For further information please contact
Christopher Hall.

Skills Commission
Policy Connect
CAN Mezzanine
32-36 Loman Street
London SE1 0EH

020 7202 8577
christopher.hall@policyconnect.org.uk

www.policyconnect.org.uk

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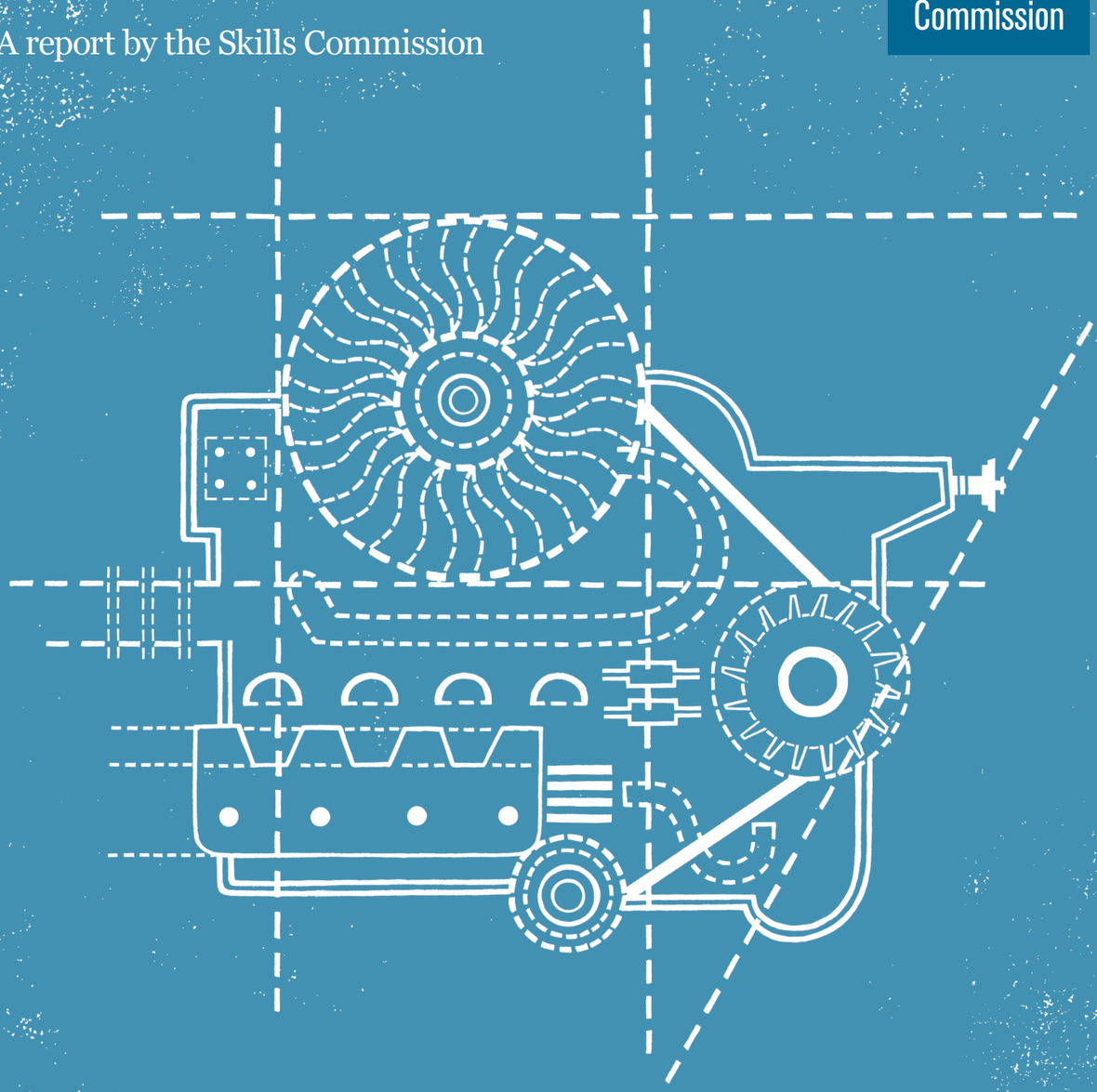

TECHNICIANS AND PROGRESSION

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SCOPE AND DEFINITIONS

Who are we referring to as technicians?

This inquiry has adopted the Technician Council's definition of technician:

> 'Technicians are concerned with applying proven techniques and procedures to the solution of practical problems. They carry supervisory or technical responsibility and are competent to exercise creativity and skills within defined fields of science and technology.'

The inquiry has therefore focused on vocational and technical education and training at levels 3 – 5.

What is STEM?

This inquiry has adopted a broad definition of STEM, including science, technology, engineering, mathematics, and related industries and sectors. This includes occupations in information technology and the health and medical industries.

The Commission is aware that technicians operate in a wide range of sectors, such as accountancy and the digital industries. This inquiry's focus, however, has been on technicians trained in STEM disciplines. We fully recognise the vital importance of other disciplines and sectors, such as the creative industries, to long-term economic growth and some of our recommendations may be applicable to these sectors. We plan to examine this in future work.

FOREWORD

Education policy has a new conceptual base. Central targets and rigid accountability are out, permissive frameworks and system stewardship are in. The regulatory straitjacket is off, and it's time for the sector to choose its own future.

It is clear from the title of this report what the Commission believes part of that future should be. Often neglected by policymakers and left on the educational sidelines, technicians are the unsung heroes of some of the UK's leading industries. For too long they have been undervalued, undernourished, and relegated to an occupational division considered less important than their professional counterparts. If we want to rebalance our economy to become more production and export-led, more innovative and sustainable, we need to hardwire technicians into our education system – a plan for growth needs a plan for technicians.

The second aspect of this report is progression. We define progression in its broadest sense – up-skilling, re-skilling, training for a new job, changing career path entirely. Our notion of progression is firmly rooted in the reality of today's flexible and global labour markets and the new demands this places on learners and those already in work. Throughout this inquiry we have also been acutely aware of the profound effects of our changing demography, and a need to find more cost-effective ways for individuals to access education and training throughout their lives – learning as progressive episodes, not as a one-off activity.

That is why we have taken a systems approach to this inquiry, examining HE, FE and skills provision as part of a wider lifelong learning system. Our recommendations speak to this vision.

The inquiry does not stop here. The Commission and its partners will be undertaking further work on some of the headline issues from the report, such as a new programme of work on training for SMEs – Think Small. We will also be launching a series of regional meetings, examining how our recommendations can be applied to regional and local contexts.

We would like to thank KPMG, the University of Winchester, the University Vocational Awards Council and the Associate Parliamentary Manufacturing Group for holding regional meetings as part of the inquiry, as well as the 130 individuals and organisations that contributed to the inquiry. In particular, we would like to thank Andy Frost for providing the data analysis that has helped shape the report's conclusions and Hilary Chadwick for allowing us to consult with members of the National Employers Service.

We would also like to thank our sponsors, the Gatsby Foundation, Pearson and the Tec Trust Fund, and Daniel Sandford-Smith, Jacqui Henderson and Photoula Kypri, for their support and expertise. We would especially like to thank Alison Halstead, who has so expertly chaired the inquiry and who has shown so much commitment to this issue.

Over the last five years we believe the Skills Commission has made a significant and positive contribution to skills policy. We say two cheers for skills: one because of the added investment from government and two because of the evolution and enterprise we have witnessed across the sector. But not three, as there is still work to do. We hope this report makes a constructive contribution to that work.

Barry Sheerman MP
Co-Chair, Skills Commission

Dame Ruth Silver
Co-Chair, Skills Commission

CHAIR'S PREFACE

Over the last few years I have been responsible for learning and teaching innovation at Aston University. More recently I have been in the privileged position of helping to develop a network of new University Technical Colleges (UTCs) – one of the most exciting and important initiatives I have been involved with. At Aston University we jumped at the chance to establish our own UTC, creating an innovative and employer-led curriculum providing not just good, but the best, technical education for 14-19 year olds – something that has been missing from our education system for some time.

This is why I agreed to chair this inquiry. The focus of the inquiry has been on post-compulsory education, but the issues the inquiry has considered, and the problems the Skills Commission has encountered, are similar, if not identical, to those I have been working on in 14-19 provision.

Messaging was a crucial issue. The signals that government and the sector send to learners about the quality of different types of learning. There are broadly three educational pathways: apprenticeship, vocational and technical, and academic. We must recognise the value and status of all these routes, ensuring that, whichever path a learner follows, opportunities for further study and training, or progression into work, remain open. There should be no dead ends in our education system.

Alison Wolf's review of 14-19 vocational education laid some of the foundation stones that this inquiry aimed to build upon – high standards in Maths and English for all, and employer-input into vocational provision.

During the inquiry we discussed and identified many examples of new delivery models and new types of provision, such as innovative in-house company training schemes and collaborative employer responsive training in colleges. We want to see more of this – more employer engagement, more collaboration, more integrated and joined-up provision between 14-19 providers, colleges and universities.

Other key issues from the inquiry included simplification of the funding system, proposals for a single funding agency for post-compulsory education, better professional development for our teaching workforce, exploration of new forms of technical and vocational pedagogy, and more devolution within qualification development, aligning more closely the needs of employers with the design and content of qualifications. Crucially, we want to see a cross-departmental strategy for STEM – a plan for STEM growth.

Finally, the importance of careers education, information, advice and guidance (CEIAG) has been a recurring issue throughout the inquiry. We have not made a direct recommendation about CEIAG, as this was not our primary focus, and other bodies are doing important work in this area. But the Commission felt we must acknowledge the importance of CEIAG – the determining and powerful effect it has on learners – and

the need to create an all-age careers service that supports individuals throughout the education system.

I would like to thank Christopher Hall for his support throughout the inquiry, and for representing fairly the views of both the Commission and witnesses. I would also like to thank the Gatsby Foundation, Pearson and the Tec Trust Fund for sponsoring the inquiry.

Ten years ago it was not common to find meaningful and productive curriculum partnerships between universities and employers. I am proud of what we have achieved at Aston University, developing authentic technical and employer-led provision. Many other universities and colleges have done the same, and should be congratulated for doing so. But there is still more that can be done.

I believe that for the first time we have the opportunity to establish a technical pathway through schools, colleges, universities and into the professions. So let's start thinking about technicians, promoting technicians, and valuing technicians. Let's put technicians at the heart of our education system.

Professor Alison Halstead
Inquiry Chair
Pro-Vice-Chancellor, Aston University

EXECUTIVE SUMMARY

This inquiry has been undertaken at a time of extensive and ongoing reform to our public services. Universities, colleges and schools are all changing. Higher education (HE) is being delivered in new ways and in new places, further education (FE) is being given the space to expand into new markets and attract new learners, and the skills system is being reshaped around the choices of learners.

The economic and social imperatives driving this inquiry are clear. The post-compulsory education system must be an economically productive system, enabling individuals to acquire the right sort of skills; it must also be an inclusive system, offering a diverse range of provision and acting as a key route into the professions.

There is widespread support for alternatives to the traditional three year university degree. At a time when young people may be pausing to reconsider university study, and when adults already in work are searching for new ways to re-train in ever more flexible labour markets, this inquiry has sought to bring clarity to those alternatives and to their utility and value, both for the learner and employer.

The inquiry has adopted a systems approach, viewing schools, FE, HE and work-based learning as part of a wider lifelong learning system. It has not focused on supply side measures or institutional reorganisation. The report recommends a series of system adjustments designed to unclog and disentangle.

New Missions

The Government has set out its plan to rebalance our economy to become more production and export-led. To achieve this we must also rebalance our education and training system to produce the right level and type of skills. Nurturing the growth of sectors such as advanced manufacturing and engineering requires more than simply recognition of the importance of our technician (STEM) workforce – it requires a STEM activism. Governments around the world are focusing on stimulating these sectors in their own economies and investing in their STEM capital. We should do the same.

A STEM mission for post-14 education

For the first time, we have the opportunity to develop a technical pathway in schools, through further education and universities and into the professions. University Technical Colleges, specialist academies and some free schools are beginning to establish employer-led, technical 14-19 provision. This should be expanded further and fully integrated into post-compulsory education.

Analysis of STEM qualifications undertaken in the FE and skills sector reveals that the sector is not producing enough technicians. This is not a problem inherent in FE colleges, rather it is a design problem – the outcome of how the system has been

configured and the funding straitjacket colleges have historically been placed in. In a new devolved landscape there is an opportunity for colleges to create their own technician purpose and produce more advanced and higher level STEM qualifications. Government should incentivise colleges to do this and place a new strategic focus on technician qualifications and training across the sector – the supply of technicians should be a key index for a productive FE system.

Recommendation 1

The Department for Education and the Department for Business, Innovation and Skills should develop a coherent, cross-departmental strategy for STEM – a plan for STEM growth. This should include supporting a technical pathway through 14-19 provision and aligning it with post-compulsory education, and supporting FE colleges to provide STEM subjects at levels 3-5.

A skills mission for universities

HE is changing. It is being redesigned by learners and employers who, in ever more flexible labour markets, are demanding a more vocational and occupationally oriented system. Many universities have begun to offer higher level skills provision that is distinct from universities' traditional product base, new and innovative provision that is shorter, vocationally focused, and often undertaken in the workplace.

The expansion of this type of provision should be supported by government and the sector. This would provide valuable new sources of income for universities and provide new opportunities for individuals to pursue higher level learning without leaving the workplace. We need a technical and professional skills mission for universities.

Recommendation 2

Professor Sir Tim Wilson's review of university-industry collaboration should examine how universities can provide more workforce development training, and work more closely with employers and professional bodies to provide bespoke, employer-led higher level technical and vocational qualifications and training.

Open Professions

Professional education

Professional bodies must play a bigger role in the provision of technical and professional skills. Opening up the professions to apprentices and individuals with vocational qualifications requires professional bodies to be key players in post-14 vocational and technical education and training. They should be working in partnership with providers, awarding bodies and employers to help develop apprenticeships and qualifications.

Recommendation 3

Professional bodies should work more closely with schools, FE colleges, universities, sector skills councils, and awarding bodies to ensure that their membership and registration schemes recognise vocational and work-based education and training.

Technician registration

Technician registration will provide a valuable means to up- and re-skill our workforce. Technicians play a vital role in our economy, particularly new emerging markets, and are sources of innovation and sustainable growth. Technician registration has been in decline over the last 20 years. Government must support the establishment of a new technical pathway as a route into the professions, and as a worthwhile alternative to university education.

Recommendation 4

Technician registration should be promoted as an alternative route into higher level learning and the professions.

Recommendation 5

Sector bodies and employers should support the Technician Council and its role in promoting the growth of our technician workforce and establishing a respected and widely recognised technician brand.

New Professionalism

Devolved design

A responsive and flexible lifelong learning system requires responsive and flexible systems for developing qualifications and curricula. Qualification and curriculum development should be driven by awarding bodies, learners, teachers and employers – a distributed design process, directed by those who are using and paying for the qualification and training.

The distribution of degree awarding powers has become a headline policy issue. Granting colleges the freedom to offer vocationally oriented degrees is vital if we are to achieve an authentic vocational pathway from the lowest to highest levels.

This reform would also send a clear signal to learners and employers regarding the status and economic value of vocational education and the FE sector.

Recommendation 6

The Department for Business, Innovation and Skills should ensure that FE colleges are

able to respond to growing demand for technician and higher level skills by:

- Ensuring that colleges are granted the powers to work in close partnership with awarding bodies, professional bodies and employers to develop the type and length of qualifications that individuals and employers demand, which could include full vocationally oriented degrees.
- Simplifying the process for FE colleges to be granted foundation degree awarding powers.
- Developing funding incentives for FE colleges to prioritise STEM provision at levels 3 to 5.

Missing pedagogies

Outstanding technical and vocational provision requires outstanding practitioners and teachers. Successive governments have failed to give the post-16 teaching workforce the attention it deserves.

Lifelong learning has signfiicant implications for the place and type of learning, with the classroom becoming only one of many locations. The implications for the way in which learning is taught and assessed are profound. Teaching and learning becomes less about transmission and passive accumulation of knowledge, and becomes a participatory process, co-designed by the teacher and learner. The teacher is challenged to become more entrepreneurial and creative, responding to a proactive learner and a changing and dynamic work place.

The Commission welcomes the Government's intention to establish an independent commission on vocational pedagogy but urges it to include technical and higher level vocational pedagogies.

Recommendation 7

The Training and Development Agency for Schools, the Learning and Skills Improvement Service, the Institute for Learning and the Higher Education Academy should develop a cross-organisational strategy for the development of vocational and technical pedagogies. The strategy should include:

- A focus on pedagogies for technician and higher level vocational education.
- The quality of careers education, information, advice and guidance training given to teachers, particular in relation to STEM subjects.
- Relevant forms of assessment for technician and vocational education.

Dynamic Funding

A single funding agency

The split between the Higher Education Funding Council for England and the Skills Funding Agency creates unnecessary obstacles in the provision of technician and higher

level skills, particularly from an employer perspective. This is a problem for provision such as higher apprenticeships, different components of which require funding from each agency.

Recommendation 8

The Government should establish a single funding agency for post-compulsory education.

A learner-driven system

FE, HE and lifelong learning offer a diverse range of provision for a diverse range of needs. There is growing demand for more personalised and customised learning, reflecting the needs of individuals trying to navigate more flexible labour markets.

Recommendation 9

The Department for Business, Innovation and Skills should examine how Learner Accounts can:

- Act as a mechanism to empower learners and enable them to make choices about when, what and how they learn.
- Stimulate more non-state investment in technician and higher level skills.
- Help facilitate the development of a lifelong learning Credit and Accumulation System.
- Be used to incentivise STEM provision.

Think Small

Small and medium sized enterprises are a key driver for economic growth, employing 13 million individuals and creating 65% of new jobs. However, they often struggle to train to the same levels as larger employers. This has implications for their own growth as well as the health of the industry as a whole.

Smaller employers require something very different from the skills system – architecture that is more supportive and that can assist in pooling resources and articulating and aggregating demand for training. Larger employers have a key role in developing training schemes that support their supply chains and the recruitment needs of smaller employers. Government must rethink how it works with SMEs.

Recommendation 10

The CBI and Federation of Small Businesses should establish an independent employer-led taskforce to examine how large employers can work with their supply chains to facilitate more technician and higher level skills training in SMEs.

1. INTRODUCTION

HE, FE, and the skills system are all changing. Since the publication of the Independent Review of Higher Education Funding and Student Finance, the Government has outlined plans for wide ranging reform to our universities. In FE, devolution and new open governance structures are providing opportunities for the sector to expand into new markets and attract new learners. The establishment of a network of University Technical Colleges is also providing new opportunities for young people to undertake employer-led technical education.

These reforms cannot be considered in isolation. The proposed changes to universities will have a profound impact on the FE and skills system. This inquiry has therefore looked strategically at the post-compulsory sector as a whole, examining how its sub-systems interact, how employers engage with them and how learners move between them.

Any examination of technician and higher level skills is an examination of HE, just a different kind of HE – one that is more technically and vocationally oriented, undertaken in new places, and through new models of delivery. It is a type of education and training that sits comfortably in FE colleges, the workplace and universities, and it is the product of collaborative design between employers, learners, providers and professional bodies.

The economic and social imperatives driving this inquiry are clear. Our education system must be an economically productive system, enabling individuals to acquire the right sort of skills; it must also be an inclusive system, offering a diverse range of provision and acting as a key route into the professions.

There is widespread support for alternatives to the traditional three year university degree, not least from the current Government. At a time when young people may be pausing to question whether full-time university study is right for them, and when adults already in work are searching for new ways to re-train in ever more flexible labour markets, this inquiry has sought to bring clarity to those alternatives and to their utility and value, both for the learner and employer.

The Government has also outlined its desire to rebalance our economy to become more production and export-led. Whatever the extent of this rebalance, a renewed focus on our manufacturing and engineering sectors is surely to be welcomed. Central to the expansion and success of these sectors are technicians. Historically neglected, technicians – and in particular those training and operating in STEM disciplines – will be key players in securing a sustainable economic recovery for the UK. We need a plan for STEM growth.

The inquiry has adopted a systems approach – viewing schools, colleges, universities and work-based learning as part of a wider lifelong learning system. It has not focussed

on supply side measures or institutional reorganisation. The report recommends a series of system adjustments designed to unclog and disentangle.

1.1 The importance of technicians

The Commission believes that technicians should be the foundation of any government's industrial and skills strategy – as an attractive and worthwhile career destination, an educational stepping stone, and as a key driver for economic growth.

But what is a technician? The term first entered occupational terminology in the nineteenth century, and referred to individuals 'skilled in the technique of the mechanical part of an art'. By the post-war era, definitions had evolved to include reference to training in science and technology[1]. Today the Technician Council's definition states:

> "Technicians are concerned with applying proven techniques and procedures to the solution of practical problems. They carry supervisory or technical responsibility and are competent to exercise creativity and skills within defined fields of science and technology."

The technician embodies theory and practice, knowledge and skill, facts and acts – bringing the hand and mind together. Technicians therefore transcend traditional occupational dichotomies – neither white nor blue collar work captures the broad range of duties that technicians perform[2]. They apply an expansive skill set in an expansive range of sectors:

> "Automotive and factory technicians use oscilloscopes and software to create representations of an engine's or a production system's functioning… Science technicians use instruments and protocols to reduce physical and biological phenomena to data and charts… Emergency medical technicians perform interventionism, such as defibrillation or intubation, based on their interpretation of data generated at the site of an accident."[3]

Critically, the level and type of skills that technicians have are vital to emerging markets in the UK, such as advanced manufacturing and engineering industries. Becoming more production and export-led means becoming more technician-led[4].

Historically technicians have been neglected by policymakers and have not been afforded equality with their professional counterparts[5]. Whereas the number of students studying at universities has increased rapidly over recent years, since the 1980s technician registration has declined by over 50,000[6].

1 Stephen Barley, Technicians in the Work Place, Administrative Science Quarterly (1996)
2 Stephen Barley, Technicians in the Work Place, Administrative Science Quarterly (1996)
3 Ibid
4 For a statistical breakdown by sector of demand for technician skills see the UK Commission for Employment and Skills , Skills for Jobs: Today and Tomorrow - The National Strategic Skills Audit for England (2010)
5 See Michael Gove Edge Lecture 'Elevating the Practical' (2010) and William Richardson, English Technical and Vocational Education in Historical and Comparative Perspective (2010)
6 Data collected by the Engineering Council

The UK currently has 1,069,000 technicians operating in science, engineering and technology sectors, which accounts for 3.7% of the workforce – this compares unfavourably to the European average of 5.3%[7]. This is an important 1.6% as technicians are a key factor in driving economic growth and, in particular, the export competiveness of an economy[8]. Furthermore, demand for technicians – their level and type of skills – is predicted to increase. Growing technological complexity and greater demand for high value added goods and services from emerging economies will have a direct and profound impact on the role technicians play in our economy[9].

1.2 The importance of progression

Less than five years ago the percentage of apprentices progressing into HE was between 0 and 0.1%[10]. Progression from A-levels to HE was 90%. While the number of apprentices progressing to HE has improved recently – it now stands at approximately 4 - 6% – the disparity between the two routes is stark. Research undertaken by the National Apprenticeship Service suggests that there is no lack of demand for higher level vocational provision, 50% of individuals taking an advanced apprenticeship express a keen interest in moving into higher level learning.

Debate about educational progression has been dominated by access and entry to universities. Progression through vocational, technical and work based learning, and access to the professions through these routes, has received little attention. The appropriate forms of assessment for these types of education and training have also been ignored. Efforts have been made to overcome this long-standing issue and expanding the provision of advanced apprenticeships has and will continue to aid progression – in 2009/10 there were 87,700 starts, an increase of 7.9% from the previous year.

Higher apprenticeships have also been developed, providing an attractive and valuable option for many learners. Since their introduction in 2002, foundation degrees, delivered by universities in partnership with local FE colleges, have also provided a useful route for many students progressing through work-based learning. In 2008/09 around 100,000 students were enrolled on a foundation degree[11]. When this provision is designed in partnership between employers and providers it can offer both quality and relevancy and provide a worthwhile entry route to a final year at university or to further work place learning. As one participant in the inquiry said:

> "The unique position of the higher apprenticeship which combines higher level learning of both on-the-job training and academic study has provided an opportunity to link this learning with professional development and recognition. Airbus UK says over 50% of their professional engineers and 20% of their senior managers have progressed from their apprenticeship programmes. Rolls Royce say over 50% of their professional engineers have progressed from their apprenticeship programmes."[12]

7 Nick Jagger, SET Based Technicians Lessons from the UK and European Labour Force Surveys (2010)
8 Written evidence submission to the inquiry, Nick Jagger The Relative Role of Technicians (2011)
9 See the UK Commission for Employment and Skills, Working Futures 2007 – 2017 (2008)
10 Skills Commission, Progression through Apprenticeships (2009)
11 Data collected by Hefce
12 Evidence submitted to the inquiry by Semta

However, the messiness that has historically characterised vocational and technical educational pathways remains a persistent and stubborn problem. This is particularly true in England, whereas both Scotland and Wales have placed progression at the heart of their lifelong learning policies[13]. Therefore it is vital that the 64% of 18 year olds who do not enter full-time university study have a clear and worthwhile alternative, leading to employment or FE.

13 See Welsh Assembly Government, Skills that Work for Wales (2008) and the Scottish Government, Skills for Scotland (2007)

ENERGY AND UTILITIES

CASE STUDY

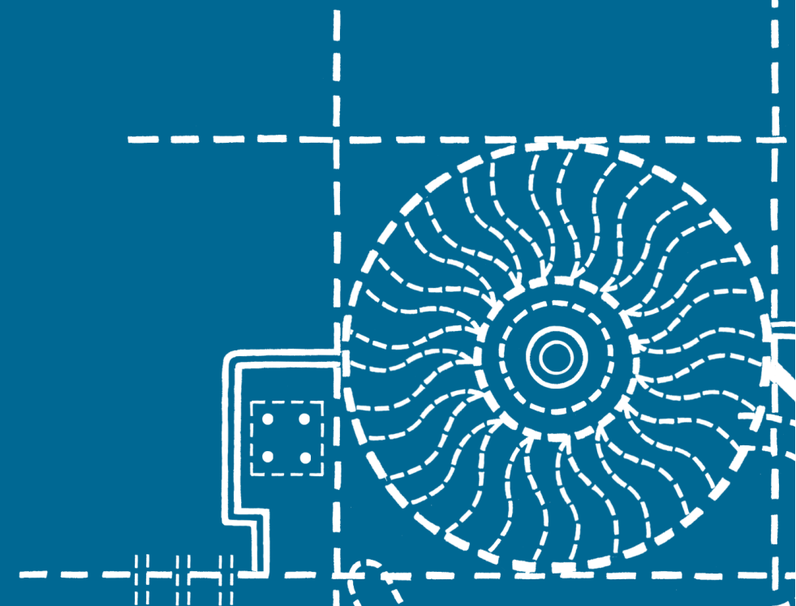
The Energy and Utility sector requires upwards of 90,000 new recruits over the next five years. Importantly, a third of the sector's technical workforce will leave the sector over same period.

The key challenge facing the industry is an ageing workforce and the need to provide a workforce able to meet the demands of major capital expenditure programmes over the coming years. Significant investment will be required in skills and training to rejuvenate the workforce, particularly in relation to technician roles. In addition, new carbon emission targets and the development of new low-carbon technologies is similarly placing new demands on the sector's workforce to develop new capabilities and new specialist skills.

In response, the sector has developed Talent Bank, an employer-led collaborative solution to partnering with education and skills providers, funding agencies and other stakeholders. The Bank will be broadly based on a Group Training Association Model and will provide the necessary infrastructure to enable the sector to respond effectively to growing demand for technicians and higher level skills. The Talent Bank will:

- Centralise recruitment and reduce other administrative burdens on small firms.
- Pool demand and commissioning, and directly contract managing training provision on behalf of employer groups.
- Directly employ apprentices and other trainees when required.
- Provide industry placements and multi-company attachments and rotation of work placements.

The Talent Bank will be established by 2012.



2. NEW MISSIONS

Key points

- The sector should support the establishment of a new technical pathway through 14-19 education.
- Colleges should be supported to play a bigger role in training STEM technicians.
- Universities have a bigger role to play in developing the technical and professional skills of people already in work.

2.1 A STEM mission for post-14 education

The history of technical education in the UK is defined by neglect. In other European countries such as France and Germany national strategies were developed for technical education in the early 1800s. The UK took another 100 years to develop similar national plans. A key factor in this neglect was a 'philosophy of laissez-faire and the subsequent acquiescence into voluntarism across the field of technical education'[14]. Yet, at the onset of industrialisation in the early 1800s, the global market for new advanced manufacturing, and therefore the need for a suitably skilled workforce, was becoming increasingly competitive.

Today, there is a similar urgency and need to expand the UK's technical workforce so that it can maintain and develop its comparative advantage in high value goods and services. Throughout this inquiry witnesses have said that we are still failing to invest adequately in our technical (and STEM) capital. Participants have consistently argued that government must do more to promote this level and type of skill and provide strategic direction to the sector.

14-19

The first part of this strategy must be supporting the development and growth of a technical pathway through 14-19 education. The establishment of a network of University Technical Colleges and the introduction of new freedoms for 14-19 institutions provides the opportunity to establish authentic and employer-led technical education in schools, with clear progression routes into colleges, universities and industry. Aligning the 14-19 curriculum with post-compulsory education and professional registration schemes is vital in helping create clear pathways to higher level learning and work. However, this must be complemented by well-designed Careers Education, Information, Advice and Guidance (CEIAG) programmes for STEM-related careers, which support the learner as they progress from schools, into further learning or work – CEIAG for technicians and progression.

The following charts show achievements in STEM qualifications in schools and the FE and skills sector. There are clear regional variations in the supply of STEM qualifications, as well as a marked difference in the number of STEM qualifications achieved by different socio-economic groups. This is discussed further in the data appendix.

14 Dick Evans, The History of Technical Education (2010)

Figure 1. This chart shows achievements in technician relevant qualifications at level 2 and 3 in schools and the FE and the skills sector in England (2009/10). The size of the bubbles relates to the volume of the qualifications achieved.

There are a significant number of level 2 STEM qualifications achieved in the FE and skills sector. However, the number of level 3 qualifications being achieved is approximately one third of the level 2 qualifications achieved.

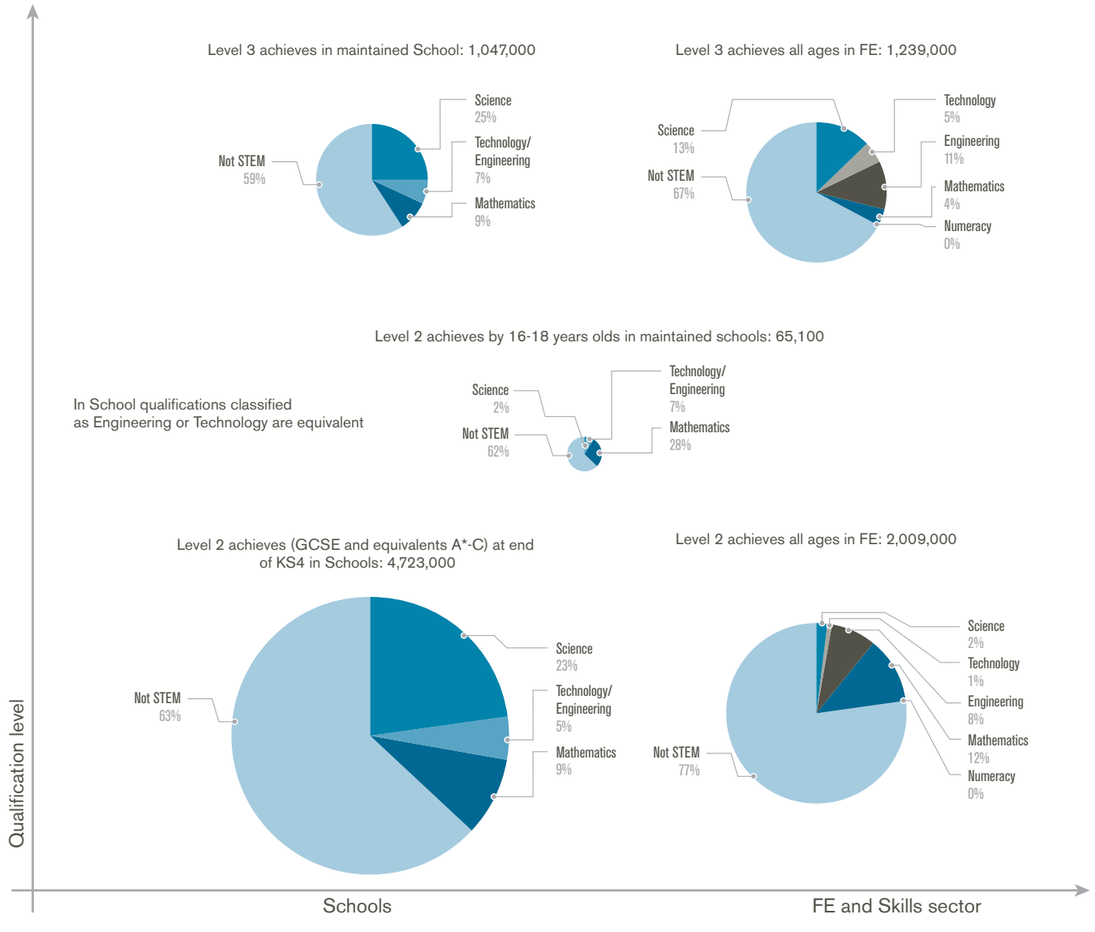
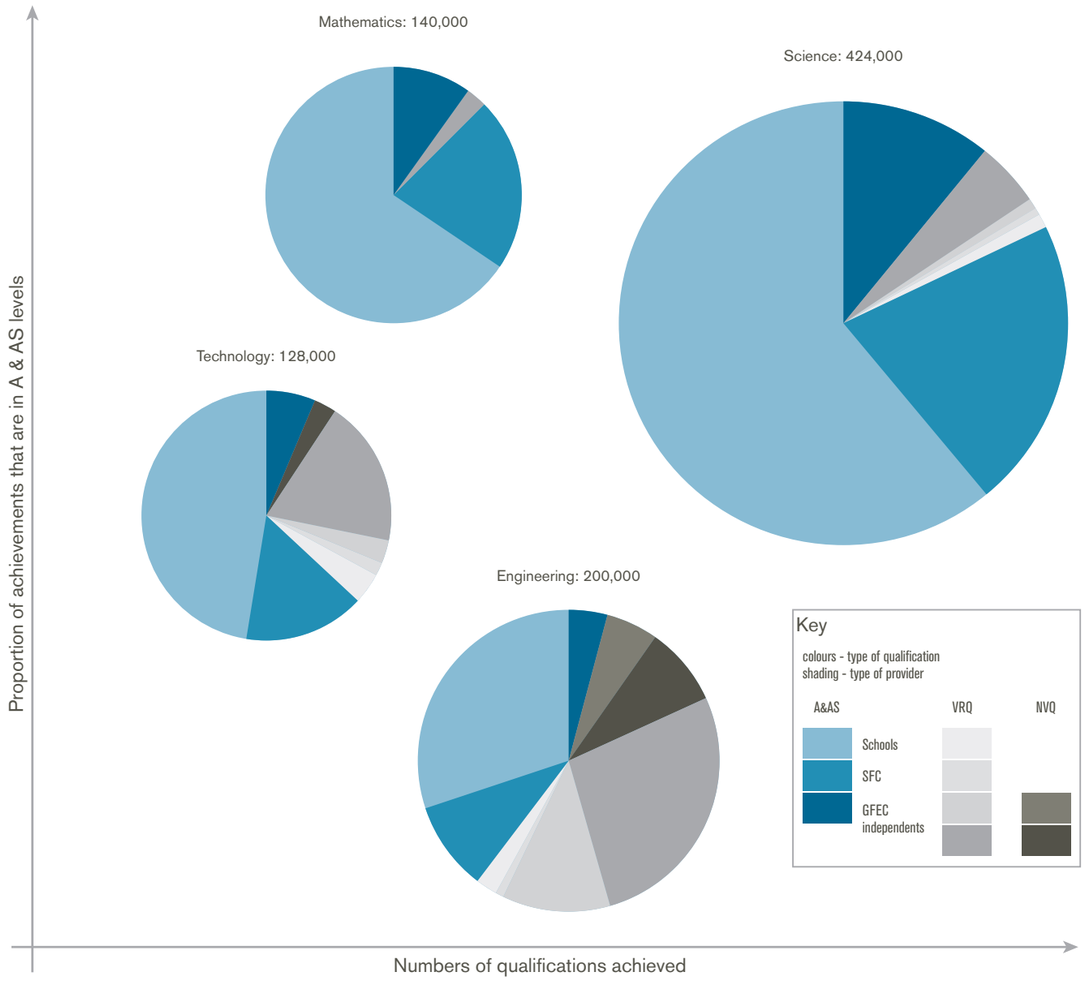


Figure 2. This chart shows the types of publicly funded STEM qualifications achieved at level 3 in different types of education providers in England (2009/10).
The pattern of STEM achievement at level 3 varies for each STEM subject and for each provider. The number of science achievements nearly equals all other achievements in STEM subjects. The profiles of science and mathematics are different to those of engineering and technology – far more science and mathematics qualifications are taken as A and AS level, and few are vocationally related qualifications.



Further education

One of the most significant findings from this inquiry has been the low levels of technician training (at levels 3 to 5) that currently takes place in the FE and skills sector. Over the last five years the role of FE in the provision of engineering and manufacturing training has declined by 25.8%. This statistic increases to 43.2% for individuals over the age of 19[15]. Furthermore, of the STEM qualifications that are provided by the FE sector, a high proportion are at lower levels, not intermediate or technician level. Of the enrollments on STEM or STEM-related qualifications in the FE and skills sector in 2008/9, 73% were at level 2 or below, 26% were at level 3, and only 1% were at level 4[16].

These statistics suggest that FE's STEM potential is far from fulfilled. The Government's new strategic focus on intermediate level skills – such as advanced apprenticeships – should be welcomed. However, more focus should be placed on the type of intermediate level skill.

Commenting on these statistics, the Royal Academy for Engineering has said:

> "The current focus in the FE & skills sector on STEM qualifications at Level 2 or below does little for the formation of engineers and technicians unless those enrolled progress to Level 3 qualifications. With engineering being central to rebalancing the economy in favour of productive industries, the FE & Skills sector needs to focus more on progression to Level 3 than it does currently."[17]

15 Engineering UK, The State of Engineering (2011)
16 Department for Business, Innovation and Skills and Royal Academy of Engineering, FE and Skills STEM Data Project (2010)
17 Professor Matthew Harrison, Royal Academy of Engineering, Letter to the Department for Business, Innovation and Skills, Re: Skills for Sustainable Growth (October 2010)

Figure 3. This chart shows the types of publicly funded STEM qualifications achieved at level 3 in different provide types in the FE and skills sector in England (2009/10).
The majority of engineering qualifications achieved at level 3 are not A or AS levels. A significant proportion of engineering and technology qualifications are taken as part of an apprenticeship, whereas very few science and mathematics qualifications are taken as part of an apprenticeship.

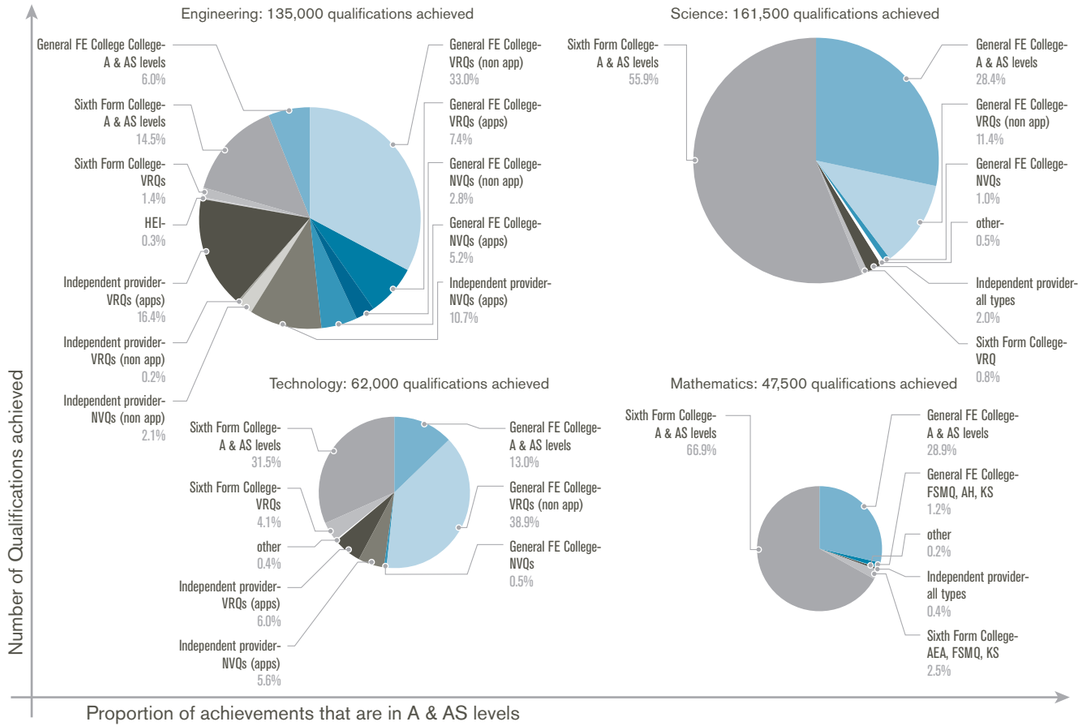


Figure 4. This chart shows the number of funded and non-funded apprenticeship starts in England (2009/10).
The chart illustrates that most apprenticeships were taken at level 2 and were not in STEM subjects. Engineering is the dominant STEM subject. There are very few level 4 higher apprenticeships currently being undertaken, and the majority of these are in mathematics (accountancy).

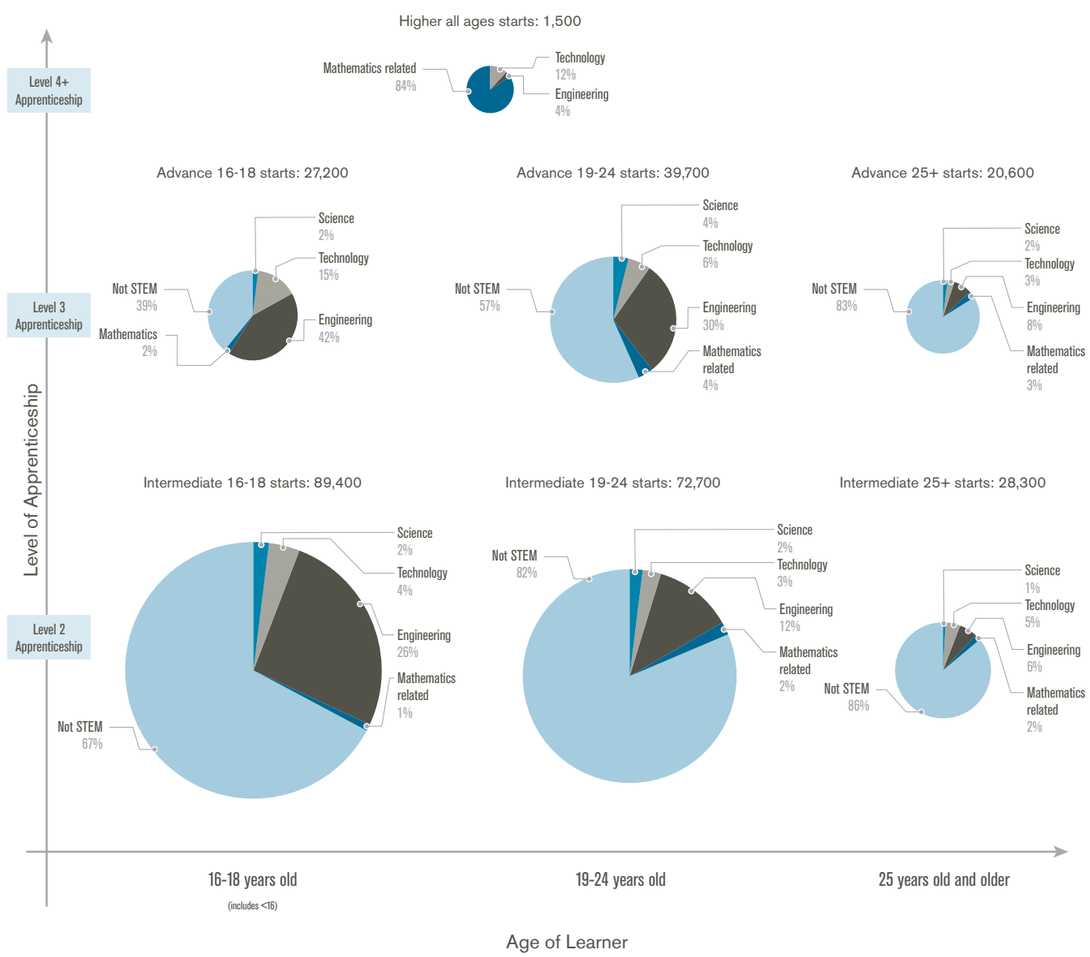
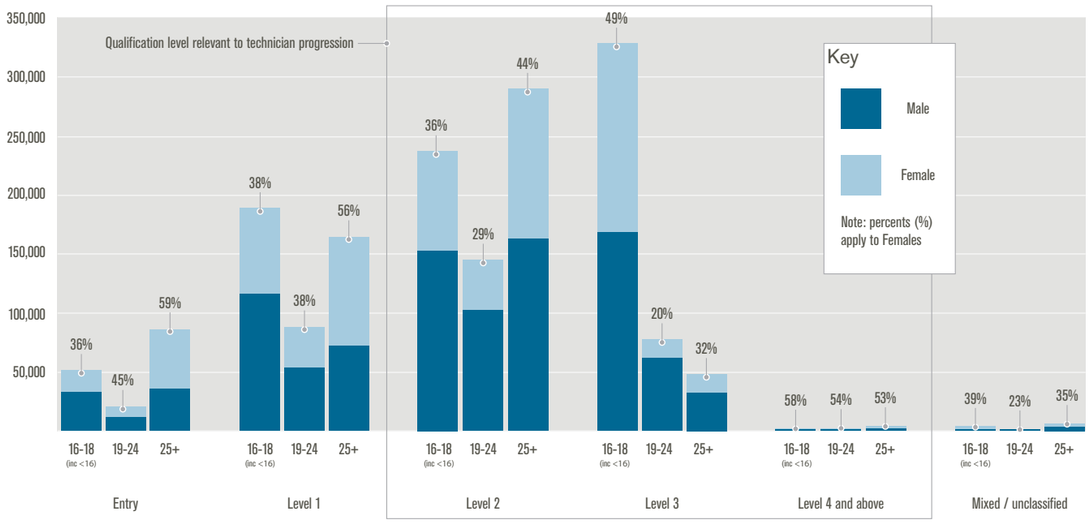


Figure 5. This chart shows the number/level of STEM qualifications achieved by age group and gender in the FE and skills sector (2009/10).
Very few adults undertake a STEM related qualification in the sector at level 3 or 4. Only 7% of STEM qualifications taken at level 3 are achieved by adult women. While a large number of 16-18 year olds are achieving level 2 STEM qualifications, only a small proportion progress onto level 3 STEM qualifications.



Of the 87,700 level 3 apprenticeship starts in 2008/09 only 11,100 were in engineering, manufacturing or IT[18]. Importantly, with the exception of the health sector, evidence given to the inquiry suggests that there has been no systemic increase in apprenticeships in STEM disciplines[19]. Between 2009-10 and 2010-11 (Q1-3) the number of apprenticeships in the retail, travel and tourism sector increased by 13,130, from 61,620 to 74,750. However, in the engineering and manufacturing technologies sector, apprenticeship starts fell by 480, from 37,860 to 37,380. Similarly, in the construction, planning and built environment sector apprenticeships fell by 1580, from 25,210 to 23,620[20].

Research suggests that this is not because of a lack of demand for STEM skills. The CBI's 2011 employer survey found that 43% of employers say that they have shortages in STEM skills[21]. Research by the UK Commission for Employment and Skills also shows that there are existing skill shortages and gaps in STEM skills, and growing demand for occupations such as technology technicians in mechanical engineering, life sciences and technology[22].

18 Government statistical release for post-16 education and training (2011)
19 Oral evidence given to the inquiry
20 Source: Department for Business, Innovation and Skills Data Service.
21 Confederation of British Industries Employer Survey (2011)
22 UK Commission for Employment and Skills, Skills for Jobs: Today and Tomorrow (2010)

Government must find a way to unblock the system and enable further take-up of STEM apprenticeships and other related qualifications and training. STEM subjects are economically vital but should now be considered vulnerable in the FE and skills sector.

Supporting subjects because they are an economic priority or considered vulnerable is not a new policy. In 2004 the Government asked the Higher Education Funding Council for England (Hefce) to develop a strategy for strategically important and vulnerable subjects. This resulted in Hefce's National HE STEM Programme. The messages given to the Commission during the inquiry were clear: STEM skills are important, and vital for new growth markets such as IT and engineering. As one participant commented:

> "There is a gap between the needs of employers and the system. From an employers' perspective, we know where growth is coming from – IT, engineering and advanced manufacturing. We need closer alignment between funding and qualification systems and these markets."[23]

Mechanisms to incentivise take-up and expand provision must be a priority for the Government and the sector. This does not mean state planning or second guessing the market. Indeed, employers have articulated their need clearly and consistently – prioritising STEM is a response to bottom-up pressure, not government dictat. Even if the notion of expanding the stock of STEM skills is questioned, surely establishing an FE STEM option – with opportunities for progression – for those individuals who do not want to study at a university is a worthwhile objective in itself?

> "…there is evidence to suggest fewer people are becoming technicians through the vocational education route. This may reflect a lack of confidence from employers in the available level 3 & 4 vocational qualifications, resulting in them recruiting graduates and 'de-skilling' them to operate as technicians. This also lowers the value of vocational STEM qualifications to young people, who perceive few benefits in terms of enhancing employability or wages. Consequently there is very low take up of the vocational courses intended for technicians."[24]

Throughout the inquiry participants have argued strongly for the need to establish a joined-up STEM strategy for post-14 education. This strategy should be integrated into wider economic policy, and recognise the Government's enabling role supporting workforce development in strategically important markets for the UK – we need a plan for STEM growth.

This plan does not just mean more STEM qualifications. It requires developing a joined-up strategy, with better employer relationships, new provider partnerships, and focusing on a particular level and type of skill. There are also important implications for

23 Oral evidence from Andy Palmer, Head of Skills BT
24 Daniel Sandford-Smith, Gatsby Charitable Foundation, Registration and Technical Education

careers education, information, advice and guidance (CEIAG). CEIAG must be at the heart of any STEM strategy, acting as the glue that binds our education system to the labour market and learners to jobs. It requires cross-departmental support and must be fully integrated into 14-19 education and lifelong learning.

Recommendation 1

The Department for Education and the Department for Business, Innovation and Skills should develop a coherent, cross-departmental strategy for STEM – a plan for STEM growth. This should include supporting a technical pathway through 14-19 provision and aligning it with post-compulsory education, and supporting FE colleges to provide STEM subjects at levels 3-5.

2.2 A skills mission for universities

HE is changing. It is evolving to include new qualifications, at new levels, delivered in new places. Programmes are being designed by employers working in partnership with educational providers, and learners are demanding a more vocational and occupationally oriented system that recognises training for work and training undertaken in work.

The provision of technician and higher level skills, distinct from traditional three year full-time courses, are opportunities for universities to expand into new markets and find new sources of income. Indeed many universities are already deeply engaged with the workforce development market. Yet the £400 million that businesses invest each year on workforce development training with universities is a fraction of the £38 billion employers spend on training overall.

Finding new sources of sustainable income, such as the international student market, has become increasingly important for universities. Expanding into the workforce development market could also be a useful income stream.

In its response to the Browne Review, the Universities Vocational Awards Council commented:

> "By linking the world class expertise the HE sector has in research and learning to the development of the skills of the workforce, the UK would have a powerful vehicle, through HE, for economic growth. Regrettably, this role is in its infancy with the HE share of the market for higher level CPD estimated at only 6 per cent by the UK Commission for Employment and Skills."[25]

An example of this in practice is Middlesex University's Organisational Development Network. The Network focuses on meeting the training needs of employers through collaboration with colleges and training providers. It provides professional development opportunities for organisations by accrediting existing company training and developing customised qualifications from level 1 - 8[26]. Partnerships between universities and employers utilises the expertise of universities to develop high-quality work-based learning. This allows individuals to stay in work, undertake professional development and have their existing training accredited with the academic rigor and specialism found in universities. The Network also allows individuals to develop the programme around their own professional development needs and individual interests, negotiate the focus, timescale and assessment of their work, and obtain an accredited qualification from a university[27].

These new partnership models between universities and employers provide valuable opportunities to develop customised training to meet the needs of those already in work – universities should have a wider customer base than simply 18 year old school leavers. This type of provision also drives greater adaptability into the university system, reflecting the diversity of training needs that individuals who exist in a flexible labour market increasingly need. They also provide opportunities for universities to develop new relationships with businesses and industry.

> "Building relationships with different kinds of students challenges a culture more accustomed to acting in established ways, but it contributes to the unavoidable evolution of HE. Working with employers and employees sharpens HE's responsiveness to the development and/or delivery of learning opportunities relevant for the 21st century, prescient, bespoke, negotiated, adaptable, and often multi-disciplinary. The best of these opportunities are also reciprocal – in that both the academy and business gain from the relationship."[28]

For some universities therefore, it would be beneficial to work more closely with employers, offering more flexible provision. Workforce development has often been a neglected sub-market of HE, suffering from a lack of prestige and understanding. Government and Hefce should develop an overarching strategy to allow these partnerships and delivery models to happen where demand exists. Good and relevant provision should be promoted wherever possible and should not be held back by structural or cultural problems.

Recommendation 2

Professor Sir Tim Wilson's review of university-industry collaboration should examine how universities can provide more workforce development training, and work more closely with employers and professional bodies to provide more bespoke, employer-led higher level technical and vocational qualifications and training.

25 Universities Vocational Awards Council, Response to the Browne Review (2010)

26 See http://www.mdx.ac.uk/aboutus/Schools/iwbl/MODNet/index.aspx.
27 Simon Roodhouse and John Mumford, Understanding Work-Based Learning (2011)
28 Ruth Helyer, Aligning Higher Education with the World of Work, the journal of the University Vocational Awards Council, Vol 1, Number 2, 2011

3. OPEN PROFESSIONS

Key points

- We need to open up and support different routes into the professions.
- We want more people of all ages to become technicians.
- Professional bodies should play a bigger role in vocational and technical education and collaborate more closely with 14-19 providers.

3.1 Professional education

Underpinning this inquiry has been the importance of progression. Whatever an individual chooses to learn, however they choose to learn, and wherever they choose to learn, options to progress into higher level learning, employment, or new disciplines should be embedded in qualifications and training. Indeed, labour market flexibility coupled with an ageing workforce will necessitate a level of functional flexibility not previously required by the workforce. Progression through and between the professions should therefore be a primary focus for our post-compulsory education and training system, and leading players in this system should be professional bodies and professional education. Professional bodies should also focus on ladders down into 14-19 education and consider new ways to embed professional recognition within 14-19 provision.

Professional education is largely developed by professional bodies and encompasses both the minimum requirements to operate in a given profession as well as a commitment to continuing development. It consists of: academic and vocational education situated in professional practice; entry qualifications and pathways to professional status; cultural education, such as professional ethics and the civic contribution of the profession. Professional education also has portability – many professional qualifications are recognised across industries and internationally. Importantly, it is long lasting, with a use by date beyond any government. Its components include: vocational training, academic qualifications, corporate learning, theoretical knowledge and applied skill[29]. It thereby encompasses knowledge, skills and behaviours – three qualities that employers have consistently identified as vital for any employee[30]. Furthermore, as many educationalists have suggested, the labour market recognises and even places a premium on professional education and qualifications because of their stability[31].

Evidence submitted to the inquiry stated:

> "…employers value traditional qualifications more than those developed by or on behalf of government. Studies of the rates of return to qualifications for example show that those awarded by City & Guilds or BTEC attract a greater wage premium than NVQs. The evidence of what employers do in the labour market we would argue is better evidence of their priorities than responses to opinion surveys.

29 Chartered Insurers Institute, Professional Education, (2011)
30 White Loop and Edexcel, Effective Education for Employment (2009)
31 Professor Alison Wolf, Independent Review of 14-19 Vocational Education (2011)

> There is also evidence that employers value stability and are confused by too much change in the nature and designation of qualifications, even when intended to simplify the system. This in part accounts for the greater importance accorded to traditional qualifications in relation to recruitment and promotion decisions."[32]

Qualifications and training offered by professional bodies, or in partnership with them, should play a central role in post-16 education. Policymakers can no longer focus narrowly on increasing the number of university enrolments. Instead, policy must be refocused on opening up the professions and ensuring there are a variety of entry routes into, through and between the professions, which are valued and sustainable - professional and technical alternatives to academic HE, delivered by public and private providers.

3.2 Technician registration

Technician registration has been in decline over the last 20 years. There are currently 1,069,000 technicians operating in science, engineering and technology sectors, but this figure has failed to expand in line with the growing demand for this level and type of skill[33]. Today, there is a growing recognition that increasing technician registration, through professional bodies and common professional frameworks, would help to ensure that we have individuals with both the right level and type of knowledge and skills so often demanded by employers. Data provided by the UK Commission for Employment and Skills details the growing need for STEM skills at levels 3,4 and 5. 58% of new jobs created by 2017 will require these skills[34]. Importantly, as we note in section 2.1, evidence suggests that fewer individuals are becoming technicians via vocational qualifications.

Evidence submitted to the inquiry stated:

> "…The key to encouraging greater take up of technician qualifications is to ensure that any qualification carries a financial premium in the workplace. One way of achieving this would be to associate technician roles with licences to practise derived from qualification requirements."[35]

Technician registration could play a vital role in overcoming these issues. The Technician Council is facilitating the development of a registration framework for the STEM disciplines that will include the existing registers in engineering and ICT as well as the new technician register in science.

The registration framework being developed will provide a vocational ladder to the professions. The framework will comprise three 'rungs' of professional standards, beginning at level 3, with 'Registered Technician' (EngTech, ICT-Tech, RSci-Tech) and concluding at level 7 with 'Chartered' status (CEng, CSci, CPhys, etc).

32 Written evidence submitted to the inquiry by the 157 Group
33 Nick Jagger, SET Based Technicians Lessons from the UK and European Labour Force Surveys (2010)
34 UK Commission for Employment and Skills, Skills for Jobs: today and tomorrow (2010)
35 Daniel Sandford Smith, Paul Lewis and Howard Gospel, Registration and Technical Education (2011)

THE TECHNICIAN COUNCIL

CASE STUDY

The Technician Council was formed in July 2010. Following a number of research studies its primary focus is to enhance recognition of the role professional technicians play and emphasise the value they bring to society. Employers and employees alike are being involved in order to help inform the development of the Council's professional recognition programme.

The Council's work, funded by the Department for Business, Innovation and Skills and the Gatsby Foundation, supports the wide range of individual institutions and bodies in the creation of a technician level qualification. The Council is chaired by Steve Holliday, CEO of National Grid, and hosted by The Royal Academy of Engineering.
The Technician Council is a collaboration among leading organisations and major employers representing science, engineering, ICT and health.

The context

The Technician Council was set up to provide an independent view of the current state of technicians in the engineering, science, ICT and health sectors in the UK and to recommend a common framework for future technicians which will ensure this critical role is more widely recognised and respected.

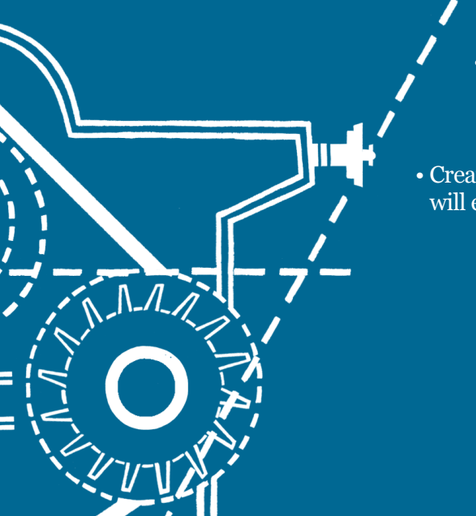
Work so far

The Council has been running for 12 months and is due to present its findings at the end of 2011. Working with key stakeholders, the early phases of activity focused on understanding the current landscape, issues and future opportunities. The Council has specifically looked at the processes for registration, the technician brand and identity, associated language and imagery. Early findings indicate there are opportunities to improve here and in the areas of cross sector mobility and up-skilling.

Current phase

Drawing on all the findings of the research conducted to date, the remaining work of the Council will focus on:

- Enhancing recognition of the role of professional technicians and the value they offer by creating and promoting a compelling technician brand and identity to key stakeholders.
- Defining minimum expectations for membership of the technician profession, including a common technician registration framework for individuals in any field, which meets the needs of employers and the aspirations of employees.
- Creating a robust business case for an enduring governance model which will ensure the growth and sustainability of the UK technician cadre.



The ladder for science is shown in the table below.

Title	Designation	Threshold Level	Linked qualifications
Registered Technician	RSciTech	Level 3	BTEC, Advanced Apprenticeship
Registered Scientist	RSci	Level 5	Foundation Degree, HND
Chartered Scientist	CSci	Level 7	Masters Degree

In engineering, for example, on completion of an approved apprenticeship the apprentice would register as an Engineering Technician and then through professional development, become an Incorporated Engineer and then a Chartered Engineer.

The engineering and science professional bodies (Institution of Mechanical Engineers, Royal Society of Chemistry, etc, working under the umbrellas of the Engineering Council and Science Council) set the standards for registration at the three levels, thus controlling the entry standards to the professions.

Individual professional bodies will decide which qualifications they will accept as evidence for meeting the standards for registration. Additionally the competence standards may be adapted by the professional body to relate specifically to the particular technologies or industries with which it is concerned.

Registration is only financially viable for professional bodies if it is sufficiently attractive to individual technicians for them to pay their registration fees. This is only the case if registration standards reflect the needs of employers. Professional bodies are thus incentivised to stay attuned to the competence required of technicians by employers, even as this changes over time due to technological innovation and shifts in the economy.

There are multiple benefits to the process of registration. The individual achieves a new status through association with a professional body. The knowledge and skills that are assessed during the process of registration are directly relevant to the needs of employers and the workplace, broader than skills assessed through occupational qualifications, and ultimately ensure expansive and transferable skills for the individual.

There are also benefits for employers. Registration allows employers to have much clearer expectations about what they can expect from potential employees. Professional registration is recognised, stable and an externally validated way of confirming a competence standard has been achieved without having to delve into the detail of the vast range of vocational qualifications. Registration could also be valuable to employers in other ways. As well as demonstrating a commitment to the training and development of staff, registration allows organisations to demonstrate their staff's competence and commitment to ethical behaviour, which could be an important feature in procurement and liability issues.

Of crucial importance is the stability and confidence that registration could bring to the qualifications landscape. By mapping qualifications against professional standards, short-term political interference in qualification development can be avoided. In its place, the long term needs of the individual, employer and the wider needs of the labour market can be embedded in new qualifications.

This argument is equally applicable to apprenticeships, ensuring they have currency and value in the professions. Mapping apprenticeship frameworks against registration standards ensures that apprenticeships lead to professional recognition, as well as avoiding academic drift[36]. For example, the Institution for Engineering and Technology and Semta (the Sector Skills Council for science, engineering and manufacturing) have worked closely to ensure that apprenticeship frameworks are mapped against the Institution's standards[37]. This provides a wide range of benefits to the individual, employer and the sector, such as helping employers and learners to choose appropriate courses, ensuring employers gain both knowledge and competence, and encouraging continuing professional development[38].

> "Professional registration could well be the key to a strengthened and streamlined vocational education system and a larger and better equipped technical workforce. It also has the advantage of requiring very little or no government funding to succeed."[39]

In its evidence to the inquiry, the Institution for Engineering and Technology commented:

> "As an important part of efforts to raise the status of vocational training, consideration must be given to the importance of progression routes. It is likely that, with changes to university fees, young people who may not previously have considered apprenticeships as an option could now do so. However, many will only be prepared to follow an apprenticeship route if it really is a route, not a dead end. Professional registration is designed to accommodate progression but progression is often not possible in practice, either because the right qualifications at Levels 4 and 5 do not exist or because they are not offered locally."

It is vital that the Department for Business, Innovation and Skills and related agencies play an active role in ensuring that there are a suitable and coherent range of qualifications at levels 4 and 5, coupled with adequate financial support. Any new qualifications and apprenticeship frameworks should be closely tied to professional standards and recognition.

The Commission also believes that the Government should explore whether the Technician Council could be replicated and developed for other sectors. The concept

36 Ibid
37 For a list of approved apprenticeships, see http://www.theiet.org/careers/accreditation/apprentice/index.cfm
38 Written evidence submission from the Institution of Engineering and Technology (2011)
39 Written evidence submitted to the inquiry

of 'joint awarding boards' is already being considered by some sector bodies as a mechanism to ensure that awarding bodies, sector skills councils and professional bodies work coherently and collaboratively in the development of professional pathways and provision such as higher apprenticeships. This collaboration will be vital if we are to develop clear, well travelled vocational and work-based pathways into technician occupations.

Recommendation 3

Professional bodies should work more closely with schools, FE colleges, universities, sector skills councils, and awarding bodies to ensure that their membership and registration schemes recognise vocational and work-based education and training.

Recommendation 4

Technician registration should be promoted as an alternative route into higher level learning and the professions.

Recommendation 5

Sector bodies and employers should support the Technician Council and its role in promoting the growth of our technician workforce and establishing a respected and widely recognised technician brand.

RAILWAY ENGINEERING

CASE STUDY

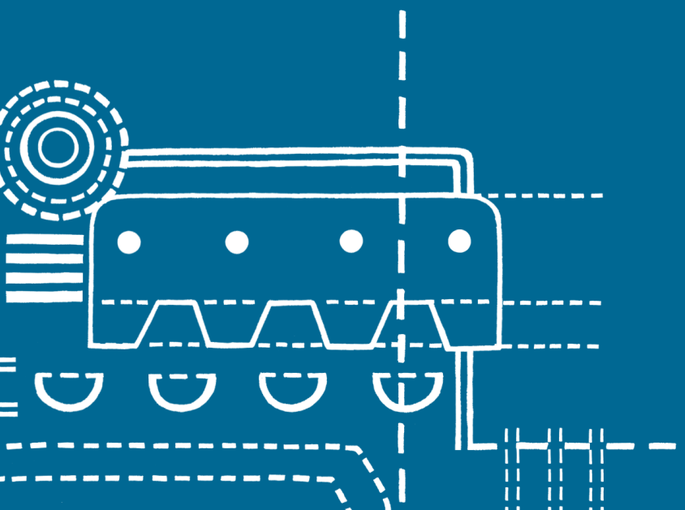
Apprenticeship to Fellowship

Maintaining and developing the UK's rail infrastructure is vital for the long-term success of the British economy. Over the last decade Britain has had one of the fastest growing railway industries in Europe with passenger numbers increasing by 43%.

£35 billion will be invested in our rail infrastructure between 2009 and 2014. This investment will require technicians and engineers trained in up to date and relevant skills. To meet this demand the sector needs to double the number of apprentices from approximately 500 to 1,000 every year. This new demand creates new job opportunities for those individuals wishing to pursue an engineering related career through a work-based route.

The Apprenticeship to Fellowship scheme has been developed by the National Academy in partnership with employers and the relevant professional engineering institutions. It will enable apprentices to gain professional recognition at all levels within their engineering institution and progress to the top of the profession via an entirely work-based route.

By linking progression to professional standards, the scheme ensures that apprentices develop both the necessary theoretical knowledge, and crucially, the practical competencies and skills that are required within the industry. This type of scheme could be applied to other sectors, ensuring the professions are open to work-based educational pathways.



4. NEW PROFESSIONALISM

Key points

- Qualification development needs to become more flexible and local.
- Employers and providers should play a bigger role in qualification development.
- How we teach vocational and technical education is important.

4.1 Devolved design

"Demand side dynamism depends on supply side diversity."[40]

A responsive and flexible lifelong learning system requires responsive and flexible systems for developing qualifications and curricula. Qualification and curriculum development should be driven by awarding bodies, learners, teachers and employers – a distributed design process, directed by those who are using and paying for the qualification and training.

Evidence submitted to the Commission suggests that while the Government's agenda is on the right track, further devolution within qualification development is needed. Removing regulatory obstacles to allow awarding bodies, providers and employers to work more closely is vital to ensuring relevancy and diversity within the qualfiication offer. As one participant commented:

> "What is the point of qualifications that have no traction with employers? There needs to be a better connect between employers and qualifications, and employers should have a greater role in evaluating qualifications."[41]

Today, sector skills councils play a critical role in the development of new qualifications. As Professor Alison Wolf commented in her recent Independent Review of Vocational Education:

> "The SSCs – which are non-statutory – have become, in the last few years, de facto designers, as well as de facto first-line accreditors, of almost all non-HE qualifications other than the academic ones. In some cases, they play a very active part in deciding which awarding bodies will be allowed to offer a qualification in a given area."[42]

In its response to the Wolf Review the Department for Education said that it would review this process and consult on the future of National Occupational Standards. In relation to the National Occupational Standards[43], evidence also suggests that the process of updating the Standards should be improved. The Royal Academy of Engineering has supported proposed reforms that would help speed up the process of qualification development, suggesting that new qualifications could be informed by National Occupational Standards rather than founded on the Standards[44].

40 John Hayes MP, Vision for Further Education (2011)
41 Oral evidence given to the inquiry by Stephen Uden, Head of Economic Affairs and Skills, Microsoft
42 Professor Alison Wolf, Independent Review of 14-19 Vocational Education (2011)
43 Department for Education, Response to the Wolf Review of Vocational Education (2011)
44 E4E (Royal Academy of Engineering) Response to Skills for Sustainable Growth (2010)

Responding to Government reforms, the Federation of Awarding Bodies has commented:

> "We look to the Government to give awarding bodies the same degree of freedom that is being proposed for colleges and training organisations. This is quite rightly stated as being necessary to enable them to respond flexibly to demand and they need units and qualifications that allow them to do this."
>
> Currently awarding bodies can only offer those qualifications that are centrally determined or approved by SSCs and, apart from exceptional circumstances, are not free to develop units and qualifications for inclusion in the Qualifications and Credit Framework to meet needs other than those identified by the SSCs."[45]

Witnesses to the inquiry have also commented:

> "We have spent 10 years establishing SSCs so that they can develop the Qualifications and Credit Framework ensuring that all qualifications that are created exist because SSCs have created them on behalf of employers…and yet employers and the sector don't recognise many existing qualifications."[46]

Throughout the inquiry concerns have been raised about the quality and relevancy of qualifications and the tensions between national standards and local flexibility within qualification development. These are valid and important concerns and relate to the determining role of Sector Qualification Strategies.

The Commission believes further consideration should be given to how the process of qualification development can be made more flexible and responsive to local need. Sector skills councils play an important role in this process but as demand from employers and learners shifts towards more flexible and personalised learning, the system also needs to be adjusted to reflect this change.

The role of FE in responding to demand for new qualifications should not be limited to FE's traditional product base – qualifications from level 2 to 5. Expanding the provision of HE within FE could be one way to maximise the economic contribution of FE. Granting colleges the freedoms to provide higher level qualifications – and the related validation powers – would also send a clear signal about the value of FE to those that learn and work within it.

Increasingly, colleges are providing courses that have traditionally been the preserve of universities and HE in FE has now become a headline policy agenda. Over 150,000 students currently undertake HE courses in FE, which accounts for one in eight of the undergraduate population[47].

45 Federation of Awarding Bodies, Response to Skills for Sustainable Growth (2010)
46 Oral evidence given to the inquiry
47 157 Group, Rising to the Challenge (2010)

Importantly, opening up HE to FE can play a key role in unblocking social mobility. Research suggests that HE in FE is more inclusive and open to individuals from more disadvantaged backgrounds:

> "The 'non-traditional' students of the wider HE sector are often the traditional students of the FE sector. They are the widening participation students the Government wants to encourage into HE but their social, economic and educational backgrounds are likely to steer them away from the more traditional forms of HE delivered through universities … many of these students rely upon the FE sector for access to HE: the FE colleges are not a last resort but a first choice."[48]

FE colleges are therefore responding to demand for a different kind of HE. This is not second best or second choice HE, rather it is personalised and customised to meet the needs of a particular kind of learner with a need for a particular type of education and training. Furthermore, evidence from the Quality Assurance Agency suggests that this provision is of good quality[49].

There is now strong support for the expansion of HE in FE. In the recent HE white paper the Government outlined plans to remove regulatory barriers preventing new providers entering the HE market, as well as plans to simplify the regime for obtaining degree awarding powers[50]. The Mixed Economy Group of Colleges has also called for 'building a strong college HE offer which adds to the diversity of the new HE sector'[51]. Expanding HE provision delivered in FE will therefore bring much needed diversity to the sector and complement the university offer. Since the publication of the white paper the Government has also granted a limited number of colleges foundation degree awarding powers, with further applications being considered[52]. It is also expected that colleges will apply for taught degree awarding powers.

In the past there have been a number of issues that have prevented the expansion of HE in FE: limited direct Hefce funding, safeguards in relation to franchising agreements between universities and colleges, and the distinction between prescribed and non-prescribed HE.

The Commission supports the Government's ambition to expand HE in FE provision. The distribution of foundation degree awarding powers and taught degree awarding powers is a fundamental issue in HE policy. Allowing colleges to offer full vocationally focused degrees would have a significant impact on diversity and choice in the HE and FE sectors, as well as the purpose of a degree itself.

48 Cristofoli and Watts, The Role of Regional FE Colleges in Delivering HE in the East of England (2010)
49 Quality Assurance Agency, Integrated Quality and Enhancement Review: Findings from the 2009-10 Summative Reviews (2011)
50 Department for Business, Innovation and Skills, Students at the Heart of the System (2011)
51 Evidence given to the Business, Innovation and Skills Select Committee inquiry, the Future of Higher Education (2011)
52 See Department for Business, Innovation and Skills website http://nds.coi.gov.uk/content/Detail.aspx?ReleaseID=420758&NewsAreaID=2

As one witness to the inquiry commented:

> "The requirement for young people to remain in a government approved form of education and training until the age of 18 is likely to increase demand for, and take up of, hybrid qualifications. Many young people may seek to keep their options open for further study while gaining vocational knowledge and skills valued in the labour market.
>
> There is a huge opportunity for a full-time vocational route. Apprenticeship provision is still very small – only about 6% of 16-18 year olds are starting an apprenticeship and 36% of 18 year olds go to university. The majority of 18 year olds aren't in either of these routes."[53]

The Further and Higher Education Act (1992) legislated for 35 polytechnics to become universities. An unintended consequence of the Act was that much higher level technical provision was lost, as the new universities refocused their offer. Granting colleges the freedom to expand into this market could lead to much needed expansion of this provision. Academic drift in higher level vocational qualifications has been highlighted as a concern throughout the inquiry[54], and participants have consistently argued for a new focus on employer-led technical training. Allowing vocational experts – colleges – to deliver more higher vocational qualifications and training could help reverse this trend and maintain the integrity of the vocational offer. The Commission does not believe that all colleges should offer degrees, or indeed that all colleges will want to do so. But taking progression and vocational education seriously must mean creating an authentic vocational pathway from the lowest to highest levels.

Recommendation 6

The Department for Business, Innovation and Skills should ensure that FE colleges are able to respond to growing demand for technician and higher level skills by:

- Ensuring that FE colleges are granted the powers to work in close partnership with awarding bodies, professional bodies and employers to develop the type and length of qualifications that individuals and employers demand, which could include full vocationally oriented degrees.
- Simplifying the process for FE colleges to be granted foundation degree awarding powers.
- Developing funding incentives for FE colleges to prioritise STEM provision at levels 3 to 5.

53 Evidence submitted to the inquiry by Professor Alison Fuller, Southampton University
54 Written evidence submitted to the inquiry by the Association of Colleges

4.2 Missing pedagogies

Michael Barber has said that an education system cannot exceed the quality of its teachers. The Government's recent schools white paper, The Importance of Teaching, also places teachers at the heart of its agenda and sets out a compelling argument for the importance of teacher professionalism and continuing professional development.

However, technical, vocational and applied pedagogies continue to be neglected, and a second thought for policymakers. Relegating teachers and instructors in FE to a second division of teaching sends a clear signal to the sector and learners, and undermines the sector's quality and value.

Lifelong learning has significant implications for where and how education and training happens, with the classroom becoming only one of many places of learning. The implications for the way in which education is taught and assessed are profound. Teaching and learning becomes less about transmission and passive accumulation of knowledge, and becomes a participatory process, co-designed by the teacher, the employer and the learner. The teacher is challenged to become more entreprenurial and creative, responding to a proactive learner and a changing and dynamic work place. Knowledge must be integrated with practical skill and situated in real-world scenarios.

One consequence of this is that assessment becomes less about exams and more about accurately judging the competence and skill of the individual, ensuring asessment is tailored to the purpose of the education or training itself, and is relevant to the required outcome. This should not be equated with a less rigorous form of assessment, just a different form. To acheive this, teachers must maintain a 'dual professionalism', combining teaching expertise with regular vocational top-ups.

The establishment of the Institute for Learning has led to new requirements being placed on teachers in the FE and skills sector to undertake a specified amount of continuing professional development each year.The Commission fully supports this requirement and the wider work of the Institute for Learning in advancing the status and professionalism of the FE and skills teaching workforce, and believes the sector should maintain a professional body.

The Skills Commission welcomes the Government's consultation on the establishment of an independent commission on vocational pedagogy and urges it to consider the recommendations within Teacher Training in Vocational Education, such as establishing a 'universal Qualified Teacher Status (QTS)'[55]. It is also vital that the independent commission considers technical and higher level vocational pedagogies – levels 3 to 6 – as well as those targeted for lower level qualifications. In addition, we recommend that the independent commission includes representatives from

55 Skills Commission, Teacher Training in Vocational Education (2010)

all provider types – schools, colleges, universities and independent organisations – working in 14-19, FE, HE and workplace learning.

Recommendation 7

The Training and Development Agency for Schools, the Learning and Skills Improvement Service, the Institute for Learning and the Higher Education Academy should develop a cross-organisational strategy for the development of vocational and technical pedagogies. The strategy should include:

- A focus on pedagogies for technician and higher level vocational education.
- The quality of careers education, information, advice and guidance training given to teachers, particular in relation to STEM subjects.
- Relevant forms of assessment for technician and vocational education.

5. DYNAMIC FUNDING

Key points

- There should be a single funding agency for post-compulsory education.
- Government should introduce Learner Accounts as a means to empower learners and incentivise STEM education and training.

5.1 A single funding agency

"Given the great efforts by Government to boost apprenticeship numbers, the need to address the systemic problems that prevent former apprentices from progressing to advanced further education and higher education becomes ever more pressing."[56]

The Government has outlined its commitment to developing more advanced and higher apprenticeships, ensuring there are more vocational pathways into higher level learning. In the Treasury's Plan for Growth, the Government announced funding for 10,000 more advanced and higher apprenticeships[57].

This welcomed investment is a reflection of the new, more diverse reality in HE. However, institutional barriers still impede the expansion and take up of higher apprenticeships. Importantly, existing funding systems are complex and make it difficult for employers to employ apprentices. As the Association of Colleges told the Commission:

> "Unlike funding for HE which has for many decades been effectively a block grant, latterly including income contingent student tuition fees, funding for FE, VET and higher level vocational qualifications has experienced a plethora of complex and often confusing and contradictory regimes which not surprisingly often baffles small employers and even providers."[58]

Undertaking a higher apprenticeship requires drawing down funding from two different agencies – the Skills Funding Agency for the NVQ component (non-prescribed HE) and the Hefce for the foundation degree component (prescribed HE). Evidence submitted to the inquiry consistently highlighted this structural obstacle and the burdens it places on businesses.

This division between the funding agencies reflects wider problems that result from having two separate funding agencies responsible for HE and training. As the boundaries between traditional HE and other lifelong learning (such as professional development and higher level work-based learning) become more blurred, the Commission believes that these problems will become more acute[59].

In the short term, the expansion of higher apprenticeships – and the ability of employers to take on apprentices – will require a resolution to this funding issue. Asking employers to navigate complex bureaucratic structures such as these is an

56 Skills Commission, Progression through Apprenticeships (2009)
57 HM Treasury, Plan for Growth (2011)
58 Evidence submitted to the inquiry by the Association of Colleges (2011)
59 For a further discussion see Liberal Democrats, Investing in Talent, Building the Economy (2009)

unnecessary hurdle for them to overcome, particularly for SMEs – these touch points must become more employer friendly.

In the long term, the Government should examine the existing divide in funding structures and seek to merge the Skills Funding Agency and the Higher Education Funding Council for England. The Commission fully supports the conclusions of the Roe Review of Post-16 Education and Vocational Training in Scotland that funding for post-compulsory education of any type should be changed to avoid any discrimination between provision[60].

Recommendation 8

The Government should establish a single funding agency for post-compulsory education.

5.2 A learner-driven system

"Post-compulsory, and especially further and adult, education are characterised by complexity of demand – people want to study at different times, with different intensity, sometimes for short term employment reasons, sometimes for longer term or more developmental ones, sometimes to top up existing skills, sometimes to learn totally new ones.

The best way to ensure that individuals have access to the education and training they want and from which they can benefit is by putting the choice in their hands and providing subsidies that affect the prices they pay. Learning accounts provide a flexible, and entirely practicable, method of achieving this, and are especially well suited to short and intermittent purchases."[61]

In 2001 the Government trialled Individual Learning Accounts (ILAs) in England. Originally introduced by local Training and Enterprise Councils, the national scheme was designed to widen participation in learning and enable learners to overcome financial barriers to undertaking training. However, the scheme was quickly abolished later that year due to highly publicised cases of fraud and because demand for the Accounts outstripped available financial resources. In reviewing the scheme, however, the Education and Skills Parliamentary Select Committee recommended that while a more effective quality assurance framework would be required, a new robust version of Learner Accounts should be developed because of the clear benefits to learners and the economy[62]. Indeed, many commentators have suggested that if additional safeguards had been introduced, the scheme would still be in operation.

60 Scottish Government, Review of Post-16 Education and Vocational Training in Scotland (2011)
61 Professor Alison Wolf, An Adult Approach to FE (2010)
62 Education and Skills Parliamentary Select Committee, Individual Learning Accounts (2001)

> "… just because that system failed did not mean that Learner Accounts were a bad idea. If there had been a requirement that the funds made available could only be used for accredited courses at approved institutions ILAs would still be with us today, and it is a near certainty that there would have been hundreds of thousands more people who had engaged with some sort of worthwhile learning."[63]

There is now strong support for the establishment of Learning Accounts as a means to support skill and professional development[64]. Outlining the benefits, the Panel on Fair Access to the Professions concluded that they could enable a genuine demand-led system, giving individuals the choice to control learning in a flexible way, helping entry and progression into and through the professions[65].

In its skills strategy, the Government set out plans to introduce Learning Accounts as a mechanism to provide information about learning options and funding[66]. The Commission believes that the Government should go further and explore how it could develop Learning Accounts that place funding in the hands of the learner. This could mean limited match-funding, government subsidies, learner contributions or employer contributions. Whatever the funding method, the Commission believes that Learner Accounts could and should be central to the Government's ambitions to create an authentically user-driven lifelong learning system. Dynamic funding mechanisms such as this will be vital if lifelong learning is to keep pace with increasingly flexible labour markets. Individuals will require funding architecture that helps them re-train, paying for small chunks of learning and bite-sized provision – pay as you go learning. The potential benefits of pooling funding from other government departments – such as health and social care – into individual accounts is an important consideration for the long term.

To ensure they fulfill their potential these accounts must place cash in the hands of the learner:

> "We support the view that ideally funding for individuals should flow through a mechanism like Learning Accounts. Accounts can only be empowering however if they contain cash; and would be most useful if they could be used to support individuals borrowing and saving for learning as well as public subsidy. Accounts that are simply a record of learning undertaken or available are unlikely to add value."[67]

Learning Accounts have the potential to help stimulate more non-state investment in training. State investment in FE and HE has been reduced by approximately 25% for both sectors[68]. In the near future, it is unlikely that we will return to the levels of state funding that both sectors have enjoyed over the last 15 years. Learning Accounts could play a pivotal role in stimulating a new shared responsibility for investment in education

63 Andrew Sich, City and Guilds, Learner Accounts are Back in Favour, FE News, (2009)
64 For example, see 157 Group, Learner Accounts that Count (2010); NIACE, The Inquiry into the Future for Lifelong Learning (2010); Liberal Democrats, Investing in Talent, Building the Economy: Policies for Adult Further and Higher Education, February (2009); Mark Corney, Funding upskilling and reskilling in the 21st century (2009)
65 Final report of the Panel on Fair Access to the Professions (2010)
66 Department of Business, Innovation and Skills, Skills for Sustainable Growth (2011)
67 Written evidence submitted to the inquiry by the 157 Group
68 See HM Treasury Comprehensive Spending Review 2010 http://www.hm-treasury.gov.uk/spend_index.htm

and training, encouraging greater employer and individual investment, and developing a culture of learning as a series of progressive episodes, not a one-off activity.

As the Banks Review of Fees and Co-Funding suggested:

> "Learning Accounts should be a source of accurate and current information, they should tell an individual or employer what they need to know about a course, including the learner or employer co-investment contribution, the total price, any eligibility for fee remission and means of accessing financial assistance. They should ultimately, however, be much more than a source of information…From the point of view of the funding process, they should become the vehicle through which a private co-investment contribution triggers the college or training provider receiving the Government co-investment contribution for that learner."[69]

Learner Accounts could also act as a vehicle through which incentives for STEM education and training could be delivered. The Commission supports the recommendations of the Roe Review to use Personal Development Accounts as a means to do this. Commenting on this model, the Review states:

> "The Personal Development Account system proposed would not be a 'product' or a 'programme' which fills a gap in the education or training landscape, but a vehicle to help bring about system change across the post-16 landscape.
>
> The model could, for example, be designed to ensure that public investment were prioritised…in strategic sectors such as STEM subjects, low carbon and resource efficient technologies, bioscience and creative industries…[and in occupations] experiencing significant skill shortages, for example care assistants, manufacturing technicians, mechanical engineers…"[70]

Recommendation 9

The Department for Business, Innovation and Skills should examine how Learner Accounts can:

- Act as a mechanism to empower learners and enable them to make choices about when, what and how they learn.
- Stimulate more non-state investment in technician and higher level skills.
- Help facilitate the development of a lifelong learning Credit and Accumulation System.
- Be used to incentivise STEM provision.

69 Chris Banks, Independent Review of Fees and Co-Funding in Further Education in England (2010)
70 Scottish Government, Review of Post-16 Education and Vocational Training in Scotland (2011)

6. THINK SMALL

Key points

- Government must rethink and redesign how it works with SMEs.
- Large firms should play a bigger role in the skills system.

6.1 Training for SMEs

Small and medium sized enterprises (SMEs) are a key driver of economic growth, employing 13 million individuals and creating 65% of new jobs. In its Plan for Growth, the Government outlined a range of policies targeted at SMEs, including rate relief, R&D tax credits, and support for developing into overseas growth markets[71]. More recently, additional funding for advanced and higher apprenticeships has been targeted at SMEs[72].

Research suggests that SMEs train less than larger companies. Previous Workforce Employment Relations Surveys found that 24% of small businesses gave off-the-job training, significantly less than among larger firms[73]. There are complex reasons as to why some SMEs do not train at the levels seen in other companies – it is not simply a lack of ambition. SMEs often struggle to train because they lack economies of scale and the costs and risks of training, for example recruiting an apprentice, are significant and can disrupt their day to day business activity. Smaller firms therefore require something very different from government and its agencies. Recent difficulties associated with the Work Programme and prime contracting illustrate the tension between efficient and cheaper central government and SME friendly government architecture. The vital role that SMEs play in our economy, both its immediate recovery and long-term growth, necessitates new forms of assistive architecture that can support SMEs to train at higher levels and in technician related disciplines. Part of the answer may be to find ways for smaller firms to align skills policy more closely with wider business development strategy, but key to this issue must be utilising supply chains by developing formal or informal training models between larger firms and their suppliers.

Supply chains

In many industries larger firms rely on the quality of smaller firms throughout their supply chains. The quality of training in SMEs is therefore a key concern for larger firms. However, without the profile to attract high quality trainees, and without the resource to develop their own in-house training schemes, smaller firms can often struggle to attract the type of employees they need.

Commenting on this issue within the engineering sector, Sir John Rose has said:

> …on balance our main concern for the engineering sector relates to the ability of smaller companies to secure the talent they need. They have a lower profile in the recruitment market and have fewer resources to address gaps in the skills and experience they find in the graduate market.

71 HM Treasury, Plan for Growth (2011)
72 See the Higher Apprenticeship Fund http://www.bis.gov.uk/news/topstories/2011/Jul/higher-apprenticeships-fund.
73 See http://webarchive.nationalarchives.gov.uk/+/berr.gov.uk/whatwedo/employment/research-evaluation/wers-2004/index.html

> "The larger UK companies like Rolls-Royce need their supply chains to have the right mix of skills and experience. The new Rolls-Royce apprenticeship academy that will 'over train' to feed the supply chain with suitably qualified apprenticeships is the start of what needs to be a wider Government initiative to increase skill levels in the UK's supply chains."[74]

The IT sector suffers from a similar issue and relies heavily on the multitude of micro, small and medium sized firms operating throughout the industry. Ensuring that these companies are populated by technicians and programmers that are skilled in the most up to date technologies is fundamental to the health of the sector, particularly as it faces rapid growth over the coming years – five times the UK average[75].

In evidence to the inquiry, Microsoft outlined how it relies on 30,000 companies across its supply chain. In response, it has developed a collaborative model of training delivery to help those companies overcome their lack of resource and financial barriers to training. By working collaboratively with both providers and e-skills (the Sector Skills Council for IT), Microsoft's programme acts as an intermediary between small firms and the skills system, helping SMEs to articulate their training needs and enabling the collaborative partnership to respond to this demand by overtraining – 3,000 over the last three years[76].

Previous policies, such as the Skills Pledge, have drawn attention to this type of inter-company training model, demonstrating how it can help articulate and aggregate demand and stimulate better training practices throughout whole supply chains and sectors. International comparisons also suggest that these models have been highly successful. In countries such as Austria and South Korea, companies have developed training strategies for their supplier network[77].

Recommendation 10

The CBI and Federation of Small Businesses should establish an independent employer-led taskforce to examine how large employers can work with their supply chains to facilitate more technician and higher level skills training in SMEs.

74 Oral evidence given by Sir John Rose to the Design Commission's inquiry into Design in Education (2011)
75 Evidence submitted to the inquiry by e-skills (2011)
76 See http://www.microsoft.com/uk/britainworks/bw_programinfo.aspx
77 Professor Ian Stone, Encouraging small firms to invest in training, UKCES (2010)

DATA APPENDIX

The supply of individuals with relevant STEM or STEM related qualifications.

Objectives and rationale

A key challenge to improving the development of technicians is the difficulty in tracking individuals as they progress through education and in to employment or unemployment. Not being able to directly assess what happens to an individual after they have undertaken an educational episode, or to reliably analyse what is the educational and/or employment experience of those embarking on a specific instance of education makes it very difficult to accurately assess the benefits of any educational initiative.

The aim of the data appendix is to illuminate technician development using existing data sources on qualification achievement.

Recognising that longitudinal data are not available that cover the full spectrum of the learner's journey, the appendix describes what qualifications people are achieving at each of the main phases of education, where they are obtaining these qualifications both geographically and in terms of different providers, and how the people differ in gender, ethnicity and socio economic status. It is hoped that the data presented will provide the reader with the context within which technician development currently occurs as well as detail of this development.

Approach

Graphs and charts are used extensively as it is assumed that most readers find visual representation of data easier to assimilate than tables and figures. The graphs and charts are supplemented with brief descriptions highlighting the key figures and summarising the main findings.

The report is structured by the main phases of education relevant to technician development, with a final section providing some international comparisons.

Section 1: STEM at the end of Compulsory Education
Section 2: Post 16 achievements in STEM at Levels 2 and 3
Section 3: Achievements in Level 4 and Level 5 qualifications in S, T, E, M
Section 4: International comparisons

Notes on the analyses and data sources are provided at the beginning of each section.

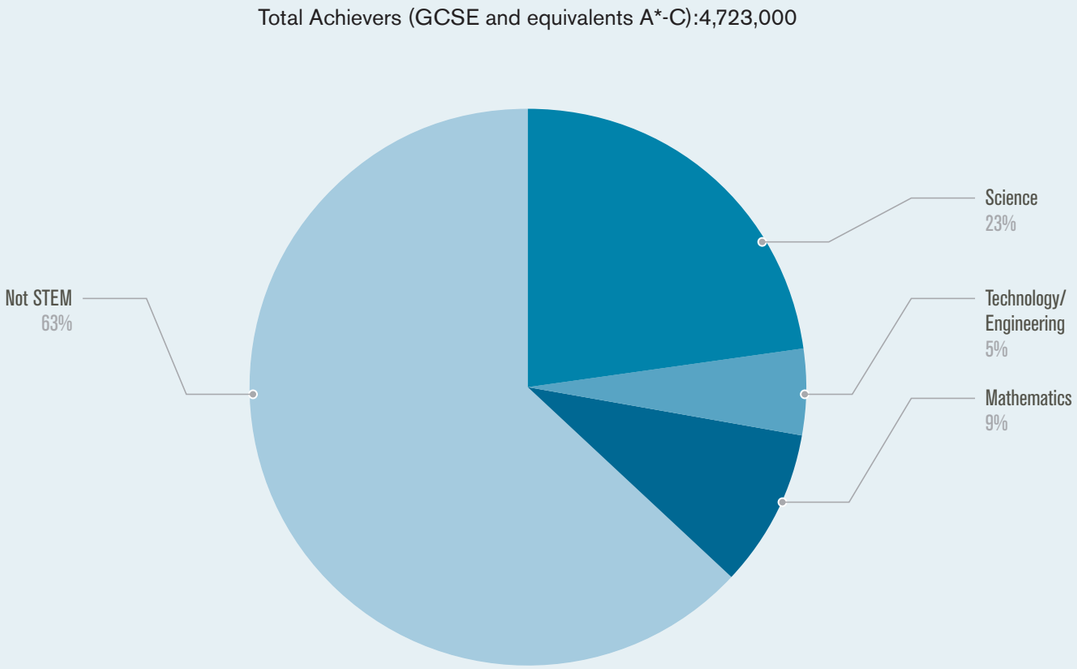
Section 1
S, T, E, M at the end of compulsory education (Key Stage 4)

- Compulsory education should provide young people with a foundation from which they can build their skills and become employable.
- Developing a knowledge base in STEM subjects is recognised as key, with achievement in Mathematics at Level 2 being integral to national assessments of educational performance. Achieving the equivalent of 2 GCSEs in Science subjects is also separately monitored.
- This section examines the extent to which young people are leaving school with these subjects.

Notes on the analyses

- The data are from the National Pupil Database and KS4 Attainment tables for all schools in England in 2009/10.
- The classification developed for the FE STEM data project has been used to identify STEM qualifications at pre 16.
- The analyses of the geographic distribution of qualification achievement are based on Local Education Authorities. While these no longer exist, they are the unit of analysis of the Department for Education, therefore when analysing data from schools they are the default unit of choice.
- Throughout the report 'Achievements' or 'Achieves' (the two are synonymous) have been used as the output measure. In this section an 'Achievement' indicates the individual has attained A*-C grade (or its equivalent) in the qualification they took.
- Where figures are used they have been rounded to the nearest 100.

Figure 1.1 Proportion of Level 2 qualifications at end of compulsory education (end of KS4) that can be classified as STEM (England 2009/10)



Notes on Figure 1.1

- Approximately 1.75 million qualifications, 37% of the total number of Level 2 (e.g. GCSE grade A*-C) qualifications achieved by pupils at the end their compulsory education are in STEM subjects, the majority being in Science subjects.
- Or in terms of pupil numbers:
  - Each year over 550,000 young people achieve qualifications at Level 2 at the end of their compulsory education; 580,000 in 2009/10.
  - The majority will have achieved 8 or more GCSEs or equivalent qualifications at A*-C grade (or equivalent) and typically 3 or more of these will be in STEM subjects.
- They are, therefore, well equipped to pursue further education and training to become Technicians, if they so wish.
- There are however, significant variations within this overall positive picture.

Figure 1.2 Differences in S, T E, M achievements due to gender, ethnicity and socio-economic status across all school types in England (2009/10)

GENDER	Achieved less than 2 Science A*-C incl BTECs, etc.	Achieved 2+ Science A*-C incl BTEXs, etc.
Females	36%	64%
Males	40%	60%
	Did not achieve 1+ Engineering/ Technology	Achieved 1+ Engineering/ Technology
Females	68%	32%
Males	72%	28%
	Did not achieve 1+ Maths A*-C	Achieved 1+ Maths A*-C
Females	38%	62%
Males	40%	60%
	Did not achieve 1+ Science A*-C	Achieved 1+ Science A*-C
Females	38%	62%
Males	41%	59%
SOCIO ECONOMIC STATUS	Achieved less than 2 Science A*-C incl BTECs, etc.	Achieved 2+ Science A*-C incl BTEXs, etc.
Rest of population	31%	
FSM eligible - in any year	54%	46%
	Did not achieve 1+ Engineering/ Technology	Achieved 1+ Engineering/ Technology
Rest of population	65%	35%
FSM eligible - in any year	82%	18%
	Did not achieve 1+ Maths A*-C	Achieved 1+ Maths A*-C
Rest of population	30%	70%
FSM eligible - in any year	58%	38%
	Did not achieve 1+ Science A*-C	Achieved 1+ Science A*-C
Rest of population	32%	68%
FSM eligible - in any year	62%	38%

ETHNIC GROUP	Achieved less than 2 Science A*-C incl BTECs, etc.	Achieved 2+ Science A*-C incl BTEXs, etc.
not known	38%	62%
Any Other Ethnic Group	39%	61%
Asian	35%	65%
Black	42%	58%
Chinese	19%	81%
Mixed	39%	61%
Unclassified	42%	58%
White	38%	62%
	Did not achieve 1+ Engineering/Technology	Achieved 1+ Engineering/Technology
not known	70%%	30%
Any Other Ethnic Group	75%	25%
Asian	71%	21%
Black	80%	20%
Chinese	56%	44%
Mixed	73%	27%
Unclassified	72%	28%
White	69%	31%
	Did not achieve 1+ Maths A*-C	Achieved 1+ Maths A*-C
not known	52%	48%
Any Other Ethnic Group	37%	63%
Asian	33%	67%
Black	43%	57%
Chinese	9%	91%
Mixed	39%	61%
Unclassified	40%	60%
White	38%	62%
	Did not achieve 1+ Science A*-C	Achieved 1+ Science A*-C
not known	32%%	68%
Any Other Ethnic Group	45%	55%
Asian	40%	60%
Black	49%	51%
Chinese	20%	80%
Mixed	41%	59%
Unclassified	43%	57%
White	40%	60%

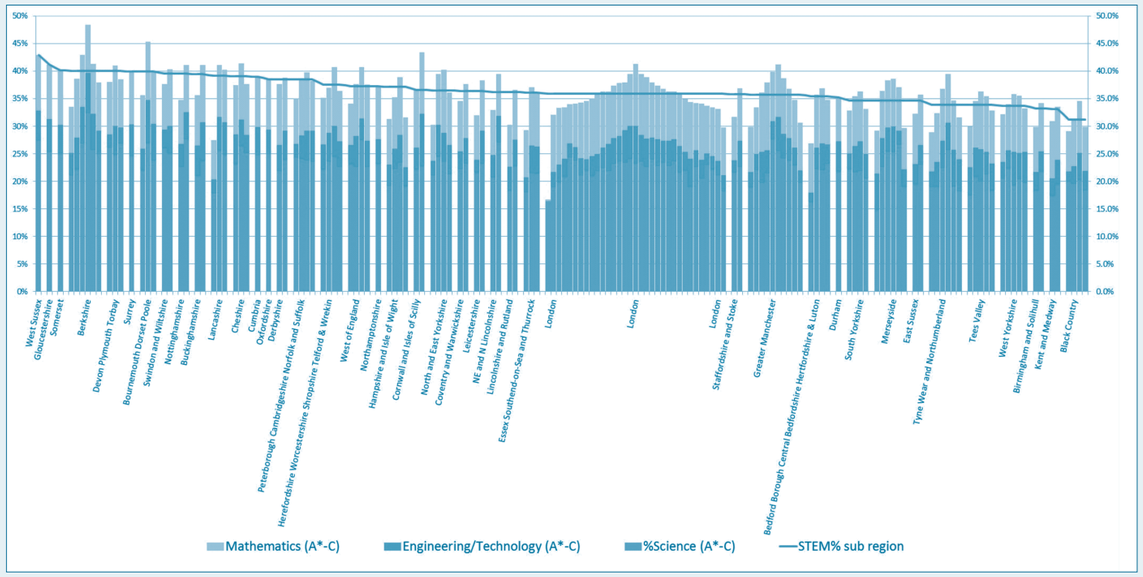
Notes on Figure 1.2

- Overall: Of those young people counted as taking Level 2 qualifications by the end of compulsory education:
  - Over 60% are achieving equivalent to A*-C grades in 2 or more Science GCSEs, when qualifications such as BTEC First Certificates or Diplomas are included;
  - Over 60% are achieving A*-C grade in GCSE Mathematics or equivalent qualifications;
  - Approximately 30% are achieving A*-C grade in Technology or Engineering, predominantly in IT and Design and Technology qualifications.
  - This does mean that over a third of young people are leaving school without a Level 2 STEM qualification.
- Gender:
  - There is little difference in the performance of males and females in STEM subjects, with females performing marginally better. This performance difference is in line with that found in other subjects.
- Ethnicity:
  - The performance of different ethnic groups is equally encouraging, with the 'Chinese' ethnic group having a particularly strong performance.
  - Only the 'Black' ethnic group and 'Unclassified' are performing consistently worse than the majority.
  - In particular, the 'Black' ethnic group is not achieving the same level of Science GCSEs as their peers.
- Socio-economic status:
  - The difference in performance is dramatic.
  - If pupils come from a socially deprived background (in terms of whether they have had Free Schools Meals at any point during their secondary education) they have nearly the same likelihood of not achieving a Level 2 qualification in a STEM subject as their peers have of achieving one.
  - The difference is most marked for Science GCSEs, where over 6 out of 10 pupils from socially deprived backgrounds fail to achieve any Science GCSEs A*-C.

Overall the conclusion is positive – by the end of compulsory education in England, the majority of pupils are sufficiently equipped to progress further in STEM, however the majority do not.
Note: The data include all schools types (including independent schools)

Figure 1.3 Distribition of the achievement of STEM qualifications at Key Stage 4 in England (2009/10)

Percent of achieved Level 3 qualifications that are in Science, Engineering/Technology and Mathematics qualifications against total number of qualifications achieved in each Local Authority (Dfe LEA) in a sub Region.



Notes on Figure 1.3

There is also substantial variation in the level of achievement in STEM qualifications dependent on where the pupil attends school.

- The number of STEM qualifications achieved as a proportion of total number of qualifications achieved at Level 2 in a sub region varies from 43% to 31% (indicated by the purple line): Pupils are up to one third more likely to have a STEM qualification as part their achievements depending on which part of the country they go to school.
- The variation in STEM achievement is often as great within a sub region as that between sub regions. For example in Lancashire, where overall the proportion of qualifications achieved in STEM subjects is higher than the national average at 39%, there is one LEA where only slightly more than a quarter of the qualifications achieved are STEM qualifications.
- Most of the variation is due to the variation in the proportion of Science qualifications being achieved. This is to be expected given the mandatory character of Mathematics at Level 2, and the relatively low numbers of pupils taking Engineering/Technology qualifications, not withstanding that in all but one LEA pupils achieved Level 2 qualifications in Engineering/Technology subjects.

There are a number of possible reasons for this variation.

- A positive reason is that the variation reflects the numbers of qualifications being achieved by pupils: those sub regions and LEAs with low STEM proportions are because pupils in these areas are achieving more qualifications overall than in the other regions.
- An equally plausible reason is that the variation reflects the socio-economic status of pupils. There appears to be some evidence for this given the ordering of the sub regions. However, for this to be valid it would mean that not only are poorer pupils achieving fewer STEM qualifications, but they are achieving disproportionately fewer STEM qualifications out of the total number of qualifications they achieve.
- A further reason is the curriculum policy of the Local Authority or school. While the proportions are measured in terms of GCSE equivalents to control for the size of a qualification, if the school (or LA) actively encourages students to take alternatives to the separate science GCSEs, then this can increase the proportion of STEM achievements. Evidence for this can be seen in the variation in proportions of Engineering/Technology qualifications achieved in the LEAs of a sub region.
- The variation is most likely to be a combination of these factors.

These data are based on the proportion of STEM achieved against the total number of qualifications achieved. The pattern of variation is similar for proportion of STEM achieved against total number of qualifications entered. However, the order is different both at sub region and LA levels. This leads to the conclusion that not only are there parts of the country where pupils take (and achieve) fewer STEM qualifications out of all the qualifications they take, but locations are different from those where pupils have a higher or lower failure rate in STEM qualifications.

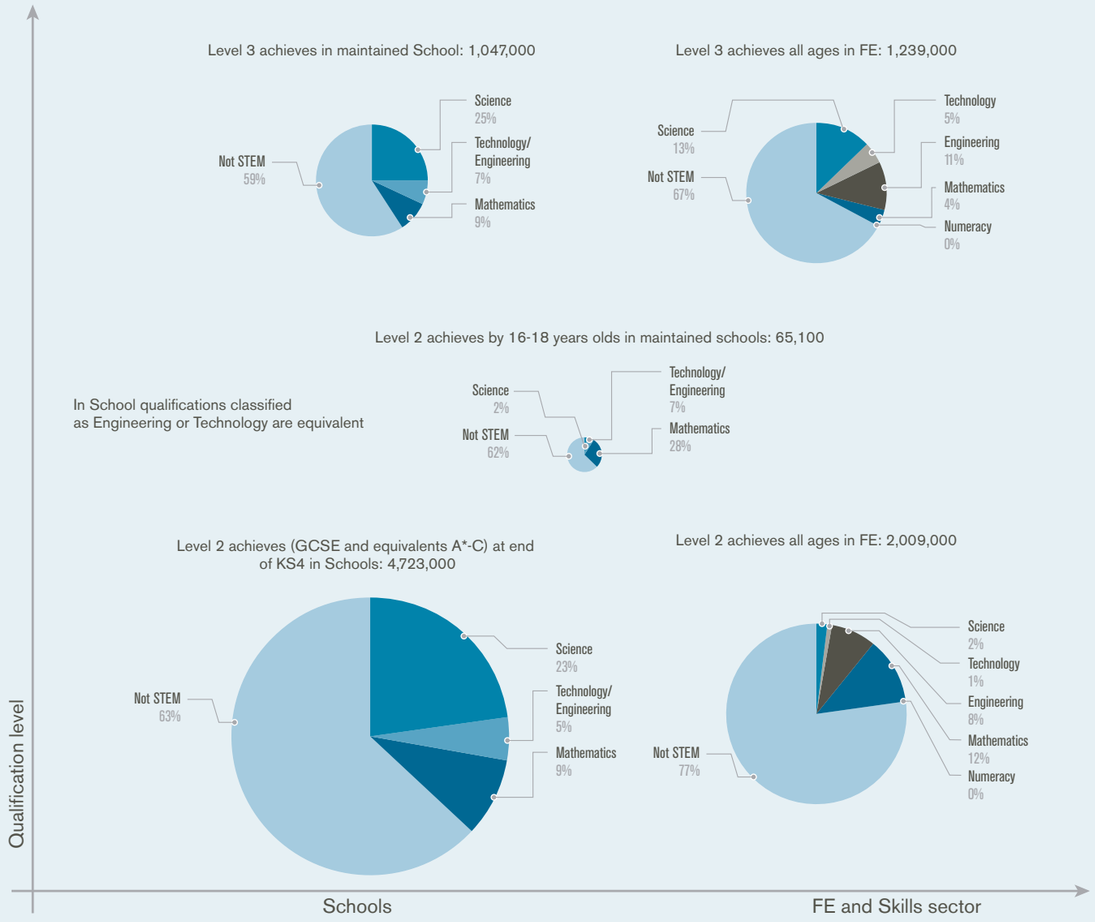
Section 2
Post 16 achievements in S, T, E, M at Levels 2 and 3

- Attainment at Level 3 (e.g. GCE A levels) is seen as key to Technician progression as well as wider progression in STEM (FE STEM Data project).
- The analysis examines attainment at this level for both 16-18 years and adults across schools and the FE and Skills sector and across other types of provision.
- The analysis starts by examining the proportions of STEM achieved at Level 2 as well as Level 3 in the post 16 sector and compares this with Level 2 achievement in compulsory education.
- The analysis of Level 4 and above qualifications is limited by the lack of qualifications at these levels being taken in these sectors.

Notes on the analyses

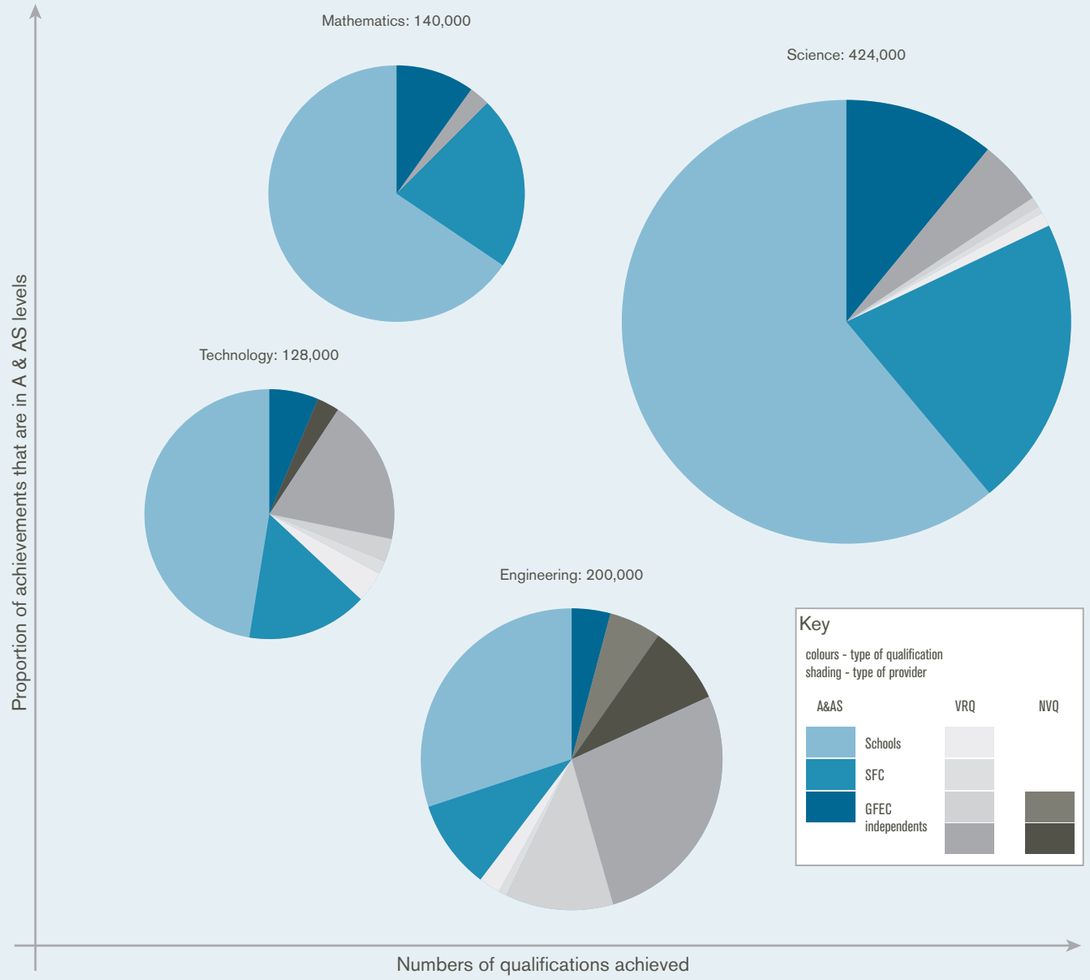
- While the majority of Level 3 qualifications are taken by 16-18 year olds, a number are also taken by adults, so the analyses includes all individuals.
- Level 3 qualifications are taken in schools and the FE and Skills sector, which includes General Colleges of Further Education (GFEC), Sixth Form Colleges (SFC), Specialist Colleges and independent training providers (including employers). As only a very limited amount of Level 3 qualifications are provided by Higher Education institutions, this provision has not been identified separately.
- Due to the variety of qualifications taken in post 16 education and mix of qualifications taken by learners, it is difficult to analyse the data at the level of the individual. For example, how many qualifications and at what level would a learner have to take to be regarded as a STEM learner? Therefore, the data is analysed at qualification level.
- The FE and Skills data are taken from the ILR. The majority of the analyses are based on those performed for the FE STEM data project.
- The Schools data are taken from the National Pupil database and the schools Key Stage 5 extract (S05) from the Schools Attainment data.
- Throughout the report 'Achievements' or 'Achieves' (the two are synonymous) have been used at the output measure. In this section an 'Achievement' indicates the individual has achieved a pass grade in the qualification in question, e.g. E grade for A levels.
- Where used figures have been rounded to the nearest 100.

Figure 2.1 Achievements in Technician relevant qualifications in Schools and the FE and Skills sector in England (2009/10)



Notes on Figure 2.1
While not strictly a bubble chart, the pie charts have been adjusted so that their areas represent the volume of qualifications achieved. The chart illustrates that:
- The volume of Level 2 STEM qualifications (e.g. GCSEs A*-C) achieved by pupils in compulsory education (bottom left) is greater than that achieved by post 16 pupils even when Level 2 and Level 3 achievements are combined. This may suggest that compulsory education has greater leverage to increase the numbers of young people obtaining qualifications necessary for Technicians.
- Notwithstanding the volumes achieved in compulsory education, the numbers of Level 2 STEM qualifications obtained in FE and Skills sector (bottom right) is substantial. Many of these qualifications are achieved by adults returning to education to obtain the qualifications they failed to achieve in compulsory education.
- The policies of rewarding providers and learners for achievement of Level 2 qualifications may have had an influence on these volumes.
- It is of note that this is the only population of learners where the proportion of STEM achievements falls below 30%.
- The numbers of learners using schools to obtain further Level 2 qualifications in STEM (bottom middle) are minor.
- At Level 3 the two sectors make roughly equal contributions to STEM achievement at approximately 400,000 qualifications, and it should be noted that the data do not include independent schools. The pattern of these contributions are, however, quite different, and this will be examined in greater depth subsequently.
- Overall the numbers of Level 3 qualifications being achieved are approximately a third of the achieved Level 2 qualifications. However, due to the different proportions of STEM qualifications, the ratio of Level 3 STEM qualifications to Level 2 STEM qualifications is more favourable at 1: 2.5.
- If one adjusts for the differences in size of qualifications, given that Level 3 qualifications tend to be larger (e.g. an AS level is twice the size of a GCSE), then the ratios reduce even further.
- Therefore, there may not be the step change between Level 2 STEM achievement and Level 3 STEM achievement that first appears to be the case.

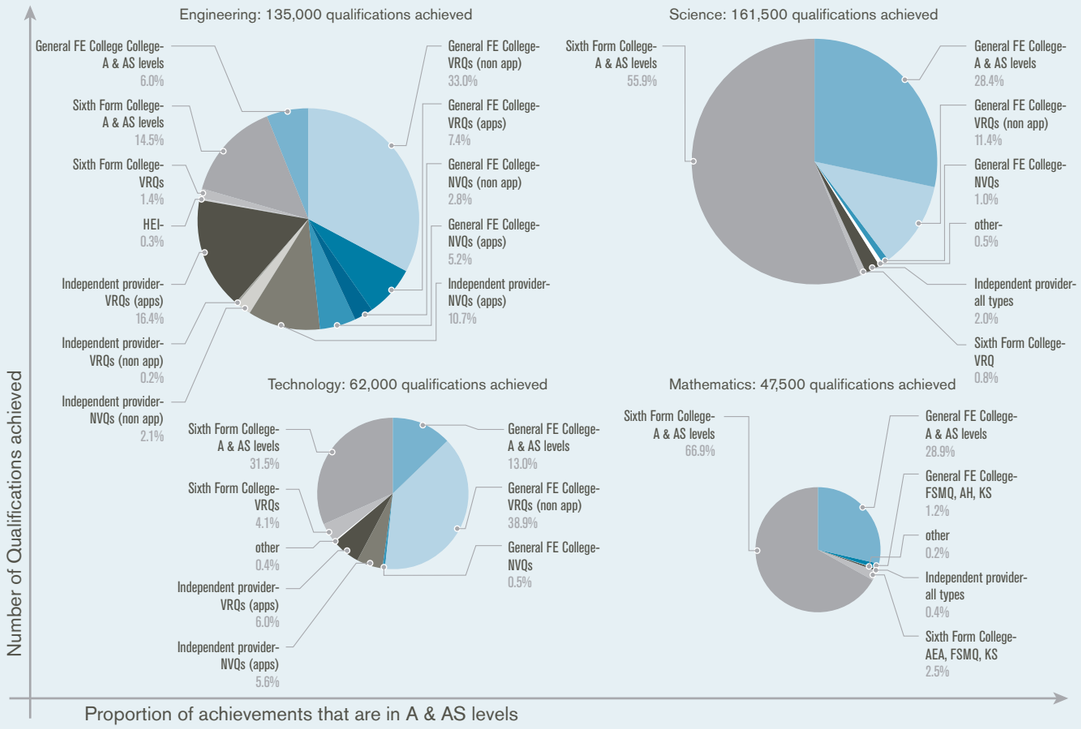
Figure 2.2 Types of publicly-funded STEM qualifications achieved at Level 3 in the different types of education providers in England (2009/10)



Notes on Figure 2.2
The pattern of STEM achievement at Level 3 is different for each of the areas of STEM and how and where it is provided:
- The number of Science achievements nearly equals the achievements in all other STEM areas, particularly when one takes into account the duplication between Technology and Engineering (due to qualifications being classed as both Technology and Engineering, mainly Computing and D&T A and AS levels).
- The profiles of Science and Mathematics are quite different from those of Engineering and Technology.
- Nearly all of Mathematics achievements at Level 3 are in GCE A and AS levels.
- Less than 50% of Engineering achievements are in GCE A and AS levels, even when Computing and D&T A levels are included.
- There are an important minority of Level 3 Science achievements that are in VRQs taken mainly in General Further Education Colleges (GFEC)
- Students attending schools tend to take A level (and AS level) STEM subjects to the exclusion of nearly all other types of qualification. The mix is greater at Sixth Form Colleges (SFC), and far greater at General Further Education Colleges.
- Independent providers (including employers) are an important source of provision, particularly for Level 3 qualifications in Engineering.

The different patterns of progression and achievement are likely to have implications for the development of Technicians, in terms of the differences in audience and developmental paths depending upon the area of S,T,E,M.
Note: as the graphs have to be manually constructed the positioning of the 'bubbles' is approximate.

Figure 2.3 Types of publicly funded STEM qualifications achieved in Level 3 in the different education providers of the FE and Skills sector in England (2009/10)



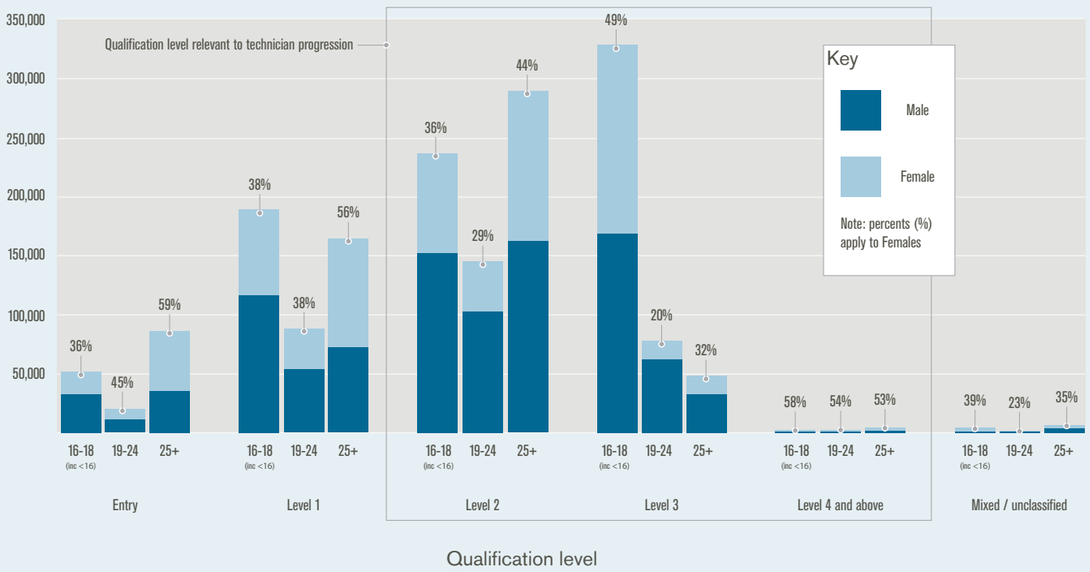
Notes on Figure 2.3
Given that STEM achievement in schools is nearly all in GCE A and AS levels, in examining the extent that information, advice and guidance may have on the development of Technicians, consideration must be given to the different types of qualifications achieved and where they are achieved.
The patterned areas of each pie chart indicate qualifications achieved as part of an apprenticeship (apps)
- The vast majority of Engineering qualifications achieved at Level 3 are not GCE A or AS levels.
- Nearly half of the achieved qualifications in Engineering have been as part of apprenticeships.
- Nearly all of the qualifications taken with independent providers are taken as part of apprenticeships.
- The only other area of STEM to have substantial numbers of qualifications achieved through apprenticeships is Technology.
- As Mathematics and Science have little or no achievements through apprenticeships, this suggests apprenticeships at Level 3 may not be a viable route for Technician development in these areas.
- As 15% of the qualifications achieved in Science in the FE and Skills sector are not GCE A or AS levels, this may warrant further investigation: Are these qualifications valued by employers? Do they lead to progression in Science or STEM as whole?
- Even in the FE and Skills sector only 4% of achievements in Mathematics at Level 3 are not in A and AS levels. If Level 3 Mathematics is important to some types of Technician roles how will the individual obtain this capability if they do not take the A-level route?

Note: as the graphs have to be constructed manually, the positioning of the 'bubbles' is approximate.

Figure 2.4 The numbers of funded and non-funded Apprenticeships started in England in 2009/10

Notes on Figure 2.4
As in the previous charts the area of the pie charts are in proportion to the number of apprenticeships. In this chart 'Starts' have been used rather than Achieves as this makes the information more current and the numbers are more relevant, especially for Higher Apprenticeships. The chart illustrates that:
- 280,000 apprenticeships were started in 2009/10, and of these approximately 85,000 were in STEM subjects.
- The large majority of these were Intermediate (Level 2) apprenticeships (68%).
- Intermediate Apprenticeships are the main type of apprenticeship taken by all young people up to 24 years old (70%).
- Overall non STEM subjects are predominant (69%), but this reduces with Level, such that 16-18 years olds take more Advanced Apprenticeships in STEM subjects than in non STEM subjects, and this is nearly the case for 19-24 years olds.
- That 19-24 years are the largest group of starts for Advanced Apprenticeships is positive news for Technicians, as this indicates that both industry and education are willing to invest in non tertiary education of this age group if the right training and incentives are there.
- While Higher Apprenticeships are all STEM, they still form a very small proportion of the total apprenticeships started or achieved. Only 182 Higher Apprenticeships were achieved in 2009/10.
- Engineering is the dominant STEM subject in Apprenticeships for all ages, except for the small number of Higher Apprenticeships where Mathematics is the main subject, actually it is Accountancy (i.e. Accounting Technicians)
- That 25 years and older are taking the smallest proportion of STEM Apprenticeships at any level may be a concern, and reflects the increase in Retail based Apprenticeships.

Figure 2.5 Numbers of funded STEM qualifications achieved by key Age Groups and Females and Males in FE and Skills sector in 2009/10 by Qualification level



Notes on Figure 2.5

Not only are the types of qualifications and mix of STEM subjects taken in the FE and Skills sector different from those taken in schools, so are the characteristics of the people taking those qualifications.

- A key difference is the predominance of adults (19+ years old).
- Level 3 is the target qualification level for Technicians (at least as a minimum requirement). But only 14% of adults are achieving STEM qualifications at this level. It could be a major challenge to encourage adults to take the appropriate qualifications at this level.
- Engaging adult females could prove an even greater challenge given that currently only 7% of STEM qualifications at Level 3 are achieved by this group.
- While 16-18 year olds are achieving over 300,000 STEM qualifications at Level 3 in the FE and Skills sector, this still means 600,000 STEM qualifications are being achieved by young people at Level 2 and below.
- There are good reasons for the focus of the FE and Skills sector on Level 2 and below, such as:
- The re-engagement of those individuals who did not manage to obtain Level 2 qualifications in compulsory education;
- Providing opportunities for young people to pursue qualifications in specific vocational areas, where Level 2 qualifications are required to enter the workplace;
- Providing the opportunity for young people to 'backfill' skill gaps and/or gain the skills and qualifications needed to go on to further study (e.g. pre-apprenticeship training).

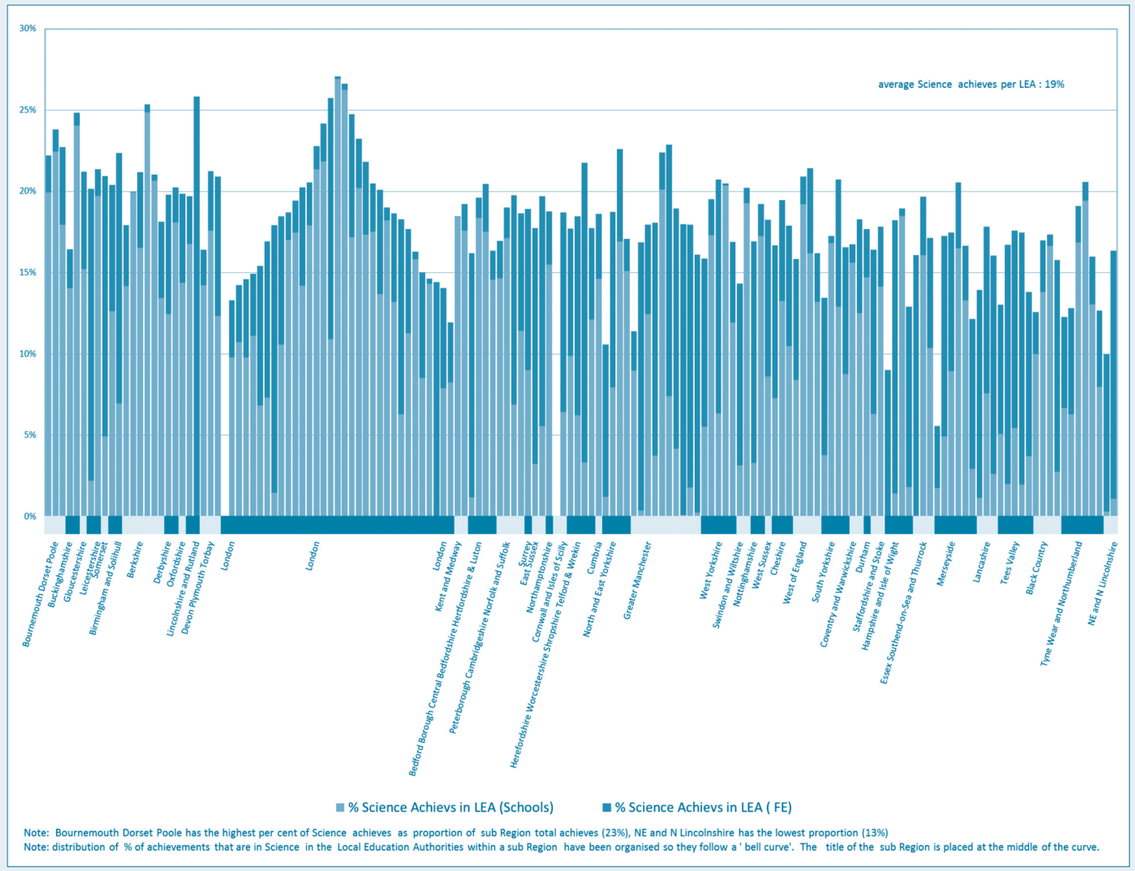
However, the balance does not seem to be that required to enable a substantial increase in the numbers of people who could progress to Technician roles.

One aspect of educational provision that could be key to the development of a Technician base is the 19-24 age group who are not in tertiary education.

- The difference in number of qualifications achieved by this cohort and the 16-18 year olds is striking, particularly when one considers that many of these individuals are still eligible for fee remission.
- It seems that while large numbers of individuals may be obtaining their Level 2 STEM qualifications when they are 16-18 years old, they are not then progressing to take Level 3 qualifications when they 19-24 years old.
- However, as there are relatively more 19-24 year olds achieving Level 3 STEM qualifications than there are in the main adult population, it still may be productive to target this age group.

Figure 2.6 Variation in the provision of funded Level 3 Science qualifications achieved by 16+ year olds in Schools and FE and Skills sector (England 2009/10)

Percent of achieved Level 3 qualifications that are in Science in each Local Authority in a sub Region (DfE LEA used for Local Authority)



Note: Bournemouth Dorset Poole has the highest per cent of Science achieves as proportion of sub Region total achieves (23%), NE and N Lincolnshire has the lowest proportion (13%)
Note: distribution of % of achievements that are in Science in the Local Education Authorities within a sub Region have been organised so they follow a ' bell curve'. The title of the sub Region is placed at the middle of the curve.

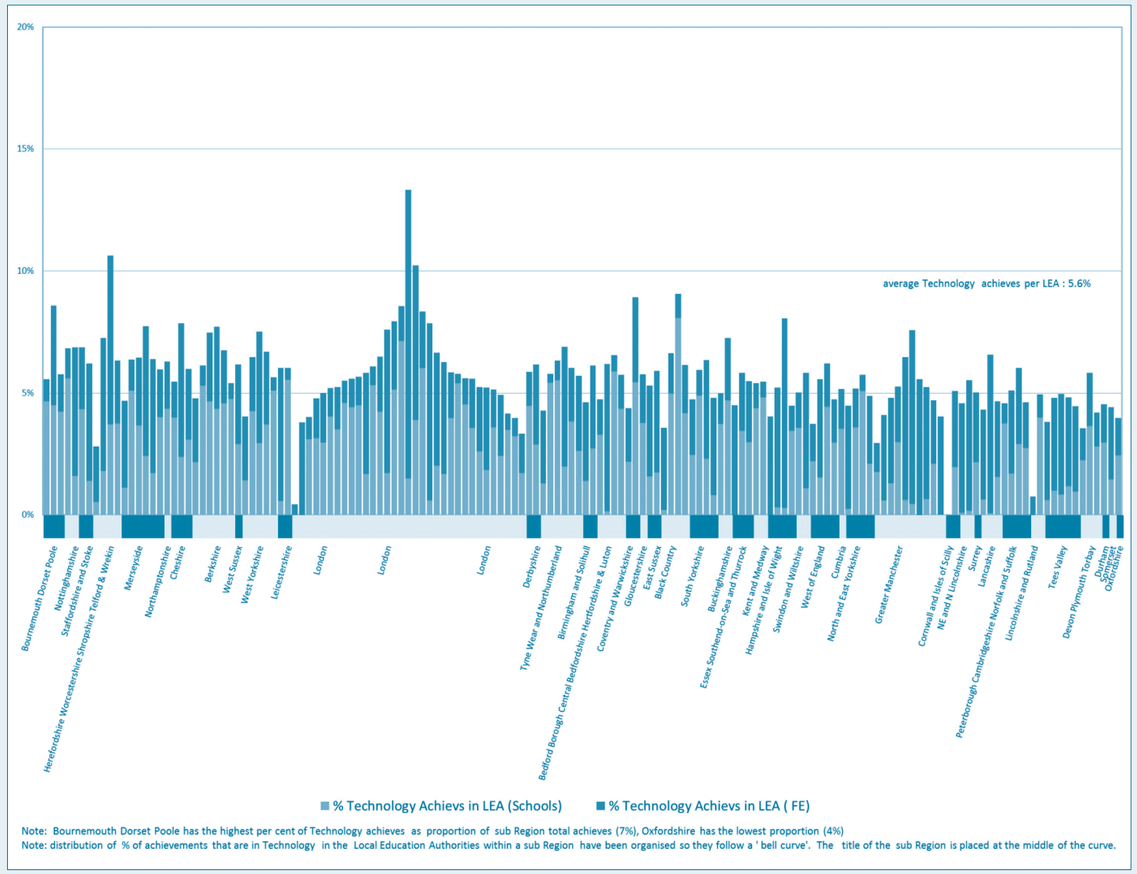
Notes on Figure 2.6

The next four charts show the geographic distribution of the proportion of achieved qualifications in a LEA that are in Science or Technology or Engineering or Mathematics. The graphs describe proportions of the S, T, E or M achievements for all post 16 provision whether in schools or the FE and Skills sector.
The LEAs have been grouped by their sub region, and the proportion of S,T, E or M achievement have been sub divided between achievements in schools and those in a FE and Skills provider. The blue line at the bottom is to help the reader identify which the LAs are in a sub region. The analysis has been performed on the core qualifications for each STEM area.
For Science:

- The proportion of Level 3 achievements that are in Science varies between sub regions from 23% to 13%. Given that the charts describes all achievements in a sub region, whether through schools or the FE and Skills sector is this two fold variation acceptable?
- There are some sub regions where the variation between LEAs in the proportion of Level 3 Science achievements is relatively low (e.g. Derbyshire), there are others where the variation is higher than the variation between sub regions (e.g. Merseyside, London).
- Where there are large differences between LEAs in the proportions of Science achievements, these differences are often greater than the total difference across the sub regions.
- There is not sufficient evidence to suggest that the proportion of Science achievements is related to type of provider.

Figure 2.7 Variation in the provision of funded Level 3 Technology qualifications achieved by 16+ year olds in Schools and FE and Skills sector (England 2009/10)

Percent of achieved Level 3 qualifications that are in Technology in each Local Authority in a sub Region (DfE LEA used for Local Authority)



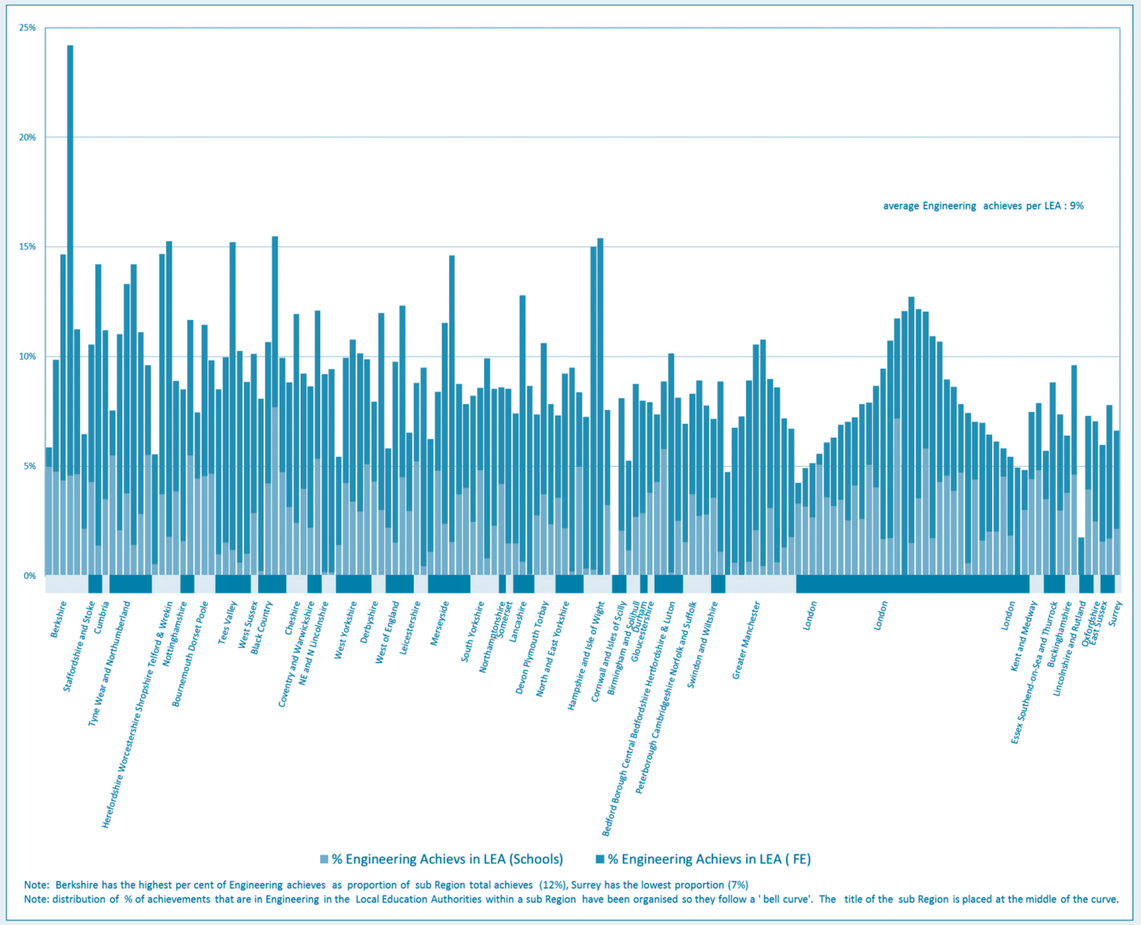
Note: Bournemouth Dorset Poole has the highest per cent of Technology achieves as proportion of sub Region total achieves (7%), Oxfordshire has the lowest proportion (4%)
Note: distribution of % of achievements that are in Technology in the Local Education Authorities within a sub Region have been organised so they follow a ' bell curve'. The title of the sub Region is placed at the middle of the curve.

Notes on Figure 2.7
For Technology
- While the overall proportions are lower than for Science, the variation between sub regions and between LEAs within sub region is still evident.
- The variation between sub regions is from 7% to 4% - nearly a two fold difference.
- In nearly all cases the variation between LEAs within a sub region is greater than the variation between the sub regions.
- There is strong evidence of concentration of provision within at least 6 sub regions (i.e. where the proportion of the S, T, E or M is 50% or greater than the national average). This concentration is higher than that observed for Science.
- There is little evidence that whether provision is in either schools or the FE and Skills sector that this influences the proportion of Level 3 achievements that are in Technology.

For further interpretation of the charts see the commentary with the Science chart: Figure 2.6.

Figure 2.8 Variation in the provision of funded Level 3 Engineering qualifications achieved by 16+ year olds in Schools and FE and Skills sector (England 2009/10)

Percent of achieved Level 3 qualifications that are in Engineering in each Local Authority in a sub Region (DfE LEA used for Local Authority)



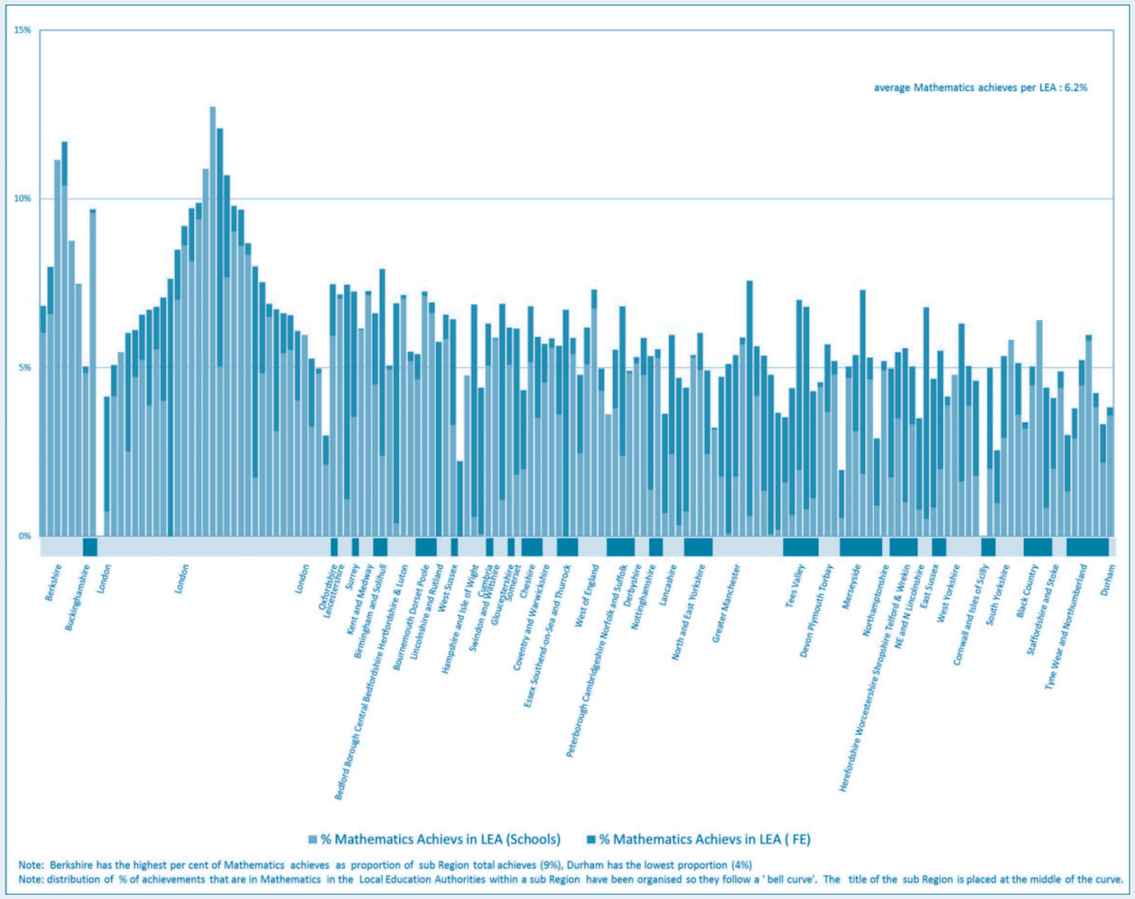
Note: Berkshire has the highest per cent of Engineering achieves as proportion of sub Region total achieves (12%), Surrey has the lowest proportion (7%)
Note: distribution of % of achievements that are in Engineering in the Local Education Authorities within a sub Region have been organised so they follow a ' bell curve'. The title of the sub Region is placed at the middle of the curve.

Notes on Figure 2.8
For Engineering:
- There is variation between sub regions in the proportion of Level 3 achieves that are in Engineering, from 12% to 7%, which is a similar ratio to Technology.
- The variation between LEAs in a sub region is greater than the variation between sub regions in nearly all cases.
- There is strong evidence of the concentration of provision in at least 5 sub regions.
- The dominance of the FE and Skills sector in providing Level 3 Engineering is clearly evident.

For further interpretation of the charts see the commentary with the Science chart: Figure 2.6.

Figure 2.9 Variation in the provision of funded Level 3 Mathematics qualifications achieved by 16+ year olds in Schools and FE and Skills sector (England 2009/10)

Percent of achieved Level 3 qualifications that are in Mathematics in each Local Authority in a sub Region (DfE LEA used for Local Authority)



Note: Berkshire has the highest per cent of Mathematics achieves as proportion of sub Region total achieves (9%), Durham has the lowest proportion (4%)
Note: distribution of % of achievements that are in Mathematics in the Local Education Authorities within a sub Region have been organised so they follow a 'bell curve'. The title of the sub Region is placed at the middle of the curve.

Notes on Figure 2.9
For Mathematics:
- There is variation in the proportion of total achievements at Level 3 in Mathematics, from 9% to 4%. This is the largest ratio of any of the S, T, E or M areas. Whether it is the differences in popularity of the subjects or students' performance, should achievement in Level 3 Mathematics have twice the incidence in one part of the country than another?
- Unlike for the other areas of STEM, the variation in the proportion of Mathematics achieved in different LEAs in the same sub region is often less than the variation between sub regions.
- Nevertheless, there is substantial variation between LEAs for at least half of the sub regions (e.g. the proportion in LEAs of Greater Manchester vary from 3% to 7.5%).
- There is less evidence of concentration of provision, but there are a number of LEAs where the proportion of Level 3 Mathematics achieved is nearly half the national average.
- The dominance in schools provision of Level 3 Mathematics is clearly seen.

For further interpretation of the charts see the commentary with the Science chart: Figure 2.6.

Why the graphs are important:

- If there were truly equal educational opportunities for all then the distributions should be relatively flat, as each LA is of sufficient size (except for the City of London and the Isles of Scilly) that they encompass normal variation of their population. As the proportions are the mean proportions they should converge to the overall population mean according to the central limit theorem.
- The fact that they do not converge is strong evidence that the variation is not random: there are systematic biases for each of S, T, E, M that influence whether an individual will achieve STEM.
- There are a number of potential sources of these biases:
  - Concentration of provision – the graphs indicate substantial concentration of provision within some of the sub regions in one or two LAs, and thus providers. This concentration is most apparent in Engineering, but exists for the other areas as well. Does concentration of provision, which is usually more efficient, impact on learner performance as well as learner choice? For example, travelling across a city or county has costs for the learner.
  - The socio economic conditions of the learners and their communities – is it just coincidence that the North East has the lowest level of achievement at Level 3 in Mathematics (less than half of the highest performers)?
  - The availability of resources - good S, T, E, M teachers may be unevenly distributed within a region, being attracted to strong departments that have a good reputation.
  - The impact of learners'/pupils' prior experience - while KS4 distributions are less due to the compulsory nature of Mathematics and Science provision, there is variation between LEAs within sub regions. So is there any relationship between the level of S,T,E or M achievements at KS4 and subsequent take up of S,T,E or M at Level 3?
- It is unlikely that the distribution reflects local employment demand because the variation exists in nearly all sub regions, and for large urban areas it would be difficult to contend that employers would not look to neighbouring LAs to obtain suitably qualified people.
- As this level of variation is not expected and applies to each of S, T, E or M, it could have a significant impact on the level of local adaptation required for any initiatives to enhance the development of technicians.

Section 3
Achievements in Level 4 and Level 5 qualifications in S, T, E, M

- The analysis is focussed on Level 4 and 5 qualifications obtained in HE institutions, given that very few of these types of qualifications are currently taken in the FE & Skills sector.
- The analysis examines trends in the achievement of all Level 4 and 5 qualifications separately for Science, Technology, Engineering and Mathematics and Medicine.
- The few Level 3 qualifications in Medicine and related areas had been included in Science, but given the large number of qualifications in these areas at Levels 4 and 5 it seemed prudent to analyse them separately.
- The analysis of the overall provision of Level 4 and 5 qualifications is followed by an subject level analysis of the qualifications for each of the areas of STEM.

Notes on the analyses

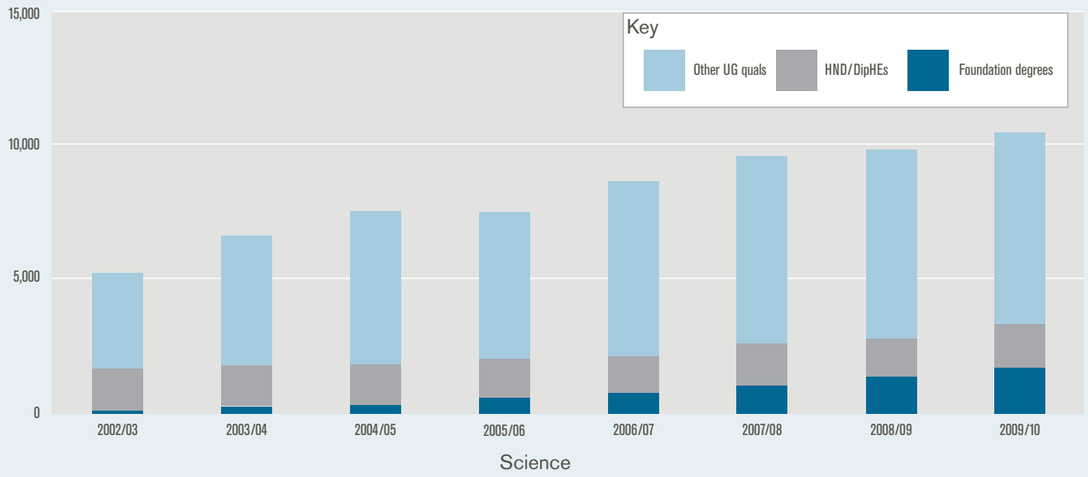
Access to HE data for this report has been restricted to publicly available data. This constraint has meant that it has only been possible to perform limited analysis of the qualifications and subject combinations:

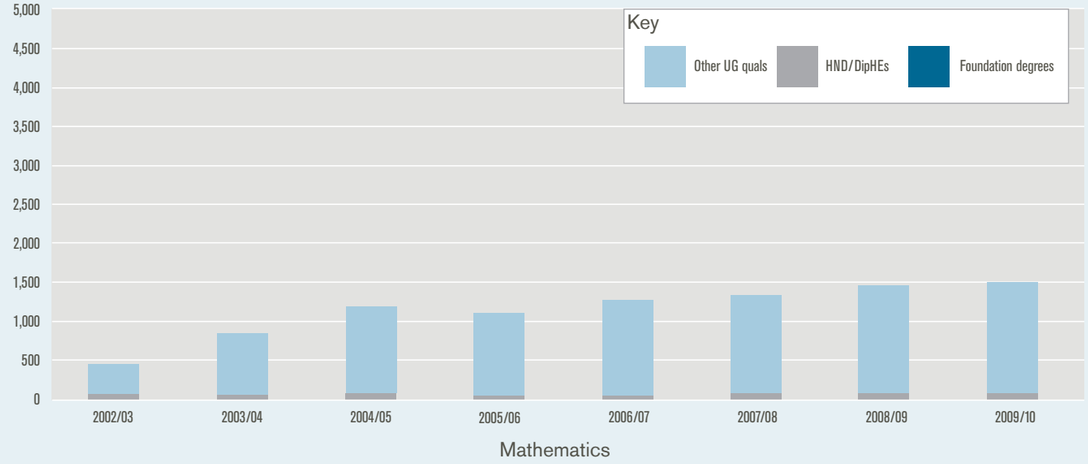
- No learner demographic data is available at this level of detail.
- It is not possible to distinguish between HNDs and DipHEs in the data, however given the characteristics of the subjects assigned to STEM it is more likely that HND/DipHEs in Technology and Engineering are HNDs and DipHEs for Mathematics.
- It is not possible to distinguish the type of qualifications in the category 'Other Undergraduate qualifications' (Other UG quals), however, information from HESA describes HNCs and Level 4 and Level 5 NVQs are included in this category.

Classification of Subjects

- In the FE STEM data project the distinction had been made between qualifications directly supporting progression in an area of STEM and qualifications that could aid progression but are not sufficient in themselves to directly support progression. These latter qualifications were labelled S, T, E or M 'related'.
- In the analysis of Level 2 and Level 3 qualifications this distinction was avoided as in nearly all cases the analysis was only of those qualifications that directly supported S, T, E or M progression.
- In the assignment of the HE classification of subject (JACS) into Science, Technology, Engineering, Mathematics or Medicine, the more narrow criteria have been used. This has allowed subjects and thus qualifications to be unambiguously assigned to Science, Technology, Engineering, Mathematics or Medicine such that there is no overlap between the areas.
- The disadvantage is that the method of assignment has the potential to under count the number of relevant subjects and qualifications.

Figure 3.1 Numbers of Level 4 and Level 5 qualifications in Science and Mathematics achieved in HE institutions from 2002/03 to 2009/10 by qualification type

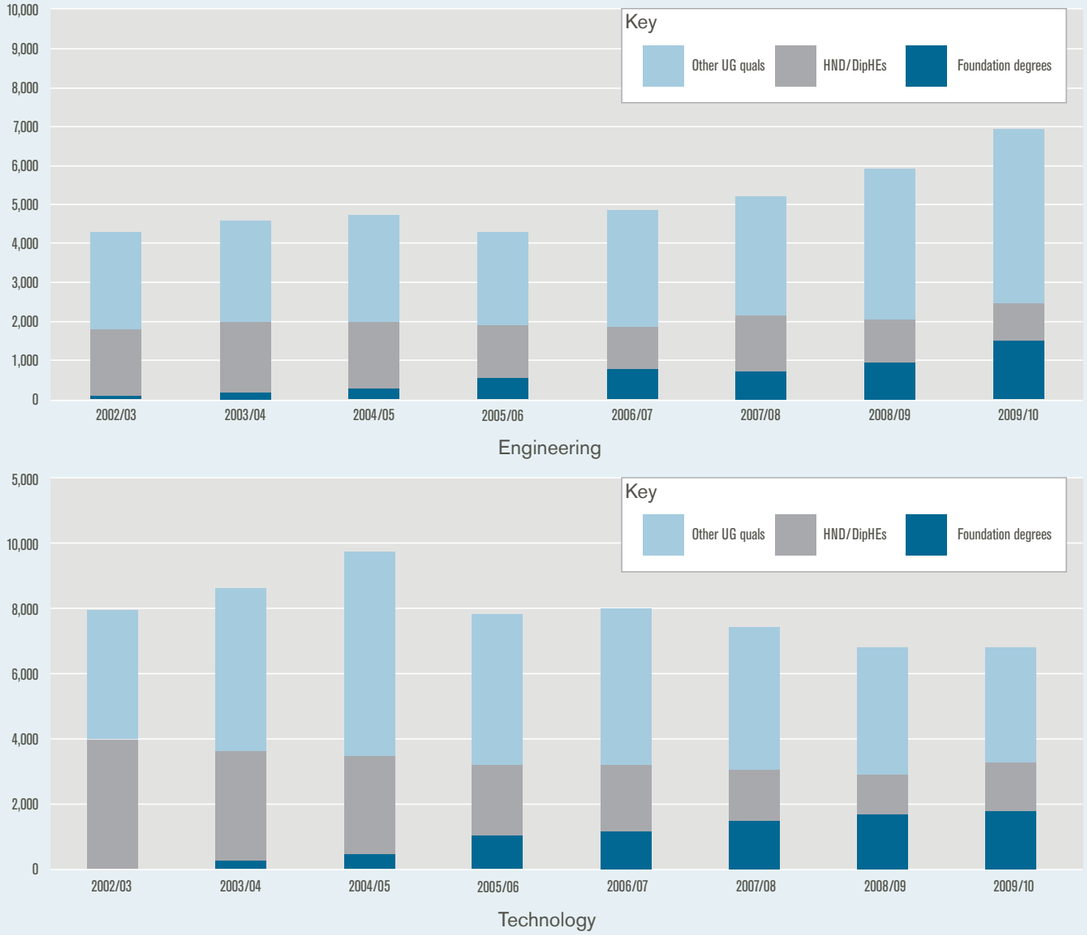




Notes on Figure 3.1

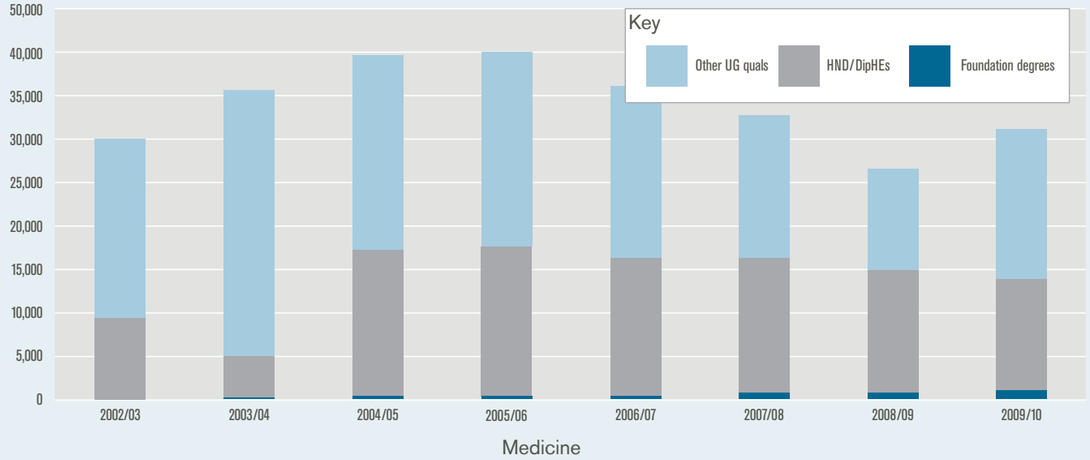
- For both Science and Mathematics there has been a two fold increase in the numbers of Level 4 and 5 qualifications achieved in HE institutions between 2002/03 to 2009/10.
- The numbers in Mathematics are, however, a magnitude lower than those in Science.
- This increase has been primarily in other undergraduate qualifications (e.g. Other diplomas and certificates as well as HNCs).
- There has been an increase in Foundation Degrees in Science; to the extent their numbers equal the combined numbers of HNDs and DipHEs.
- The numbers of HNDs/DipHEs achieved each year in Science subjects has remained relatively unchanged over the period.
- The numbers of HNDs/DipHEs achieved each year in Mathematics has also remained constant but at a very low level.

Figure 3.2 Numbers of Level 4 and Level 5 qualifications in Engineering and Technology achieved in HE institutions from 2002/03 to 2009/10 by qualification type



Notes on Figure 3.2
The patterns for Engineering and Technology are quite different from those for Science and Mathematics.
- While there has been an increase in the numbers of Level 4 and Level 5 qualifications achieved in Engineering over 2002/03 to 2009/10, the rise has been less dramatic with a 55% increase, approximately.
- For Technology subjects the numbers have actually declined over the same period.
- In both cases the number of HNDs/DipHEs achieved has declined over the period and is most marked for Technology with a four fold decline. Nevertheless, there has been over a two fold decline in the number of HNDs/DipHEs achieved in Engineering.
- Both Engineering and Technology have also had a substantial increase in the number of Foundation Degrees being achieved in their subjects, which for Engineering has offset the decline in HNDs.

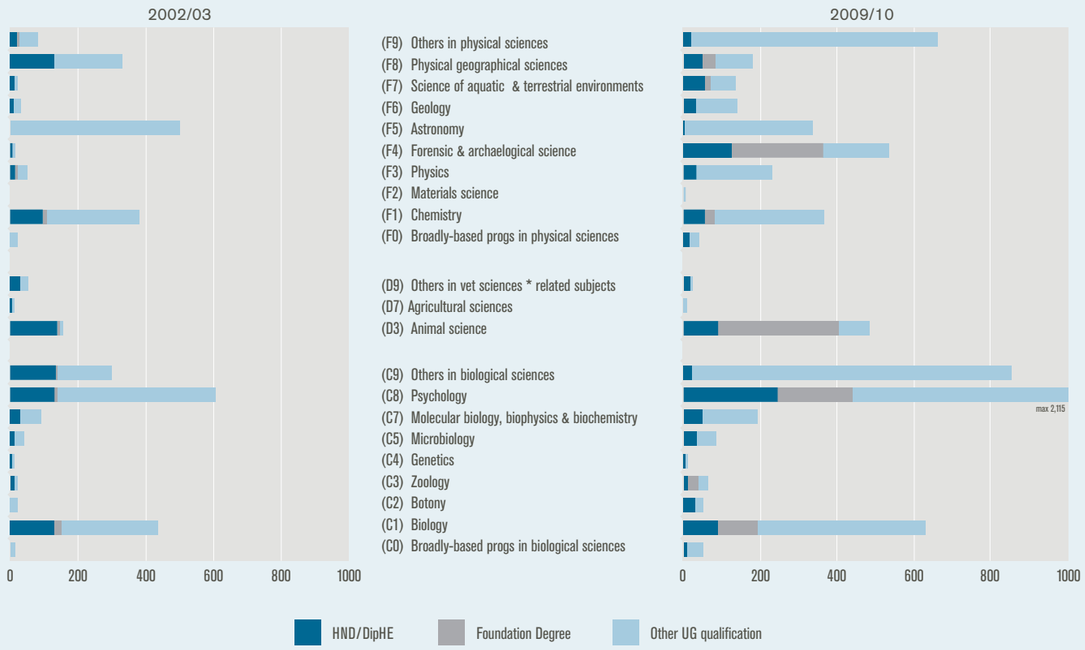
Figure 3.3 Numbers of Level 4 and Level 5 qualifications in Medicine achieved in HE institutions from 2002/03 to 2009/10 by qualification type



Notes on Figure 3.3
The pattern of Medicine qualifications achievement is substantially different from any of the other STEM areas, and reinforces the decision not to include Medicine in Science.
- The numbers of qualifications achieved are greater than the rest of S, T, E and M combined.
- A substantial proportion of the Level 4 and Level 5 achievements are in HNDs/DipHEs and for two years they form the majority of achievements.
- The majority of the HNDs/DipHEs are likely to be DipHE for nursing.
- The HE data for 2003/04 seems to be out of line with the other years, as there is a significant decline in HND/DipHE for this year but a substantial increase in other undergraduate Level 4 and 5 qualifications, with this pattern being reversed in the subsequent year.
- The take up of Foundation Degrees is also far less than for the other STEM areas.
- Medicine also exhibits a more marked decline in achievements at Levels 5, in contrast to increase or marginal decline for the other STEM areas.

These differences may well reflect the very strong governance of medicine by the professional bodies that impose a clear distinction between the professional roles and levels.
This markedly different pattern of achievements across the years, suggests that Technician development may need to be different for Medicine and associated subjects.

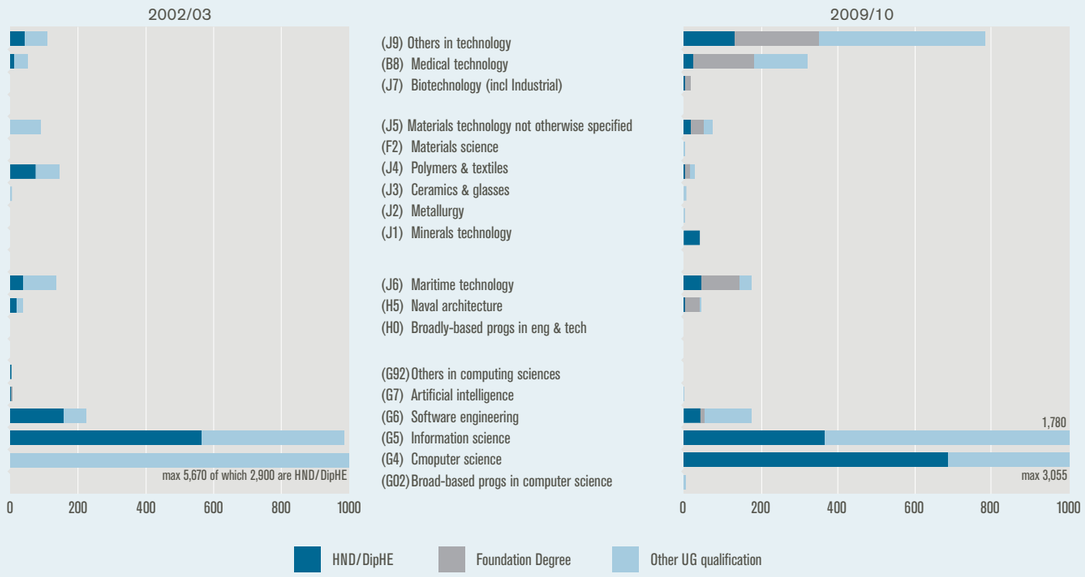
Figure 3.4 Numbers of Level 4 and Level 5 qualifications in Science subjects achieved in HE institutions in 2002/03 and 2009/10 by qualification type



Notes on Figure 3.4
The subject level analysis compares the profile of subjects and qualification types achieved in 2002/03 and the profile in 2009/10. A subject level analysis allows more detailed investigation of the growth or decline of achieved qualifications at Levels 4 and 5. A detailed subject analysis was not performed for Medicine.
For Science:
- There has been growth in the number of achievements for most subjects.
- Psychology, Biology, others in Biological Sciences, Forensic, other Archaeological Science, other Physical Sciences, and Animal Science provide the majority of growth.
- It is also these subjects where there has been the greatest growth in Foundation Degrees.
- Even some of the Natural Sciences have seen growth: there has been a near five fold increase in numbers of achievements in Physics over the period, with an increase in the numbers of HNDs in Physics being achieved.

Note: The numbers on the bars indicate the number of achievements in that subject for all qualifications. This notation is used when the bar exceeds the scale of the graph

Figure 3.5 Numbers of Level 4 and Level 5 qualifications in Technology subjects achieved in HE institutions in 2002/03 and 2009/10 by qualification type

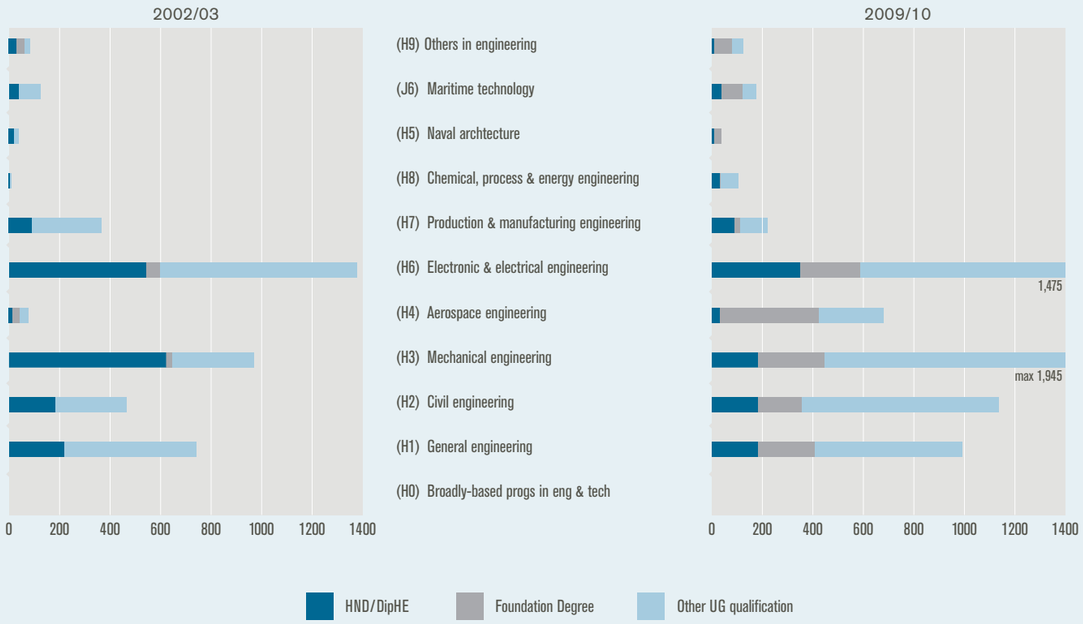


Notes on Figure 3.5
For Technology
- The subjects in decline can be readily identified - Computing and to a far lesser extent Polymers and Textiles.
- The decline in Computer Science is the main reason for the decline in the numbers HNDs/ DipHEs being achieved.
- There have been subjects with substantial growth in the number of achievements, notably Information Systems, others in Technology, Medical Technology and Maritime Technology.
- Not surprisingly, these are also the subjects with the highest growth in the achievement of Foundation Degrees.
- The exception is Computer Science, where despite a decrease overall, the number of achievements in Foundations Degrees has increased substantially over the years.

Does this decline in Computer Science, and, in particular, the decline of HNDs have any implications for the development of IT Technicians?

Note: The numbers on the bars indicate the number of achievements in that subject for all qualifications. This notation is used when the bar exceeds the scale of the graph

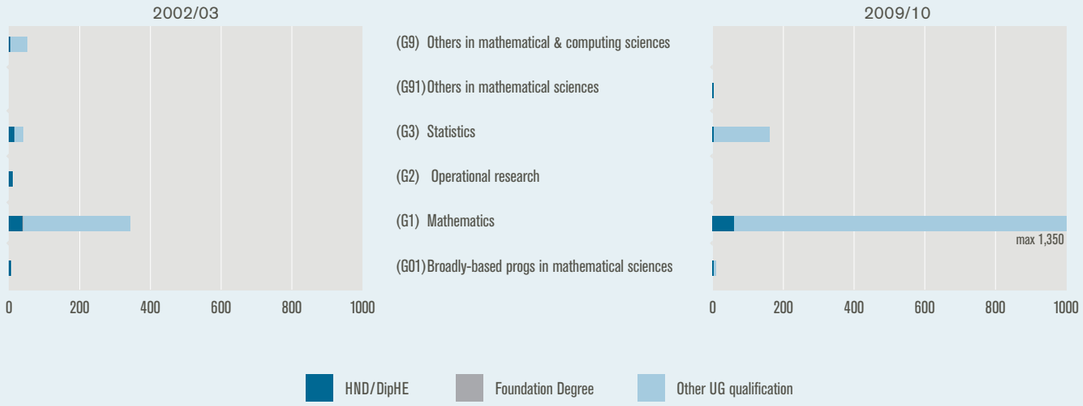
Figure 3.6 Numbers of Level 4 and Level 5 qualifications in Engineering subjects achieved in HE institutions in 2002/03 and 2009/10 by qualification type



Notes on Figure 3.6
For Engineering
• The pattern is more complex.
• For nearly all subjects there has been an increase in the number of qualifications achieved; production and manufacturing engineering being the exception.
• For most subjects the numbers of HNDs/ DipHEs has declined, and in approximate proportion to the increase in achievements in Foundation Degrees.

Note: The numbers on the bars indicate the number of achievements in that subject for all qualifications. This notation is used when the bar exceeds the scale of the graph

Figure 3.7 Numbers of Level 4 and Level 5 qualifications in Mathematics subjects achieved in HE institutions in 2002/03 and 2009/10 by qualification type



Notes on Figure 3.7
For Mathematics
• The overall numbers are small.
• Nearly all of the increase has been in Mathematics.

Note: The numbers on the bars indicate the number of achievements in that subject for all qualifications. This notation is used when the bar exceeds the scale of the graph

Section 4
International comparisons

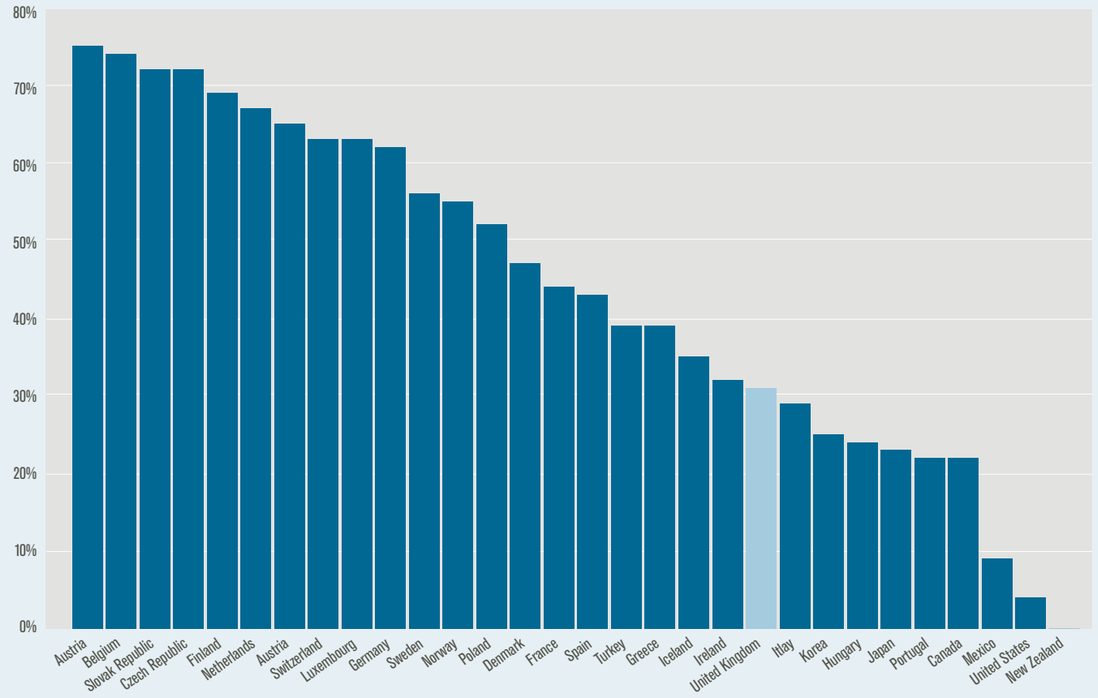
To complete the context two international comparisons are provided.
- The first is from the OECD and compares the levels of vocational and technical education in the member countries.
- The second reports on the number of Technicians being developed to support China's economic growth.

There are a number of constraints in making any international comparisons, the most significant being the difficulty of comparing like with like. The OECD comparison does not differentiate between STEM and non-STEM education, but as it includes the UK the rigorous methodologies used by the OECD and Eurostat statisticians should ensure that the comparisons are valid.

The China analysis is not a comparison, but the data is taken directly from the national statistical yearbook.

Notes on the analyses
- OECD data source is OECD.StatExtracts 2011
- China data source is China Labour Statistical Yearbook 2010

Figure 4.1 Proportion of students (under 21) enrolled on vocational and technical programmes in 2008 by country

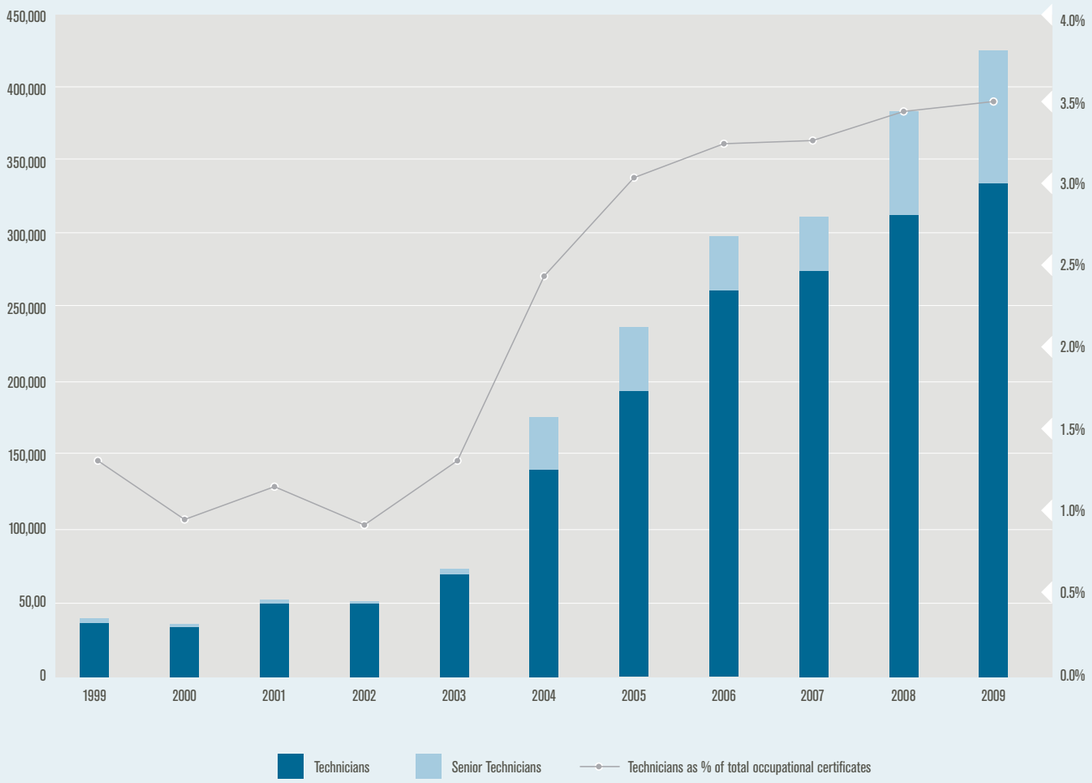


Note: Denominator is all students under 21 enrolled in upper secondary education and post-secnodary non-teritary education

Notes on Figure 4.1
The population is equivalent to that analysed in section 2 and covers schools and FE equivalents.

Even if the proportions of students taking STEM qualifications are lower than in England and that these students are taking qualifications at lower levels, and there is no reason to think they are, the numbers of potential Technicians being developed in most of the other countries in Europe would still be substantially higher than in England, in terms of their overall populations.

Figure 4.2 Increase in the number of candidates obtaining Technician and Senior Technician certificates in China from 1999 to 2009



Notes on Figure 4.2

- These type of certificates require additional study beyond compulsory education and people possessing such certificates are classified at 'college' education level, which is positioned one level below 'University' in the Statistical Yearbook.
- While the starting point, even in 2003, was very low, the growth is dramatic for both Technicians and Senior Technicians.
- Key is the increase in the proportion of occupational certificates that are now for Technicians/ Senior Technicians.

CONTRIBUTORS

First evidence session

Philip Rutnam	Director-General, Business and Skills, Department for Business, Innovation and Skills
Susan Pember	Director of Further Education and Skills Investment, Department for Business, Innovation and Skills
Stephen Uden	Head of Skills and Economic Affairs, Microsoft
Dame Pat Bacon	Principal, St Helens College

Second evidence session

Jaine Bolton	National Apprenticeships Director, National Apprenticeship Service
Dave Newborough	Head of Employee Relations, E.ON
Martin Hottass	Energy Sector Development Partner, Siemens Energy
Dr Henri Winand	Chief Executive, Intelligent Energy Ltd
Prof Jonathan Garnett	Institute for Work Based Learning, Middlesex University

Third evidence session

Steve Holliday	Chair, Technician Council, Chief Executive, National Grid
Michelle Richmond,	Director of Professional Registration, Institution of Engineering and Technology
Professor Alison Fuller	Southampton University

Fourth evidence session

Verity Bullough	National Director of Employer Learner Services, Skills Funding Agency
David Sweeney	Director of Research, Innovation and Skills, Higher Education Funding Council for England
Alastair Thomson	Principal Advocacy Officer, National Institute for Adult Continuing Education
Iain Murray	Senior Policy Officer, Trades Union Congress

Regional meeting - Birmingham

Khalil Ali	Student (HND Aerospace) Solihull College
Adrian Bailey MP	Chair, Business, Innovation and Skills Parliamentary Select Committee
Richard Benefer	Foundation Degree Development Manager, Staffordshire University
Jerry Blackett	CEO, Birmingham Chambers of Commerce
Ben Brogden	Student (HNC Electrical and Electronic Engineering) Solihull College
Kevin Buckley	Birmingham, Blackcountry and Solihull Lifelong Learning Network
Tim Etherton	Programme Development Manger, Learning and Skills Improvement Service
Muriel Green	Head of Skills and Employer Responsiveness, Learning and Skills Improvement Service

Warwick Hall	Director of Regional Strategy, Foundation Degree Forward
Prof Alison Halstead	Pro-Vice-Chancellor, Aston University, and Chair, Skills Commission inquiry
Peter Harpin	Charter Castings Ltd
Debbie Harris	JHP Training
Patrick Highton	Director, Birmingham, Blackcountry and Solihull Lifelong Learning Network
Clive Jennings	Semta
Paul Kitchen	Higher Education Development Manager, Walsall College
Liz McPherson	Birmingham, Blackcountry and Solihull Lifelong Learning Network
Kevin Moran	Birmingham, Blackcountry and Solihull Lifelong Learning Network
Sue McGregor	Director, Higher Education and Curriculum, Solihull College
Jane Newman	Principal Employment Development Officer, Birmingham City Council
Brenda Shiels	Principal, Solihull College
Neil Tamplin	JHP Training
Lee Weatherly	MGTS Ltd
Lowell Williams	Principal, Dudley College
Karen Woodward	Regional Apprenticeships Director, National Apprenticeship Service

Regional meeting – University of Winchester

Graeme Hall	LLN Director, West London LLN
Chris Mason	Standards and Qualifications Developer, Education, Training and Qualifications, Construction Skills
Dr. Julie Wintrup	Academic Lead Education, University of Southampton
Debi Hayes	Director Partnership Division, University of Greenwich
Jamie Mackay	Partnership Development Manager - Solent Partnerships Team Southampton Solent University
Neli Dlamini	Higher Skills Manager, Skills for Logistics
Gordon Jackson	Consultant, Universities for the North East
Hugh Joslin	Employability and Higher Level Apprenticeship, University of Greenwich
Adrian Anderson	Chief Executive, UVAC
Joy Carter	Vice Chancellor, University of Winchester
Geoff Anderson	Programme Director (Fd ENG) and Work Based Learning Consultant, University of Greenwich
Dr Andrew Kent	Technical & Physical Resources Manager - Faculty of Science & Technology, University of Plymouth
John Plunkett	Head of Stakeholder Management, OCR (Oxford Cambridge and RSA Examinations)
Nick Davy	HE Policy Manager, Association of Colleges

Joint meeting with the Associate Parliamentary Manufacturing Group

Gordon Birtwistle MP	House of Commons
Elizabeth Bonfield	Policy Advisor EAL Awarding Body
Andrew Brown	Public Affairs Advisor British Printing Industries Federation
Angela Coleshill	HR Director Food and Drink Federation
Rita Congera	PR Manager Automotive & Industrial Products, PWC
Hannah Dolan	Researcher to John Stevenson MP
Hugo Donaldson	Skills and Education IET
John Harris	Higher Skills / Education Manager, SEMTA
Roger Jeary	Director of Research Unite the Union
Dr Rhys Morgan	Head of Secretariat, E4E Royal Academy of Engineering
Andrew O'Brien	Researcher to Chris White MP
Paul O'Donnell	Head of External Affairs MTA
Chris Richards	Transport and Manufacturing IET
Barry Sheerman MP	House of Commons
Tom Toolan	Assistant Principal Lowestoft College (rep. IMechE)
Baroness Wall	House of Lords
Chris White MP	House of Commons

Written evidence submissions and other contributors

157 Group
Alliance of Sector Skills Councils
Association of Accounting Technicians
Association of Colleges
Babcocks International
Angela Borman, Siemens
The Chartered Institution of Building Services Engineers
City and Guilds
Cogent
e-skills
Elaine Fisher, University of Bath
Engineering Council
Engineering UK
Andy Frost, Development Focus
Graham Drummond, City and Islington College
Graham Hoyle, Chief Executive, Association of Learning Providers
Hefce
Dr Hilary Steedman, London School of Economics
IET
Hugh Joslin, Centre for Work-Based Learning, University of Greenwich
Dr Henri Winand, Intelligent Energy Ltd
Institute of the Motor Industry
Isabel Sutcliffe, Chair, Federation of Awarding Bodies
Prof Derek Longhurst, Foundation Degree Forward

Mark Maudsley, Chief Executive, GTA England
Prof Medhat, New Engineering Foundation
MTA
National Skills Academy for Financial Services
Nick Jagger, University of Leeds
Dr Rhys Morgan, Royal Academy of Engineering
Semta
Summit Skills
TUC
Unite
Universities Vocational Awards Council
Lee Walker, City and Islington College

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