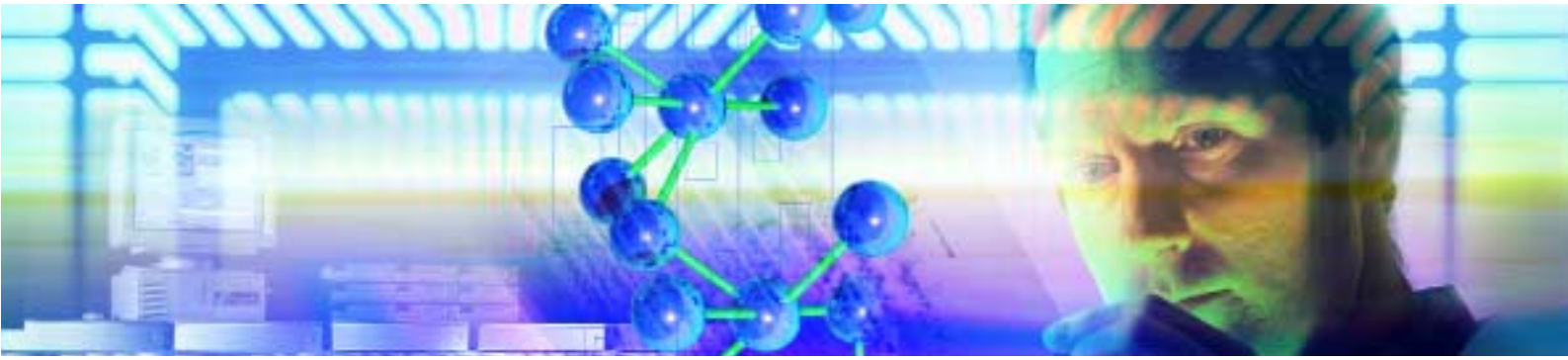
Delivering the Commercialisation of Public Sector Science



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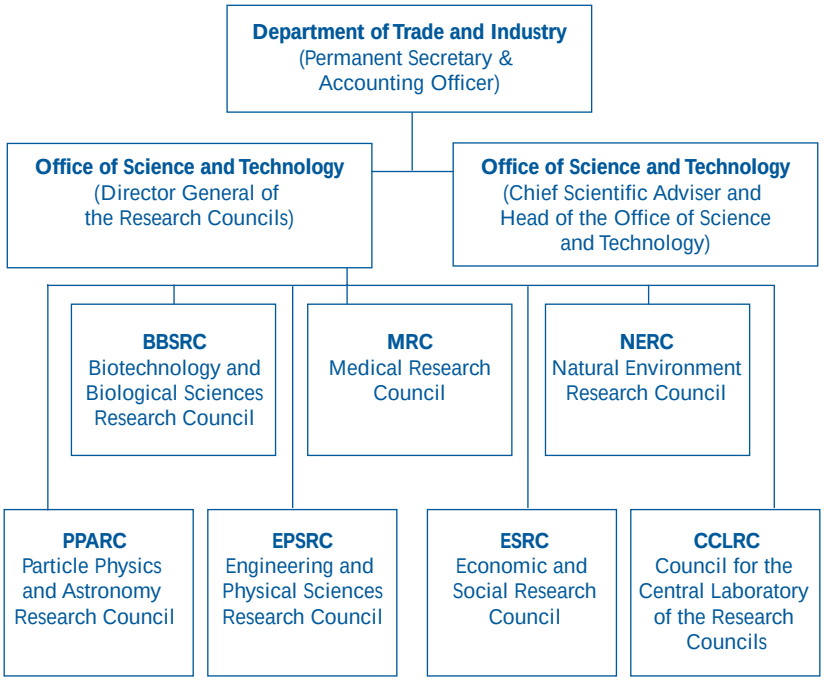
executive summary

Executive Summary

The Government is encouraging Research Establishments to realise the economic benefits of their research through commercial arrangements with the private sector

1 The Government invests heavily in science - across all government departments some £7 billion is devoted annually to scientific research and development spending. Over £500 million of this in 1999-2000 funded research and research facilities in 83 Public Sector Research Establishments ("Research Establishments"), 59 of which are grouped together under seven Research Councils. The Councils are Non-Departmental Public Bodies brigaded under the Office of Science and Technology, which is part of the Department of Trade and Industry (the "Department") **(see Figure 1)**. The Research Councils cover broad scientific streams and provide funding and strategic direction for their Research Establishments along the lines illustrated by **Figure 2**.

1 The relationships between the DTI and its Research Establishments



Source: Department of Trade and Industry

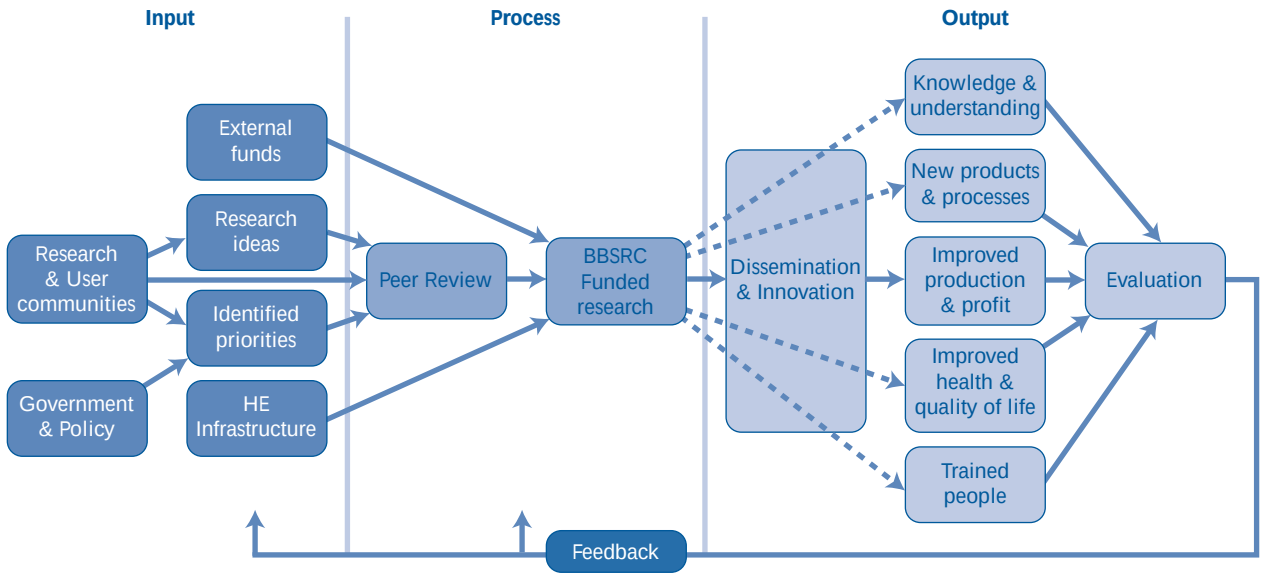
2 The vital core role of the Research Establishments, and the scientists who staff them, is to conduct research in support of the public interest including:

- achieving advances in science, which receives the majority of funding;
- informing government policy-making through the provision of comprehensive scientific data and independent advice;
- training the next generation of research scientists; and
- assisting public sector bodies carry out their statutory or regulatory functions.

3 Many of the Research Establishments are internationally acknowledged centres of excellence in their field. The Medical Research Council claims thirteen Nobel prize winners since 1952, ten of them scientists from the Medical Research Council Laboratory of Molecular Biology, world leaders in research on the structure of biological systems relevant to human disease. Many perform critical advisory roles, such as the Institute for Animal Health, which has played a major role in combating the recent outbreak of Foot and Mouth Disease, including extensive testing and analysis.

4 Although the United Kingdom has a strong record in innovation, it is widely considered to have been less successful in capturing the economic benefits of scientific advances. The ability to capture such benefits - in particular the creation of novel products and processes - could have a significant impact on the competitiveness and growth of the UK economy. For this reason, without wanting to compromise the Research Establishments' core scientific role, the Government is keen to encourage them, in co-operation with the private sector, to apply the outputs of publicly funded scientific research to stimulate economic and social benefits, such as job creation, increased prosperity and enhanced quality of life. This is termed "commercialisation". We describe different forms of commercialisation of research outputs in **Figure 5** (page 15). An early example of successful commercialisation of research is Celltech, a biotechnology company created in 1980 which employed total staff of 1,803 in the year to 31 December 2000, including some 1,150 research and marketing staff in the United Kingdom and abroad. This was built on science originating in Medical Research Council laboratories.

2 A Research Council Grant Support Cycle



Source: The Biotechnology and Biological Sciences Research Council Strategic Plan 1999-2004

The National Audit Office has considered whether the Research Establishments can meet the challenges of commercialisation

5 We have stated publicly that we encourage worthwhile and well thought through innovation in the public sector, for example that we "support well managed risk taking intended to result in tangible benefits for taxpayers" (Para 8, Executive Summary 'Supporting Innovation: Managing Risk in Government Departments' HC864 99/00). In line with this we have examined the capacity of the Research Establishments to meet the challenges arising from increasing commercialisation to deliver the potential economic and social benefits for the nation. Our methodology is described in detail in Appendix 1 - in brief, we considered:

- the key importance of building an enabling culture, capable of encouraging and stimulating effective commercialisation;
- whether Research Establishments are identifying and putting in place the capabilities required; and
- how Research Establishments can best realise the potential benefits of commercialisation.

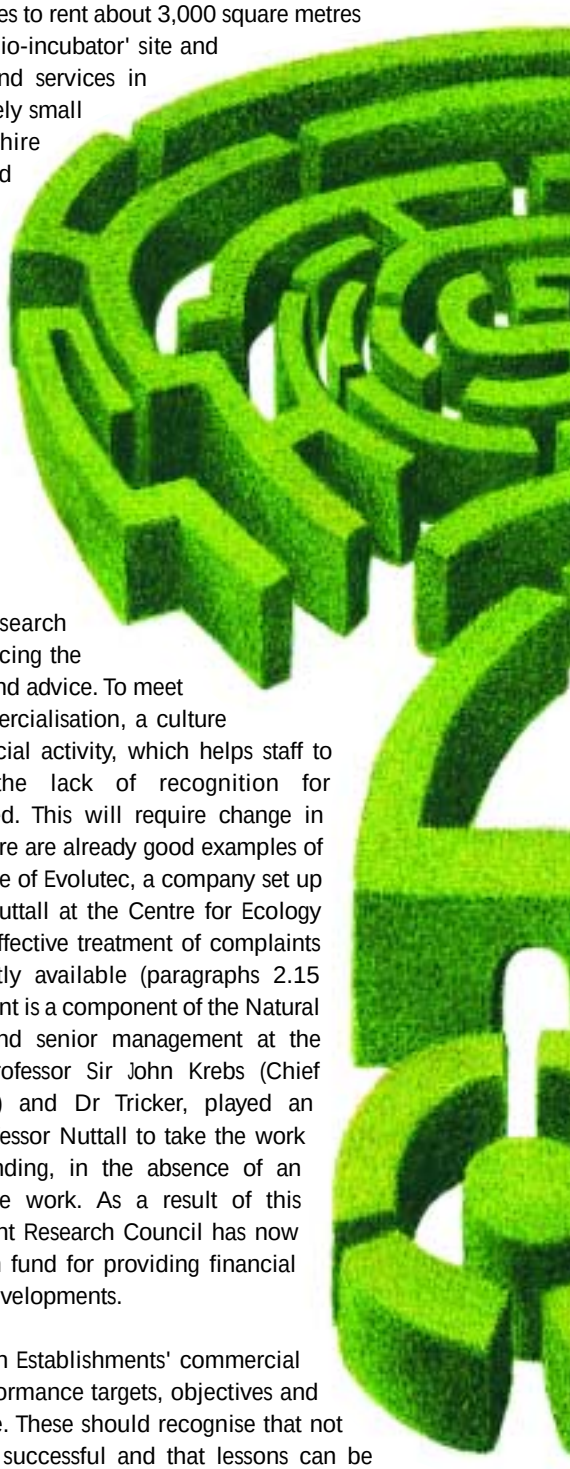
6 We focused our investigation on the 53 Research Establishments within three Research Councils for which the Department for Trade & Industry has responsibility - the Biotechnology and Biological Sciences Research Council, the Medical Research Council and the Natural Environment Research Council. This is because these Research Councils have differing potential for commercialisation so that the collective experience of their Research Establishments is likely to be of relevance to the others. Together, the Research Establishments covered by these three Research Councils received funding of about £443 million in 1999-2000. This study has been carried out in parallel with another National Audit Office report that considers the commercialisation of research sponsored by the Department for the Environment, Food and Rural Affairs which is expected to be published later in 2002.

With committed leadership, Research Establishments can meet the challenges of commercialisation

7 Our examination has shown that where there has been committed and effective leadership at both senior and middle management level there has been significant progress in constructing commercialisation deals with the private sector. Leadership has been a major factor in the fostering of a culture that promotes commercialisation - a prerequisite for success - and has built the capabilities needed to support this culture, without compromising the core public service role in scientific research.

8 The Medical Research Council has been particularly successful in building on intellectual property arising in its Research Establishments (which it calls units). Active leadership from senior staff in the Medical Research Council led to the creation of Medical Research Council Technology Ltd (Medical Research Council Technology) which has been allocated sufficient resources to lead the commercialisation research outputs for all Medical Research Council units. The Medical Research Council was also instrumental in the creation of MVM Limited, a venture capital company managed by individuals from the private sector. This has two funds which invest in early stage life science companies, the first, UK Medical Ventures Fund, raised £40 million in 1998 and the second fund raised a similar amount in October 2001.

9 Other Research Establishments have also demonstrated leadership by obtaining funds to develop commercialisation activity. The Biotechnology and Biological Sciences Research Council sponsored Babraham Institute, for example, competitively obtained a £250,000 grant from the Department to refurbish laboratory and support facilities appropriate for use by early stage companies. This attracted 19 fledgling companies to rent about 3,000 square metres of space at their suitably named 'Bio-incubator' site and generated £680,000 from rents and services in 2000-01. Implementing this relatively small initiative provided funds to hire qualified people and helped to build an effective framework for commercialisation activity. This has since led on to a larger public private partnership project, with similar aims, at the Babraham site.

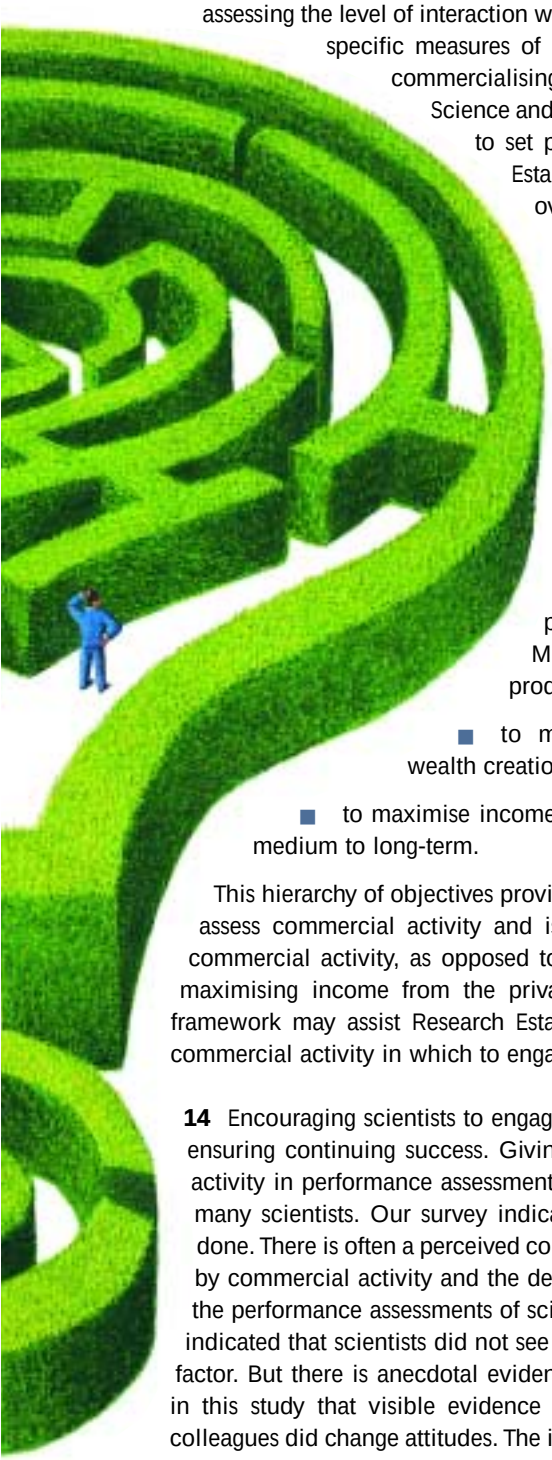


Without enabling cultures, effective commercialisation is not possible

10 The traditional focus in Research Establishments is, rightly, on producing the highest quality scientific research and advice. To meet the increasing emphasis on commercialisation, a culture that is also supportive of commercial activity, which helps staff to overcome barriers, such as the lack of recognition for commercialisation work, is needed. This will require change in many Research Establishments. There are already good examples of such support as in our case example of Evolutec, a company set up to exploit research by Professor Nuttall at the Centre for Ecology and Hydrology to develop more effective treatment of complaints such as asthma than are currently available (paragraphs 2.15 and 4.3). This Research Establishment is a component of the Natural Environment Research Council and senior management at the Research Council, particularly Professor Sir John Krebs (Chief Executive until September 1999) and Dr Tricker, played an important role in encouraging Professor Nuttall to take the work forward and in finding some funding, in the absence of an established budget for early stage work. As a result of this experience the Natural Environment Research Council has now established a £500,000 innovation fund for providing financial support from the centre for such developments.

11 Effective accountability of Research Establishments' commercial performance through relevant performance targets, objectives and review will also encourage change. These should recognise that not all commercial initiatives can be successful and that lessons can be learned from studying successes and failures. The Government has set a high level target to 'increase the level of exploitation of technological knowledge derived from the science and engineering base, as demonstrated by a significant rise in the proportion of innovating business citing such sources.'

12 The Office of Science and Technology is revising the performance indicators that apply to Research Councils to reflect this high level target. These indicators currently include measures such as the level of income received from the private sector, the number and value of collaborative or co-funded research projects and the number of co-publications with industry. Such broad measures are of use in assessing the level of interaction with the private sector although they are not specific measures of Research Establishments' performance in commercialising their research outputs. The Office of Science and Technology would like Research Councils to set performance indicators for their Research Establishments which are consistent with their overall targets. It emphasises, however, that its role is to influence targets rather than to set them.



13 Medical Research Council Technology has prioritised its objectives for commercial activity in the light of the policy aim of capturing economic and social benefits and the mission of the Medical Research Council:

- to choose the most suitable commercial arrangement and the partner(s) judged most likely to develop Medical Research Council technology into products and services useful to society;
- to maximise the contribution to national wealth creation and UK industrial competitiveness; and
- to maximise income to the Medical Research Council in the medium to long-term.

This hierarchy of objectives provides a clear context for decision makers to assess commercial activity and is likely to stimulate long term types of commercial activity, as opposed to potential short term objectives such as maximising income from the private sector. The establishment of such a framework may assist Research Establishments in deciding on the forms of commercial activity in which to engage.

14 Encouraging scientists to engage actively in commercialisation is vital to ensuring continuing success. Giving adequate weight to commercialisation activity in performance assessments is likely to be an effective incentive for many scientists. Our survey indicated, however, that this is frequently not done. There is often a perceived conflict between the confidentiality required by commercial activity and the desire to publish research results, on which the performance assessments of scientists are largely based. Our survey also indicated that scientists did not see financial incentives as a main motivating factor. But there is anecdotal evidence from many of those who participated in this study that visible evidence of the positive impact of incentives on colleagues did change attitudes. The impact of the awards to inventors schemes and the scope for staff to act as company founders were thought to be particularly important. A recent innovative example comes from the Human Reproductive Science Unit where a number of scientists have been given the opportunity to take equity stakes in a spin out company specialising in women's health **(Figure 8)** and this, in conjunction with the input of market knowledge from the private sector, is linked to an upsurge in commercial activity. It appears, therefore, that scientists' involvement can be stimulated and rewarded through the provision of fair and effective incentives.

15 Scientists do not generally have business training and cannot be expected routinely to display or to acquire the full range of commercial skills required to commercialise their research. Our work points to the benefits of offering incentives to scarce professional commercial staff who also have a key role to play in successful commercialisation activity. They bring to bear business and intellectual property management knowledge allied to the commercial experience to assess opportunities realistically and to negotiate successfully.

16 As scientists become involved in commercial ventures, conflicts of interest may emerge. The Office of Science and Technology has produced guidance on managing these conflicts of interest (which is available on their website www.dti.gov.uk/ost). All the Research Establishments we have studied have developed procedures to register, assess and monitor potential conflicts. After such scrutiny, some commercial activities may only be taken forward after the development of specific measures to manage risks relating to such conflicts. The arrangements rely on transparency and oversight from senior management who do not stand to benefit. The concerns voiced by scientists responding to our survey suggest that they attach importance to having access to an impartial procedure for challenging specific commercial activities.

Effective commercialisation requires supporting capabilities

17 All Research Establishments have some scope for commercialisation and seek to ensure that commercial ideas are identified. The extent depends largely on the nature of an individual Research Establishment's science and the level of demand from the market sector in which it operates. Research Establishments sponsored by the Medical Research Council operate in the human healthcare market sector with significant external demand in the United Kingdom and internationally. In contrast, for example, the Biotechnology and Biological Sciences Research Council sponsored Silsoe Research Institute has traditionally operated in the agricultural engineering sector, where demand in the United Kingdom appears low, following problems in that industry. Most Research Establishments do not carry out assessments of prospective world-wide industry demand and do not generally have enough staff to follow a proactive industrial strategy.

18 There are examples of successful commercialisations from research developed following demand from industry (technology pull) and from Research Establishments, themselves, deciding to take development forward (technology push). But there are indications that technology push projects have a comparatively lower success rate, encounter difficulties in raising development finance, and require more confidence in the science, resources, effort and time from commercialisation specialists and the scientists. The Office of Science and Technology and the Treasury consider that technology push projects can usefully play a part in a portfolio, bearing these factors in mind.

19 The three Research Councils have chosen to apply different degrees of centralisation to their commercialisation activities, which they explain as due to differences in mission and the scope of the opportunity. Our examination has shown that different approaches can work, when allied to commitment. Developing a portfolio will help Research Establishments to diversify risk, explore options, and possibly increase the number of successful projects. There are two distinct portfolios that Research Establishments could aim to develop: where practical, a related body of intellectual property or know-how which they could manage actively; and if this is achieved, a portfolio of commercialisation projects based on different routes to market and incorporating different types of partnership with the private sector.

20 Research Establishments can maximise a portfolio of commercial activity either individually or, even though they are often in competition for grant funding, by working together across organisational boundaries to establish a critical mass of opportunities (paragraph 3.10). To facilitate this, the Baker Report recommended that intellectual property should be delegated to Research Establishments. The Babraham Institute, for example, building on past success, manages actively its own relatively modest amount of intellectual property (paragraph 4.16). In the case of the Medical Research Council intellectual property is managed centrally on behalf of its 40 component units, many of which are small, realising the advantage of critical mass in the Bio-medical sector; in contrast the Biotechnology and Biological Sciences Research Council is decentralised, partly because its eight institutes are all large and operate in distinct market sectors. As funding for research programmes often comes from more than one source, pooling intellectual property could involve a number of different parties that have different intellectual property policies. Co-ordination of these policies is important to ensure that there is clarity about which policy applies and who will lead for commercialisation purposes.

21 Adequate finance is needed to resource commercialisation including patenting, funding additional scientific work to demonstrate commercial potential, remunerating professional commercial staff, and obtaining external advice. Once a portfolio of commercial deals is in place, it may provide an income stream which can be recycled to produce a continuing flow of opportunities. The Medical Research Council income has grown from £150,000 in 1986-87 to some £7 million in 1999-2000 and £17.9 million in 2000-01. Other bodies are at an earlier stage and may need external resources to help to kick-start the process.

22 Tackling this initial shortfall in resources is important if the commercial potential of Research Establishments' scientific output is to be realised. The Government has recognised the need to provide additional finance through a £10 million competition held in 2001, called the PSRE Fund competition. Up to half this fund was planned to build commercial capabilities in eligible bodies, with the balance intended for pre-seed funding, that is funding to demonstrate to potential partners the link between an invention or a range of intellectual property and the proposed new products or services. The potential scale of commercial activity, and the limited extent of existing finance, is indicated by the fact that bids for the fund exceeded the £10 million on offer, even though Partnerships UK told us that some likely bidders were discouraged by what they considered the modest amount proposed. On the basis of a 50:50 split, the PSRE Fund has been over-subscribed by 11:5 for capability building and 13:5 for seed funding. The Office of Science and Technology guidelines for seed funding suggests that investments are made over a three year period and requests that funds be managed in a way that ensure a good prospect of continued existence in the long term. Given the length of time taken for commercialisation work to yield a return, venture capitalists commented that this appears a difficult, and quite possibly unrealistic, objective. The Office of Science and Technology will, however, monitor the financial position of the seed fund, allocated £4 million funding after the PSRE Fund competition, with a view to understanding the prospects for the emerging portfolio of investments.

23 The Government also encourages Research Establishments to explore other sources of finance such as those available from Regional Development Agencies and the University Challenge scheme, which "enables universities to establish seed funds to assist the transformation of good research into good business", with the Government providing some £40 million in two rounds by the end of 2001 alongside an equivalent sum from charities and university sources. Research Establishments can apply for University Challenge funding as part of a university bid. Information on Research Establishments' success in obtaining funding from these sources, including successful University Challenge bids, and how it is spent is not easily available. The Office of Science and Technology monitors funding committed to particular projects through the annual reporting process and makes summary information available at the aggregate level, but not at the detailed level.

Realising the potential benefits of commercialisation

24 The Research Establishments we studied, as a group, have developed the full range of commercialisation opportunities, from free dissemination of information to venture capital financed spin out companies. These developments offer significant potential benefits to the economy and to society

as well as to the Research Establishments themselves. Since the Treasury agreed in 1999 that Research Councils and Research Establishments could retain the financial benefits of their commercial activity and share this between them in whatever proportion they agree, commercialisation receipts have been used not only to sustain further commercialisation activity but also for extra scientific research. Our parallel report on research funded by the Department for the Environment, Food and Rural Affairs examines a notable example at the Biotechnology and Biological Sciences Research Council sponsored Roslin Institute, where nuclear transfer technology, pioneered by cloning Dolly the sheep, generated such receipts. The Biotechnology and Biological Sciences Research Council also anticipates that, if it is brought to market successfully, the Roslin Institute will earn substantial future royalties from a cystic fibrosis treatment currently undergoing clinical trials.

25 As suggested in paragraph 13, these benefits are most likely to be realised if a Research Establishment has a strategy for its intellectual property and know-how which focuses on a clear set of desired outcomes. Thorough risk management procedures, although not formally undertaken at present, are also important. A key determinant of the value obtained from commercialisation deals is the worth of the intellectual property that the Research Establishment is committing. By providing a range of intellectual property, as in the case of the Human Reproductive Science Unit **(Figure 15)**, Research Establishments can make a venture more attractive to the private sector. Assessing the worth of intellectual property is difficult, and precise valuation is unrealistic. A systematic categorisation, for example, into therapeutic area, market potential, competition, cost of manufacture (if knowable), complexity of development and time to market, can, however, inform the comparative assessment of projects in a portfolio.

26 In the sample of Research Establishments we examined, we have not investigated specific deals in detail, but the Research Establishments appear to be reducing their potential exposure by taking little management or financial risk and allowing these risks to be managed by the private sector. This is a sensible way to start. We also found that Research Establishments are seeking to protect the public interest from non-financial risks, such as developing intellectual property in a way that impacts adversely on the achievement of their core pure science goals, through ad hoc arrangements.

27 We have examined "The Radiocommunications Agency's joint venture with CMG" (HC21 December 2000) in detail. This innovative joint venture was entered into partly to help the Radiocommunications Agency exploit its technical expertise. Although the Radiocommunications Agency has a very different role to that of a Research Establishment, there are some useful general lessons. We praised the Radiocommunications Agency for identifying the key elements of a successful partnership and incorporating them in the joint venture, while at the same time negotiating a contractual framework that meant that satisfactory delivery was not solely dependent on a collaborative relationship. Partnerships UK published detailed guidance on setting up joint venture companies in December 2001. In constructing partnership deals, Research Establishments will benefit from a considered choice of partner, where possible, and a cohesive negotiating strategy that keeps the scientists well-informed and fully motivated, alongside their commercial colleagues, to take forward the scientific aspect of commercial development.

Recommendations

Recommendation	Aim	Responsibility
(A) For the Department, the Office of Science and Technology, and Research Councils: Review performance indicators including recognition of the diversity of research and hence of the performance indicators required. **(paragraphs 2.8 and 2.9)**	To agree performance indicators with Research Councils that strengthen accountability, taking into account the goal of improving UK competitiveness, and to review relevance of existing targets, some qualitative, for Research Establishments.	Director General of the Research Councils and Research Council Chief Executives.
(B) For the Research Councils: B.1 Research Councils should hold annual operational reviews, dealing with commercialisation, with all Research Establishments. **(paragraph 2.13)**	To review the progress of commercialisation efforts at frequent intervals.	Research Council Chief Executives.
B.2 Research Councils should establish guidelines, on an exception basis, for Research Establishments to take advice on conflicts of interest and to consider forming an independent science advisory board to advise them on novel cases. **(paragraph 2.30)**	To provide, when appropriate, external advice on conflicts of interest	Research Councils and Establishment Chief Executives.
B3 Research Councils should define major deals, or what would constitute novel deals, for oversight purposes, including guidelines for taking expert advice. **(paragraph 4.13)**	To ensure that they are kept informed and consulted when appropriate.	Research Councils and Establishment Chief Executives.
(C) For Research Establishments: C1 Chief Executives (in the case of the Medical Research Council the head of Medical Research Council Technology) should review the scale of the commercial opportunity annually and submit a plan for their establishment explaining any major constraints. **(paragraph 2.13)**	To review scope for commercialisation and budget accordingly	Research Establishment Chief Executives
C2 Research Establishments should review and set minimum levels of training in commercialisation **(paragraphs 2.16, 2.23 and 2.24)**	To define and make obligatory an appropriate level of training for scientists and for team leaders	Research Council Chief Executives

Recommendations

Recommendation	Aim	Responsibility
C3 Scientific staff and research appraisals should give 'kudos' for effective participation in commercial exploitation, including timely patent applications. **(paragraph 2.17)**	To encourage early identification of opportunities for commercialisation.	Line Managers, starting from the Chief Executive Officer and including the guidance that he gives to Peer Review Panels.
C4 Research Establishments should budget time, down to research team leader level, for market assessment of the commercial opportunities of research projects. **(paragraph 2.25)**	To identify and assess, from a commercial perspective, whether current research has potential commercial applications.	Commercialisation Officers, Technology Transfer Officers and Team Leaders
C5 Each Research Council should review its budget for 'proof of principle' funding, i.e. funding work to demonstrate the commercial promise of an initial scientific discovery. **(paragraph 3.25)**	To improve the prospects for commercialisation by funding the gap between scientific discovery and an initial proposal to prospective private sector partners.	Research Council Chief Executives
C6 Research Establishments should analyse the potential of their intellectual property in a systematic way. **(paragraph 4.18)**	To manage patent costs effectively and to help estimate approximate differences of potential value between projects.	Commercialisation Officers and Technology Transfer Officers