

The routes through which the science base is translated into innovative and competitive technology : Government response to the first report of the House of Commons Select Committee on Science and Technology, 1993-94 Session / presented to Parliament by the Chancellor of the Duchy of Lancaster by Command of Her Majesty, September 1994.

Contributors

Great Britain. Chancellor of the Duchy of Lancaster.

Publication/Creation

London : H.M.S.O., 1994.

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THE ROUTES THROUGH WHICH THE SCIENCE BASE IS TRANSLATED INTO INNOVATIVE AND COMPETITIVE TECHNOLOGY

Government response to the First Report of
the House of Commons Select Committee
On Science and Technology, 1993-94 Session

Presented to Parliament by the Chancellor of the Duchy of Lancaster
by Command of Her Majesty

September 1994



THE ROYAL SOCIETY
WHICH THE SOCIETY
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AND COMPREHENSIVE
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GOVERNMENT RESPONSE TO THE HOUSE OF COMMONS SELECT COMMITTEE REPORT ON THE ROUTES THROUGH WHICH THE SCIENCE BASE IS TRANSLATED INTO INNOVATIVE AND COMPETITIVE TECHNOLOGY

INTRODUCTION

1. The Government is grateful to the Select Committee for its Report. During the past 18 months the Government has issued two major statements of policy on the issues which the Committee has addressed:

- the White Paper on science, engineering and technology¹; and
- the White Paper on competitiveness².

2. The White Paper on science, engineering and technology (SET) described how the Government is working to strengthen collaboration between the science and engineering base and industry. It also stated the Government's belief that "the capacity to put science and technology to commercial use through innovation plays a significant part in successful modern industry" (paragraph 2.3) and its wish "to harness the intellectual resources of the science and engineering base to improve economic performance and the quality of life" (3.9).

3. The SET White Paper announced a range of measures to encourage stronger partnership between industry, the science and engineering base and Government. These include:

- the Technology Foresight Programme, which is creating networks between those involved in it, to the lasting benefit of industry and of the research base;
- the annual Forward Look of Government-funded SET, which provides industry and other users of research with a statement of the Government's strategy;
- the restructuring of the Research Council system, which has laid a basis for the strengthening of links between the Research Councils and the potential users of research in industry and elsewhere, to their mutual advantage.

1 "Realising our Potential: a Strategy for Science, Engineering and Technology" Cm 2250 HMSO 1993

2 "Competitiveness: Helping Business to Win" Cm 2563 HMSO 1994

4. The Competitiveness White Paper reiterated the importance of innovation. It described measures being taken to improve the climate for innovation and initiatives to improve access to advice and services, including:

- the introduction of Innovation and Technology Counsellors in Business Links and their equivalents in Scotland and Wales;
- the provision of Innovation Credits to encourage firms to use external services;
- the development of local and national networks;
- improvements in accessibility of overseas technical services to UK customers;
- special support for innovation in smaller firms.

That White Paper also announced an important series of measures to allow industry to make better use of the science and engineering base through increasing rewards for high quality industrially-relevant research in academia and stimulating the exchange of people between industry and academia.

5. The Government welcomes the recognition given by the Select Committee to the action it is taking. Its detailed comments on the Committee's recommendations and conclusions are set out below. References to the paragraphs from which those recommendations and conclusions are drawn are given in brackets.

THE ROLE OF GOVERNMENT

6. The creation of the Office of Science and Technology (OST) within the Cabinet Office, under the direct control of a Cabinet Minister, signalled a determination to improve the co-ordination of policy towards the science and engineering base and to link it with the pursuit of national goals of enhancing wealth creation and the quality of life. The OST is pursuing this role vigorously. The Government also has a role in ensuring a stable macro-economic climate which will encourage industry to plan ahead and in providing the advice and information necessary to allow firms to make informed choices.

7. OST is headed by the Government's Chief Scientific Adviser (CSA), Sir William Stewart. The Committee comments (350) on his role, which has been set out³ as follows:-

"The Chief Scientific Adviser, Cabinet Office, is responsible for providing, or organising the provision of, advice to the Prime Minister and the Cabinet Office on scientific and technological matters, or scientific and technological aspects of other issues. He is concerned to influence positively the economic contribution from Government spending in science and technology. He sits on the principal interdepartmental committees which deal with the scientific and technological issues that come before Government. He also has a general responsibility for co-ordination of international scientific and technological relationships, and is the Government's scientific representative on many international occasions."

An important aspect of that role is the advice which he gives to the Government on Departments' plans for expenditure on S&T. As the Government's response⁴ to the House of Lords Select Committee Report on "Priorities for the Science Base" said, "The CSA ... has authority to advise on the science spending plans of Government Departments at the highest levels..." That response went on to explain that over time, the Forward Look, which the OST, directed by the CSA, co-ordinates on behalf of the whole Government, will "... set strategic objectives for the totality of publicly funded S&T. While individual Departments will remain responsible for taking their own spending decisions, the new arrangements will make it possible better to relate Departments' programmes to the Government's overall strategy as set out in the Forward Look. The official Cabinet Committee on science and technology, which the CSA chairs, will be responsible for keeping under review Departments' performance in relation to the Forward Look... The Government wishes to see how these new arrangements develop in practice before contemplating the need for further changes."

8. The Committee makes a number of comments (342, 345, 348) on the Technology Foresight Programme which are consistent with the way in which it is developing. The Programme is looking ahead over the next 10 to 20 years. It will assist in the formation of new and extended networks between industry, academia and Government, and inform spending decisions in both public and private sectors. The process of networking started with the consultation seminars in the second half of 1993 and is continuing. The aim is to identify the most promising market and technological opportunities for UK industry. Each of the fifteen sector panels taking forward the work is considering a defined market sector. The Programme will also look across sectors.

3 In "Civil Research & Development: The Government Response to the First Report of the House of Lords Science and Technology Select Committee 1986-87", Cmnd 185 HMSO 1987

4 "Government Response to the House of Lords Select Committee Report on Priorities for the Science Base" Cm 2636 HMSO 1994

9. The Department of Trade and Industry (DTI) and other Government Departments complement the OST's role by focusing on business, industry and their representative bodies. The Industry Departments are already working energetically with other Departments, including OST, to help create a sustainable long term climate for innovation in which the best companies can flourish. The Industry and other Departments are fully involved in the Technology Foresight Programme.

10. The Government agrees with the Committee (329) on the key role DTI can play at the interface between industry and Government. With this in mind, the President of the Board of Trade has established sector divisions covering all aspects of the UK economy. These divisions have a remit to get close to the companies in their sector and represent their views within DTI and more widely. Other Government Departments maintain close links with particular industrial sectors, for example, the Department of the Environment with the construction industry. Similarly, the Government's new regional structure in England, the DTI's Business Links network and the activities of the Northern Ireland Office, Scottish Office and Welsh Office help the Government to understand the needs of industry. The DTI's Innovation Unit, partly staffed by senior industrial secondees, works to promote the importance of innovation among companies, financial institutions and the media.

11. As the Committee notes (329), DTI's post of Chief Adviser on Science and Technology has been discontinued. However, Dr David Evans, formerly Chief Scientist at Department of Energy and currently head of Technology and Innovation Policy Division, DTI, provides advice to the Department on science, technology and innovation matters. A recent Departmental restructuring has brigaded his Division with the Sector Divisions under one Deputy Secretary Industry Command. This is one of a number of measures aimed at integrating DTI's work on science and technology more closely with its promotion of industrial competitiveness.

12. The Government notes the Committee's comments (332) about responsibility for identifying and maintaining the wider knowledge base that industry requires. In the Government's view, it is for industry to identify and maintain the expertise it requires. The Government's role is to facilitate this process. Industry Departments recognise the importance of an infrastructure able to help industry to access technology and are working with relevant business support organisations, including Research and Technology Organisations (RTOs) and Government Laboratories, to achieve this. The Business

Links, along with their Scottish and Welsh equivalents and their supporting networks, and the expansion of the overseas technology brokerage services, will be vital parts of this infrastructure.

13. The Ministry of Defence (MOD) is well aware of the importance of maintaining its intelligent customer capability, to which the Committee refers (325). This is one of the key aims of its Applied Research Programme. It is acknowledged that the US approach to defence research is in many ways different in concept as well as resources from ours. In the UK, MOD research is targeted at the specific needs of defence, particularly equipment procurement. Within this remit, however, the Ministry is making significantly increased efforts to enhance the contribution of its research programmes to wealth creation in the economy as a whole. In particular, the Defence Research Agency (DRA) is formally encouraged, in its Framework Document, to enter into collaborative arrangements and develop agreements to assist the transfer of technology to industry. In addition to its Pathfinder and Strategic Alignment initiatives, the DRA has recently opened the first of its Dual Use Technology Centres - the Structural Materials Centre at Farnborough - aimed at two-way technology transfer between MOD and industry. The importance of spinning-off the results of MOD-funded research is also well recognised, and there are many notable examples⁵ of the successful civil exploitation of technologies developed for defence. A recent Defence Costs Study report⁶ set out the Government's intention to bring together the major non-nuclear science and technology organisations into a single Executive Agency. This should provide a wider focus to encourage collaboration with the civil sector and help ensure the exchange of technologies between the civil and defence sectors.

14. The Committee comments (323) on the Government's use of its purchasing power. In exercising this power, the Government has two fundamental aims, as explained in the Competitiveness White Paper. These are to obtain value for money and to improve the competitiveness of its suppliers. In pursuing these aims, it is the Government's policy to specify its requirements in output performance terms in order to encourage product and process improvement and innovation. The Government agrees that price alone should not be the criterion for awarding contracts. In addition, as the White Paper states, the Government will pay attention to avoidance of over-specification and will report progress early next year. Goods and services will almost

5 Examples include novel uses for carbon fibres, sonar research leading to better pressure pad burglar alarms, and underwater remote autonomous vehicles used in pipeline and cable laying; as well as the more familiar liquid crystal displays and inertial navigation systems.

6 "Front Line First" HMSO 1994

always be acquired by competition but exceptionally, where there are convincing reasons, Departments have discretion to let tenders without competition, subject to European Community (EC) and GATT procurement rules.

INNOVATION

15. The Government agrees fully with the Committee (307) about the importance of the innovative capacity of UK industry. It has described, in the Competitiveness White Paper, the partnership between Government and the private sector that is needed.

The economic and financial climate for innovation

16. The Government agrees with the Committee (260) that a competitive manufacturing sector is essential for the long-term prosperity of the United Kingdom. Manufacturing continues to be a major employer and remains the key tradeable sector. However, the increasing interlinkage between different sectors of the economy means that the success of manufacturing industry depends more than ever on the efficiency of the rest of the economy. In particular, the performance of the service sector is vital; it accounts for around two-thirds of total output and employs well over 16 million people. In the Government's view, the relative size of each part of the private sector is not important in itself. What matters is the competitiveness of the economy as a whole.

17. The Government recognises that a successful macroeconomic policy is central to competitiveness (209). Business needs a stable framework if it is to invest for the future and develop the products and services upon which its prosperity depends. The Government must set policies that deliver low inflation, and the interest rates that go with this. Since October 1992, underlying inflation has stayed within the target range of 1-4 per cent and compares favourably with inflation in other industrialised countries. Sound public finances are also important and the Government has taken tough action in the two 1993 Budgets to reduce the high borrowing requirements resulting from the last recession and to restore the health of public sector finances. These steps will provide the essential macroeconomic environment in which industry and commerce can meet the competitive challenge.

18. As part of its Industrial Finance Initiative, the Treasury is looking at the whole area of the supply of finance, including capital markets, savings generally, the flow of funds to business, and the implications for

taxation and other policies. Many of the Committee's concerns, particularly the effects of the financial system on innovation and industrial growth (196, 216, 259), the structure of UK financing (203), small companies' reliance on overdraft financing (237), and development finance (247, 248), will be considered as part of this review.

19. The Government does not, however, agree with the Committee (186) that there is a case for general tax incentives for spending on research and development. Its position was set out in paragraphs 2.12 and 2.13 of the SET White Paper.

20. The Government notes the Committee's concerns (194) about hurdle rates of return and their impact on investment and agrees that innovative companies have an important role in relation to the UK's long-term economic performance.

21. On the Committee's point (241) about the lending decisions of the banks, the Government has been informed by the banks that they are seeking to base their lending decisions primarily on the basis of the quality of proposals being considered, and are making efforts to adopt a more systematic approach to risk assessment. All major banks also appear to be keen to promote the use of term finance and to reduce the reliance of their customers on overdrafts.

22. The Government shares the Committee's objective (253) of promoting appropriate investment by "business angels" in smaller companies. The Government welcomes the Stock Exchange's recently announced plans to promote the interests of smaller companies and to facilitate trading in their shares. In last November's Budget, the Chancellor announced the introduction of the Enterprise Investment Scheme, consultation on Venture Capital Trusts and capital gains tax reinvestment relief. All of these are aimed at bridging the so-called 'equity gap'. The Government notes the Committee's view (250) on the Enterprise Investment Scheme.

23. The Government welcomes the Committee's favourable comments (335) about Government policy on inward investment. Inward investment indeed contributes to increasing the innovative and technical capacity of UK industry. The success of most foreign companies, and British companies that have been recipients of foreign investment, has resulted in substantial benefit to the British economy, not least in terms of employment creation, and in the significant boost which has been given to British exports.

24. The Government agrees with the Committee (256) that relationships between UK companies of all sizes would benefit from better collaboration. It is in the process of setting up a network of regional supply offices to work with private and public sector purchasers to promote supply chain partnerships, thus leading to greater levels of understanding and trust between companies. In 1991, the Source Wales Initiative was established to develop the performance and promote the capabilities of the supply base in order to create business opportunities for Welsh based companies. Managed by the Welsh Development Agency, current activities identify Supplier Associations as a key component of development programmes.

25. The Government agrees with many of the Committee's comments (144, 334) on support for collaborative research. In reviewing its future spending on innovation, DTI has sought to focus on those areas where it could make the most impact. DTI has concluded that rather than using its modest funds (amounting to only 2 per cent of industry's R&D spending) on technology generation, its efforts would be best directed at encouraging companies, particularly small and medium-sized enterprises (SMEs), to improve best practice and use new technology more effectively. The review of Government policy which preceded this change followed wide-ranging consultation with industry. Industry generally has been supportive of DTI's refocused policy.

26. The Committee recommends (144) an evaluation of the effectiveness of the Advanced Technology Programmes. By their nature, the full extent of the economic benefits of these programmes will take some years to emerge. An evaluation of their effects will be undertaken at the appropriate time.

27. It is appropriate for the Departments which have closest links with industry to give advice and help to higher education institutions (HEIs) and Research Councils in forming strong industrial links in accordance with their missions. The Government agrees with the Committee (331) that such interaction will sometimes involve the provision of funds.

28. The Committee mentions (329) DTI support for the LINK scheme. No reduction has occurred in the DTI funding for LINK as a result of the LINK Secretariat transferring to OST. LINK programmes are sponsored by a number of Government Departments and Research Councils. DTI, along with the Engineering and Physical Sciences Research Council (EPSRC), remains a leading sponsor of LINK programmes. The Prime Minister, in a written reply to a Parliamentary

Question (16/6/93 - Commons Col 583) said "DTI's financial commitment to LINK will continue to be substantial and is unaffected by the transfer . . . to OST".

Research, innovation and information networks

29. The Government supports the broad thrust of the Committee's views on industrial research (69, 138). The Government believes that the successful management of change and technology is vital to the future success of UK business. This view is fully described in chapters 6 and 7 of the Competitiveness White Paper. The annual UK R&D Scoreboard, supported through the DTI's Innovation Unit, details the R&D expenditure of over 350 UK companies along with international benchmarks. This shows that UK companies have over recent years invested less in R&D than their international competitors. The Government believes that companies need to give greater consideration to the potential value of R&D and to consider a higher level of investment, whether via a corporate research laboratory or any other route. The 1994 R&D Scoreboard indicates a 9% increase in R&D investment over 1993 for the top 200 UK companies, compared to 3% by our top overseas competitors. This is an encouraging development. R&D is, however, only one aspect of successful innovation; it needs to be related to an awareness of market opportunities, and allied to skills in design and management.

30. The Government agrees with the Committee (57) that industry is responsible for successful innovation and that Government can help by identifying and spreading best practice and by increasing awareness of the strategic importance of innovation for competitiveness and wealth creation. This strategy was set out most recently in the Competitiveness White Paper. As the Committee says (46), an understanding of the processes by which innovation takes place is important. The Economic and Social Research Council's (ESRC) new programme - Management for Innovation - is therefore particularly timely. The DTI has been closely involved with the development of the programme and will continue to be involved in the review process.

31. In addition, the DTI is currently identifying the links between external influences on companies and best practice in management and innovation. This is being achieved by senior industrial secondees from within the Department's Innovation Unit carrying out in-depth discussions with Chairmen and Chief Executives from over 100 of the best UK companies. The results will be available in September 1994 and will influence the nature of DTI's future best practice initiatives, such as 'Managing in the 90s'. The Committee's support (56) for this work is welcome.

32. Like the Committee (52, 61), the Government recognises the importance of innovation networks and their complexity. It has encouraged the development of many first class industry-led initiatives such as the Welsh Medical Technology Forum. The Competitiveness White Paper announced the Government's intention to establish both local and national networks in order to promote the provision of innovation-related services to industry as a whole. Local networks (NEARNETs) will be established under the auspices of individual Business Links in England and other initiatives in Scotland and Wales (see next paragraph). The DTI will support the creation and management of a national network, to be known as "SUPERNET", to link national centres of excellence more closely. Government actions in supporting the creation of SUPERNET will do much to facilitate the coherent development of future networks, although their effectiveness is ultimately the responsibility of their members.

33. The Business Links and their supporting networks will facilitate local access to the assistance that companies need. The Government also offers information services on overseas technology. In Scotland, a business shop network is being set up to provide general advice and signposting expertise. In Wales a prospectus was published in early June inviting bids from local business development consortia for improving business and enterprise support services throughout Wales. This work is done alongside DTI's sector divisions, the activities of Departments with specialist sectoral interests, Government Regional Offices, Territorial Departments and local bodies; it fully recognises the variety of needs within industry.

34. The Committee comments (77, 78) on the Business Links initiative. The NEARNET and SUPERNET proposals described above are intended to serve and take account of the needs of all businesses within the area of a given Business Link. Although some services are targeted specifically towards the needs of SMEs, all businesses will be encouraged to make full use of their Business Link and its background networks. National centres of expertise, such as RTOs, will be an important part of the Business Link networks. Other DTI initiatives are being designed to help such organisations develop their services in support of that role.

35. DTI is putting in place a comprehensive programme of training, updating and internal networking for all the Innovation and Technology Counsellors being appointed to Business Links, together with appropriate DTI staff. It is taking steps to ensure that, whilst it provides an adequate degree of leadership for such activities, the activities themselves are perceived as being owned and operated wholly by individual Business Links.

36. The establishment of Business Links, together with the placement of Innovation and Technology Counsellors within them, is intended to encourage and enable businesses to contact and use the services of universities and other educational institutions. HEIs, which are already developing closer links with Training and Enterprise Councils (TECs), have the opportunity to use both the TEC and Business Link networks as a means of informing employers of the range of services which they have to offer. The Scottish Enterprise Network and the Welsh Office are working with HEIs in their areas in the development of various measures to signpost the expertise held by specific institutions.

37. The Government agrees with the Committee (75) that diversity within the higher education (HE) system is a strength: indeed, its policy is to encourage such diversity. HEIs themselves should, as autonomous bodies, market effectively what they have to offer - whether individually or, where appropriate, collectively. The Charter for Higher Education strongly encourages them to do so in a way which will be helpful to industry and commerce. The Government will be reviewing the impact of the Charter, in conjunction with the representative bodies of HEIs, later in 1994.

International issues

38. The Government agrees with the Committee's comment (165) on the additional benefits of international collaboration. Participation in such projects can demonstrate a firm's capabilities to potential customers. A strong R&D capacity will help a firm to make the most of the opportunities arising from international collaborative projects.

39. The UK Government has played a leading role in negotiation of the Fourth Framework Programme for EC Research and Technological Development. The OST takes the lead on this within Government, with DTI and other Departments playing a full part. The Government is pleased with the general level of UK participation in EC R&D programmes, but is undertaking a series of seminars and other promotional activities to boost industry's awareness of the opportunities available. UK industry also benefits from the EUREKA initiative which, with support from DTI, facilitates collaborative R&D projects between European companies and research organisations.

40. The Committee comments (167) on the system of attribution of expenditure on these programmes. The gross cost of money spent on EC programmes is attributed to Departments in accordance with the policy responsibilities for the specific programmes. In determining the

impact on a Department's budget there is flexibility, both through the public expenditure process itself and in terms of how a Department chooses to cope with any resulting offsets across its total spend. The indicative gross UK contribution to the EC budget in respect of R&D is shown in the Statistical Supplement to the 1994 Forward Look (which has replaced the Annual Review of Government-Funded R&D). The Government agrees that, with effect from 1995, the Statistical Supplement should also set out the notional breakdown of the UK's gross contribution between Departments.

41. The Government welcomes the Committee's endorsement (171) of its emphasis on subsidiarity in research.

THE SCIENCE AND ENGINEERING BASE AND INDUSTRY

Links between industry and the science and engineering base

42. The Government agrees with the Committee (18, 311) about the importance of the partnership between the science and engineering base and industry, and that the UK's long term future rests on world class innovative industry.

43. Industry needs to make more use of external skills and know-how whatever the source. The UK science and engineering base has an essential underpinning role in this respect. The Government agrees with the Committee (101) that both industry and the science and engineering base need to understand each other better to maximise the benefit to themselves and the UK. As the Committee recognises (83,92), several specific initiatives are being, or have been, undertaken to encourage the development of a partnership between the science and engineering base and industry. They include the Teaching Company Scheme, LINK, the European STRIDE Programme, the ROPA scheme (see paragraph 45), the new Innovative Manufacturing Initiative (involving industry, Research Councils, HEIs and Government Departments) and measures by the HE funding bodies to encourage interaction with industry. The role of SMEs is fully recognised and their distinctive needs and contributions are being taken into account sympathetically.

44. The Government's arrangements for sponsorship of the Teaching Company Scheme have been recently reorganised to give the sponsors a clearer customer role; this should in turn make the scheme more

responsive to the needs of different industry sectors, as represented by those sponsors, and also different sizes of company. The Government is currently reviewing LINK with a view to ensuring that it offers a simple and more versatile vehicle for all Government Departments and Research Councils to use in pursuing collaborative research with industry.

45. The SET White Paper made it clear that publicly-funded research within the science and engineering base would not be driven by the shorter-term needs of industry. However, the Government agrees with the Committee (98) that there is exciting high quality basic research to be taken forward in areas of strategic importance. The Technology Foresight Programme will be a key mechanism for identifying areas where such work should be funded. Other approaches include: the new generic research (GR) funding element introduced by the Higher Education Funding Council for England (HEFCE), which rewards HEIs which conduct basic and strategic work where there is already a partnership between researchers and users working on long-term, more speculative investigations; and the Realising Our Potential Award (ROPA) scheme under which public funds are given to research teams, already identified by industry as meriting support, enabling them to take forward underpinning strategic work. ROPA is being run as a pilot by three of the Research Councils in 1994-95; the aim is to extend it across all the Research Councils next year.

46. The Committee's point (83) that universities have specific roles is well made. It is clearly important that HEIs play a full part in wealth creation through the generation of new science and technology, skilled graduates, and helping industry to be successful in scientifically and technically intensive arenas. The national Technology Foresight Programme, in which industry, academe and others are coming together under the aegis and with the facilitation of OST, is an important aspect of this process. However, as the Committee has noted, it is also important to maintain the other important role of universities in pushing back the frontiers of science and engineering over a wide front, building the intellectual capital of the nation and contributing to learning.

47. The Government is pleased that the Committee recognises (109) the valuable contribution which the Technology Audits Scheme and the Industrial Units Scheme are making to help HEIs to assess research strengths with commercial relevance and to market their research more effectively. Industry Departments are undertaking a range of follow up activities to the first scheme. The second scheme is continuing for a further two years.

48. As the Committee recognises (112), links between HEIs and employers are extremely diverse and may include many which are not directly income-generating. The funding of the development of continuing education and of research enables HEIs to provide services to employers, and otherwise develop links with them, in cases where an immediate and full return from employers could not appropriately be expected. The general principle of the Government's policy, however, is that the beneficiaries should pay for such services; and the very substantial investment by employers - in, for instance, academic consultancy, research contracts, joint ventures and professional updating courses - demonstrates their willingness to do so.

49. The Government believes that all customers of HEIs, including firms, should pay the full economic costs of near-market research (113). The HEFCE has encouraged institutions to recover full costs on contract research (CR) through moderating grant, in respect of its CR element, by the rate of overhead recovery achieved. The Council has decided to continue such moderation for its new GR element to keep up the pressure for institutions to seek to recoup full costs in their negotiations with sponsors. It is recognised, however, that meeting the full economic costs of research can present difficulties to some SMEs; some of the HEI-industry partnership arrangements pay specific attention to the circumstances of SMEs.

Intellectual property

50. The Government fully endorses Dr Robinson's view (120) that diversity in intellectual property exploitation is a strength and that it is important for universities to recognise the value of intellectual property rights (IPR) and to protect their activities appropriately. The Government believes that companies and universities need to have regular dialogue to ensure that pragmatic solutions are sought which allow exploitation to occur.

51. Like the Committee (123), the Government continues to support the introduction of a "grace period" as part of an overall package of patent law harmonisation, including the requirement for all countries to grant patents to the first inventor to file an application. The United States (the only country operating first to invent) indicated earlier this year that it could not continue to take part in these negotiations, but the UK Government is currently seeking ways in which the negotiations can, nevertheless, be taken forward.

Research assessment

52. The Government shares the Committee's view (129) that academic success and the quality of academic research must be linked. This is achieved at institutional level by the HE funding bodies, which allocate research funds to universities by reference to quality as measured by their Research Assessment Exercise (RAE). In the 1996 Exercise, the assessment panels will be instructed to give full recognition to work of direct relevance to the needs of commerce and industry, as well as to the public and voluntary sectors. The resulting quality assessments of this work will then influence the funding bodies' allocation of funds and, as the Competitiveness White Paper stated, "HEIs will increasingly receive financial recognition for research conducted in partnership with industry. The proportion of the HE [funding bodies'] agreed total budgets used for this purpose will increase."

53. The funding bodies are deploying a range of mechanisms to reflect the significance of research for or involving industry and other user communities. The new GR element introduced in the HEFCE's funding formula will provide incentives for institutions to work with users of research on long-term, more speculative projects. In the longer term, this may assist in encouraging industry and other sponsors to take more risks in collaborating with universities on research with less clearly defined results or specific applications with the confidence that there will be tangible returns. The criteria for GR funding focus on IPR and publication practices, and may encourage institutions in their development of clear and strategic approaches to the intellectual property which they generate.

54. The Scottish Higher Education Funding Council has implemented a funding structure which seeks to encourage the interaction of the Scottish research base with its user communities. The funding formula used gives equal weight to all external research income and therefore provides an incentive to institutions to maximise this. In addition, the willingness of other bodies to fund work is used as an alternative quality assessment for the allocation of funds for the development of the research base, which are distributed on the basis of the external income earned by departments which did not win high quality ratings in the 1992 RAE. In Wales, the Higher Education Funding Council for Wales is seeking to help raise the quality of research, in particular research which has the capacity to assist wealth creation. It has supported competitive proposals from HEIs that hold out the prospect of the achievement of excellence. In Northern Ireland, additional development research funding (NIDevR) is directed towards

bringing about an improvement in the quality of research undertaken and offers a means of sustaining and developing the university research base there in ways which reflect and respond to the economic, social and cultural needs of the community.

55. The Science and Engineering Base Co-ordinating Committee, chaired by the CSA, provides an effective forum for the discussion and co-ordination of science and engineering base issues. The role of the Committee is to provide advice to Ministers and to ensure that the Research Councils' and funding bodies' policies for the science and engineering base form coherent and co-ordinated policies.

56. There is no reason for the RAE and the increase in student numbers to create what the Committee describes (125) as "an unbridgeable division between teaching and research". Institutions are asked to put forward for assessment only those staff who are active in research. There is no supposition that all such staff are engaged solely in research, although this is the case for a minority whose conditions of employment specify that they act exclusively as researchers. While the increase in student numbers has necessarily required institutions to review the deployment of resources, there is no question of institutions being required or encouraged to divide academic staff between those engaged in research and those engaged in teaching.

Government laboratories and independent research and technology organisations

57. The Committee comments (150, 160) on Government Research Laboratories. Given the substantial resources that the Government spends on these laboratories and the importance of their work, it is vital that they are organised to ensure the best output of good science and the capacity to respond rapidly to Government's requirements for information. It is not evident to the Government that the value of Government Research Laboratories depends on their ownership, and indeed their effectiveness and the efficiency with which they use their resources in response to industrial need may well be greater if they operate under the commercial disciplines of the market.

58. The Committee refers (164) to the Efficiency Scrutiny. A team within the Efficiency Unit has recently carried out a scrutiny of public sector research establishments to review the options for their future organisation, ownership and financing arrangements. The team's report⁷ was published on 11 July and a consultation period is now under way so that the Government can decide on the way forward in the light

7 "Multi-Departmental Scrutiny of Public Sector Research Establishments" HMSO 1994

of the views of all interested parties. In considering the Efficiency Unit's report, the Government will want to make sure that the arrangements adopted for the laboratories are those which ensure the greatest output of good science.

59. There have already been some cases where, following in-depth reviews, the Government has announced that particular laboratories will be transferred to the private sector. In these cases the aim is to provide the laboratories concerned with the flexibility to take best advantage of changing market conditions. The Chancellor of the Duchy of Lancaster noted in his evidence to the Committee that there are cases where privatisation might not be appropriate.

60. The DTI's laboratories are an important national resource. Each of them plays a significant role in ensuring the competitiveness of British industry and in meeting the needs of Government Departments. They have a unique asset in the expertise of their staff, which is respected internationally. The Department agrees with the Committee (162) that, in formulating its major programmes of work at the laboratories, it is essential to consult industry on the nature of the work to be done. It is for this reason that consultants are engaged to consult industry on its priorities for future programmes of work on the national measurement system, and the Department has committees of experienced technical experts from industry and elsewhere advising on the strategic direction of the programmes. The proposed changes in the status of the laboratories will not reduce the need for consultation on programmes of work. The Department is therefore reviewing the way in which it manages such programmes to ensure that the arrangements are appropriate for future circumstances, and that they will continue to allow the laboratories to contribute to the health of industry on a broad front, as well as to meet the Government's needs.

61. As regards the Committee's point (156) on Government support for RTOs, the Government is seeking to encourage RTOs to become more attuned to market needs. Access to their services will increasingly become available through the new network of Business Links, Business Shops and business development consortia (paragraph 33). The DTI is actively engaged in discussions with many of these organisations to explore new ways in which they can help business in the future, and to consider how it can help them adapt to the challenges ahead. The Department is also in close touch with the Association of Independent Research and Technology Organisations, and has agreed a concordat covering the future role which RTOs might play in support of business.

PEOPLE, EDUCATION AND TRAINING

62. The supply of trained people, and their effective deployment at all levels within an organisation, is crucial to the successful development and use of technology.

Science and engineering skills

63. The Government notes the Committee's comments (272) about the supply of people with science and engineering skills at technician and graduate level, and with a balance of managerial and technical expertise. It broadly agrees with the Committee's comments on the supply at technician level, and responds in more detail below by describing what action it is taking in vocational training. The Government has also responded more generally to concern about the number of young people in England and Wales qualifying at GCSE and GCE A level in science and mathematics. The Department for Education issued a report as a consultation document, and is considering the responses it has received. More detailed comments on the supply of graduates are offered below. There is no firm evidence of a current shortage of science and engineering graduates to fill specialist posts.

64. However, the Government agrees strongly with the Committee's central point (306) that the UK tends to undervalue science and engineering skills. As the Government has emphasised in both White Papers, those with engineering and scientific qualifications have crucial roles to play in developing and adapting new technology in all sectors of the economy. Industry at large seriously risks missing opportunities if it fails to encourage the acquisition of world-class skills.

65. Engineering and science qualifications can and should open up rewarding and fulfilling careers to young people. They will be encouraged to take those topics only if UK firms better utilise and reward the related skills at all levels and in a range of posts. In particular, too small a proportion of those who reach the top in business, or the 'establishment' at large, have a science or engineering background; this is likely to be a factor influencing young people's subject choices. It is also important to improve management skills among practising scientists and engineers, for example by giving them broader and earlier responsibility. Again, action must rest primarily with companies; but professional bodies and universities also have a role to play and this is discussed further below (paragraphs 75-78).

66. The White Papers make clear that the Government and the professions need to enhance the understanding and status of science and engineering at Board level in companies, and among financial institutions, opinion formers, and the public generally. The Government is playing its part through the Public Understanding of Science campaign and by the establishment of a Development Unit⁸ within the OST to promote the participation of women in science, engineering and technology. The Government welcomes the engineering profession's proposals for reform of its institutional structure and its commitment to further development. It expects to see rapid progress. In Wales, the Engineering Centre for Wales has been established to act as a single forum for all engineering interests in the Principality and is co-ordinating activities to promote the profession and to enhance the public perception of the value of engineering as a career and as a basis for wealth creation.

67. The Government welcomes the Committee's comments (277) on science and technology in the National Curriculum, in particular the attention it draws to the improved performance of girls in GCSE science. Increased flexibility in the National Curriculum will allow a wider range of courses to be offered to pupils in England and Wales from the age of 14. The Government agrees with the Committee that the great majority of 14-16 year olds in England and Wales should take double science or three separate sciences: according to a recent sample survey, nearly 90% do so. Single science is nevertheless appropriate for a minority of pupils and should remain the statutory minimum, as recommended by Sir Ron Dearing in his review of the National Curriculum. The evidence is that there is very little difference between the proportions of boys and girls taking single or double science. The Government will continue to monitor the take-up of the different science options including the relative take-up by boys and girls. In Scotland all pupils now study science up to the age of 16. Those in the third and fourth years of secondary education can study general science or choose a combination of physics, chemistry and biology. Beyond this stage, study for Higher level examinations is all through specific subjects. There has been a steady rise in the percentage of girls studying science since 1983.

Vocational training

68. The Committee refers to vocational training (281). The Government has endorsed the National Targets for Education and Training, launched by the Confederation of British Industry, which provide a focus for a partnership between teachers, pupils and their

⁸ "Government response to the report - The Rising Tide: Women in Science, Engineering and Technology" HMSO 1994

parents, colleges and their students, employers and their staff. As they become more widely known, these targets are beginning to act as a catalyst, stimulating employers, individuals and providers to raise their expectations and attainment. In March 1993, Government established the National Advisory Council for Education and Training Targets (NACETT). The Council monitors the Targets and advises the Government on performance and policies which influence progress towards them.

69. The Government is establishing a new framework of post-16 qualifications in England, Wales and Northern Ireland, based on GCE A levels and AS courses, NVQs and the new GNVQs. It will monitor the take-up of science and technology subjects carefully. In September 1994, science GNVQs will become widely available at Intermediate and Advanced levels and will begin to be piloted at Foundation level. GNVQs in Engineering and Information Technology will also begin their pilot phase in September 1994.

70. The Scottish Vocational Education Council, the single awarding body for vocational training through schools and further education provision in Scotland, offers General Scottish and Scottish Vocational Qualifications (GSVQs and SVQs) which are analogous to GNVQs and NVQs respectively. In 1993 the Advisory Scottish Council for Education and Training Targets was established to advise and report to the Secretary of State for Scotland annually on progress towards achievement of the Targets.

71. Work will continue to secure improvements in the quality and rigour of GNVQs and to ensure their successful introduction in schools and colleges. The Government will also ensure that NVQs and SVQs remain up to date and continue to observe strict standards. The content and structure of all existing NVQs and SVQs will be rigorously reviewed by April 1996.

72. Other measures which the Government is taking in the field of vocational qualifications include the introduction from 1995 of Modern Apprenticeships for 16 and 17 year olds, and accelerated Modern Apprenticeships for 18 and 19 year olds, which will offer work-based training to NVQ Level 3, and an assessment of the feasibility of developing a new variant of the Teaching Company Scheme based on further education colleges and aimed at one year placements of those with technician level qualifications into SMEs. The approach to Modern Apprenticeships in Wales has put a special emphasis on the supply of technicians in manufacturing engineering.

Degree courses and postgraduate training

73. The Committee comments on science and engineering degree courses (288). Science and engineering have benefited from the expansion in the proportion of young people entering higher education in recent years. There has been particularly fast growth in the numbers studying mathematics, computing and science combinations. Biological and physical science have increased by slightly less than the average for all subjects, however, while engineering has grown much less quickly.

74. It is for universities and colleges to decide on the number of places to offer on science and technology courses, in the light of student demand. The Government has, however, made changes in the fee structure to provide an incentive to offer relatively more places in science and technology. Fees for laboratory and workshop-based courses will continue to be significantly higher than those for classroom-based courses. The Government has also taken measures to encourage and attract more able students onto first degree engineering courses through the Engineering Bursary Scheme. This will provide an additional £500 a year to those who enter accredited engineering degree courses in autumn 1994, 1995 and 1996 and have achieved grades AAB at A level or its equivalent.

75. The Government believes that it is the responsibility primarily of universities - working with employers, professional bodies, chartered institutions and others - to incorporate appropriate elements of management, finance, language and personal skills training in specific courses. The Government has encouraged such development, for example through the Enterprise in Higher Education initiative. The ESRC is also developing new modules on innovation, new product development and the management of science and technology in conjunction with the Business Schools for inclusion in MBA degrees and shorter training packages. In addition to accreditation of and advice on course provision, professional bodies and chartered institutions also have a wider role in specifying the qualities required for professional development more generally.

76. As the Committee says (293), the Research Councils have already taken steps to bring to the research training which they support some of the skills acquired by exposure to industry. One important aim of the postgraduate training policies set out in the SET White Paper was to encourage more systematic development of that trend, in particular by requiring Research Council students normally to complete a Master's year in which they might acquire those broader

skills as well as experience of research. The policies are also aimed at improving the quality of postgraduate training more generally.

77. The Government shares the Committee's view (296) of the need to respect the diversity of the science and engineering base and industry in developing these new arrangements. It has consulted widely on its proposals: a consultation document on the Master's year produced over 270 responses. In carrying this initiative forward the Government will have regard both to the diversity of needs and to the need for improvement in postgraduate skills.

78. The Government welcomes the Committee's approval (293) of postgraduate training schemes, such as the Teaching Company Scheme, which are aimed more specifically at giving postgraduates direct experience of industry. The Competitiveness White Paper announced that the Scheme will be extended by the establishment of Teaching Company Centres in specific universities in order to improve links between universities and potential SME participants in the Scheme. The Government has been pleased to note the good progress that has been made so far by the Postgraduate Training Partnerships that were established in 1992. The sponsors are currently considering options for the future of this scheme. The EPSRC will also be monitoring closely the success of its 4 year ("Parnaby") Engineering Doctorates.

CONCLUSION

79. The Government is committed to a continuing programme of measures to enhance the partnership between the science and engineering base, industry and Government and to stimulate innovation and competitiveness. It is taking forward the measures announced in the SET and Competitiveness White Papers with vigour and in full consultation with the various constituencies. These issues are of central importance to the prosperity and quality of life of our country.

