CEG SEMINAR REPORT
on
Future Skill Needs of Process Industry

Wednesday 20 November 2002

Introduction

The aim of the seminar was to produce recommendations for actions which would enhance the ability of chemistry-using companies in the UK to recruit the skilled people they will need in the coming 10-15 years. A list of those present is at Annex A. The seminar was chaired by Sir David Harrison, Director of the Salters' Institute.

Background Presentations

Sir Gareth Roberts, Wolfson College Oxford, and Dr Peter Brooke, DTI, gave the introductory presentations, setting out policy development.

Sir Gareth said that we were now waiting to hear how Government Departments planned to spend the extra resources allocated to them by the Chancellor in response to his report on the supply of scientists and engineers. His report had found problems in physical science, maths and engineering (and in other subjects, particularly modern languages). Teachers were under-qualified; numbers taking A Levels had declined; and the percentage of students taking maths and physical science for their first degree had decreased. Californian and Irish studies had reached similar conclusions.

The Government's response to Sir Gareth's report had accepted all the 37 recommendations (where action lay with Government). There were significant increases in the science and the education & skills budgets. Universities would get more for capital expenditure, recurrent expenditure, indirect research costs, and knowledge transfer activities. There were some new research programmes, recognising the need for good physical science even as a basis for biological sciences.

Sir Gareth forecast that secondary school science would benefit from Departmental decisions relating to teachers, laboratories, students, the curriculum, and school-business links. He also expected that universities would see benefits relating to research students, post-docs, contract researchers, and staff; to university laboratories; and to university-business links.

Peter Brooke gave the first public airing of the results of the work of the industry-Government Chemical Innovation and Growth Team (CIGT). Against a background of massive restructuring, growing globalisation, and increased financial pressures, the UK industry needed to be innovative and creative to survive and prosper, and it therefore needed innovative and creative people. A barrier to recruiting such people was the poor public image of the industry, which was perceived by young people as being predominantly male, white, middle aged and slightly aggressive.

The core message from the CIGT was that the chief responsibility to improve the competitiveness and sustainability of the industry lay with the industry itself. The CIGT proposed the formation of a 'Chemistry Leadership Council' to address the key challenges, raise the industry's public profile, and motivate individual companies to rise to the challenges. The CIGT envisaged three bodies reporting to the Leadership Council: a Futures Group (which inter alia would deal with the linked issues of reputation and sustainability), an Innovation Centre, and a Skills Network Group. The last of these would seek to encourage and help the industry to find ways of recruiting more young people, and more people from diverse backgrounds. [Note: the full report was published on 12 December.]

The Speakers' Challenges

Sir Gareth and Peter each set the delegates four challenges, which were greatly complementary:

Sir Gareth Roberts	Dr Peter Brooke
How can we encourage more young people, especially girls, to continue SET during	How can the chemicals industry go about recruiting and keeping a more diverse

secondary education?	workforce?
How can we encourage physical science university departments to encourage creativity and reward breadth?	How can it make itself more attractive to prospective young employees?
How can employers make themselves and the physical sciences more attractive to the very best students?	How can we encourage more young people to study science, in particular chemistry?
How can we encourage physical science companies to engage more with universities, and invest more in R&D?	What is the right balance between academic and vocational skills, and how can we achieve it?

These challenges helped mould the subsequent discussion.

Discussions Amongst Delegates

Following are the main points which emerged from the discussions round the six tables of delegates**. My own comments and recommendations are in bold**.

1 Trends in industry
Some delegates believed that the bulk chemical industry would leave the UK for Asia, though the demand for its products would remain. Others disagreed, citing the difficulties and cost of transporting these materials over long distances compared with their intrinsic value, the investment already on the ground in the UK, and the UK's availability of raw materials (e.g. salt). In any case, today's specialities will become tomorrow's commodities, and the need for continuous innovation will be ever present. There will be increased financial pressures, and further consolidation. Manufacturing will become more complex, more efficient, and greener. There will be greater attention paid to quality. The demographics of Europe (a stable and mature population) will impact on markets, e.g. for pharmaceuticals, cosmetics, toiletries and nutriceuticals.

2 Growth technologies
There will be much more automation throughout R&D and manufacturing. Other growth areas will include

- Nanotechnology
- High throughput technology
- Cheminformatics
- Genomics/proteonomics
- Analytical science.

3 The need for the UK to specialise
But there was consensus that the UK could not be excellent at everything, and should specialise. UK industry should decide its long-term direction, and our infrastructure and skills should be developed accordingly to enable the industry be world-class. **This seems to be core to the task of the Chemistry Leadership Council**.

The need for specialisation extends to the academic world. We will not be able to be excellent – and excellence is what is required – across all fields of chemistry. It was said that UK chemistry departments have a long tail of mediocrity. **CEG's members should continue to exert influence over the development of the UK's physical science base, with the aims of ensuring that UK university departments teach and research areas in which UK industry specialises; and that funding is concentrated on university departments which are excellent.**

4 The need for the industry to market itself better
There was widespread agreement that the industry needs to market itself better to youngsters if it is to be successful in its recruitment. This is in line with the conclusions and proposed actions of the CIGT. The industry should:

- show students that it offers careers which encourage creativity, innovation and independence
- promote company visits
- use young people to do its recruiting
- make better use of the internet

- sell itself through a sustainability/green agenda, but also through an innovation/high technology image
- offer good career paths from the outset, including competitive salaries
- demonstrate that the industry's careers involve working with people
- make a particular point of showing people that it has changed, and telling them what it does now.

Employers need to make themselves attractive to the very best students.

CEG may consider that much of this agenda is slightly outside its remit, and is best left to the CIGT and individual companies. But structured and well-prepared school visits, as undertaken in the 'Children Challenging Industry' programme initiated by CIEC and Thomas Swan, do seem relevant to CEG's concerns, and CEG may wish to consider how it and its members can encourage the further development of this programme.

5 The need for diversity

The industry needs more women, more people from diverse ethnic backgrounds, and more youngsters. It needs to attract physical scientists who are not interested in synthetic organic chemistry as well as people who are keen on synthetic organic chemistry. It needs technicians as well as researchers. Schools have to teach physical science to potential researchers, to potential technicians, and to people whose only contact with science will be as members of the general public.

Some of these issues are a matter for the industry's recruiters. Some, however, are educational. CEG should consider, taking account of existing initiatives, whether current school curricula cope adequately with these diverse needs, and if not, what should be done to improve matters.

6 The need for creativity and innovation

Against competitive challenges from other parts of the world, the UK can succeed only through innovation. This requires creative people, with a sense of independence. It is more than just R&D – it involves getting new ideas all the way through to the marketplace. The education system should do more to encourage the necessary skills, which involve understanding markets as well as science and technology. One proposal was an MBA which teaches technology management.

It was felt that science and engineering courses are failing in this area. Some courses stifle creativity; instead, they encourage fact-learning. PhD students need to be encouraged to develop originality, teamworking, breadth and flexibility as well as depth and specialist knowledge. There was a plea to reduce the emphasis on assessment in schools to allow more time for innovative science.

A challenge for the CIGT's proposed Innovation Centre, and for others, would be to get physical science-based companies to engage more with universities, and to get such companies (with the exception of the pharmaceutical sector, which has an excellent record) to invest more in R&D. The Innovation Centre will be helping the industry to understand the available knowledge transfer schemes, whose numbers and rules boggle the mind, and to improve links with academia.

CEG should consider what more could be done in schools – and universities, to the extent that it decides that its remit extends to that sector – to improve the development of creativity and other skills needed for successful innovation, including links between science/technology and markets. The Salters' Institute, or some combination of CEG member bodies, may be able to acquire government funding for a detailed study of this area.

7 The skills which will be needed

The industry will continue to need world-class specialists in synthetic organic chemistry, despite other advances. People will need the skills required to deal with an ever-increasing level of automation. Although youngsters are now quite good in communication skills, this area will continue to be important. Marketing is crucial: one view was that firms themselves can teach this to their chemists and chemical engineers, but another was that universities should teach it. **Some universities should offer this option.**

Core skills will need to be supplemented with bioinformatics and manufacturing skills. People will need to be good at interdisciplinary working. Above all, as change continues, there will be a strong need for continuing professional development. There will not, however, be a need for more people than are currently employed in the process sectors.

CEG should consider holding regular seminars – say every three years – to allow people from industry and from the academic world to exchange ideas on the skills needs of the future. As a basis for discussion, such seminars should be preceded by carefully constructed surveys, conducted by one or more CEG members.

8 Curriculum content

Delegates said that the skills being developed in schools and universities do not really mirror industry's needs. Coursework in particular should be changed to develop collaborative/transferable skills. Emerging new areas of science and technology should be in the curriculum, and schoolchildren should be told what has not been solved, as well as what has been solved. The amount of practical work should increase, but with equipment which reflects what science is like now in industry. The old split of chemistry/physics/biology should be revisited to reflect the modern world.

There should be some interdisciplinary first degrees and PhDs, and degrees for chemical technologists, incorporating elements of chemistry and chemical engineering.

Delegates felt that polytechnics should somehow be reinvented, because of the severe shortages of people with the type of technical skills which the polytechnics used to produce.

I understand that a new GCSE (21st Century Science) is soon to be piloted, and that this may address some of the above issues. Once the pilot is under way, CEG should consider whether a study of relevant school curricula should be commissioned by one or more of its member bodies to see if the above points are valid; and, to the extent that they are, to recommend changes. In addition, CEG's members should open/continue dialogue with the relevant funding bodies about the above points about university courses.

9 Teaching skills

Delegates felt that the skills and confidence of all teachers, including those at university, needed improving by continuing professional development. **CEG should discuss any evidence available to its members on whether there are sufficient well-designed courses etc available and used, and if there are not, consider how the supply and/or take-up might be improved. In doing so, it should take account of forthcoming Government initiatives, including the proposals for a new National Centre for Excellence in Science Teaching.**

10 The interface between industry and education

Delegates felt that the education/industry interface was very complex, and should be simplified. They welcomed schemes which encouraged academics to engage with industry. The Teaching Company Scheme was particularly praised, except for the fact that, as a pump-priming scheme, its application was limited: it was suggested that this limitation in the number of people who could be linked to a company be abolished.

The Chemistry Leadership Council should address these issues, which are particularly important if medium and smaller companies are to become more innovative.

11 Careers teaching

It was suggested that careers teaching for physical science careers needed improving. In particular, it currently failed to convey the range of careers open to youngsters (vocational, research, etc). **CEG should revisit the issue of careers teaching and guidance for chemistry-based jobs, taking into account other studies; and, as appropriate, make recommendations to Ministers for improvement.**

Responses by Professor John Holman and Professor Ray Allen

John Holman pointed out that there are limits to what schools can do – e.g. the perception of industry is embedded in society. He said that we should not be too pessimistic – an international study had

placed the UK fourth in the world on scientific literacy of 15-year olds. We have come a long way in recent years - e.g. girls no longer opt out of physics, and science is studied by everyone.

However, there are still areas for improvement. We have to do more to recognise the two different groups being addressed by science education: those destined to use science only as members of the general public, and those destined to use it in their careers. For the former, we need to aim to produce a public who can critically assess newspaper reports on technical issues. John felt that this required getting primary school pupils and their teachers out more into industry. For specialists, we need to differentiate in the science curriculum between academic and vocational, the latter being currently much neglected for youngsters approaching 16. We need to look at A Levels – is the curriculum broad enough? John was attracted to the International Baccalaureate.

John endorsed delegates' comments that the quality of careers advice is crucial, and that there is a need for a great improvement in quality. He wondered whether IT had a role to play.

To achieve what we all wanted requires teachers of the appropriate quality. Improvements in continual professional development are needed. He felt that forthcoming government proposals responding to Sir Gareth's report could be very helpful.

Ray Allen said that the future chemical industry is not going to be reached by a linear extrapolation from the past – products will be sold more on functionality, and university courses will need to recognise this. Courses will also need to be designed to recognise that industry will turn more to multidisciplinary teams. People will need core skills plus the ability to expand and update their knowledge. They will also need to develop business and transferable skills. He felt that students could spend 2 years of a 4-year course on non-core knowledge.

There will be some merging of chemistry and chemical engineering.

There had been some success in chemical engineering in improving recruitment through the use of professional image-makers. Even better results might be achieved if this were done jointly between chemists and chemical engineers. Ray endorsed the importance of sustainability and the green agenda if the industry was to attract the people it needed.

Finally, Ray cautioned on top-up fees. He said that students of chemistry and chemical engineering typically came from backgrounds which were middle class but not well off – just the sort people who would lose out most from the introduction of means-tested top-up fees.

The main points made by these two speakers have been picked up in my recommendations above, and which are collected below.

Summary of Recommendations

1. **A core task of the Chemistry Leadership Council should be to forecast the long-term direction of the UK chemical industry, and ensure the development of the infrastructure and skills needed to ensure that the industry is world-class, recognising that the UK cannot be excellent at everything.**

2. **CEG's members should continue to exert influence over the development of the UK's physical science base, with the aims of ensuring that UK university departments teach and research areas in which UK industry specialises; and that funding is concentrated on university departments which are excellent.**

3. **CEG may consider that much of the work needed to ensure that the industry markets itself better is slightly outside its remit, and is best left to the CIGT and individual companies. But structured and well-prepared school visits, as undertaken in the 'Children Challenging Industry' programme initiated by CIEC and Thomas Swan, do seem relevant to CEG's concerns, and CEG may wish to consider how it and its members can encourage the further development of this programme.**

4. **Some of the issues relating to the need for more diversity are a matter for the industry's recruiters. Some, however, are educational. CEG should consider, taking account of existing initiatives, whether current school curricula cope adequately with industry's diverse needs, and if not, what should be done to improve matters.**

5. **CEG should consider what more could be done in schools – and universities, to the extent that it decides that its remit extends to that sector – to improve the development of creativity and other skills needed for successful innovation, including links between science/technology and markets. The Salters' Institute, or some combination of CEG member bodies, may be able to acquire government funding for a detailed study of this area.**

6. **Some universities should offer the option of including marketing in chemistry and chemical engineering courses.**

7. **CEG should consider holding regular seminars – say every three years – to allow people from industry and from the academic world to exchange ideas on the skills needs of the future. As a basis for discussion, such seminars should be preceded by carefully constructed surveys, conducted by one or more CEG members.**

8. **I understand that a new GCSE (21st Century Science) is soon to be piloted. Once the pilot is under way, CEG should consider whether a study of relevant school curricula should be commissioned by one or more of its member bodies, to see if the curricula adequately reflect industry's current and forecast needs; and, to the extent that they do not, to recommend changes. In addition, CEG's members should open/continue dialogue with the relevant funding bodies about the corresponding concerns about university courses.**

9. **CEG should discuss any evidence available to its members on whether there are sufficient well-designed courses etc for teachers' continuing professional development which are both available and used, and if there are not, consider how the supply and/or take-up might be improved. In doing so, it should take account of forthcoming Government initiatives, including the proposals for a new National Centre for Excellence in Science Teaching.**

10. **The Chemistry Leadership Council should address the complexity and limitations of schemes designed to improve the operation of the university/industry interface, which**

are particularly important if medium and smaller companies are to become more innovative.

11. **CEG should revisit the issue of careers teaching and guidance for chemistry-based jobs, taking into account other studies; and, as appropriate, make recommendations to Ministers for improvement.**

Elliot Finer
9 December 2002