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Science, Engineering and the Economic Downturn

Public expenditure has substantially increased over the last decade of economic growth under the Labour Government. In the last Comprehensive Spending Review (CSR), however, many areas of public finance were curtailed. Happily, the Science Budget was a notable exception. Nevertheless, the Chancellor of the Exchequer has warned that the UK must brace itself for an economic downturn and CaSE is determined to make sure that science and engineering remains as much of a funding priority in the future as it has been in the past.

CaSE is keen to see the UK achieve its stated aim of 2.5% Gross Domestic Product (GDP) invested in R&D. As this target is related directly to the size of the overall economy, this goal need not be adjusted, but a greater commitment towards R&D must be made given that in 2004 we were at around 1.8% GDP.

The Government must maintain its commitment to the 10 year Science and Innovation Framework, increasing the Science Budget accordingly. In the run up to the next CSR in 2011, the final one of the Framework, CaSE will continue to push for investment in science and engineering. The Government has embraced the economic argument for funding research as the basis of a knowledge-economy and the validity of this argument is not negated by an economic downturn. Over the coming months, CaSE will be looking at the range of impacts of basic research and what are sensible ways to assess and increase it.

As well as advocating for the future Science Budget, we must make sure that the supposed "ring-fence" around the allocated money is not violated. Unfortunately, this occurred in early 2007 when the Department of Trade and Industry pulled £68m back from the Science Budget to fill the hole in its budget created by the collapse of Rover. CaSE

and others tried to elicit a firm commitment from the Government to respect the ring-fence, but given that it has been breached once, we are still worried that it could happen again. CaSE will also be arguing for implementation of the Sainsbury Review's recommendation that Governmental Departmental R&D budgets should be ring-fenced.

Although banking and the housing market are currently bearing the brunt of the downturn, its impact will increasingly permeate throughout the economy. If industry starts to cut costs in R&D it is more important than ever to make sure that the UK is seen as a choice location to invest. Skills are one of the key determinants for locating R&D and current concerns about enabling international workers to work in the UK (see pages 4 & 10) must be quickly dealt with to maintain our attractiveness. Skills training in the UK must be improved, and it is here that there may actually be a bright side to an economic downturn.

Poor employment prospects elsewhere may increase the attractiveness of public sector work, with students who had been lured away by the bright lights and big pay packages of the city choosing to work as teachers or in academia. There is a clear precedent for this with numbers of applicants to mathematics teacher training relating to rising graduate unemployment in the recessions of the '70s and early '90s. However, the unique pattern of today's inclement economy means that we must not depend upon this effect and must continue with initiatives to increase the attractiveness of teaching.

It is critical that CaSE works to anticipate foreseeable political developments, such as the next CSR, the next election and possibly a new Government. But we must also be alert to the impact of changes in the economic climate and we are, indeed, striving to do so.



Nick Hall joins CaSE Staff

Since starting as Research and Administrative Assistant just over a month ago, I have had a lot of acclimatizing to do. This has been made easier by the warm and friendly welcome I've received from the CaSE team.

In taking over from Susan O'Dwyer, who left as CaSE's administrator in April, I appreciate

that I have some pretty big shoes to fill. As well as taking over Susan's duties, I hope to provide additional research capacity to the organization; supporting the excellent work already done by Nick, Hilary, and David.

Despite my father being a Biology teacher and taking the subject at A-Level, a degree in History at Warwick University and a Masters in Russian politics didn't necessarily provide me with a working knowledge of CaSE. However, since leaving university I worked for several MPs in Westminster and have developed an understanding of the environment in which CaSE works and an appreciation of the important role it plays in striving to improve the health of science and engineering in the UK.

Although I continue to work part-time in Parliament, my new position with CaSE offers the more challenging role of lobbying and influencing government policy from the outside, alongside the opportunity to immerse myself in some of the big scientific funding and research debates currently taking place.

Despite the many positive improvements brought about by CaSE since its creation, I believe that now is a crucial time for the organisation, in terms of how it sees itself and its future role. I'm therefore looking forward to getting stuck in and taking a pro-active role in helping CaSE continue to grow and develop.

CaSE Strategic Survey

As part of its new five year strategy, to be produced over the next few months, CaSE recently carried out a membership survey. This enabled us to gauge the views and makeup of our members, and in so doing, help inform the creation of the strategy. The results of the survey have now been collected.

Both organizational and individual members were in firm agreement that CaSE's role for the future should be as a campaigning group, rather than a network alliance or think-tank, although aspects of those two roles should feature. Raising the importance of science and engineering in public policy and political decision making was seen to be CaSE's major objective, along with helping the scientific and engineering community communicate with politicians, and shaping the political agenda.

Respondents called on CaSE to engage with a wide range of policy influences: the Comprehensive Spending Review, Science and Innovation white papers, and government consultations, in order to achieve those objectives.

Although the majority of respondents believed that CaSE was finding the right balance between influencing and reacting to policy developments, a number called for a more proactive stance in anticipating and influencing government policy. Developing strong relations with government ministers and civil servants was seen to be a key strength of CaSE.

In regards to communicating with its members, respondents found both the CaSE e-bulletin and newsletter to be extremely useful, as well as CaSE policy reports for keeping them informed.

CaSE would like to thank all those who took the time to complete the survey. The five year strategy will be announced over the next few months.

Discussing Science Policy



Nick Dusic (left) and Dr Ian Gibson MP, on the panel)

CaSE took part in this year's BA Science Communication Conference, which brought together science communicators,

academics and journalists from across the country. The session, entitled Engaging in Policy with the Purpose of Explaining Science, was organised by Newton's Apple.

The discussion, chaired by Alok Jha (Guardian Science Correspondent), allowed the conference audience to question and debate with four guest panelists: Dr Stephen Axford and Dr Anthony Whitehead (Department of Innovation, Universities and Skills), Nick Dusic (Director of CaSE) and Dr Ian Gibson MP, on the matter of engaging the public with science policy.

Questions covered ranged from whether public opinion should be considered when making science policy decisions, to how Parliament balances public opinion with scientific evidence in current debates, such as that on hybrid embryos. Public engagement with science was also seen as vital to society, especially since public money is involved in research. However, the audience believed that decisions over what type of science is funded should not be left to the public.

CaSE News

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CaSE Members

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A final comment from Peter Saunders...

This is the last issue of CaSE News before I give up the post of editor, and naturally I've been thinking back to its beginnings in 1994. Joe Lamb, who was then the chair of Save British Science (as CaSE was then known as), thought we needed something more suitable than our detailed reports to let our members know what we were doing. So he invited me out for dinner, and in the middle of it he suggested we should have a newsletter, which I would edit.

I asked a number of people for advice. One of them, who had a lot of experience of new periodicals, warned me that the first issue is always easy because you've got lots of things you want to say. For the next three, you ring up all your friends and get them to write something. It's only if you can produce a fifth issue, when you've used up all the ideas you had at the start and all your friends feel they've done their bit, that you've really got the thing off the ground.

Well we did produce a fifth issue, and we're still going. And the reason is simple: so much has happened in British science since 1994 that there has been no shortage of things for CaSE to do and for the newsletter to write about.

Like SBS and then CaSE itself, the newsletter has changed a lot over the years, and not just in its name. It began as a four page flier that I put together with the help of Alex Crawford, who was then with *Laboratory News*. It is now a much larger and more professional production,

with the most of work done in the CaSE office. It used to be mostly written in house, but now there are more articles by other people, which allows us to cover many important issues we couldn't deal with as well by ourselves.

On the whole, I've enjoyed editing the newsletter (I've got used to saying CaSE instead of SBS but *CaSE News* is still "the newsletter" to me) though I won't miss the hectic day every few months when it was time to get it ready. There generally seemed to be too much material, or too little, or both - don't ask me how that can be, but it's what it felt like. Things always came out right in the end, even if that sometimes meant writing a few hundred words in a hurry, or having to explain why an article I had been nagging someone for was not going to appear until the next issue.

It's been worth it because in addition to being the best way of communicating with our members, the newsletter is read by the many of the people CaSE is trying to influence. We know that partly because they tell us so, and partly because when we say something they don't like - which occasionally happens - we hear about it pretty fast. They also sometimes let us know when they find our articles helpful - which also happens - though the response time is generally a bit longer.

But almost fifteen years is long enough, and it's time to move out of the chair and welcome Hilary LeEVERS as the new editor.

Demand STEM skills

Over the last few months, CaSE has met with many business and industry leaders to talk with them about our work and to listen to their concerns. The most consistent message we hear is to work on policies that will alleviate the skills shortage. This message is supported by recent surveys.

Across most OECD countries, employment in science and technology grew twice as fast as overall employment between 1995 and 2004. The EU Lisbon target is for 3% of GDP to be spent on R&D (although the UK Government has only committed to a target of 2.5%). According to EU estimates that demand for science, technology, engineering and mathematics (STEM workers will reach 2.4 million by 2014. The CBI Education and Skills Survey published in April this year reported that six out of ten employers were having difficulty recruiting enough workers with STEM skills. Shortages are even more apparent for specific skills, for instance, a 2007 report by the Association of British Pharmaceutical Industry and the Bioscience Federation found that 75% of relevant employers found it 'difficult' or 'very difficult' to hire staff with appropriate *in vivo* skills.

It is vital to increase the availability of skills not just for employers based in the UK but particularly for those that are more globalised. In the UK, foreign capital funds an unusually high level, 27%, of business R&D and it is essential to continue to attract this investment. In contrast to low-tech manufacturing, high-tech manufacturing and knowledge-intensive services choose where to invest not on cheaper production factors, but on non-monetary factors. The most consistently important factor for locating R&D investment identified in a range of studies is access to skilled staff (see Work Foundation report listed below). Interestingly, access to a low cost skills base, and local subsidies, incentives, and regulation has little impact.

So how can the UK increase the size of its STEM workforce? Larger firms are looking abroad to fill their STEM vacancies, with over a third recruiting from India and a quarter from China. Later in CaSE News, we report on various issues arising from employing international scientists and engineers. International workers can greatly benefit the UK STEM workforce, adding to its diversity of skills and outlook and presenting opportunities for international collaboration. However, we should not turn to migrant workers as a solution to the shortfall of STEM graduates coming through our own education system.

The workforce could also be massively increased by more fully using what we already have. For various reasons, many people who train in STEM do not sustain a career in the sector and this is particularly true of women and certain ethnic minority groups. Aside from any principled argument, this is an incredible waste of resources. Despite increasing recognition of this problem and of the value of diversity, it is proving very hard to fix. For instance, latest DIUS figures from the Quarterly Labour Force Survey show that the number of workers with science, engineering and mathematics qualifications actually working in those occupations had fallen over the 5 years between 2001 and 2006, from 58 to 56% for men and a disappointing 34 to 28% for women. This is despite many new initiatives to maintain and return women with SET skills in the sector. Clearly much more needs to be done in this area, and CaSE continues to work on improving diversity.

The UK also obviously needs to increase the numbers of students choosing a STEM education. The Government is increasingly looking to employers to become more and more involved in the education of their future employees. According to the CBI, three quarters of firms offer work experience and almost half give lectures or are involved with careers fairs. As the new Diplomas for 14-19 year olds come on stream, employers will be asked to make significant commitments in providing workplaces for the minimum of 10 days experience for each student. CaSE objected to the initial announcement of the academic diplomas, which seemed to be for purely political reasons. Since then, CaSE has contributed to the Science Diploma Development Partnership and voiced serious concerns over many practical issues, including the organisational complexity and the collaborative requirements. We

can only hope that the less than rosy economic outlook does not reduce the extent to which employers can and will engage in all these activities. As it is, and as might be expected, employer involvement in many activities, such as outreach or the apprenticeship schemes, varies with the size of firm, with the majority of large firms participating, but significantly fewer SMEs.

Employers do not only rely on skills coming to them, of course, as many invest significantly in employee training. For example, nine out of ten firms offer training and development for their staff, and whether a firm participates or not again relates to their size. The Government is supporting more employer-led education to fill specific needs, for instance in the automotive industry, and are also giving more recognition to in-house employer training.

CaSE will continue to campaign to improve the quantity and quality of the STEM workforce, through influencing policy to improve education at all levels (see pages 6-7), to enhance the diversity of the workforce and therefore equality of opportunity (see page 12 and next issue), and to maintain the attractiveness of the UK to migrant workers (see pages 10-11).

Find out more from:

CBI/Edexcel Education & Skills Survey 2008.
www.cbi.org.uk
Towards a Global Labour Market?
Globalisation and the Knowledge Economy, The Work Foundation, June 2008.
www.theworkfoundation.com/research/publications.aspx

CaSE Updates

If you'd like to know more about CaSE's recent activities and also what CaSE is planning, then please sign up for the CaSE monthly email update by emailing nickh@sciencecampaign.org.uk. You can also visit the members' area of our website at www.sciencecampaign.org.uk.

We now post and circulate information on the consultations and inquiries that responses are being planned for as well as various CaSE projects - we always welcome input from our members so do not hesitate to call or email the CaSE office with any comments.

Science and the Assembly



Hilary Leever talks with Dr Stephen Benn, Royal Society of Chemistry, Parliamentary Affairs, at the Welsh Assembly

Science and the Assembly

In May this year, CaSE co-sponsored *Science and the Assembly* organised by the Royal Society of Chemistry. The day began with a series of presentations on Green Chemistry and the Environment held in the Welsh Millennium Centre and was followed by an exhibition, in which CaSE participated, and reception at the Senedd. Wales has a science policy that promotes work on a low carbon economy, capitalising on an established area of scientific strength and local resources. The varied presentations conveyed the breadth and importance of research in this area.

Jane Davidson, Minister for the Environment, Sustainability and Housing, gave the keynote address emphasising the value placed on evidence-based policy making and assuring participants that her door was always open to scientists who wanted to contribute. She conveyed the Welsh Assembly Government's commitment to sustainability as well as to the science that can advance it.

At the same event last year, participants had signed a petition for the appointment of a Chief Scientific Advisor to the Welsh Assembly Government. It was gratifying, to say the least, that Chris Pollock started in this role in November 2007. It was also encouraging to see the interest and support that Assembly Members had for science in Wales.

DIUS annual report

June 2008 saw not only the first anniversary of Gordon Brown's premiership, but also the first anniversary of the departmental changes he made to Government upon coming to power. Most important, from the point of view of CaSE, has been the creation of the Department of Innovation, Universities and Skills (DIUS), replacing the old Department of Trade and Industry (and Office of Skills and Innovation within it), as well as taking on certain responsibilities from the old Department for Education and Skills.

As the key department in charge of science and engineering policy, funding and higher education in the UK, CaSE has been closely monitoring the performance of DIUS since its conception. In its first annual report, released earlier this year, DIUS set out its key achievements so far, alongside its objectives for the future, and how it would go about meeting those objectives.

Crucial to the structuring of DIUS's priorities has been the Comprehensive Spending Review (CSR), published by the Government in October 2007, just a few months after DIUS was created. The CSR included a number of Public Service Agreements, which outlined the Government's priority objectives for the next spending period up to 2011. Of those, two fall under the remit of DIUS: the first one, to improve the skills of the population on the way to ensuring a world-class skills base by 2020, and the second, to promote world-class science and innovation in the UK.

This has meant the CSR has effectively set DIUS's agenda for the next three years. As outlined in its annual report, supporting

the achievement of these two targets are six Departmental Strategic Objectives, which will define DIUS's activities until 2011. These objectives include: accelerating the commercial exploitation of innovation and research (as outlined in the *Innovation Nation* white paper); implementing the Leitch Review of Skills so as to ensure a world-class skilled workforce; pursuing global excellence in STEM research and knowledge in line with employer demand; improving the quality of further and higher education to support national economic and social needs; and encouraging better use of science in Government.

While broadly supporting these objectives, CaSE has a number of concerns, and would seek to caution DIUS on becoming too fixated on a relatively short-sighted target-based approach. The annual report's emphasis on funding only the best research, and exploiting as quickly as possible the knowledge generated by this research for the good of the UK economy and society, may undermine R&D funding in underlying areas. CaSE welcomes the annual reports' recognition that STEM skills are in short-supply, and that urgent action is needed in addressing this problem, and we will be monitoring what concrete steps are being taken by DIUS to this goal. In regards to the last strategic objective, improving the quality and use of science and technology advice across government, this is unfortunately at odds with the reduction over the last year in scientific advisors among individual government departments. CaSE has been a consistent critic of these developments, including the decision to re-locate the Government's Chief Scientific Advisor to within DIUS, thereby undermining the trans-departmental nature of its work.

CaSE will continue to meet with key individuals from DIUS, seeking to highlight these concerns and help to shape policy. If you have any particular issues you wish CaSE to raise, please get in touch.

Incentivising STEM

CaSE responded to a recent DIUS consultation on High Level Skills and we were interested by the number of questions that asked about incentives. For instance, we were asked to suggest incentives for employers to provide more careers advice, and for universities to offer workplace access to students and academic staff. CaSE commented on these and other issues, but we were particularly interested in incentives to encourage more students to take STEM subjects, an area in which we have developed specific policy suggestions.

The pleasure of learning about and understanding STEM subjects should be a powerful incentive – sadly, too few pupils have the schooling to capitalize

on this. CaSE continues to campaign hard for improvements in this area (see page opposite). But pleasure is not the only driver for subject choice. Last year we published a policy report following an Opinion Forum on improving careers advice on STEM subjects. There are now positive developments in this area, with increasing numbers of employers and other organisations becoming involved, and Government funding of a central database.

Improving schooling can be a slow process and not all students base their subject choice on future careers. For additional and rapid impact, CaSE proposes a scheme of *STEM Diversity Bursaries* targeted to the brightest students studying these subjects in schools with a poor history of university access. These bursaries should work as an incentive to increase uptake of STEM subjects at school and beyond. They should also widen participation, particularly to include those

from disadvantaged backgrounds and ethnic minorities. Students throughout the target schools would be motivated to choose STEM subjects and to perform well in them. Schools that participate in the scheme should become more appealing to children and STEM teachers, thereby helping to even-out inequalities.

The scheme would depend upon universities recognising the potential that the Bursary students represent. Reference to the Texan *Ten Percent Plan* should help to alleviate concerns. All students in the top ten percent of Texan high schools are guaranteed a place at public college or university and these students have gone on to complete their courses at normal rates and perform better than would be expected from their school grades. Florida and California have now adopted similar plans and we believe that it is time for the UK to do so also, at least for the strategically important STEM subjects.

Science Budget Allocations

In April, the Innovation, Universities, Science and Skills (IUSS) Select Committee published its Fourth Report of session 2007-08, on Science Budget Allocations.

Although welcoming the overall increase in the Science Budget, announced in the 2007 Comprehensive Spending Review, CaSE shares the concerns outlined in the Committee's report that the increase is not sufficient to cover both existing commitments and new priorities, such as the requirement for Research Councils to cover 80% of the Full Economic Cost, the Technology Strategy Board and Cross-Council Research Programmes.

The Government's response to the report's recommendations was decidedly mixed. While accepting small scale changes, such as the Science Budget being renamed the Science and Research Budget in order to reflect the inclusion of arts, humanities and knowledge transfer, the government rejected many of the Committee's concerns and proposals.

CaSE supports the Committee's recommendation to make the Science Budget Allocations process more transparent by publishing any guidance from the Government to Research Councils. Without this information it is impossible to assess the degree to which the

Government is directing Research Councils and who should be held responsible for decisions. Although the Government agreed with the Committee's concern that there should be more transparency in the allocation process where possible, they argued that the procedure is one of negotiation, where candid discussion and robust appraisal is crucial, and that this is best achieved behind closed doors.

The government also rejected the Committee's accusation that regional policy was a criterion when Research Councils made funding decisions (such as the funding of Daresbury Science Park) and furthermore rejected the Committee's recommendation that they publish a white paper on regional research policy.

CaSE strongly supports the Haldane Principle, which stipulates that the Government should not interfere in how the Research Councils spend their money (see CaSE News 55). However, there is little independence when so much of the Research Council money is allocated to prior commitments and new Government initiatives, leaving some Research Councils with only limited options for how to spend the rest of their funds. It is pretty uninspiring that it is at this point in the process the Government cites the Haldane Principle to avoid taking responsibility. During a recent parliamentary debate on the science budget, the Chair of the IUSS Committee, Phil Willis MP, pointed out that, *"Accusations that the Government have broken the Haldane principle are already coming from organizations such as CaSE... and when strong such strong*

organizations make complaints, people sit and listen, and so should the Government."

In particular, CaSE and the IUSS Committee have sought to highlight proposed shortfalls in the Science and Technology Council's (STFC) budget allocation, which will severely affect the health of the physics and astronomy communities. Although the STFC and the government have subsequently announced the financial safety of larger-scale projects, such as Jodrel Bank, CaSE fears that less media-attractive projects will continue to suffer shortfalls and urges the Government to wait until the Wakeham Review is published in the autumn before making any irreversible funding cuts. Following the criticism it received in the Committee's report, the STFC has also agreed to commission an organisational review, to be completed by September, which will involve both self-assessment and external scrutiny. Speaking during the science budget debate, the Minister for Science and Innovation, Ian Pearson MP, insisted that, *"The Government are working with the STFC to review the way in which its allocation was handled, and to ensure that all relevant lessons are learned for the future. In particular, the STFC has recognized that it could have communicated its plans better, and it is taking steps to address that."*

CaSE will continue to work with the science and engineering community, members of the IUSS Committee and the Government in finding a solution to the Science Budget Allocation issue. If you wish to find out more please see the CaSE website or get in touch with your comments.

UCAS points the way?

A significant incentive for students taking A levels is the UCAS points that they accumulate, which are crucial for further study and are often assessed by employers. Currently all subjects accrue the same amount of UCAS points for each grade. CaSE proposes awarding more UCAS points for science and mathematics A levels and other similar qualifications as an incentive for more students to choose these subjects given the importance the Government is placing on improving uptake. The justification for this is similar to that for strategic and vulnerable subjects at degree level, but is actually stronger as it will have a positive impact for many, not just those pursuing a STEM career. If more students take STEM subjects, without necessarily going onto further study, this will increase the scientific literacy and numeracy of the general population, empowering all to make better-informed decisions on increasingly relevant scientific issues. It will also improve the skills of workers in other sectors that draw upon analytical and mathematical abilities (e.g., finance, law). Some Australian universities offer a similar Bonus Points scheme for important subjects in response to their own national shortage of engineers and scientists.

We might expect UK universities to increase the entrance requirements for courses in science and mathematics, but as students would have studied these subjects and reaped the higher UCAS points, it should not cause problems. In fact, some universities are already manipulating UCAS points, for example

the University of Chester awards double UCAS points for Further Mathematics grades, and others, like Cambridge, have clarified what they consider to be more “suitable” or “effective” subjects to prepare for entrance.

Science and mathematics are perceived to be among the most challenging subjects and as students, schools and colleges are assessed by performance this can reduce their uptake. Increasing the UCAS points available for these subjects should motivate schools and colleges to encourage students to pursue these subjects and provide optimal teaching to enhance their position in the league tables.

Several quantitative research studies with a range of methodologies support the idea that some A levels, including the sciences and mathematics, are harder than others. This includes the recent report by The Curriculum, Evaluation and Management Centre, at Durham University, funded by the Institute of Physics and the Royal Society. But this report did not recommend manipulating UCAS points on this basis. This is probably a wise decision given that the Government seems firm in its refusal to accept such data and because assessing the actual difficulty of different subjects, and thereafter maintaining relative differences, is fraught with complication. In contrast, providing more points as an *incentive* to study strategically important STEM subjects seems like a straightforward and obvious solution to national shortages. (The evidence and perception that these subjects are also more difficult is advantageous but not essential.)

Secondary Science Campaign

CaSE continues to campaign for specialist science and mathematics teachers and for the provision of separate science GCSEs in all secondary schools. The *Secondary School Curriculum and Staffing Survey 2007*, published by the Department of Children Schools and Families (DCSF) in June, confirmed the importance of continuing our work in this area. In mathematics, only 74% of teachers had a post-A level mathematics qualification. The Government target is for 95% of mathematics lessons to be delivered by a maths specialist, but this was the case in only 84% of lessons, down from 88% in 2002. There were also large inequalities with school type: 75% of mathematics lessons at grammar schools are taught by teachers with a mathematics degree, compared with 47% of lessons in comprehensives to age 16 and 58% of comprehensives to age 18. The impact of school type is even greater for general science teaching, but less for the individual sciences. The Government has introduced many initiatives to increase the number of specialist science and mathematics teachers, but it seems that more effective steps still need to be taken. CaSE has argued for a strategy to target newly qualified teachers to schools where they are most needed; it is not particularly efficient to spend thousands of pounds on bonuses encouraging teachers to train in these subjects if they end up teaching in grammar schools that are already well provided for.

Unfortunately, the survey apparently failed to appreciate the importance of specialist teachers for the separate sciences – it was stated that over 90% of physics, chemistry and biology lessons were delivered by teachers with an appropriate post-A level science

qualification, but this included those with general or combined science. When science teachers were broken down by their main subject specialism, rather than considering general science as sufficient for all, quite a different picture emerges. In 2005, one in twenty science teachers “specialised” in general/combined and this has risen to one in six in 2007. Over the same period, the number of physics specialists has risen from 19% to 22% (the Government target is 25% by 2014), but the number of chemistry specialists has dropped from 25% to 22% (target of 31%) and the number of biology specialists has dropped more dramatically from 44% to 32%. Bizarrely, the general science teachers seemed to be so busy teaching separate sciences, that only 79% of combined science lessons were delivered by someone with a science background.

CaSE is keen to see that the Government reaches its target for all students achieving an appropriate level to be able to study triple science GCSE from this September (although not necessarily in their own school). Unfortunately, information obtained from the DCSF under the Freedom of Information Act revealed that a fifth of schools that do not already offer triple science have no plans to do so. The main barrier to offering triple science was timetabling the subjects, but schools also reported that they needed better specialist equipment, more specialist teachers and more training.

CaSE frequently raises these issues with MPs and policy makers and will be commenting on student’s results as they come out over the summer.

The case for 'total innovation'



Dr Michael Harris,
Research Director
– **Innovation Policy,**
NESTA.

Science is not innovation. The confusion between these two terms has led us to an unnecessarily narrow conception of both science and innovation, and hasn't served either particularly well.

Despite its name, NESTA (the National Endowment for Science, Technology and the Arts) has been suggesting for some time that innovation is not encompassed by what has remained, until recently, 'science policy plus' in all but name.

Equally, it has seemed somewhat dangerous to attempt to justify science research funding on the basis of a supposed direct relationship to economic growth and prosperity. That's not the justification for supporting a strong science research base – at least, not one supported by decades of research into innovation or economic development.

However, it has been the dominant story in policy for innovation. Hence the focus on stimulating science-based innovation and knowledge transfer: incentivising research and development (R&D); encouraging businesses to collaborate with universities; and substantially increasing public investment in scientific research.

However welcome these initiatives, they haven't stood a chance of touching on the innovation that takes place in the majority of the economy.

There are two main reasons for this.

Firstly, most of our economy (more than 75 per cent) is made up of services. In the main, services – from financial institutions to IT services – don't rely on formal R&D to innovate. They use technologies, not invent

them. Knowledge transfer partnerships won't help to boost the productivity of these sectors; better regulation, more imaginative public procurement, and stronger management skills will have far more of an impact on their ability to innovate.

Of course, we're aware that some people don't consider the new products, processes or services developed in such sectors to be 'innovation'. But, ultimately, we're not concerned with innovation for its own sake. What we care about is the productivity of our economy and our ability to respond to major social challenges – to which innovation can make a major contribution. Most of the gap in productivity between the UK and countries such as the US isn't down to science funding; far more significant is the way that, over the past 15 years, American retailers, financial and business services firms have been better at harnessing information and communications technology in making their processes more efficient and in launching new products for their customers.

What has happened, from this perspective, is that a 'gap' has opened up between the types of innovation that matter most directly to the majority of the UK economy and the established policy interventions that are intended to promote innovation – particularly given the size and importance of the UK's service-based sectors and public sector.

We call what's left behind 'hidden innovation' – covering the many different forms of innovation that directly contribute to the real practice and performance of a sector, but which are not captured by traditional, science-based measurements of innovation such as R&D activity and new patents.

Secondly, even in the six per cent of the UK's economy that is characterised as being at least 'medium-high tech', scientific knowledge is only one input into the innovation process. An important one, certainly, but not always a definitive one.

In these sectors – from pharmaceuticals to automotive – innovation is about more than product breakthroughs resulting from scientific and technological research. It can be as much about new ways of doing things, or new business models. Such hidden innovation enables UK firms to change and adapt in the face of rapidly increasing international competition.

Just as firms need to harness several different forms of innovation from new technologies to new business models – a process we call 'total innovation' – policy also needs to reflect this broader understanding of what innovation is and where it comes from. Most importantly, the UK needs to develop strategies to stimulate total innovation in these sectors and others if it is to remain competitive in today's world.

In this way, we think that there is both too much pessimism and too much complacency about the UK's high-technology sectors – a picture that can't be developed solely by looking at levels of spending on R&D by UK firms vis-à-vis their international competitors. Too much pessimism because the UK remains strong within major sectors such as aerospace, pharmaceuticals and automotive; too much complacency because the nature of innovation in these sectors – particularly in the need for total innovation from new business models to new services – is changing rapidly and may overtake UK industry and the innovation policies designed to support it.

This is why science (alone) is not innovation, and why it is so important that this broader innovation agenda has been recognised in the Government's recent White Paper *Innovation Nation*. What remains is for us to build the new forms of innovation policy that do better reflect the innovation that matters to the UK – alongside, not in place of, the science-based initiatives that have previously been so much the focus.

NESTA's report, 'Total Innovation', can be found on the NESTA website at: www.nesta.org.uk/total-innovation-report/

The Science of Services



Kevin Bishop,
Vice President, IBM

With more than 70 per cent of the UK economy and employment now drawn from across the field of services, the nation has thrived on the silent revolution of a successful service economy.

Central to creating more than 60 consecutive quarters of GDP growth, this track record of success is now at risk and a coherent response from UK plc is urgently required,

Why now? While it is true that services have

dominated our domestic economy for a long time - price and cost pressures; disruptive technology; rapid globalisation; and unrelenting focus by overseas governments on capturing higher value services business have combined to deliver a major competitive warning to the UK's success in this sector.

In response to this challenge, there exists a unique opportunity to build a new competitive advantage. To create a new professionalism in services - to understand and build on successes that are oft created by Darwinian competitive forces rather than being rigorously understood, engineered and managed.

Services Science

We need the rigour of **science** to interpret data and derive knowledge, **engineering** to turn this into useable tools and **management** practices to evolve to combine a vast array of disciplines into real value.

This overall need to address service innovation in order to support globally distributed service-dominated economies is widely acknowledged.

Industry dependency on services revenue is increasing and the economics for effective delivery can be a challenge - especially in professional services where scalability and repeatability may prove problematic for some suppliers. The gap between customer demands and fulfilled expectations grows too, due to increased complexity. This leaves corporations, governments and national economies exposed to potential economic and competitive threats.

What is true of the UK economy as a whole is reflected by industries that invest here. For example, more than 50 per cent of IBM and Rolls-Royce's revenue is services-driven. Xerox earns more than 70 per cent from this segment - and all these companies are renowned for high value products and services.

Yet the scale of response gives cause for concern. In the UK, R&D intensity (R&D as a proportion of revenue) in services is just one-tenth of that in manufacturing. In goods markets, simply

keeping a high value product in the marketplace requires ongoing investment. But in services, this approach appears deficient. This lack of investment is not just a commercial issue but it also impacts the public sector. The education sector has annual revenues of around £36 billion yet research intensity is tiny at less than 0.1%. And this in a market that is rapidly globalising and for a service of unmatched personal importance and value.

Success so Far

We should recognise the emerging success of initiatives here in the UK. These include the Cambridge Symposium on Service Science, Management and Engineering - and its resulting White Paper: Succeeding through Service Innovation www.ifm.eng.cam.ac.uk/ssme/. Also SSMEnetUK - the EPSRC-funded network of UK researchers interested in Service Science Management and Engineering www.ssmenetuk.org and the new Masters courses established by Westminster and Exeter universities. Further, the leadership of bodies such as the Advanced Institute of Management Research in appointing Services Fellows should be acknowledged.

Put simply though, business, government and academia need to work together on an interdisciplinary approach to research and education in order to deliver innovation that matters in services. We need champions and leaders from all three groups - but particularly politicians and government, given its wide reach and influence.

Education, curricula and training need to deliver the right 'T-shaped' people - with expertise in existing core disciplines yet with the breadth to work across industries and cultures. We need research that is high in impact and relevant to what is happening in our social, public and economic environment. It is by no means clear that the incentive structures we have in the UK deliver the required scale of response and relevance.

Necessary Appetite

The Rt Hon John Denham MP, Secretary of State for Department of Innovation, University and Skills, in his speech to the Royal Society on Science in Society this year, highlighted the issue succinctly as he discussed the challenges of pension reform. "When there is an appetite for academic input, it can be hard to source relevant advice," he stated.

Clearly, the UK services sector has an overwhelming appetite for academic input on the matter of services science. In order to remain "relevant", academic and research institutions need to respond to this demand, requiring transformation of how they address the notion of service as a discipline and engage practitioners.

Without a formal process to study service systems, knowledge cannot translate into understanding. Without doubt, service science has the potential to be as important to UK business as the foundation provided by physics, chemistry, biology, cognitive science or computer science.

In summary, the services sector is seeking the right foundations and framework. Universities, please apply.

International Scientists and Engineers

In early July, CaSE held an Opinion Forum on *Attracting, Educating and Collaborating with International Scientists and Engineers*, sponsored by the British Council.

Over the course of the day, speakers addressed a wide range of issues laying the basis for later discussion in break-out groups. All of CaSE's organisational members were invited to contribute, joining participants from other relevant organisations, including Government departments, think tanks, and Research Councils.

The varied presentations revealed some common themes and also some tensions between them. The day opened slightly worryingly with Phil Willis MP, Chair of the IUSS Committee, starting his key-note speech by wondering what he could add to the line-up. Fortunately, this reflected a lack of vanity rather than knowledge, as he then delivered an excellent and insightful speech that perfectly set the scene for the day (see page opposite).

Speaking from The British Council, Dr Lloyd Anderson, Director of Science, argued that it is time to move on from discussions of brain gain or drain, but rather to aim for an international brain circulation benefiting all participating countries (and individuals, of course). He argued that our reliance on international knowledge and skills is not just an inappropriate response to the skills shortage, but also an unsustainable one.



Catherine Marston,
Universities UK

Giving the perspective from Universities, the sector most affected by international flow, was Catherine Marston, from Universities UK. She provided evidence of the increasingly important role of immigrants, particularly at academic and post-graduate levels and in STEM subjects. Currently, it is hard to accurately monitor circulation, and this should be improved. Catherine also described concerns over the introduction of the new points based visa system. While there are many

positives to this new system, it is not clear that it will be able to accommodate academics and particularly visiting academics.

Katerina Rüdiger from the The Work Foundation described how important access to an international workforce is to



Katerina Rüdiger,
The Work Foundation

attract industry to locate in the UK. She also touched upon some of the visa issues. She argued that immigrants should not just be seen as filling a skills gap, but as diversifying and enhancing the workforce.

On the new points based visa system, CaSE has already responded to an inquiry and raised some of the concerns voiced at the Opinion Forum with Bill Rammell, Minister for Lifelong Learning, Further and Higher Education and responsible for international relations.

After lunch, Dr Iain Cameron, Head of Research Careers and Diversity Unit at Research Councils UK described their international strategy. It aims to engage the "best with the best" by enabling access to data and resources, influencing the international research agenda, and enabling movement of collaborators. New offices in China, India and the US have important and evolving roles in fulfilling these goals.

Finally, Ashley Ibbett, from the Department for Innovation, Universities and Skills, outlined the roles of the new International Science and Innovation Unit. He argued that while the UK is in a good position, it is critical to build upon our strengths, to forge more collaborations and derive more impact from them. He believed that encouraging the free movement of knowledge was important for this.



Dr Lloyd Anderson,
The British Council

Summarising the mood of the day, it was recognised that while the UK reaps a wide range of benefits from the presence of international scientists and engineers, there is a vulnerability that goes in hand with this. The UK must not be complacent about its current attractiveness to international scientists and engineers.

There is also a tension between attracting international students and workers and depleting the skills available in developing nations. Accordingly, there was a move towards a collaborative approach encouraging brain circulation, with an opening up of international opportunities.

The presentations and deliberations from the Opinion Forum will be supplemented by further research and discussion and developed into a CaSE Policy Report, by Dr Hilary Leever, CaSE's Assistant Director. Please contact her if there is a particular issue that you would like to see considered.

Many thanks to the Institution of Engineering and Technology (IET) for hosting the event and if you would like to see the presentations, then please go to the following link where they are available on IET.tv: <http://www.sciencecampaign.org.uk/members/meetings.htm>

International Solutions

This article is based on the keynote speech made by Phil Willis MP, Chair of the IUSS Committee, at the CaSE Opinion Forum (see page opposite).

The increasing competition for skills is now not only confined to the UK, Europe and the USA, but every aspiring and developing nation. Furthermore, the greatest competition will inevitably be for high-level skills in science, technology, engineering, and maths (STEM).

The Leitch Report, although noble in its attempts to improve the UK skills base, risks lulling government ministers into a false sense of security and of failing to equip graduates with the skills needed to boost the wealth of the nation. Put quite simply, the current UK skills gap cannot be solely rectified by domestic policy solutions. Even if Lord Leitch's target of a 40% graduate workforce by 2020 were to be reached, the UK would still lag significantly behind many of the now-emerging nations. This debate around attracting, educating and collaborating with international scientists and engineers is therefore an appropriate and challenging one.

Despite the supportive rhetoric emanating from government, there is a surprising lack of new thinking about the issue. Although the government has recognized the need for more international STEM workers, this has not been integrated into a comprehensive policy framework which includes, for example, managed immigration. Rather than viewing domestic and international contributions as two separate entities, a single global science and engineering strategy is needed.

The UK is highly reliant on international scientists and engineers and by 2020 this reliance will not have diminished. Last year, for example, 27% of all newly appointed academics were from overseas, and the UK is second only to the US in attracting international students (376,190 in 2006/07), a third of whom were studying STEM courses. While international undergraduate students make up 4% of the total US HE student population, the proportion in the UK is 16%, with 33% of postgraduate students coming from overseas, the majority studying STEM.

The economic benefits of such integration are clear. Universities UK calculates that British universities receive fee income of £2 billion from international students with a further £1.6 billion going to the wider economy. The British Council estimates that by 2020 the international student market will be worth £5.8 billion. As a nation we are far more vulnerable to any change that government, universities or our overseas competitors may make than almost any other nation.

In a recent survey, the UK came out as the most popular destination for international students in terms of security, reputation and

they are appropriately investigated and that the whole process of recruitment is transparent. Any attempts to dumb down our university system for short-term gain would be hugely damaging.

Further improvements must be made to allow international students easier access to study and work in the UK. These could include retaining the 12 month academic visitor route visa to allow overseas sabbaticals and so promote greater academic collaboration, developing a more flexible and student-centred visa system, and removing bureaucracy so as to help international students, academics,



Phil Willis MP (centre) with Professor Hugh Griffiths and Nick Dusic

access. However, this privileged position is increasingly coming under threat as almost every developed nation experiences the growing skills deficit, and sees the necessity of attracting, educating and retaining scientists and engineers. The number of foreign students may have risen in UK by 43% between 2000 and 2005 but in Australia it grew by 67%, Ireland by 74% and New Zealand by a staggering 745%! The UK is being overtaken, both in terms of foreign student take-up and percentage increase in academic publications, as competitors in Europe, the Middle East and Asia make huge investments in research-intensive universities. Furthermore, speaking English is not the competitive advantage it was, as many countries are now prepared to teach and publish in English.

The key, therefore, to continued success lies in maintaining the quality of the product we offer. This is hampered by accusations that fee income is more important than academic integrity, and that overseas students are being awarded degrees without academic justification. It is crucial that the UK Government sends out the strongest possible message that such claims are unfounded, that when they arise

and skilled workers move into the UK workforce. The points-based immigration system introduced earlier this year for example, offers 'highly-skilled' non-EU scientists and engineers' automatic entry to the UK (as Tier 1 entrants) and therefore allows us to retain the most able international graduates. Although the system is not perfect (the cost of applications and confusion over the points-based system being two particular issues) the Government is moving in the right direction. Ministers now need to gain the confidence to relax further the controls to allow an even greater flow of international graduates from our universities into the workplace.

A further dilemma is the possible exploitation involved in taking the best of the developing world's intellectual talent. A solution needs to be found which promotes bilateral support for the development of new talent, while avoiding a 'brain-drain' in those countries.

The Government, Universities and employers have a very real challenge addressing the global issues in this area, a challenge that should not be ducked.

Invited Article & CaSE News

Metrology – Measuring Europe's Future

Andy Henson
Director, International Projects
National Physical Laboratory

The central nerve in the spine of our high-tech world is metrology, the science of measurement. Precise, reliable measurements are essential for research and innovation, healthcare, protection of the environment, and in many other areas of our daily lives. Metrology researchers are pushing back the boundaries across a huge range of technologies and applications ranging from medical diagnosis and therapy tools such as biomarkers, through to understanding "grand challenges" such as climate change and enabling our traditional industries to make ever more complex and innovative products. The UK is a major player in measurement science, supporting a vibrant, SME-rich instrumentation sector, providing wider contributions to science & innovation and underpinning regulations and legislation. In the words of Lord Kelvin (1824-1907), President of the Royal Society and developer of the Kelvin temperature scale *"When you can measure what you are speaking about and express it in numbers you know something about it; but when you cannot express it in numbers your knowledge is of a meagre and unsatisfactory kind"*.

Metrology research is facing a dilemma. The need to provide ever-greater accuracy over ever-wider ranges and technologies is stretching the available resources and challenging the world-class laboratories in the UK and Europe. Recognizing the need

to act, the National Physical Laboratory (NPL) and DIUS are leading an initiative to bring together resources across Europe, and to attract further EC funding. They have been working with the Commission to launch a 400 M€ seven year European Metrology Research Programme (EMRP) funded by the European Commission and some 20 European states under Article 169 of the European Treaty. A new not-for-profit body, the European Association of National Metrology Institutes (EURAMET), was created last year to facilitate the EMRP.

With the shape and structure of the programme nearly finalised, progress is now in the hands of the European Commission who are completing public consultation and internal approvals. Whilst participating states have already identified their budgets, the Commission funding needs to be drawn from a number of the FP7 thematic areas, a process that is proving complex and time consuming. The Commission's current timing is such that submission to the Council of Ministers and the European Parliament is unlikely before December 2008, leaving little time for approval before the June 2009 EP elections.

With the extended powers in the new European Treaty due to come into force in January 2009, the EMRP may well be referred back to the national Parliaments, giving MPs the opportunity to hear directly about European collaborative metrology research. However the delays and uncertainty around the new Treaty requirements and the EP elections raise serious concerns over loss of momentum for this excellent initiative. Thus the metrology community will be looking for positive and speedy support from the national Parliaments if the dossier is referred to them.

Delivering Diversity

In May this year CaSE launched its latest policy report *Delivering Diversity: Making Science and Engineering Accessible to All*. The report developed out of an Opinion Forum on Under-Represented Groups in Science and Engineering held at the end of last year, sponsored by the UK Resource Centre for Women in Science, Engineering and Technology. The report sets out a series of recommendations to help eliminate under-representation particularly considering the impact of disability, social-disadvantage, ethnicity and gender on science and engineering education and careers.

Improving the diversity of STEM workers not only enhances equality and reduces skills shortages, but it brings its own gain in facilitating innovation. Diversity brings a broader range of perspectives, new approaches to problem solving and a greater understanding of different markets.

CaSE urged for more radical steps to be taken to improve the diversity of the science and engineering workforce arguing that while there is much talk about diversity

and a lot of good practice, it is hard to see significant impact in a lot of areas. The science and engineering community prides itself on being a meritocracy at the same time that much of society is under-represented at its highest levels. While success may depend upon merit it is also limited for many by practical barriers and bias. Recommendations ranged from providing a resource centre for disabled scientists and engineers, to reducing the social-inequalities in secondary schools. It is argued that pushing for diversity at high levels is essential to help pull people up, for example, by improving the make-up (and reducing the potential bias of) influential selection committees and by providing role models.

We are working with Claire Curtis-Thomas MP to get the topics covered in this report debated in the Houses of Commons. We will also use the report to guide our policy work. For instance, it helps us respond to consultations, such as those on Science and Society and the Single Equality Strategy currently running by DIUS, and it enables us to highlight some of the issues that could promote diversity in the development of the new Science Diplomas.

Download the report from the Documents section of the CaSE website:
www.sciencecampaign.org.uk/documents/index.htm

CaSE Elections

As part of CaSE's commitment to delivering diversity, the Executive Committee has decided to strive to broaden its membership. We will be holding elections at our next AGM and would like to encourage a range of candidates to put themselves forward. Currently, many Executive Committee members are senior academics based around London. As we go forward, we would like our Executive Committee to better represent women, ethnic minority groups, and disabled scientists and engineers, as well as different sectors of science and engineering, career stages, and geographic locations. The Executive Committee normally meets three times a year to set the strategic direction for CaSE and discuss organisational issues. If you are interested in running for election to CaSE's Executive Committee and would like to find out more about what this entails, then please contact Nick Dusic at CaSE.