary Education	http://www.cie.org.uk/
JCQ	Joint Council for Qualifications	http://www.jcq.org.uk/
LFS	Labour Force Survey	
LLWR	Lifelong-learning Wales Record	
LSC	Learning and Skills Council (England)	http://www.lsc.gov.uk/
MA	Modern Apprenticeship	
MAC	Migration Advisory Committee	http://ukba.homeoffice.gov.uk/
NEET	Not in Education, Employment or Training	
NES	National Employers Service	http://nes.lsc.gov.uk/
OECD	Organisation for Economic Co-operation and Development	http://www.oecd.org/
OED	Oxford English Dictionary	http://www.oed.com/
Ofgem	Office for Gas, Electricity	http://www.ofgem.gov.uk/
Ofsted	Office for Standards in Education, Children's Services and Skills	http://www.ofsted.gov.uk/
ONS	Office for National Statistics – (UK Statistics Authority)	http://www.statistics.gov.uk/
PBS	Points-based System	
PSSSG	Power Sector Skills Strategy Group	
QCA	Qualifications and Curriculum Authority	http://www.qca.org.uk/
RAEng	Royal Academy of Engineering	http://www.raeng.org.uk/
ROSE	Relevance of Science Education	
RPI	Retail Prices Index	
SCQF	Scottish Credit and Qualification Framework	http://www.scqf.org.uk/
SDS	Skills Development Scotland	http://www.skillsdevelopmentscotland.co.uk/
Semta	Science, Engineering, Manufacturing Technologies Alliance	http://www.semta.org.uk/
SEn	Scottish Enterprise	http://www.scottish-enterprise.com/
SET	Science, Engineering and Technology	

SFC	Scottish Funding Council (Further and Higher Education)	http://www.sfc.ac.uk/
SIC	Standard Industrial Classification	
SKOPE	Centre on Skills, Knowledge and Organisational Performance	http://www.skope.ox.ac.uk/
SOC	Standard Occupational Classification	
SOL	Shortage Occupation List	
SSC	Sector Skills Council	http://www.sscalliance.org/
SSV	Skills Shortage Vacancy	
SQA	Scottish Qualifications Authority	http://www.sqa.org.uk/
SQS	Sector Qualification Strategy	
SSDA	Sector Skills Development Agency	http://www.ukces.org.uk/
STEM	Science, Technology, Engineering and Mathematics	
UCAS	Universities and Colleges Admissions Service	http://www.ucas.ac.uk/
UK	United Kingdom of Great Britain and Northern Ireland	
UKCES	United Kingdom Commission for Employment and Skills	http://www.ukces.org.uk/
UoC	University of Cambridge	http://www.cam.ac.uk/
UUK	Universities UK	http://www.universitiesuk.ac.uk/
WAG	Welsh Assembly Government	http://new.wales.gov.uk/
WBL	Work-based Learning	

2b. Terms

Table E2.2: **List of Key Terms**

Generic Skills	Usually describes a range of skills applicable to many different types of occupations typically including; written/verbal communication skills, team working skills, problem-solving skills, customer service skills, and such like.
Hard-to-fill Vacancies	Vacancies that are self-classified by respondents as being hard-to-fill.
Non-departmental Public Body (NDPB)	Not an integral part of a government department and carry out their work at arm's length from Ministers, although Ministers are ultimately responsible to Parliament for the activities of bodies sponsored by their department. The term includes the four types of NDPB (executive, advisory, tribunal and Independent Monitoring Boards) but excludes public corporations, National Health Service (NHS) bodies and public broadcasting authorities (BBC and S4C).
Skills Gaps	The extent to which employers perceive their existing employees to be less than fully proficient for their current job.
Skills Shortage Vacancy (SSV)	Vacancies that are hard-to-fill where applicants do not have the required qualifications, skills, competences, or experience for the job. These are a sub-set of hard-to-fill vacancies.

E Appendices
3 SIC and SOC Code Definitions Used

3a. Standard Occupational Classification (SOC) Codes

i. SOC Codes Used with Working Futures

The analysis carried out based around Working Futures 3 has used the following SOC 2000 Codes at two- and three-digit levels:

e. 212 – Engineering Professionals

f. 213 – ICT Professionals

g. 31 – Science and Technology Associate Professionals

h. 52 – Skilled Metal and Electrical Trades

i. 531 – Construction Trades

j. 81 – Process, Plant and Machine Operatives

ii. Four-digit SOC 2000 Codes – Engineers and Technicians

The following list of SOC codes has been used to define engineers and technicians more specifically.

1121	Production, Works and Maintenance Managers
1122	Managers in Construction
1123	Managers in Mining and Energy
1136	Information and Communication Technology Managers
1137	Research and Development Managers
1141	Quality Assurance Managers
2121	Civil Engineers
2122	Mechanical Engineers
2123	Electrical Engineers
2124	Electronics Engineers
2125	Chemical Engineers
2126	Design and Development Engineers
2127	Production and Process Engineers
2128	Planning and Quality Control Engineers
2129	Engineering Professionals n.e.c.
2131	IT Strategy and Planning Professionals
2132	Software Professionals
2433	Quantity Surveyors
2434	Chartered Surveyors (not Quantity Surveyors)
3112	Electrical/Electronics Technicians
3113	Engineering Technicians
3114	Building and Civil Engineering Technicians
3115	Quality Assurance Technicians
3121	Architectural Technologists and Town Planning Technicians
3122	Draughtspersons
3123	Building Inspectors
3131	IT Operations Technicians

3132	IT User Support Technicians
3218	Medical and Dental Technicians
3422	Product, Clothing and Related Designers
5211	Smiths and Forge Workers
5212	Moulders, Core Makers, Die Casters
5213	Sheet Metal Workers
5214	Metal Plate Workers, Shipwrights, Riveters
5215	Welding Trades
5216	Pipe Fitters
5221	Metal Machining Setters and Setter-operators
5222	Tool Makers, Tool Fitters and Markers-out
5223	Metal Working Production and Maintenance Fitters
5224	Precision Instrument Makers and Repairers
5231	Motor Mechanics, Auto Engineers
5232	Vehicle Body Builders and Repairers
5233	Auto Electricians
5234	Vehicle Spray Painters
5241	Electricians, Electrical Fitters
5242	Telecommunications Engineers
5243	Lines Repairers and Cable Jointers
5244	TV, Video and Audio Engineers
5245	Computer Engineers, Installation and Maintenance
5249	Electrical/Electronics Engineers n.e.c.
5311	Steel Erectors
5312	Bricklayers, Masons
5313	Roofers, Roof Tilers and Slaters
5314	Plumbers, Heating and Ventilating Engineers
5315	Carpenters and Joiners
5316	Glaziers, Window Fabricators and Fitters
5319	Construction Trades n.e.c.
5493	Pattern Makers (moulds)
8111	Food, Drink and Tobacco Process Operatives
8112	Glass and Ceramics Process Operatives
8113	Textile Process Operatives
8114	Chemical and Related Process Operatives
8115	Rubber Process Operatives
8116	Plastics Process Operatives
8117	Metal Making and Treating Process Operatives
8118	Electroplaters
8119	Process Operatives n.e.c.
8121	Paper and Wood Machine Operatives
8122	Coal Mine Operatives
8123	Quarry Workers and Related Operatives
8124	Energy Plant Operatives
8125	Metal Working Machine Operatives
8126	Water and Sewerage Plant Operatives
8129	Plant and Machine Operatives n.e.c.
8131	Assemblers (Electrical Products)
8132	Assemblers (Vehicles and Metal Goods)
8133	Routine Inspectors and Testers
8134	Weighers, Graders, Sorters
8135	Tyre, Exhaust and Windscreen Fitters
8138	Routine Laboratory Testers
8139	Assemblers and Routine Operatives n.e.c.
8141	Scaffolders, Stagers, Riggers
8142	Road Construction Operatives
8143	Rail Construction and Maintenance Operatives
8149	Construction Operatives n.e.c.

3b. Standard Industrial Classification (SIC) Codes

SIC 2007[117]

05 (all)	Mining of Coal and Lignite
06 (all)	Extraction of Crude Petroleum and Natural Gas
07 (all)	Mining of Metal Ores
08.1	Quarrying of Stone, Sand and Clay
08.91	Mining of Chemical and Fertiliser Minerals
08.93	Extraction of Salt
08.99	Other Mining and Quarrying n.e.c.
09 (all)	Mining Support Service Activities
13.96	Manufacture of Other Technical and Industrial Textiles
16.23	Manufacture of Other Builders' Carpentry and Joinery
19 (all)	Manufacture of Coke and Refined Petroleum Products
20 (all)	Manufacture of Chemicals and Chemical Products
21 (all)	Manufacture of Basic Pharmaceutical Products and Pharmaceutical Preparations
22 (all)	Manufacture of Rubber and Plastic Products
23 (all)	Manufacture of Other Non-Metallic Mineral Products
24 (all)	Manufacture of Basic Metals
25 (all)	Manufacture of Fabricated Metal Products, Except Machinery and Equipment
26 (all)	Manufacture of Computer, Electronic and Optical Products
27 (all)	Manufacture of Electrical Equipment
28 (all)	Manufacture of Machinery and Equipment n.e.c.
29 (all)	Manufacture of Motor Vehicles, Trailers and Semi-Trailers
30 (all)	Manufacture of Other Transport Equipment
32.11	Striking of Coins
32.30	Manufacture of Sports Goods
32.40	Manufacture of Games and Toys
32.50	Manufacture of Medical and Dental Instruments and Supplies
33 (all)	Repair and Installation of Machinery and Equipment
35.11	Production of Electricity
35.12	Transmission of Electricity
35.13	Distribution of Electricity
35.21	Manufacture of Gas
35.22	Distribution of Gaseous Fuels Through Mains
35.30	Steam and Air Conditioning Supply
36 (all)	Water Collection, Treatment and Supply
37 (all)	Sewerage
38.2	Waste Treatment and Disposal
38.3	Materials Recovery
39 (all)	Remediation Activities and Other Waste Management Services
41.2	Construction of Residential and Non-Residential Buildings
42 (all)	Civil Engineering
43.1	Demolition and Site Preparation
43.2	Electrical, Plumbing and Other Construction Installation Activities
43.39	Other Building Completion and Finishing
43.99/9	Specialised Construction Activities (other than Scaffold Erection) n.e.c.
45.20	Maintenance and Repair of Motor Vehicles
49.50	Transport via Pipeline
51.22	Space Transport
58.21	Publishing of Computer Games
58.29	Other Software Publishing
61.90	Other Telecommunications Activities
62 (all)	Computer Programming, Consultancy and Related Activities
63.1	Data Processing, Hosting and Related Activities; Web Portals
71.12	Engineering Activities and Related Technical Consultancy
71.20	Technical Testing and Analysis
72.19	Other Research and Experimental Development on Natural Science and Engineering
74.90/1	Environmental Consulting Activities
74.90/2	Quantity Surveying Activities
80.20	Security Systems Service Activities
95.1	Repair of Computers and Communication Equipment
95.21	Repair of Consumer Electronics
95.22	Repair of Household Appliances and Home and Garden Equipment

115 These codes have been mapped back to SIC 2003

3c. Sector Skills Council (SSC) Footprints

Table E3.1 lists the seven key Sector Skills Councils (SSCs) that cover the E&T industry in the UK.

Table E3.1: **Definition of Sector Skills Council Footprint**

SSC	Description	SIC 2003 Code Footprint
Cogent SSC	Chemicals and pharmaceuticals, nuclear, oil and gas, petroleum, polymers and sign making.	11. 23-25 (excluding 24.3, 24.64, 24.7, 25.11, 25.12), 50.5
Construction Skills	Construction	45.1, 52.2, 45.32, 45.34, 45.4, 45.5, 74.2
e-skills	IT, telecoms and contact centres (covering all industries as well as licensed SIC codes)	22.33, 64.2, 72, 74.86
Energy & Utility Skills	Electricity, gas, waste management and water industries	37, 40.1, 40.2, 41, 60.3, 90.01, 90.02
Proskills	Process and manufacturing of extractives, coatings, refractories, building products, paper and print.	10, 12-14, 21.24, 22.2, 24.3, 26.1, 26.26, 26.4 to 26.8
Semta	Science, engineering and manufacturing technologies	25.11, 25.12, 27 to 35, 51.52, 51.57, 73.10
SummitSkills	Building services engineering (electro-technical, heating, ventilation, air-conditioning, refrigeration and plumbing).	31.1, 31.62, 33.3, 45.31, 45.33, 52.72

Source: UKCES

ITB	Description	SIC 2003 Code Footprint
ECITB	Engineering Construction Industry Training Board	11.2, 28.11, 28.21, 28.3, 28.52, 29.11, 29.12, 29.21, 29.22, 29.23, 31.1, 33.3, 40.1, 45.11, 45.21, 45.22, 45.25, 45.32, 71.32, 74.2, 74.3, 74.5, 74.7, 90.

Source: ECITB

3d. Scottish Credit and Qualifications Framework (SCQF)

Table E3.2: The Scottish Credit and Qualifications Framework (SCQF)

SCQF Levels	SQA Qualification			Qualifications of Higher Education Institutions	Scottish Vocational Qualifications
12				Doctorates	
11				Masters Post Graduate Diploma Post Graduate Certificate	SVQ5
10				Honours Degrees Graduate Diploma	
9			Professional Development Awards	Ordinary Degree Graduate Certificate	SVQ4
8		Higher National Diploma		Diploma of Higher Education	
7	Advanced Higher	Higher National Certificate		Certificate of Higher Education	SVQ3
6	Higher				
5	Intermediate 2 Credit Standard Grade				SVQ2
4	Intermediate 1 General Standard Grade	National Certificates	National Progression Awards		SVQ1
3	Access 3 Foundation Standard Grade				
2	Access 2				
1	Access 1				

The new Skills for Work courses are National Courses available as Access, Intermediate and Higher Qualifications (SCQF levels 3-6).
Ongoing work to credit rate SVQs shows that SVQ units range from SCQF level 4 to level 12. SVQs at 3 and 4 can be placed at different SCQF levels.

3e. HE Applications Engineering Subjects 2003-2007

Table E3.3: HE Applications General Engineering 2003-2007

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	755	754	853	855	824	+9.14%
EU (excluding UK)	103	84	118	183	176	+70.87%
Non-EU	146	147	185	229	215	+47.26%
Total Non-UK	249	231	303	412	391	+57.03%
Total	**1,004**	**985**	**1,156**	**1,267**	**1,215**	**+21.02%**
Percentage of Non-EU	14.5%	14.9%	16.0%	18.1%	17.7%	+3.15%

Source: UCAS

Table E3.4: HE Applications Civil Engineering 2003-2007

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	1,894	2,205	2,557	2,453	2,924	+54.38%
EU (excluding UK)	378	607	626	698	831	+119.84%
Non-EU	619	739	714	616	760	+22.78%
Total Non-UK	997	1,346	1,340	1,314	1,591	+59.58%
Total	**2,891**	**3,551**	**3,897**	**3,767**	**4,515**	**+56.17%**
Percentage of Non-EU	21.4%	20.8%	18.3%	16.4%	16.8%	-4.58%*

Source: UCAS

Table E3.5: HE Applications Mechanical Engineering 2003-2007

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	3,700	3,797	3,839	3,560	3,888	+5.08%
EU (excluding UK)	283	386	449	412	483	+70.67%
Non-EU	939	1,174	1,265	1,149	1,307	+39.19%
Total Non-UK	1,222	1,560	1,714	1,561	1,790	+46.48%
Total	**4,922**	**5,357**	**5,553**	**5,121**	**5,678**	**+15.36%**
Percentage of Non-EU	19.1%	21.9%	22.8%	22.4%	23.0%	+3.94%*

Source: UCAS

Table E3.6: **HE Applications Aerospace Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	1,459	1,628	1,673	1,647	1,714	+17.48%
EU (excluding UK)	102	112	113	151	146	+43.14%
Non-EU	306	379	472	447	465	+51.96%
Total Non-UK	408	491	585	598	611	+49.75%
Total	**1,867**	**2,119**	**2,258**	**2,245**	**2,325**	**+24.53%**
Percentage of Non-EU	16.39%	17.89%	20.90%	19.91%	20.00%	+3.61%*

Source: UCAS

Table E3.7: **HE Applications Electronic and Electrical Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	3,729	3,146	2,934	2,462	2,381	-36.15%
EU (excluding UK)	367	376	335	336	397	+8.17%
Non-EU	2,280	2,330	2,190	1,696	1,621	-28.90%
Total Non-UK	2,647	2,706	2,525	2,032	2,018	-23.76%
Total	**6376**	**5852**	**5459**	**4494**	**4,399**	**-31.01%**
Percentage of Non-EU	35.8%	39.8%	40.1%	37.7%	36.8%	+1.09%*

Source: UCAS

Table E3.8: **HE Applications Production and Manufacturing Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	904	801	721	467	424	-53.10%
EU (excluding UK)	29	31	29	13	31	+6.90%
Non-EU	102	91	96	68	65	-36.27%
Total Non-UK	131	122	125	81	96	-26.72%
Total	**1,035**	**923**	**846**	**548**	**520**	**-49.76%**
Percentage of Non-EU	9.9%	9.9%	11.3%	12.4%	12.5%	+2.64%*

Source: UCAS

Table E3.9: **HE Applications Chemical, Process and Energy Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	559	561	683	713	877	+56.89%
EU (excluding UK)	31	48	51	62	84	+170.97%
Non-EU	338	420	494	493	553	+63.13%
Total Non-UK	369	468	545	555	637	+72.63%
Total	**928**	**1,029**	**1,228**	**1,268**	**1,514**	**+63.15%**
Percentage of Non-EU	36.4%	40.8%	40.2%	38.9%	36.5%	+0.10%*

Source: UCAS

* Percentage points increase

3f. HE Acceptances Engineering Subjects 2003-2007

Table E3.10: **HE Acceptances General Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	2,056	2,016	2,245	2,176	2,269	+10.4%
EU (excluding UK)	130	169	186	249	272	+109.2%
Non-EU	375	432	456	438	438	+16.8%
Total Non-UK	505	601	642	687	710	+40.6%
Total	**2,561**	**2,617**	**2,887**	**2,863**	**2,979**	**+16.3%**
Percentage of Non-EU	14.6%	16.5%	15.8%	15.3%	14.7%	+0.10%*

Source: UCAS

Table E3.11: **HE Acceptances Civil Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	1,871	2,267	2,469	2,458	2,607	+39.3%
EU (excluding UK)	294	426	423	494	583	+98.3%
Non-EU	507	619	563	502	564	+11.2%
Total Non-UK	801	1,045	986	996	1,147	+43.2%
Total	**2,672**	**3,312**	**3,455**	**3,454**	**3,754**	**+40.5%**
Percentage of Non-EU	19.0%	18.7%	16.3%	14.5%	15.0%	-4.0%*

Source: UCAS

Table E3.12: **HE Acceptances Mechanical Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	3,157	3,387	3,515	3,311	3,193	+1.1%
EU (excluding UK)	283	314	334	365	383	+35.3%
Non-EU	716	846	885	874	1,016	+41.9%
Total Non-UK	999	1,160	1,219	1,239	1,399	+40.0%
Total	**4,156**	**4,547**	**4,734**	**4,550**	**4,592**	**+10.5%**
Percentage of Non-EU	17.2%	18.6%	18.7%	19.2%	22.1%	+4.9%*

Source: UCAS

Table E3.13: **HE Acceptances Aerospace Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	1,397	1,412	1,522	1,483	1,289	-7.7%
EU (excluding UK)	71	87	80	120	99	+39.4%
Non-EU	232	256	300	302	273	+17.7%
Total Non-UK	303	343	380	422	372	+22.8%
Total	**1,700**	**1,755**	**1,902**	**1,905**	**1,661**	**-2.3%**
Percentage of Non-EU	13.6%	14.6%	15.8%	15.9%	16.4%	+2.8%*

Source: UCAS

Table E3.14: **HE Acceptances Electronic and Electrical Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	4,272	3,469	3,336	2,824	2,699	-36.8%
EU (excluding UK)	333	329	325	311	389	+16.8%
Non-EU	1,770	1,969	1,620	1,495	1,549	-12.5%
Total Non-UK	2,103	2,298	1,945	1,806	1,938	-7.8%
Total	**6,375**	**5,767**	**5,281**	**4,630**	**4,637**	**-27.3%**
Percentage of Non-EU	22.8%	34.1%	30.7%	32.3%	33.4%	+5.6%*

Source: UCAS

Table E3.15: **HE Acceptances Production and Manufacturing Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	1,177	980	899	677	618	-47.5%
EU (excluding UK)	48	44	37	36	49	2.1%
Non-EU	122	114	106	109	103	-15.6%
Total Non-UK	170	158	143	145	152	-10.6%
Total	**1,347**	**1,138**	**1,042**	**822**	**770**	**-42.8%**
Percentage of Non-EU	9.1%	10.0%	10.2%	13.3%	13.4%	+4.3%*

Source: UCAS

Table E3.16: **HE Acceptances Chemical, Process and Energy Engineering 2003-2007**

Domicile	2003	2004	2005	2006	2007	Percentage Change Over Five Year Period
UK	676	689	768	855	953	+41.0%
EU (excluding UK)	42	47	46	58	80	+90.5%
Non-EU	282	362	389	393	422	+49.6%
Total Non-UK	324	409	435	451	502	+54.9%
Total	**1,000**	**1,098**	**1,203**	**1,306**	**1,455**	**+45.5%**
Percentage of Non-EU	28.2%	33.0%	32.3%	30.1%	29.0%	+0.8%*

Source: UCAS

* Percentage points increase

etb
Progress through partnerships

The Engineering and Technology Board (ETB).
The ETB is an independent organisation that promotes the vital role of engineers, engineering and technology in our society. The ETB partners business and industry, Government and the wider engineering and technology community: producing evidence on the state of engineering; sharing knowledge within engineering, and inspiring young people to choose a career in engineering, matching employers' demand for skills.

The ETB
2nd Floor, Weston House, 246 High Holborn, London WC1V 7EX.
Telephone: 020 3206 0400
www.etechb.co.uk