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SCIENCE FOR CAREERS

Report of the Science and Society Expert Group

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Rationale of Science for Careers Group

The Science for Careers group was charged with:

- **Raising awareness of the opportunities for those who study science;**
- **Providing increased information on the range of science careers available to those who study STEM subjects; and**
- **Ensuring that the science workforce is more representative of the diversity of modern society.**

In responding to this, our Action Plan aims to:

- **Bring alive, through improved communications, the value of science skills in the workplace and therefore the opportunities that are available to those who study science for longer, including building on the Science: [So what? So everything] campaign and Science and Maths: See Where They Can Take You;**
- **Co-ordinate and improve the provision and accessibility of careers advice;**
- **Build partnerships between business, schools, colleges and universities to enhance the provision and quality of work experience and provide more opportunities for different types of scientists to become role models and mentors to encourage people to study science;**
- **Develop mechanisms for widening participation within the scientific workforce; and**
- **Encourage greater awareness and take-up of opportunities for informal adult learning in science.**

Introduction from Diana Garnham, Chair

An early decision was made that the group would need to embrace as wide a range of perspectives as possible, as this was an issue on which many organisations were already working in different ways with different audiences. Moreover, the 21 members of the group had wide-ranging expertise and experience, and passionate concerns about particular aspects of science careers awareness and provision of careers information, advice and guidance (IAG).

The area we were tasked with covering was very broad and potentially included education from primary to postgraduate, as well as lifelong learning. There were also many different views on what constituted a science career. The Science and Learning Expert Group were charged with exploring issues in education to 19 years, including careers education, and we did not want to duplicate their work. We were also conscious that the expert group was one of five arising from the Science and Society consultation[1] and that this should set the context for our discussions. The Department for Children Schools and Families (DCSF) has already established a programme of work which aims to increase the take-up of science and mathematics post 16 years for which Kate Bellingham is the National STEM Careers Co-ordinator. When we started our work in July 2009, the DCSF was already close to publication of its new Careers EIAG strategy and we tried also to take account of this. We therefore agreed to focus our discussions on raising *awareness* of science careers across audiences more generally and looking at the consistency and appropriateness of messages as well as the continuum in the provision of careers Education, Information, Advice and Guidance (EIAG). This gave rise to our concept of Careers Awareness, Education, Information, Advice and Guidance (AEIAG).

I am very grateful for the commitment and time that all members of the group put into this work. I want especially to thank Kate Bellingham who chaired a small working group exploring messages and messenger issues, and Richard Wainer who took the lead in shaping our discussions around employer engagement and the interface with higher education. Many of the members of the group had not previously worked together and I hope that a further consequence of this work will be continued collaboration and greater cohesion as we move forward. Kate Bellingham provided huge support as Deputy Chair of the group and was a wise sounding board as we identified and prioritized issues.

My thanks to the Science and Society team for their contributions and organisation, and especially to Anne Grikitis and Cate Dobson whose advice, support and guidance has been an essential and valuable part of this report.

1 http://interactive.bis.gov.uk/scienceandsociety/site/careers/

The Group's Ambition

It became apparent in the course of our discussions that the overarching ambition of the group was:

To increase awareness of the career opportunities arising from the study of science post-16 years.

For our purposes, the definition of "science" used in this report is drawn from the BIS website, namely encompassing research and practice in the physical, biological, engineering, mathematical, health and medical, natural and social disciplines, and research in the arts and humanities. Science is a process rather than a discipline, and the term "scientist" refers to those who apply and practice science. It therefore embraces engineering, technology and mathematics in addition to physical, biological and chemical sciences).

1. *"As the E in STEM is largely silent in the school curriculum, it's all the more crucial to provide accurate and engaging careers information advice and guidance in this field."*

Paul Jackson,
Chief Executive, EngineeringUK

We aimed to report back within six months of our initial meeting, so decided that we should not be diverted by a discussion about 'what was a career?' although we acknowledged that there is a great deal of debate about whether a single career was either aspirational or a reality for the 21st Century.

We agreed that we wanted to embrace within our ambition attracting people to careers *in* science and *from* the science, as well as motivating people to have a career as a scientist and using their science knowledge and skills in other ways. This included:

2. *"Studying science and maths does not mean narrowing your options or restricting yourself to a 'pipeline' for a particular job. Choosing to study science and maths creates the talent pool that UK employers need and leads to a wide range of career opportunities. It's important that all young people, and their influencers, are made aware of this."*

Kate Bellingham,
National STEM Coordinator

- Creating the widest possible landscape of choice for those starting out in education;
- Providing high quality evidence-based information for those on their educational journey to a career; and
- Looking at the needs of those seeking career progression using and building on their STEM skills and knowledge.

The opportunities are – literally – everywhere – in all areas of society and the economy, at many different levels and available to all. It is a very positive message.

We also identified that there were a wide range of activities that would be necessary if the UK was going to succeed in motivating more people, and more young people in particular, to consider a career that drew on science education and skills. Of central importance is an education system that delivers high quality and inspiring science to all; i.e. that is one which encourages increasing numbers of learners to progress beyond the minimum levels of study and choose to continue with core science disciplines post-16 years; an education system that has an appropriate choice of qualifications that provides for the full range of potential careers in science including, but not exclusively, stretching the most able towards careers as leaders in research and innovation. For those wishing to pursue a non-academic route through vocational qualifications it is essential that this form of education is not considered second-class and delivers practical skills underpinned by essential core knowledge. Once in higher education, degrees need both to attract able students and to have content that is informed by employment needs.

1.1 Key Goals

With this ambition in mind, the Science for Careers Group's key goals can be summarized as:

- Increase the number of scientists and engineers in UK workforce;
- Increase the number of people choosing to study science at each progression point;
- Increase number of science graduates choosing science employment;
- Attract from diverse communities, those with talent and commitment;
- Increase entry to technician careers; and
- Retain those already qualified in the science workforce.

1.2 Raising Awareness

A plethora of organisations provide information on careers, including individual companies, trade bodies, professional bodies, government agencies such as Connexions and Sector Skills Councils and commercial careers IAG providers. We concluded that these were largely sources of information which did not necessarily raise awareness. Information, now largely published on the Internet, needs to be accessible and easily found. Most importantly, users must feel that this is *their* information, available for *them*, in a way that *they* want to use it.

Much of the information produced is in the form of printed materials that are quickly out of date, may not work for all audiences and may not appeal to a modern generation of young people. Young people expect to be able to access careers information on-line and to make use of interactive technologies. This is a clear message that all of us need to find new ways to engage with the scientists and engineers of tomorrow and meet their expectations.[2] Raising awareness is about generating the interest to seek out information and will demand effective communication about science, its place in society and will showcase those individuals who undertake it. We therefore welcomed the acknowledgement that promoting science for careers was very much part of the Government's wider Science and Society programme and we would like to see awareness raising addressed as an essential part of a strategy for careers education, information, advice and guidance. Awareness raising has not previously been acknowledged as a task for careers EIAG providers.

2 British Youth Council, National Children's Bureau and Young NCB, October 2009. "Young People's Views on Finding Out About Jobs and Careers."

The Milburn Report, *Unleashing Aspirations*[3], identified that young people were more likely to aspire to a professional job, and more likely to achieve one, if they had a parent who was already a professional.[4] We were aware that a significant proportion of the population, and many young people from disadvantaged backgrounds, may not be aware how many scientists, or how much science, they encounter on a regular basis. The stereotypical image of the scientist, particularly for young people from disadvantaged backgrounds, remains the researcher or inventor surrounded by laboratory equipment or books[5, 6, 7]. In this context, we noted the BIS-supported communications campaign, 'Science: [So what? So everything…]'[8] and DCSF's 'Science and Maths: See Where They Can Take You'. Whilst we welcomed these communications campaigns, we felt that there should be stronger alignment in the messages and much greater clarity in the 'call to action' as it relates to careers awareness and information. Whilst the BIS 'Science: [So what? So everything…]' campaign had taken a broad and thematic approach to raising awareness of the science and technology around us, and had used a wide range of case studies – which we welcomed – the follow-through on careers-related links could have been stronger.

We also welcomed the fact that the DCSF campaign aligned well with careers EIAG providers, but the case studies were from a fairly narrow range and the single unchanging message might not appeal to all audiences. Additionally, the campaign failed to maximise the potential linkages with 'Science: [So what? So everything…]', National Science and Engineering Week (NSEW) and other national science engagement and communication activities. Finally, the group questioned whether the multiplicity of PR companies working for Government and major engagement activities leads to confusion in messaging.

3 The Panel on Fair Access to the Professions, 2009. "Unleashing Aspiration: The Final Report of the Panel on Fair Access to the Professions."
4 Mori/Sutton Trust, 2006. "Creating a High Aspiration Culture for Young People in the UK."
5 Bethany Fralick et. al., 2009. "How Middle Schoolers Draw Engineers and Scientists."
6 Jennifer Carr et. al., UKRC, Bradford, UK, 2009. "(In)visible Witnesses: Drawing on Young People's Media Literacy Skills to Explore Gendered Representations of Science, Technology, Engineering and Mathematics."
7 http://nysgjerrigper.no/Artikler_Engelske/childrens-attitudes-towards-science
8 http://sciencesowhat.direct.gov.uk/

Summary of the Group's Recommendations

In order that we could efficiently identify areas for recommendations, the group split into three sub groups, chaired by Diana Garnham, Richard Wainer and Kate Bellingham respectively, these were:

- Awareness, Education, Information, Advice and Guidance (AEIAG);
- Employer, HE and Schools Interface;
- Perceptions, Values, Skills and Messages.

To determine our headline messages we decided, as a group, what the key messages for, and needs of, a prospective STEM employee were. We considered these to be:

- The development of an integrated and comprehensive Careers Awareness, Education, Information, Advice and Guidance Service for with an integrated science strand;
- The development of more accessible and comprehensive labour market information (LMI) on the demand for STEM-skilled workforce;
- Employers must be encouraged to engage with HE/FE and other course providers to design courses which reflect business skill needs and to increase access to practical work experience and placements;
- Awareness needs to be raised, of the full range of STEM careers which are available, including those in less obvious sectors and those in SMEs and emerging technologies;
- More rigorous and complete data needs to be gathered about how early attitudes to STEM subjects and careers are set, and we must find exemplars of best practice for early interventions in this area;
- The potential impact of the new Equality Bill on careers in the sciences should be investigated;
- Consistent messaging on the value of STEM careers from Government and stakeholders should be made a priority; and
- It is of key importance that parents and carers are fully engaged in the decision making process. A high proportion of young people state that their parents are their greatest influence.[9, 10, 11]

3. *"With our society evermore dependent on technology, we rely increasingly on the technicians who install and maintain the nation's technological infrastructure. Yet the contribution made by these people who can match a knowledge of science with real practical skills goes unsung. We need a careers service that understands all of the careers that spring out of the study of science, not just the graduate careers."*

Matthew Harrison,
Director, Education Programmes, Royal Academy of Engineering

9 Construction Skills, 2007. "Positive Influence? A Report into Parents' Attitudes to their Children's Career Choices."
10 ETB, 2006. "Factors influencing year 9 Career Choices"
11 Angela Daly and Liz Thomas, Widening Participation Research Centre, Edge Hill University, 8th January 2008. "What Influences Vocational Choice."

2.1 The Need for an Integrated and Joined-up Careers Awareness, Education, Information, Advice and Guidance for Science

As a group, we quickly realised that a fundamental issue was how to co-ordinate and improve the provision and accessibility of careers advice. All members of the Expert Group *have* had some involvement in STEM careers activities but had never worked together previously. Additionally, it was unclear to us, how the various activities undertaken by the plethora of different bodies we had identified were expected to be co-ordinated to deliver national objectives. In the absence of a single agency charged with having an overview of either careers EIAG provision or science careers related activities within that programme, it is intensely difficult to carry out gap analysis or to evaluate the effectiveness of existing programmes of work.

The group welcomed DCSF's EIAG strategy[12], with its ambition to give every young person up to the age of 18 years access to careers education. In addition to initiatives aimed at improving the delivery of careers education in schools, the new strategy highlighted the potential for working with parents. However, the DCSF strategy only covers up to the age of 18 years and drawing on the Milburn (*Unleashing Aspirations*) report, it lays emphasis on the need to encourage young people to aim for higher education as a route to a career. In doing so it highlights the vacuum in careers EIAG provision post-19 years. There are concerns that if the DCSF's commitment and strategy is not followed through, the lack of careers education and IAG post-19 years could undo the gains.

We were almost overwhelmed by the wide range of existing initiatives already available for which we had no compendium or map. We were very reluctant to spend resource at this stage drawing up a map of existing provision of science careers related activities but a useful first point of reference was found in the existing STEM directories (developed by STEMNET).[13] We noted that even a mapping exercise would not help to clarify the links between the many initiatives, especially if those activities were wrongly described as having a careers awareness or EIAG role when in fact they were essentially provision of information about the school curriculum.

With regard to our contact with professional bodies, we identified 11 existing professional bodies[14] for careers specialists, as well as a large number of providers and commercial organisations and sub-sector bodies. While we met and had input from some committed and interested individuals, there was no single point of contact and no evidence of leadership from the careers EIAG sector. We believe that if the UK is to establish a coherent comprehensive careers EIAG strategy, the profession, both as individuals and organisations, must begin to play a stronger role.

With these issues in mind several of our proposed actions relate to making the systems smarter and more integrated without necessarily adding to the activities – until such time as gaps in provision are identified. At this point, there would need to be agreement between BIS and DCSF as to the best way of tackling these. To this end, we suggest actions 1.1–1.3 (**Table 1**) to join up existing careers advice initiatives. Through these actions we aim to ensure that young people and interested parties have access to the best possible careers AEIAG.

12 DCSF, 2009. "Quality, Choice and Aspiration – A Strategy for Young People's Information, Advice and Guidance."
13 http://www.stemdirectories.org.uk/
14 See Appendix 3 for details.

Table 1: Actions 1.1-1.3, Careers Awareness, Education, Information, Advice and Guidance

Action 1.1	*Impact*
• Call for a national science AEIAG strategy for all ages with an integrated science strand; • Have a clearer mapping of who is doing what and for which audiences; • Improve understanding of key audiences and targets and include research on user experience; • Listen to the opinions of end users; • Ensure that the professions are engaged as end users of graduates; • Careers IAG organisations to be brought together in the new Guidance Council.	Cross-government initiatives and thinking are joined up. The strategy would ensure that messages are consistent and mutually supportive across all agencies. The strategy will enable integration of STEM specific services within a wider framework.
Existing Programmes and Potential Partners:	• *Unleashing Aspirations* report and the Milburn agenda focus on this; • DCSF published a national IAG strategy in October 2009; this concentrated on IAG for children under the age of 18 years; • STEM careers awareness campaign aimed at young people and their parents and promoting STEM careers awareness CPD for school staff.
Suggested Owner:	• BIS to lead and consult with DCSF as their national IAG strategy for young people provides a framework for much of this activity to take place; • The Science Council and EngineeringUK to work with Sector Skills Councils (SSC) to lead STEM institutions and employers.
Action 1.2	*Impact*
• Establish Expert Review Group to maintain overview of strategy, review good practice and guide evaluation of impact. • Expert group to establish a web forum and publish an annual review of good practice commending exemplar projects.	This ensures consistency of messages and coherence across sectors and ages and improved understanding of impact.
Existing Programmes and Potential Partners:	• Not Applicable.
Suggested Owner:	• Existing members of the Science for Careers Group and other interested parties.

Action 1.3	*Impact*
• Support a 'professional' body for Careers IAG with a strong STEM sub-sector; • Establish a high level group bringing together the wider careers EIAG community to foster coherence and collaboration; • Support DCSF's current IAG initiative and ensure HE and FE are linked in with schools; • Develop a central portal for HE Careers IAG and 'lead' HE providers for STEM opportunities; • Monitor the roll out of the Adult Advancement and Careers Service (AACS) in autumn 2010 and efforts to review the quality and effectiveness of the service (2011) and consider how the specific needs of science can be addressed.	The impact of the group's actions and recommendations is wider than schools and offers support to HE and FE.

Existing Programmes and Potential Partners:	• The group has asked a leading careers guidance professional to organise and chair a workshop on the CPD needs of careers guidance experts; • DCSF established a Task Force on the careers profession in January 2009, this will report in summer 2010. The terms of reference have been agreed and Ministers have asked them to advise specifically on the development of the careers profession and specialist STEM CPD; • The AACS is currently being developed within BIS/SFA and will go live in August 2010; • The Council for Industry and Higher Education (CIHE) are proposing to set up a UK Careers Sector Strategic Forum.
Suggested Owner:	• DSCF/BIS lead.

2.1.1 Raising Awareness of the Full Skills Set Needed for STEM Careers

It is clear that those working in science and the promotion of science should aim to increase awareness amongst young people of the skills needed to succeed in technical and scientific careers. By this, we mean the skills which are additional to knowledge gained through studying science. These may be 'soft' skills or desirable character traits.

Alongside this increased awareness, we must improve the level and quality of information available to learners, as to the range of qualifications and pathways open to them at all levels, that will deliver these skills.

While we agreed we knew what scientific knowledge would be required, there was less clarity about what science skills were and how those skills were acquired, described and promoted. Employers were also considered to be poor at articulating the general and transferable skills they require from their employees, in addition to science or technical knowledge. We identified that the language surrounding skills needs should be consistent across sectors, school, colleges, HE and employment.

4. *"As a student, the first port-of-call for getting careers advice or help finding a job is the University Careers Centre. My experiences here have been very mixed. In order to get worthwhile advice, one is always asked which specific industry one is interested in. This is not the most useful start for me, a physics undergraduate with a broad range of skills, who doesn't know exactly which industry would suit them best. Once you've established in which industry you would consider a career, only the big name players are explored, with little or no mention of SMEs as potential employers.*

   Additionally, one often receives emails about job prospects and vacancies. It was with much excitement that I opened an email entitled "What can you do with a physics degree?", I was disappointed to learn that the company's suggestion was simply……anything! Reassuring, but not particularly helpful."

Holly Batchelor,
Physics Student, University of St. Andrews

We believe that understanding the skills, as well as the knowledge acquired, though the study of science subjects will work effectively towards overcoming the myths of lack of transferability, and that study of science subjects only leads only to science jobs. Once the skills that can be gained through STEM study are identified and articulated, they can be included and illustrated in communications and used to inform learners about qualifications and training that would enable them to acquire the skills. Ideally, the language of skills would be consistent across schools, colleges, FE, HE and employment.

There was also a concern that the wide range of Sector Skills Councils, each describing their employment sectors and skills requirements differently and in different settings, worked against the message that study of science, technology, engineering and mathematics led to core knowledge and skills that could be applied in a variety of employment sectors.

This led us to call on the STEM Sector Skills Councils and Trade Bodies to examine the way in which they disseminate information on skills requirements for particular jobs and industries (Action 2.1, **Table 2**).

Table 2: Action 2.1, Examining How Skills Needs are Portrayed for STEM Roles

Action 2.1	*Impact*
• The Science Sector Skills Councils and Trade Bodies should work together to make clear the range of roles, qualifications and skills needs, and, importantly, progression routes available in their sector; • A skills checklist should be developed to describe employability skills gained from the study of STEM subjects. This should encompass both technical and soft skills; • Draw from the STEMNET *Manufacturing the Future* examples for pre-19 years and develop for post-19 years.	Job seekers will have increased awareness of the skills demanded by employers. Training will be better and more appropriate.
Existing Programmes and Potential Partners:	• SSC Cluster work; • CIHE projects; • The Institute of Physics (IOP) already provide a module on transferable skills; • Manufacturing the Future; • Rolls Royce; • BT Apprenticeships.
Suggested Owner:	• SSC/Trade Bodies with the CBI; • ABPI; • Motor trade; • The TUC will lead on defining skills.

2.1.2 Returners and Progression

There is a need to inform people about the opportunities to return to science after 'leaving' it for another occupation. Many campaigns promote entry into science learning and careers, but few actually take account of the skills of those who are temporarily out of the economy through a career break. Employment in the sciences tends not to be seen as a career to which one can return after non-science study or employment.

Additionally, the return rates for women after a career break are still relatively low for high level science roles. Some schemes exist to help women return to work, such as those run by the UK Resource Centre for Women[15]. Anecdotal evidence suggested that the shortage of funding for these qualifications has had a negative impact and we would like to see the issue investigated further.

15 http://www.ukrc4setwomen.org/

We feel that more work could be done to help those who do wish to return to science, leading to Action 3.1 (**Table 3**), calling for trial access courses through FE and engagement with employers to help them understand the business case for employing returners.

Table 3: Action 3.1, Calling for More Work to get Returners back into STEM

Action 3.1	*Impact*
• Trial access courses through FE to draw back returners, supported by employers; • Engage with employers to help them to value the business case for employing returners and look at where their skills shortages are; • Undertake research into the impact on STEM retention of changes to equivalent and lower qualifications (ELQ) funding.	This would allow the UK to make full use of the workforce it has. Business would save money as retraining is often more effective than training from scratch.
Existing Programmes and Potential Partners:	• UKRC for Women in STEM; • Dorothy Hodgkin Scholarships; • NHS; • Open University Courses; • Head of Science and Engineering Profession; • The Research Concordat; • HECSU.
Suggested Owner:	• HE-STEM initiative.

2.1.3 Better Careers EIAG for graduates

We need to improve and join up STEM graduate careers EIAG to enable support for career progression and UK-wide opportunities.

We noted that the Adult Advancement and Careers Service (AACS) proposals covered the broad range of skills with strong partnership with Jobcentre Plus but concluded that the lack of focus on HE reduces capability to deliver comprehensive EIAG for graduates.

We considered data on the numbers of students in HE now studying for STEM degrees. At a simple level the data suggests that the numbers of STEM graduates has been increasing over the last 20 years but this is not true across all subjects. We were surprised by some of the degree courses included as STEM degrees as well as by some of the exclusions. Our first action should be to try to achieve some agreed consensus about what should and should not be included in this data. The lack of consistency in the data available to us meant that it was impossible to understand trends in take-up of STEM degrees overall. However, there were a number of specific issues we identified:

- There needs to be an agreed consensus about what is and what is not included as a STEM degree in the data;
- Only consistent data will enable long term trends to be fully understood and disseminated; and

- There has been little change in the numbers studying physics over the last 10 years[16] and a strikingly different trend in biology/biosciences. We noted the wide choice of bioscience degrees available, but in comparison, a relatively small range of physics degrees or physical science degrees. We noted the evidence of demand for broadly based STEM degrees and that environmental sciences, climate change and earth sciences all had the potential to increase take up in physical sciences post-19 years.

We considered data on graduate employment 3.5 years after degrees[17]. Some areas which need to be tackled soon became apparent. For example, we identified:

- The need to improve data on employability of graduates and to relate this to degree choice/ module choice. There is a need for increased information and advice on which modules and degrees were most appropriate for particular employers and employment sectors;
- The need for professional pathways from non-vocational degrees, raising awareness of the possibilities;
- The need to raise awareness of 'next steps' and the possibility of mentoring. We identified here a clear role for professional bodies; and
- That individual (HEIs) provide their own careers and employment services and we understood why they viewed this as a service for their own students. On web sites in particular, there seemed to be a high level of duplication and we considered that there was potential for linkages and partnerships that should be explored, especially with regard to supporting graduates seeking employment in other geographical locations.

The quality and breadth of careers EIAG in HE, and the almost total absence of careers education for the current post-18 years generation, was the subject of lengthy discussion and there are a number of actions that arose. These were consolidated to form Action 4.1 (Table 4).

Table 4: Call for HE Specific Careers Strategy

Action 4.1	*Impact*
• Consider HE specific strategy in consultation with UUK, HESCU and Funding Councils; • Strengthen quality and breadth of provision in HE and clarify provision for alumni; • Ensure quality control of HE-based information about progression to HE courses, the establishment of a web portal for HE IAG could be explored; • Higher level skills needs and opportunities should be integrated into the AACS project.	Improved, consistent and impartial IAG is provided to all graduates.
Existing Programmes and Potential Partners:	• DCSF/BIS HE work on access to HE in disadvantaged groups; • The London School of Economics' global vision was inspirational for students and alumni.
Suggested Owner:	• HEFCE/AGCAS.

16 Strategically Important and Vulnerable Subjects Advisory Group, Internal Communication, January 2010.
17 DIUS, January 2009. "The Demand for Science, Technology,Engineering and Mathematics (STEM) Skills."

2.2 Supply of STEM Graduates and Labour Market Information

The group reviewed data from the Department for Business, Innovation and Skills (BIS) and other sources had examined data on STEM graduate employment. Employer organizations and research findings have argued that there are difficulties recruiting STEM graduates[18, 19, 20] and call for an increase in the supply of graduates in these disciplines. Cogent data from 2008 suggests that there will be shortages of low level skilled workers in the near future[21] and EngineeringUK have identified similar potential shortages in manufacturing industry[22]. However, the data we reviewed does not seem to show a skills shortage at higher levels. Data from the Department for Innovation, Universities and Skills (DIUS – now BIS)[23], and the Higher Education and Statistics Agency HESA[24] show that a number of STEM graduates are going into non-STEM employment sectors. Whilst we were firmly of the view this was a 'good thing' overall, in this context, it was hard to make the case for increasing the numbers without understanding fully why STEM employers had not used market forces (i.e. increased pay and attractive conditions) to attract a greater percentage of the STEM qualified graduate talent pool. There are a number of possible factors, all of which require further consideration. Firstly, we need to examine why some STEM graduates choose not to enter STEM jobs. We understand that BIS has already identified the importance of understanding this,[25] and more information may be available once CRAC publishes the findings of the research it is currently undertaking, later in 2010.

The second issue that we identified, is that we may not know enough about the STEM graduate labour market. This market has clearly changed fundamentally in recent years. There is a need to establish models and gather data to understand and describe more fully STEM graduate jobs and the skills and knowledge base required in different roles. Analysis of the graduate labour market and graduate career paths still relies on broad occupational classifications. However, these groupings do not fully describe the changes in the organisation of work and changes in the supply of, and demand for, particular skills and knowledge that have been taking place over the last 20 years.

Central to good careers EIAG is reliable information about employment opportunities. There is research available that indicates that awareness of shortages and long term opportunities influences both young people and parents.[26, 27, 28] We noted that a diverse range of agencies produce a mass of information in various formats, from which direct and historical comparison is often not possible. Neither the reports nor the outputs are readily accessible to careers advisors or other primary users and they certainly do not lend themselves to wider communication and dissemination to key audiences. A perception of unsustainable or vulnerable industrial sectors, structural change and reducing demand for certain skills (as may currently be the view, for example, with the pharmaceutical sector in the UK) can be balanced by labour trend information that shows transferability of skills and emerging sectors where other opportunities can arise.

18 CBI Education and Skills Survey, 2008
19 Rob Wilson, Warwick Institute for Employment Research, 2009. "The Demand for STEM Graduates:some benchmark projections"
20 National Grid, 2010. "Engineering Our Future, Inspiring and Attracting Tomorrow's Engineers."
21 Cogent, 2008. "Supply and Demand in the Process Industries by 2022."
22 EngineeringUK, 2009. "EngineeringUK 2009/10."
23 DIUS, 2009. "The Demand for Science, Technology, Engineering and Mathematics (STEM) Skills." (http://www.dius.gov.uk/~/media/publications/D/Demand_for_STEM_Skills)
24 Higher Education Statistics Agency Data.
25 CBI, 2008. "Taking Stock: CBI Education and Skills Survey 2008."
26 Blenkinsop, S et al., Slough: NFER, 2006 "How do young people make choices at age 14 and 16?"
27 McCrone. T et al., Slough: NFER, 2005 "Pupil Choices at Key Stage 3 – Literature Review."
28 Moon S et al., Research Evidence in Education Library, 2005. "A Systematic Review of Recent Research into the Impact of Careers Education and Guidance during Key Stage 4 on Young Peoples' Transitions into Post16 Opportunities."

5. *"As someone who started out as an apprentice, I'm very keen to emphasise to young people the different routes into STEM careers and to show that not all STEM roles involve laboratory work and Bunsen burners. There are careers that will take you into the oil and gas industry working offshore, careers that could take you around the world to explore and exploit alternative fuels and green technologies and careers to build and run the next generation of nuclear power stations."*

Joanna Woolf
Chief Executive, Cogent SSC Ltd.

We noted from the various 'top graduate employer' tables, that some of the important issues influencing graduate career choice include perceptions of the stability of employment, work-life balance, mobility and geography. We considered research on key motivations for degree and career choice which, in addition to the desire to do something new or inventive and gain financial security, included a wish for respect from family/peers and a desire to make a difference in the world (this last factor being significantly more important for women). An awareness of these influencing factors should be embedded in employer case studies. Labour market information also tends to be collected, and presented on the basis of historical employment sectors and does not provide much of a basis for indicating future rather than past employment trends. Some work to address this is already going on in the Adult Advancement and Careers Service (AACS), which has been working with the Sector Skills Clusters to get them to deliver sector specific LMI to support the AACS. This data is being provided in a pre-agreed format containing pertinent end-user information.[29] We applaud this work, and recommend that more is done to ensure that LMI continues to be disseminated in an accessible form (**Table 5**).

Table 5: Improving Labour Market Information

Action 5.1	*Impact*
• Improve consistency and accessibility of Labour Market Information (LMI) for careers AEIAG stakeholders and users. There should be some geographical concerns addressed, i.e. if a particular employer recruits from particular colleges, this should be explained; • Develop an annual review report.	Learners, influencers and IAG professionals will be able to find up-to-date information in a useable, relevant and accessible form.
Existing Programmes and Potential Partners:	• DCSF's strategy supports improved links between Connexions Direct and the SSC LMI; • AACS, UKCES and the SSCs have been working together to provide LMI for the AACS on sectors and regions in a format useful for both advisors and customers. This work could be linked into.
Suggested Owner:	• SSCs and UKCES should lead this. A work stream in the Science Cluster of SSCs is preparing LMI reports on 6 priority NINJ sectors. We would urge that this is informed by the needs of other stakeholder communities, to ensure outputs are useable; • Colin Blakemore/Richard Smith group to act as "real world" channel to employers; • GO Science could co-ordinate this.

29 http://www.advice-resources.co.uk/UsefulInformation/lmi/

2.3 Employer Engagement with HE/FE and Other Course Providers

As a group, we felt that it was important that employers were willing to engage with HE, FE and other course providers to create courses which reflect business skill needs and to increase access to practical work experience and placements.

Employers in many science sectors raise concerns that the content of STEM degrees is not relevant to their business needs (the skills gap). Concerns include course content, as well as lack of practical skills and of an awareness of the industrial environment.[30] Practical experience is highly valued by employers and by many students, however, there is evidence that students may find it difficult to find a placement which provides them with an accurate picture of a career in science. SMEs in particular value the experience and the opportunity to get to know students and potential employees in this way.

It is important that students and potential employees are offered a high standard of experience; poor quality placements may have a negative impact and the group had concerns regarding the quality and value of many pre-19 years placements, although the difficulty of providing meaningful science experience at this level was acknowledged. Handled appropriately, the group believed that work experience opportunities, especially post-19 years, could have the potential to be a strong route into jobs with SMEs.

Potential problems associated with work experience placements include:

- Prohibitively expensive sandwich placement years, with full fees often being charged by the university;
- Health and safety concerns may discourage employers as they drive up the cost of the placement or may result in the student undertaking non-relevant work;
- Placements are often only available to those perceived as the best. This means that opportunities for those from non-Russell Group Universities may be limited and these students may struggle to find placements; and
- Internship schemes were specifically encouraged in the Milburn report on *Fair Access to the Professions*, but may be closed to many individuals as they often require previous experience.

6. *"Business, schools, colleges and universities, working in partnership, need to provide young people with a clearer picture of work, equip them to make decisions about their future career paths and increase their employability. Organisations should be encouraged to provide more and better work placements for students, bridging the gap between the classroom or university and the world of work."*

Richard Wainer,
Head of Group, Education and Skills CBI

This led us to call for work examining access to work experience placements and course content (Actions 6.1 and 6.2, **Table 6**).

30 Association of the British Pharmaceutical Industry (APBI), 2008 "Skills Needs for Biomedical Research: Creating the Pools of Talent to Win the Innovation Race."

Table 6: Improving Work Experience Placements and Course Relevance

Action 6.1	*Impact*
• SSCs, HE and FE to work together to ensure degree content remains relevant and up-to-date, reflecting changing skills needs and developments; • BIS to resource a forum to deliver this.	HE courses will reflect employer needs, and employers will be actively engaged in their design. This will reduce the possibility of students graduating without the work skills they require. This work will inform both the student and the employer.
Existing Programmes and Potential Partners:	• Science Council project on accreditation of STEM degrees; • Office for Life Sciences (OLS) Blueprint.
Suggested Owner:	• SSC Science Cluster; • Learned Societies and professional bodies to work together to look at accreditation processes and gaps.
Action 6.2	*Impact*
• Undertake research into the demand for science and engineering work experience and sandwich year placements and the barriers to their supply; • Look at both pre-19 and post-19 years provision of work experience as well as lifelong learning and career change; • Develop better support and guidance for employers offering work experience, to ensure greater links to school activity and HE and to ensure the opportunities are open to all; • Ensure work experience is well planned, to give an accurate picture of STEM employment; • Consider the possibility of lowering fees for sandwich years.	Students will have a STEM work placement which is informative and insightful. Graduates will have an improved level of practical skills. Those who need to gain experience in order to upskill themselves will have the opportunity to do so.
Existing Programmes and Potential Partners:	• DCSF are already looking at work experience issues in schools; • Science and Innovation Forum Skills Group; • Industry and Higher Education Advisory Forum.
Suggested Owner:	• The CBI will lead on breaking down barriers to access to practical work experience and will draw on partners such as EngineeringUK to support them in this.

2.4 Raising Awareness of the Full Range of STEM Careers Available

One of the key areas the group considered, was how to engage more non-traditional science and technology employers in careers awareness related activities. This is as important for careers *in* science as it is for those careers *from* and *using* science. Recent proposals for re-classification of graduate careers suggests that new professions and growing tertiary sector employment are areas where science skills are sought.[31] Newer industries in fields such as creative and media, marketing, tourism and many new care- and health-related professions, all draw on science graduates. However, the lead names in science employment and careers awareness activities tend to be the global high profile employers from sectors such as energy, pharmaceuticals, defence and aerospace. While these are undoubtedly important industries, working in these sectors may not necessarily appeal to all.

The group agreed that, as we move forward, all careers awareness and EIAG must work more closely with the non-traditional employers and science-using sectors. This latter group can be found in almost every area of the economy and society. We had a clear consensus that it was productive for people with STEM skills to be employed everywhere in the economy, and therefore, we believe that it follows that there is a need to show that these career options exist.

A number of 'poor' practice issues were also identified in our discussions. For example, there is a tendency to talk about 'industry' rather than 'employers' which means that there is a focus on commercial environments, and consequentially an omission of other employment sectors, including central Government, local Government, the health service and not-for-profit organisations. Additionally, SMEs are very rarely high profile in any communication campaigns and are much less visible in terms of career opportunities. There is also a great deal of science and technology in use in the high street, but the careers in these settings, or behind the scenes in these sectors, rarely feature in STEM careers awareness or information. Examples of this type of opportunity include supermarkets (e.g. food and drink, packaging, logistics, IT, finance), fashion (including textile technology, materials, computer aided design, dyers, colour psychology), and built environment (e.g. construction engineering, materials sciences, environmental issues, energy). While we accepted that many of these roles are embedded in the supply chain, the lack of visibility of science careers in these areas is a missed opportunity.

A large proportion of *in* science employment opportunities are in the supply chain for the big name industrial sectors and employers rather than directly with those employers. The large high profile companies are very visible in all STEM careers awareness activities and information, but there is very little visibility of the SMEs within the supply chain and on which they depend. Despite this, the number of direct STEM related employment opportunities available in SMEs is high.

31 Peter Elias and Kate Purcell, April 2003. "Measuring Change in the Graduate Labour Market."

We also need to be mindful that some of the characteristics of the science and engineering based sectors may not be attractive and inspirational for all. For example, there may be a perception that the gender balance, pay and conditions and work-life balance in such organisations may be poor. There are also concerns about whether the companies deliver on graduate expectations, particularly in terms of job stability, work-life balance and with regard to gender. Some initiatives are beginning to address these concerns, in particular, with the introduction of the *SET Fair Standard Chartermark*[32]. There needs to be clear guidance on how to look for employment in an SME. This led to the call for work to be undertaken to increase the visibility of SMEs, and the CBI have agreed to lead a focus group on employer awareness and SME visibility with a view to potentially pilot sharing this information (**Table 7**).

2.5 The Importance of Role Models

The group considered that it would be good practice for all programmes to establish balance and breadth in role models and case studies promoting the diversity of opportunities in STEM related employment at all levels and for all skill sets.

The group agreed that the current communication around science careers is focused too strongly on academic role models, research science and HE case studies – generally those with higher level or traditional academic career paths. The danger is that these examples serve to reinforce the stereotypical image of the lone scientist working in a lab surrounded by equipment and books[33]. While such role models are a potential hook to 'exciting' science and can be aspirational, they are not necessarily realistic for the majority of students. The group agreed they would like to see more effort in showing the excitement and satisfaction achieved from 'real' jobs.

7. *"There are now new work-related Diplomas in Engineering and Manufacturing and Product Design, and apprenticeships developed with business designed to give young people a valuable grounding in STEM knowledge and experience. These routes give young people a springboard from which they can apply for a huge variety of potential roles in the science-based industries. In addition, the new practically-based Foundation Degrees in STEM subjects also offer a flexible alternative route to Higher Level Skills for people who might have thought HE was not for them."*

Joanna Woolf
Chief Executive, Cogent SSC Ltd.

32 http://www.ukrc4setwomen.org/html/employers/set-fair-standard/
33 Footnotes 5-7 for more details

Table 7: The Role of SMEs in STEM Employment

Action 7.1	*Impact*
• Review existing research into graduate perceptions of science employers; • Trade bodies should do more to focus on raising awareness of SMEs in their sectors; • Leading science employers should consider what they can do to raise visibility of opportunities in their supply chains; • Leading non-STEM sector employers should consider what they can do to raise visibility of science-related careers in their sectors; • Learned societies and professional bodies should develop SME and emerging technology focused careers awareness projects; • Facilitate greater visibility in HE careers IAG for SMEs.	Job seekers will have greater awareness of the opportunities afforded by SMEs.
Existing Programmes and Potential Partners:	• A strong focus on interactions between HE and employers in *Higher Ambitions*; • The National Council for Excellence in Education have an employer engagement strand; • Business Links is a good way to gain access to SMEs; • Learned Societies have work around SMEs; e.g. RSc • www.monster.co.uk for engineering jobs; • Universities.
Suggested Owner:	• CBI to lead a focus group on employer awareness and SME visibility with a view to sharing this information through a pilot; • We would like HE to lead on getting learned bodies and other organisations to engage fully with the implementation of BIS' *Higher Ambitions* White Paper; • Colin Blakemore/Richard Smith Group to explore issues and challenges with employers; • A big name company could be approached to promote opportunities in its supply chain. e.g. Shell

For the most part science in the media coverage is either around policy (and often disagreements) or new research. Whilst there are many good examples of public engagement activities[34, 35, 36] these have a tendency to focus on key 'issues' in science rather than the everyday use of science. In both settings, it is probably inevitable that the visible scientists are leading edge researchers or leading science communicators. As the work of the Expert Groups on Science and Media and Science for All move forward, we agreed that we would like to explore this issue further. Rarely do we find in the media stories that bring to life the day to day application of science in today's world – which is where most science careers jobs will be found. In this way, the work of all three Expert Groups can be brought together usefully and the synergies between the reports explored by any follow on groups.

The UK needs top level research scientists, of course, but as this is not the only *in* science career option role models and case studies must come from a broader base.

The Science Council has developed a matrix of 10 types of scientist[37] which is intended to illustrate the range of opportunities available, rather than fully describe all that is on offer. The Future Morph web site also illustrates a range of different professional careers at different levels including a game for young learners that emphasises the 'from' message.[38] Finally, Channel 4 and the Wellcome Trust developed the 'Sneeze Game'[39] to engage the public in science, through a simple, everyday example.

With role models so focused on high achievers there is little to attract level 2 and 3 students to STEM, yet there are career opportunities (and some documented shortages)[40] for individuals with this level of science qualifications. There are also very few role models or case studies for the *from* science and *using* science messages[41] and very little that shows the enormous range of different types of *in* science career opportunities. If the science community is serious about welcoming the fact that those with STEM qualifications take up careers in all areas of the economy, it must show this positively in all its careers related activities. One example of this is the STEMNET "*Leading Lights*" photography exhibition[42]. The exhibition showcases 19 STEM Ambassadors[43] using science in a variety of settings and at a variety of levels. Similarly, the *Manufacturing the Future* campaign has a series of case studies which highlight the use of science in 'alternative' careers[44]. For this reason, the group would like to see a wider range of role models available for young people and influencers (**Table 8**).

34 http://www.publicengagement.ac.uk/
35 http://www.noisemakers.org.uk/
36 http://www.thenakedscientists.com/
37 The Science Council has created a set of 10 types of scientist: Explorer, Investigator, Developer, Operational/Service, Monitorer/Regulator, Entrepeneur/Business, Communicator, Teacher, Manufacturing/Marketing and Policy Maker. These go beyond the tranditional boundaries of chemist, physicist and biologist and reflect how modern science is evolving.
38 http://www.futuremorph.org/viewitem.cfm?cit_id=4295
39 http://www.routesgame.com/games/?challengeId=2
40 Cogent, September 2008, "Skills for Science Industries: Skills at Work.".
41 Future Morph has led the development of material for teachers including an award winning video of a glass artist http://www.futuremorph.org/teachers/viewitem.cfm?cit_id=4344
42 http://www.stemnet.org.uk/ambassadors/leading_lights.cfm
43 http://www.stemnet.org.uk/ambassadors.cfm
44 http://www.stemnet.org.uk/manufacturing_the_future/true_snowboards.cfm

Table 8: Examining Role Models and Qualification Routes

Action 8.1	*Impact*
• Young people and influencers to experience a wide range of realistic, aspirational role models; • Special event campaigns could be used to showcase alternative role models and science routes.	Young people are enthused by having aspirational role models with whom they can identify; Identifying alternative STEM routes offers new ways of engaging young people.
Existing Programmes and Potential Partners:	• STEMNET's *Leading Lights* photographic exhibition; • EngineeringUK and the Science Council's 'I could' campaign; • SSWSE Ambassadors.
Suggested Owner:	• BIS through the SSWSE campaign.
Action 8.2	***Impact***
• Develop and promote technician class as an important step towards raising attainment and take-up in science and maths and increasing access to the professions in science, engineering and health care; • This has implications for qualifications post-16, and will need research into the non-HE route.	Attract level 2 and level 3 students to science and technology careers.
Existing Programmes and Potential Partners:	• Engineering technician registration scheme; • Engineering Council, Science Council and other professional bodies.
Suggested Owner:	• Lord Sainsbury led Technician Council and BIS follow through on Higher Ambitions/Skills for Growth.

2.6 Careers Arising from Other Progression Routes.

2.6.1 Increasing Understanding of Careers Opportunities Arising from FE and Vocational Qualifications

The further education qualifications landscape – including BTEC and diplomas and others - is diverse and not well mapped. It was noted that particular employers and sectors have an understanding of what is relevant for them, but that there appears to be little or no joined-up thinking. FE careers awareness and opportunities were often very local or narrow and do not tend to focus on transferability of skills. Furthermore, there seems to be little or no understanding or promotion of a 'technician' class of careers (**Table 8**). There were particular concerns amongst the group about the evidence base of some of the messaging related to progression around vocational qualifications and the way in which some qualifications continued to be perceived as gender specific. This led to a call for exploitation of the opportunities offered by FE (Action 9.1, **Table 9**).

Table 9: Exploiting the potential of opportunities in further education (FE)

Action 9.1	*Impact*
• Exploit potential opportunities offered by FE; • FE to work with key partners such as RAEng to facilitate this. Two relevant projects currently under way are: – The post-16 stem partnership to encourage greater participation in STEM post-16 and greater diversity of the workforce; – The STEM data; an attempt to create a base line for the quantity and quality of STEM provision in FE in academic and vocational routes. It will examine who teaches what where and whether the qualifications meet the needs of the end users e.g. employers.	The choices of FE and vocational qualifiers will be broadened.
Existing Programmes and Potential Partners:	• Cogent and other SSCs are already trying to map career pathways for non-HE students in their industries; • The Sutton Trust have carried out some work in this area; • RAEng have carried out a small study.
Suggested Owner:	• FE Lead working with RAEng and others.

Unfortunately, we did not have time to discuss in depth, the range of Diplomas which are available in science and non-science subjects. Concerns were expressed by some members of the group about the viability of Diplomas as a route into the study of science in Higher Education, and in particular about the way in which they were promoted to girls. We felt that this was an area that could warrant further investigation.

2.6.2 Increasing Understanding of Careers Opportunities in STEM Careers Arising from Non-traditional Science Subjects

Non-traditional science subjects such as art and design, design technology and geography, provide an alternative route to raising awareness of the applications of science and for raising awareness science career opportunities. These subjects are often popular amongst school students but, for many in the science community, are not seen as being rigorous enough to be a starting point for science jobs.

Young people are inspired by case studies that feel relevant to them. Broad themes enable different learners to relate to the role of science in *their* lives. Such an approach enables teachers and careers advisors to draw on a broad range of science related employment and careers, taking into account interests, age, ability, and geography etc. and increases the opportunities for this discussion. For this reason, we support the work DCSF is doing to place emphasis on careers IAG within non-traditional science subjects (e.g. art and design, geography and design technology) as described in Action 10.1 (**Table 10**).

Table 10: Exploring STEM Opportunities in Non-Traditional Science Subjects

Action 10.1	*Impact*
• Continue to place emphasis on careers IAG within non-traditional science subjects (such as art and design, design technology and geography) and demonstrate their potential as a route into the sciences; • Encourage teachers to use these alternative subjects as an inspiration to engage with the sciences and to look for cross-curricular teaching opportunities.	Students will have an increased insight into the relevance of STEM to subjects and sectors other than science and maths.
Existing Programmes and Potential Partners:	• EngineeringUK has picked up on this in their annual report; • The Training and Development Agency for Schools (TDA) is working with subject associations to develop careers opportunities which embed careers in subject teaching; • The TDA programme is making careers resources available for English, history, modern languages, geography, citizenship and art and design from April.
Suggested Owner:	• DCSF; • Teacher subject associations; • Science Learning Centres.

2.7 Improving Data on Early Perceptions of STEM Qualifications and Careers

There is a great deal of research into perceptions of STEM qualifications, but it is patchy and often inconsistent. Some studies cover too many disparate issues and do not help us to understand fully, why certain subjects and subject combinations are selected, or rejected, particularly at A level. Issues our group identified, that might be the subject of further research included, in particular, the perception of science subjects, particularly at degree level. Science degrees are rarely vocational in their content, but are often perceived and promoted as direct routes to particular technical careers. In contrast, through our discussions, we identified three broad groups of degrees:

- Vocational (e.g. medicine where the qualification was also a license to practice or a clear first stage of a professional pathway);
- Occupation facing (degrees that may be occupation or sector specific but were not in themselves a license to practice or an essential first professional qualification (biomedical sciences, forensic science, engineering); and
- Generic or Academic degrees which provided an initial qualification pathway to a wide range of employment not exclusively limited to that subject area (core sciences and mathematics);

The language used to promote the study of science subjects often implies that the only reason to study the science is to reach a specific career goal. We felt that this is at odds with the aim of creating a larger pool of science qualified people.

Table 11: Ascertaining the Drivers for Studying STEM[45]

Action 11.1	*Impact*
• Carry out secondary research to develop the bigger picture; • Find out if any research already exists as the science community are not the only people interested in this topic; • Work with the broader IAG/stakeholder/ recruitment community to realise this, much research exists, it could be analysed in new ways; • Look at those who left the sciences as well as those who stayed.	A better understanding of these drivers would allow engineering bodies and FE to tailor their course provision and IAG.
Existing Programmes and Potential Partners:	• EngineeringUK; • ESRC Science Initiative; • Kings College Aspires Survey.
Suggested Owner:	• EngineeringUK have indicated that they could, in principle, extend their attitudes survey (*Engineers and Engineering Brand Monitor*) at relatively low cost; • BIS/DCSF/CRAC.

45 Paul Greenbank and Sue Hepworth, Edge Hill University, January 2008. "Working Class Students and the Career Descision-making Process."

If we could ascertain which drivers[46], e.g. pay, role in society or local employment, were strong influencers amongst given sub-groups, careers messaging could be targeted more effectively. To achieve this we have suggested that more research is carried out to determine what these drivers actually are (Action 11.1, **Table 11**).

2.7.1 Target Careers Information at Parents and Carers

The importance of parents and carers as influences on both on subject and career choice[47, 48, 49] appears not to have been adequately addressed in communications strategies or in the provision of information.

We need to ensure that parents and carers are addressed individually, rather than as a generic group, and that communications and information must be informed by their needs and experience. The vital role that parents and carers play is recognized in DCSF's recent IAG strategy; *Quality, Choice and Aspiration* with the following quote: "They know their children better than anyone and it is most commonly parents that children turn to for advice about their futures."[50] We also noted that, amongst this audience, many individuals will not have studied STEM subjects themselves beyond 16 years, and may never get beyond the image of science as the subjects they learned at school.

8. *"Parents and carers remain the primary educators and influencers of young children; if we are to break the intergenerational link that limits the aspirations and potential of bright pupils from less privileged homes to study subjects like science, engineering and maths, then it is essential that any education and advice service targets children - but also mothers and fathers and carers as well, many of whom will not be familiar with these subjects themselves".*

Lee Elliot-Major,
Director of Research, Sutton Trust

Parents and carers should be a new priority audience for DCSF careers EIAG programmes. Communications campaigns need to focus on parent messages and on the potential of offering parents their own set of role models. This group will not necessarily be inspired by a scientist or engineer, but instead by the parent who has been able to help their child find pertinent careers information.

This should be an avenue for discussion with any follow-on group. We need to engage and find ways of providing parents with examples of other parents, who have found themselves in a similar situation, and have found a way to get their child the best information possible. In this way, we should aim to allow every parent to be the best advisor they can be. Communications campaigns, run by both BIS and DCSF, should ensure that they consider both messages for pupils and for parents, at all times.

46 Appendix 5 – Oliver O'Hanlon, The Science Council, 2009. "Why Do Graduates Apply to their Employer." (Original Literature Review).
47 Payne J,. DfES Research Report 414, 2003. "Choice at the End of Compulsary Schooling: a Research review."
48 Morris, M, Presentation to the Economic and Social Research Council, 2006. "Pupil Subject Choice in Schools."
49 Moon, S et al., Research Evidence in Education Library, 2004. "A Systematic Review of Recent Research (1988-2003) into the Impact of Careers Education and Guidance on Transitions from Key Stage 3 to Key Stage 4."
50 DCSF, 2009. "Quality, Choice and Aspiration: A strategy for young peoples' information advice and guidance", Foreword

2.7.2 Science – Perceptions of Difficulty?

Perceptions of the difficulty of the study of science subjects post-16 years clearly influences many learners away from it, especially for physics and mathematics.[51] One of the many issues we discussed, but did not resolve, was the perception that one must have at least an A grade GCSE to progress to science at AS or A Level.

We concluded that the pressure of school league tables could be an issue but also that science teachers in some schools may be unwilling to approach physics, chemistry and biology as mixed ability subjects. Anecdotal feedback from head teachers suggests that ability sifting seems to be more acute in physics. However, it is hard to deny that the knock-on impact of this is a severe shortage in the take-up of physical sciences post-16 years and we agreed that this is one of the big issues that should be addressed. Selection of only A grade students also contributes to the perception of physics being especially difficult and only for the exceptionally bright. This frustrates potential young scientists, and in particular engineers.

9. *"The short-term nature of the three-year More Maths Grads project meant that legacy and sustainability were very important. More Maths Grads took the viewpoint that tangible outputs such as brochures, booklets, mpegs, DVDs and other materials were the key to the achieving this. All these products could be shared and cascaded to as many schools as possible, enabling the project to touch the hearts and minds of far more teachers, students, parents and employers further into the future than it could do during its short lifespan."*

Makhan Singh,
More Maths Grads

In some schools efforts to increase take up of sciences post-16 years has included better articulation of course profiles to emphasise transferable skills, as well as getting a message over to parents and students, that the subjects are suitable for a range of abilities.[52] The pilot schools have seen numbers increase for A level chemistry and biology across all abilities. We would like to question whether this approach might also be applied to physics and whether more could be done with schools or parents. Another area of discussion was whether there was room for more choice in physics qualifications, for example further physics, and a wider range of degree options where physics was a significant part of the offering, for example earth sciences or natural sciences.

51 Royal Society and SCORE, September 2008. "Science and Mathematics Education, 14-19."
52 The work of the DCSF Secondary National Strategies team has identified case studies where a message about the potential of mixed ability to undertake biology, and chemistry.

2.7.3 Influencing Degree Choice

The group also discussed other incentives that might be introduced to influence decisions to continue to study science disciplines post-19. There was insufficient time to discuss this in detail, but we would like to explore further whether financial or other incentives might be worthwhile. Nonetheless, we consider that some actions should be put forward (**Table 12**) around this and welcome any further suggestions on how STEM employment might be made more attractive.

Table 12: Incentivising STEM study and careers

Action 12.1	*Impact*
• Incentives to study that compete with other opportunities e.g. the CPD offered by finance companies; • Investigate course subsidies, golden hellos, training and other perks.	STEM employment is seen as an attractive option.
Existing Programmes and Potential Partners:	• No known existing programmes.
Suggested Owner:	• No suggested owner at present.

2.8 Equality and Diversity

Throughout the group's discussions, there was an awareness that an important issue underlay our discussion of careers in science, namely that of equality, and the new rights that have been enshrined for various groups in the new Equality Bill, which it is hoped will come into force in autumn 2010.

10. *"Women are desperately under-represented in physical science and in engineering. This means that women are effectively disenfranchised from the technological decisions that affect society and are making only a limited contribution to the wealth creation that flows from science and engineering. As a nation we are trying to compete in a global economy with one hand tied behind our back. We need a careers service that places equality and inclusion at the heart of everything it does."*

Matthew Harrison,
Director, Education Programmes, Royal Academy of Engineering

The new Equality Bill would introduce or reinforce the rights of:

- Women;
- People from ethnic minorities;
- Disabled people;
- People of different religions or beliefs;
- Older people;
- Lesbian, Gay and Bisexual people; and
- Transsexual people.

A number of the issues which are cited as making the new legislation necessary directly relate to education and employment, which were key topics in the group's discussions:

- Despite progress since 1997 to reduce the gender pay gap, women still earn, on average, 22.6% less per hour than men;[53]
- Increasing numbers of women are qualifying in SET subjects – in 2008 women made up 37.3% of UK domiciled SET graduates, yet women still make up less than 16 per cent of the professional SET occupations;[54]
- Less academically able, but better off children, overtake more able, poorer children at school by the age of six;
- The gap between the employment rate of disabled people and the overall employment rate has decreased from 34.5% to 26.3% since 1998[55], but disabled people are still more than twice as likely to be out of work than non-disabled people;[56] and
- If you are from an ethnic minority, you were 17.9% less likely to find work in 1997 than a white person. The difference is still 13%[57].

Careers in both traditional and emerging fields of scientific research and endeavour can offer interesting and well-paid routes out of socio-economic inequality, provided that those who need access to the relevant advice and guidance know where to find it. This is clearly an area which needs further investigation and which the group intends to look into more closely, should time permit.

2.9 Consistent Messaging on STEM Careers from Government and Stakeholders

2.9.1 Positive Use of Language

High-level speakers must use positive language when talking about science in any setting and under any circumstance. It is important that the language surrounding career opportunities in science is positive, when terms such as 'loss' and 'attrition' are used to describe the diffusion of the science graduates into other work areas and non-obvious science roles, the result may be a negative message. These words mean future science applicants may believe that they won't get a job, or that roles in the sciences are not interesting.

53 As measured using the overall median gender pay gap, which is women's median hourly pay (excluding overtime) as a percentage of men's median hourly pay (excluding overtime).
54 UK Resource Centre for Women in SET, Annual Review 2008-09, "Stronger Through Change."
55 Government Equalities Office, April 2009. "A Fairer Future; The Equality Bill and other action to make equality a reality."
56 Family Resource Survey, 2006/7
57 Labour Force Survey, Q3, 2008

The language used by high-level speakers often implies that the only reason to study science is to reach a specific career goal. This is at odds with the aim of creating a larger pool of science-qualified people. If we talk in terms of the opportunities available to those who have studied science or their diffusion into other employment areas, or indeed the study of science in terms of gaining transferable skills, the message is a much more positive one. For this reason, we are suggesting that school advocates and high-level speakers use only positive and appropriate language (Actions 13.1 and 13.2, **Table 13**).

Table 13: Co-ordinated Messaging and Positive Language

Action 13.1	*Impact*
• Encourage school advocates and FE/HE/ employer mentors (in line with the new IAG strategy); • Encourage increased links between schools, STEM Ambassadors and influencers; • Champion a 'core' Whitehall script with key STEM messages, which should be developed and shared.	A co-ordination of messaging and activities leads to useful guidelines for employers and stakeholders etc.
Existing Programmes and Potential Partners:	• STEM leadership qualification.
Suggested Owner:	• BIS with DCSF.
Action 13.2	***Impact***
• Encourage positive and appropriate language in high level speakers and all those who engage with young people and influencers.	Young people and influencers will see STEM study as valuable in its own right, not just as a route to a career.
Existing Programmes and Potential Partners:	• SSWSE Ambassadors e.g. Rachel Riley; • SSWSE campaign *Shape of Jobs to Come*.
Suggested Owner:	• BIS and DSCF to lead with Ministers.

2.9.2 Messages and Messengers

As a group, we would like to see the introduction of personalised messaging that addresses the barriers that different individuals encounter. To achieve this ambition, we need to identify and challenge both the perceived and real barriers to entry into the science workforce at all skills levels and for all social groups. Activities and communications that aim to increase awareness and set out the opportunities available for all, will need to address individual embedded perceptions and myths, taking account of gender, ability, socio-economic background and culture. If we are going to attract increased take up of the study of STEM subjects post-16 years we must address and speak to the 'science is not for me' response as well as address gender, cultural and other perspectives and concerns; our messages must not be 'top-down' reflecting what the science community considered individuals need to know.

One of our key concerns was how to address the fact that the science community was often its own worst enemy in promoting science careers and so much of what it did actually worked against achieving this. There are many clichés; speakers and role models that are too 'stale, male and pale', language full of acronyms and unapproachable jargon, too much about what individuals do in their job and not enough about the context and opportunities for the future, seeming too clever and too remote, and information and web sites that are too industry or job specific and do not link to the wider issues that attract young people to science. Careers awareness activities of this kind are wasting time and resources. We agreed the sector could be smarter and more effective without necessarily spending more but to achieve that we must now put real effort behind championing and sharing good practice. We all had common concerns which were often ignored in sector specific activities and communications. For example, individual organisations fail to get the message across about the need to continue with the study of mathematics. Neither did it seem to be any individual industry or profession's interest to emphasise the transferability of skills.

11. *"Providing targeted, tailored and above all inspiring science and engineering activities across the gender divide, The Big Bang: UK Young Scientists' and Engineers' Fair does things differently. Offering interactive shows and activities as diverse as welding with chocolate, mapping the human genome and exploring the 'hospital of the future', and following up with related STEM careers information, advice and guidance, The Fair attracts as many young women as it does young men."*

Paul Jackson,
Chief Executive, EngineeringUK

There is increased understanding of gender related issues in communications but still low awareness of the differences that age and culture will have. There is a significant level of bad practice and unbalanced messaging that feeds myths and stereotypical thinking and may actually discourage some audiences. We agreed that the science community needs to discard the assumption that there is a single audience and that one message will be appropriate for all. It is fundamental to the success of any awareness raising campaign that we listen to the audience's concerns and address them. There must also be recognition the different starting points for dialogue, for example decision points such as qualification choice at 14, 16 and 19 years and post-19 years career and professional options, career breaks etc.

It is also crucial that the science, technology, engineering and mathematics communities work together to raise awareness through multi-disciplinary approaches rather than individual professions, industries, roles or disciplines. We already know that a thematic approach is important for younger audiences and there is some evidence that a similar approach could also be effective post-19 years. With such a strategy, careers awareness can be increased around topics that interest young people, such as climate change, environment and health, featuring a range of different science disciplines and jobs but it does require organisations to collaborate in clusters. For this reason, we must ensure that messages are appropriately targeted and disseminated (**Table 14**).

Table 14: Appropriately targeting, disseminating and improving messaging

Action 14.1	*Impact*
• Review what we know about the impact of messages for particular audiences; • Develop and disseminate good practice and initiate mechanisms to highlight good practice (and expose poor practice); • All programmes should establish balance in role models and case studies. Promote the breadth of opportunities in STEM related employment at all levels; • Develop technician availability as an important step towards raising attainment and GCSE and take-up of A Levels. This has implications for qualifications post-16, and will need research into the non-HE route; • Develop IAG strand for those wishing to enter or re-enter STEM careers pathways post-19 and ensure that returners are encompassed fully.	The range of skill requirements and capabilities are recognised. Strategy applauds and encourages entry to STEM at all levels. An end result of greater recognition and co-ordination of career opportunities from Level 2 upwards.
Existing Programmes and Potential Partners:	• STEMNET's "Leading Lights" photographic exhibition highlighting a wide range of role models in attractive work environments; • BIS Apprenticeships Policy Unit are already engaged in PR activity; • DCSF are advocating more hands on experience through experiential learning and peer mentoring guides, we can link into this work as appropriate; • BIS's recent Higher Ambitions/Skills for Growth White Papers both already address aspects of this issue; • Future Morph has an excellent set of role models; • Union Learn working with Union Reps; • Noisemakers programme (http://www.noisemakers.org.uk/); • Beacons of Public Engagement (http://www.publicengagement.ac.uk/beacons); • The Naked Scientists (http://www.thenakedscientists.com/).
Suggested Owner:	• EngineeringUK and the Science Council to work together to lead institutions and pilot dissemination of information, potentially through an institutions' afternoon.

Action 14.2	*Impact*
• Improve mechanisms for teachers and careers advisors to personalise careers messaging by promoting and exploring relevant and alternative engagement and enrichment routes and other interventions; • Reach out through 'ground up' networks rather than depending on national programmes; • Develop thematic approaches which appeal to broad groups, e.g. environment, rather than those based on single jobs and role models.	Targeted messaging will encourage more people into sciences and will discourage the "Science isn't for me attitude".
Existing Programmes and Potential Partners:	• Manufacturing Insight; • Manufacturing the Future; • Science: [So what? So everything]; • DCSF's Science and Maths: See Where They Can Take You campaign; • EPSRC's Impact Campaign.
Suggested Owner:	• BIS/DCSF; • Science Council/EngineeringUK; • Colin Blakemore/Richard Smith group to consider how employers might work colaboratively on themes.

Action 14.3	*Impact*
• Improve consistency and accessibility of Labour Market Information (LMI) for careers AEIAG stakeholders and users. Geographical concerns to be addressed. i.e. recruiting from particular colleges,or with specific qualifications. • Develop an annual review report.	Learners, influencers and IAG professionals will be able to find up-to-date information in a useable, relevant and accessible form.
Existing Programmes and Potential Partners:	• DCSF's strategy supports improved links between Connexions Direct and the SSC LMI; • AACS, UKCES and the SSCs have been working together to provide LMI for the AACS on sectors and regions in a format useful for both advisors and customers. This work could be linked into.
Suggested Owner:	• SSCs and UKCES should lead this. A work-stream in the Science Cluster of SSCs is preparing LMI reports on 6 priority NINJ sectors. We would need to urge that this is informed by the needs of other stakeholder communities to ensure outputs are usable; • Colin Blakemore/Richard Smith group to act as "real world" channel to employers; • GO-Science could co-ordinate this.

2.9.3 *Using Wider Networks to Raise Awareness of Science Careers*

In exploring possible actions that might address the lack of visibility of the scientist in every day lives, we noted that the vast majority of science careers outreach and volunteering schemes focused on schools. We agreed that the next phase must move beyond the classroom and maximise opportunities for interaction with a wider public[58]. This type of 'soft' influence has the potential to increase awareness of the different types of science career routes through involvement with broader volunteering and widening participation programmes and make more efficient use of alternative STEM and non-STEM networks. It will increase opportunities for young people, and those who influence them, to meet and engage directly with scientists and engineers outside education. We welcomed the success and reach of STEMNET[59] but noted that it is very much '*in*' science and schools based. We agreed that we need to make better use of other opportunities, different skills and volunteering networks to draw out the *from* science message and the environments where scientists use their skills without being described or known as scientists, for example in the science communication, policy and business environments.

Table 15: Ensuring a Variety of Role Models and Exemplars are Available

Action 15.1	*Impact*
• A national event to bring out the society's 'hidden' or 'unrecognised' science and scientists linked with an essay and painting competition for schools around 'how many scientists did you meet today'; • Inspire science community to become involved; • Inspire individual scientists to take part.	Increased potential for individuals to meet and engage with a range of scientists.
Existing Programmes and Potential Partners:	• Various SSWSE campaigns.
Suggested Owner:	• Ministerial involvement from both BIS and DCSF.

58 Philip Bell et al., People, Places and Pursuits, 2009. "Learning Science in Informal Environments."
59 www.stemnet.org.uk

Action 15.2	*Impact*
• Develop volunteering opportunities for scientists and engineers of all ages and experience; • Create opportunities which are diverse and can influence the local community i.e. beyond education based schemes and the STEM Ambassadors; • Develop plan to integrate careers awareness into museum and science centre activities; • Ensure there is appropriate engagement and involvement with influencers, such as parents; • Encourage companies to work together, both through SSCs and employer networks; • Ensure existing volunteering networks have STEM links where possible; • Enable involvement of parents and influencers through existing programmes. e.g. Future Morph.	All sections of society will have at least some exposure to people working in a STEM field or with a STEM background. All sections of society have role models which are relevant to them and with whom they can identify with. This will increase engagement with and appreciation of STEM careers. Awareness is raised, of the range of science careers and opportunities by maximising informal engagement of individuals and organisations in the wider community.
Existing Programmes and Potential Partners:	• National Trust; • DCSF/DCMS tie in to National Museums Programme; • National Museums of Science and Industry[60]; • Association of Science and Discovery Centres/Science Museum (DCSF is advocating more hands on experiential learning); • Mentoring programmes such as the Boyhood to Manhood Foundation, Social Mobility Foundation and National Mentoring Programme; • Volunteering England, V and YouthNet; • Science Centre Programmes; • Project Enthuse[61]; • RSPB.
Suggested Owner:	• Possible leads include Science Council, EngineeringUK, Volunteering England, 'V' and YouthNet; • Needs to involve the Beacons for Public Engagement, Professional Bodies and Learned Societies, Business in the Community and others; • TUC to examine alternative STEM employment networks.

60 http://www.nmsi.ac.uk/index.asp?flash=yes
61 http://www.wellcome.ac.uk/News/Media-office/Press-releases/2008/WTD039207.htm

Conclusion

Producing this report has involved a fascinating journey, if occasionally a somewhat fraught one. Six months has provided us with an opportunity to share ideas and work our way through a wide range of initiatives, an enormous amount of information and data, some of it with conflicting messages. We also came to realise fairly quickly just how much consensus there was across the sector about the need for change and greater coherence in the way we approached motivating people to consider careers in and from science.

12. *"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change."*

Charles Darwin

The group has put forward what we believe is a clear steer; if we are to ensure that the UK economy has a workforce with the science skills that it needs, then we need to be much smarter and better aligned in our communications and messages as well as providing information, advice and guidance on science careers. It is not a question of inventing new kinds of information, but we will need to work together to draw out the common messages in a way that our audiences can make sense of. We hope that the action plan will ensure that the stakeholder communities – parents, children, teachers, careers advisors, employers, professional bodies, policy-makers and universities – are talking to each other and producing communication and information that is right for the audience, easily accessible and comprehensible.

I would like to suggest that the work of the Science for Careers Expert Group continues in some form. There were areas that needed far more time than we were able to devote to them – equality and diversity in the STEM workforce and lifelong learning are two examples that immediately spring to mind. Ideally, we would like to take forward our recommendations in co-operation with Government and other bodies that we have identified in the course of this report.

Finally, I would like to reiterate that we found a great deal to applaud in the work that is already being done in this area. Our aim is to complement it, not to contradict it.

Glossary of Terms

AACS	–	Adult Advancement and Careers Service
ABPI	–	The Association of the British Pharmaceutical Industry
AEIAG	–	Awareness, Education, Information, Advice and Guidance
AGCAS	–	Association of Graduate Careers Advisory Services
BIS	–	Department for Business, Innovation and Skills
CIHE	–	Council for Industry and Higher Education
CPD	–	Continuous Professional Development
CRAC	–	Careers Research and Advisory Centre
DCSF	–	Department for Children, Schools and Families
EIAG	–	Education, Information, Advice and Guidance
EPSRC	–	Engineering and Physical Sciences Research Council
ESRC	–	Economic and Social Research Council
FE	–	Further Education
HE	–	Higher Education
HEFCE	–	Higher Education Funding Council for England
HESA	–	Higher Education Statistics Agency
HECSU	–	Higher Education Careers Service Unit
IAG	–	Information, Advice and Guidance
LMI	–	Labour Market Information
NINJ	–	New Industry, New Jobs
RAEng	–	Royal Academy of Engineering
SFA	–	Skills Funding Agency
SME	–	Small and medium sized enterprises
SSC	–	Sector Skills Council
SSWSE	–	Science: [So what? So everything]
STEM	–	Science, Technology, Engineering and Mathematics
TDA	–	Training and Development Agency for Schools
UKCES	–	UK Commission for Employment and Skills

Appendices

Appendix 1 – List of Tables

Appendix 2 – Table of Visionary Quotes

1. "As the E in STEM is largely silent in the school curriculum, it's all the more crucial to provide accurate and engaging careers information advice and guidance in this field."

Paul Jackson **5**

2. "Studying science and maths does not mean narrowing your options or restricting yourself to a 'pipeline' for a particular job. Choosing to study science and maths creates the talent pool that UK employers need and leads to a wide range of career opportunities. It's important that all young people, and their influencers, are made aware of this."

Kate Bellingham **5**

3. "With our society evermore dependent on technology, we rely increasingly on the technicians who install and maintain the nation's technological infrastructure. Yet the contribution made by these people who can match a knowledge of science with real practical skills goes unsung. We need a careers service that understands all of the careers that spring out of the study of science, not just the graduate careers."

Matthew Harrison **8**

4. "As a student, the first port-of-call for getting careers advice or help finding a job is the University Careers Centre. My experiences here have been very mixed. In order to get worthwhile advice, one is always asked which specific industry you are interested in. This is not the most useful start for me, a physics undergraduate with a broad range of skills, who doesn't know exactly which industry would suit them best. Once you've established in which industry you would consider a career, only the big name players are explored, with little or no mention of SMEs as potential employers.

Holly Batchelor **12**

5. "As someone who started out as an apprentice I'm very keen to emphasise to young people the different routes into STEM careers and to show that not all STEM roles involve laboratory work and Bunsen burners. There are careers that will take you into the oil and gas industry working offshore, careers that could take you around the world to explore and exploit alternative fuels and green technologies and careers to build and run the next generation of nuclear power stations."

Joanna Woolfe **17**

6. "Business, schools, colleges and universities, working in partnership, need to provide young people with a clearer picture of work, equip them to make decisions about their future career paths and increase their employability. Organisations should be encouraged to provide more and better work placements for students, bridging the gap between the classroom or university and the world of work."

Richard Wainer **18**

7. "There are now new work-related Diplomas in Engineering and Manufacturing and Product Design and apprenticeships developed with business designed to give young people a valuable grounding in STEM knowledge and experience. These routes give young people a springboard from which they can apply for a huge variety of potential roles in the science-based industries. In addition the new practically-based Foundation Degrees in STEM subjects also offer a flexible alternative route to Higher Level Skills for people who might have thought HE was not for them."

Joanna Woolfe **21**

8. "Parents and carers remain the primary educators and influencers of young children; if we are to break the intergenerational link that limits the aspirations and potential of bright pupils from less privileged homes to study subjects like science, engineering and maths, then it is essential that any education and advice service targets children - but also mothers and fathers and carers as well, many of whom will not be familiar with these subjects themselves."

Lee Elliot-Major **28**

9. "The short-term nature of the three-year More Maths Grads project meant that legacy and sustainability were very important. More Maths Grads took the viewpoint that tangible outputs such as brochures, booklets, mpegs, DVDs and other materials were the key to the achieving this. All these products could be shared and cascaded to as many schools as possible, enabling the project to touch the hearts and minds of far more teachers, students, parents and employers further into the future than it could do during its short lifespan."

Makhan Singh **29**

10. "Women are desperately under-represented in physical science and in engineering. This means that women are effectively disenfranchised from the technological decisions that affect society and are making only a limited contribution to the wealth creation that flows from science and engineering. As a nation we are trying to compete in a global economy with one hand tied behind our back. We need a careers service that places equality and inclusion at the heart of everything it does."

Matthew Harrison **30**

11. "Providing targeted, tailored and above all inspiring science and engineering activities across the gender divide, The Big Bang: UK Young Scientists' and Engineers' Fair does things differently. Offering interactive shows and activities as diverse as welding with chocolate, mapping the human genome and exploring the 'hospital of the future', and following up with related STEM careers information, advice and guidance, The Fair attracts as many young women as it does young men."

Paul Jackson **33**

12. "It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change."

Charles Darwin **38**

Appendix 3 – List of Careers Organisations Consulted

Association of Careers Education and Guidance

Careers Research and Advisory Centre (CRAC)

Careers England

Careers Wales

Careers Scotland

Careers NI

Connexions

Learn Direct

National Association of Adult Continuing Education

National Association of Educational Guidance in Adults

Institute of Career Guidance

Appendix 4 – List of Individuals and Organisations Consulted

Kate Bellingham
DCSF Action Programme 8 and STEM Cohesion Team (National STEM Centre)

Professor Colin Blakemore
Professor of Neuroscience at the Universities of Oxford and Warwick

Claire Donovan
SEMTA

John Green
Creator of "My Uni Choice" and "My Oxbridge Choice" Websites

Nicola Hannam (Future Morph)
Science Council

Sue Hill (Extraordinary Lives)
Department of Health

John Holman
National STEM Director and Director of NSLC

Paul Jackson
EngineeringUK

Pat Langford
STEMNET

Robin Mellors-Bourne
CRAC

Claire Nix
VT Enterprise

Fiona Sanford
London School of Economics (LSE) Careers Office

Richard Smith
Winchester Consulting Limited

Peter Stagg (DCSF Timelines research work)
CEI, University of Warwick

Sir Mark Walport
Chair of the Science and Learning Group

ProfessorTony Watts
Visiting Professor of Career Development, International Centre for Guidance Studies (iCeGS),

University of Derby.

Tony Whitehead
Joint Chair of the Science and Trust Expert Group

Sarah Wilson (Science and Maths Communication Programme)
Department for Children, Schools and Families (DCSF)

David Youdan (mathscareers.org.uk)
IMA

Astra Zeneca Science Forum
(Chaired by Aileen Allsop – Joint Chair of the Science and Trust Expert Group)

BIS (Department for Business, Innovation and Skills) – Further Education Directorate

Coca Cola

Council for Industry and Higher Education (CIHE)

DCSF (The Department for Children Schools and Families)

The Expert Group for Women in STEM

The Science Council

Sector Skills Council for Science, Engineering and Manufacturing Technologies (SEMTA)

Appendix 5 – Original Literature Review, "Why Do Graduates Apply to their Employers." (Oliver O'Hanlon, The Science Council)

The **UK Graduate Careers Survey 2007**[62] identifies the career sector that final year (2006/7) graduates applied to:

- 9.5% to Science and R&D (9.8% in 2005/6);
- 8.1% to engineering (7.5% in 2005/6).

Media, teaching, investment banking, marketing, accountancy, and consulting were sectors that had a higher percentage of applicants. This information only shows the attraction of specific sectors, rather than the percentage of successful applicants.

The most important factors when deciding which graduate employers to apply to are:

- 32% Not working evenings or weekends;
- 32% Achieving Professional Qualification;
- 30% Early contact with clients or customers;
- 29% Start a 'real' job straight away;
- 29% Using degree Subject Studied;
- 27% Job that allows you to 'give something back to the community';
- 26% Joining a structured Graduate Programme;
- 19% Responsibility for managing other people[63].

In the 2006 Survey starting salary and the content of work were two of the most important factors for **44%** of people.

The study also shows the percentage of final year students who used career services during their job search. On average 79% of students between 1997 and 2006 used their university career service. Over half (54%) met with a Career Adviser.

Real Prospects 2009

Main reasons for applying to current employer:

- 38% offered job opportunities I was looking for;
- 29% I needed a job;
- 14% recognised employer as a leading organisation in the sector;
- 7% job was located where I wanted to work;
- 7% reputation as a good employer;
- 4% recommended to me.

NUS Student Experience Report 2008[64] of 3135 students from 146 HE institutions responding to an online questionnaire.

62 http://www.sussexlearningnetwork.org.uk/documents/GradSurveySummary07.pdf P.12
63 Ibid P.15
64 http://tinyurl.com/yz4etcn

The most common response from final year students about their post course plans are:

- 46% permanent full time employment;
- 34% looking for work;
- 27% Further study;
- 6% 'no idea'.

(Historically, the percentage of graduates looking to join the graduate job market has not changed significantly. The UK Graduate Careers Survey 2006 outlines that the average between 1996 and 2006 was 41%).

Gender Differences:

- Permanent full time employment: 51% Male, 42% female;
- Looking for work: 36% male, 33% female;
- Further study: 21% male, 32% female;
- 'No idea': 7% male, 5% female;
- Unpaid/voluntary work: 5% male, 7% female.

The study also highlights students attitudes towards post course plans are dependent on the type of institution they attend:

Permanent full time employment:

- Russell Group: 35%;
- Pre 1922: 41%;
- Post 1922: 54%;
- Other: 48%.

Looking for work:

- Russell Group: 29%;
- Pre 1922: 32%;
- Post 1922: 39%;
- Other: 32%.

Further Study

- Russell Group: 34%;
- Pre 1922: 30%;
- Post 1922: 21%;
- Other: 32%.

The study also states that 41% of students thought that the career advice provided by their university met their needs, while 21% said that it did not. This is also split into the four types of institutions, and whether the career advice provided by the institution itself met students' needs:

Did not meet my needs:

- Russell Group: **12%;**
- Pre 1922: **20%;**
- Post 1922: **24%;**
- Other: **26%.**

Partially met my needs:

- Russell Group: **31%;**
- Pre 1922: **21%;**
- Post 1922: **30%;**
- Other: **32%.**

Meets my needs:

- Russell Group: **50%;**
- Pre 1922: **47%;**
- Post 1922: **33%;**
- Other: **35%.**

As might well be expected, the Russell group and the pre 1922 universities provide the most positive careers advice to their students.

Also this might be useful and of interest to you. These are percentages of students who felt that they were equipped with the necessary skills to enter the labour market:

- 49% of Medicine & Life science students;
- 52% Physical science & related;
- 52% Social Studies;
- 64% Law;
- 62% Business & Admin. Studies;
- 60% Mass communication & documentation;
- 61% Education.

Also asked was whether their studies had increased their careers prospect:

- 69% of Medicine & Life science students;
- 74% Physical science & related;
- 79% Social Studies;
- 81% Law;
- 73% Business & Admin. Studies;
- 70% Mass communication & documentation;
- 78% Education.

48% of graduates in Medicine & life sciences and 57% graduates in Physical sciences & related subject felt that their numeracy skills had improved. We know from employers that they are rather underwhelmed by the level of numerical knowledge of graduates, so this is something that I thought would be of interest to you.

Additionally, 62% of Medicine and 75% of Physical science graduates felt that their IT skills had improved.

Appendix 6 – Bibliography

BIS, *2009*
'Building Britain's Future – New Industry, New Jobs'

BIS, *2009*
'Higher Ambitions'. The future of universities in a knowledge economy.

BIS, *2009.*
'Increasing the Supply of STEM Graduates or Reducing Leakage?'

BIS, *2009*
'Science and Innovation Investment Framework 2004:2014, Annual Report'.
http://www.dius.gov.uk/~/media/publications/A/annual-report-2009

CBI, *2009*
'Stronger together – Businesses and Universities in turbulent times. A report from the CBI Higher Education Task Force.'

Centre for Education and Industry, University of Warwick (for Institute of Physics), *2008.*
'Tracking careers of UK Physics students'.

Connexions, *2009.*
'Supporting Careers Education and IAG. Better Advice 14-19 CEIAG Briefings'

ConstructionSkills, *2007.*
'Positive Influence? A report into parents' attitudes to their children's career choices'

Council for Science & Technology, *2008.*
'How academia and government can work together'.

Council for Science & Technology, *2001.*
'Imagining and Understanding', A Report on the Arts and Humanities in relation to Science and Technology.

Coyne, J. *(University of Derby)* ***& Goodfellow, J.*** *(University of Kent), 2008.*
Report to the Secretary of State, DIUS, on Universities' links with schools in STEM subjects.

DCSF, *2009.*
'Quality, Choice and Aspiration: a strategy for young people's advice and guidance'.

DCSF, *2009.*
'STEM Learning for pre-19 year olds: policy context and trends'.

DCSF and Centre for Science Education, *2009*
'STEM Supply and Demand Research'.

DEMOS. *1996.*
'Careerquake. Policy support for self-managed careers.

DIUS, *2008.*
'Shaping the Future: a new adult advancement and careers service for England'.

DIUS, *2009.*
'The Demand for Science, Technology, Engineering and Mathematics (STEM) Skills.'
www.dius.gov.uk/consultations/~/media/publications/D/Demand_for_STEM_Skills

Elias, P. and Purcell, K., April 2003, ESRU, University of West of England and IER, University of Warwick
'Measuring Change in the Graduate Labour Market'
http://www.prospects.ac.uk/downloads/csdesk/members/reports/seven_years_on.pdf

EngineeringUK (formerly the Engineering Technology Board), *2008.*
'Where do Engineering Graduates Go?'. Briefing paper.

EngineeringUK (formerly the Engineering Technology Board), *2008.*
'Women in SET'. Briefing paper.

EngineeringUK (formerly the Engineering Technology Board), *2009.*
'Rebuilding the UK Economy: Changing Perceptions of Engineering'. Research paper.

EngineeringUK (formerly the Engineering Technology Board), *2009.*
'An Informed Choice: A Road Map for Improving Careers Information, Advice and Guidance (IAG) Across the UK'. Briefing paper. Government Equalities Office, 2009.
'A Fairer Future: The Equality Bill and other action to make equality a reality.'

Girlguiding UK, *2009.*
'Education, Training, Skills and Careers'.
http://girlsattitudes.girlguiding.org.uk/data_and_report.aspx

Herrmann, Keith, *CIHE Policy Forum Meeting, 2008.*
'Careers Information, Advice and Guidance. A National Framework: myth, fiction, reality?' .
http://www.cihe.co.uk/category/knowledge/publications/

Herrmann, Keith, *Research Fortnight 311, 22 October 2008, p.19.*
'STEM the critical shortage of wealth creators'.

Herrmann, Keith, *CIHE,STEM Policy Group, January 2009.*
'The Demand for STEM Graduates and Postgraduates'. Policy Paper
http://www.cihe-uk.com/category/skills/

House of Commons Business and Enterprise Committee, *2009.*
'Risk and Reward: sustaining a higher value-added economy'. Eleventh Report of Session 2008-09.

Institute of Engineering & Technology, *2008.*

'Studying Stem: what are the barriers?'.

***National Grid,** 2009.*
'Engineering Our Future: inspiring and attracting tomorrow's engineers.'
http://www.nationalgrid.com/NR/rdonlyres/63EF4A6E-C6DB-4D0C-A749-D1500C465B3B/36759/7315_engineeringthefuture_brochure_32_p11.pdf

***NESTA,** 2007.*
'Ready for the future? Young people's views on work and careers'.
http://www.nesta.org.uk/library/documents/ready-for-the-future.pdf

***Policy Exchange,** 2009.*
'Educating Rita?'. A Model to Address Inadequate State Support for Part-time Students. Research Note.

***Policy Exchange,** 2009.*
'Science Fiction?' Uncovering the real level of science skills at school and university. Research Note.

***Sainsbury Review of Science and Innovation,** 2007.*
'The Race to the Top'.
http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/d/sainsbury_review051007.pdf

***STEMNET,** 2009.*
STEM Ambassadors and Careers – internal memorandum. 'Scope for and feedback from careers-related activities in London September 2008 to September 2009.'

***UK Commission for Employment and Skills,** 2009.*
'Ambition 2020: World Class Skills and Jobs for the UK: Key Findings and Implications for Action'.

***UK Resource Centre for Women in Science, Engineering and Technology,** 2009.*
Statistical information on gender split in STEM education, qualification and occupation.
http://www.ukrc4setwomen.org/html/research-and-statistics/statistics/students-in-higher-education-2009/

***VT Research,** 2009.*
'Science, Technology, Engineering and Mathematics (STEM) Subject Choice and Careers Literature Review'.

Watts, A.G,
Career Research and Development, No. 13, Autumn, pp.7-10, 2005. 'The Economic Case for Careers Guidance: Has There Been a Paradigm Shift?'

http://interactive.bis.gov.uk/scienceandsociety/site/science-for-all/
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