Lambert Review of Business-University Collaboration

Final Report

December 2003

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Devolution and business-university collaboration

The remit of this report is UK-wide. However, there are important differences in the roles of the devolved nations and English regions in supporting business-university collaboration. Institutional funding for higher education is devolved, while the principle source of funding for science, through the Office of Science and Technology and its Research Councils, is UK-wide. The development agencies in Scotland, Wales and Northern Ireland are funded by their respective devolved administration. So it will be for the devolved administrations to consult on and decide how to take forward the recommendations on devolved issues in this report.

Where references are made to programmes for supporting knowledge transfer, those available through HEFCE, such as HEIF, are available only in England. The devolved administrations have similar programmes of support through their own Funding Councils. Programmes run through the DTI, such as University Challenge, are generally available on a UK-wide basis.

Throughout this report, for ease of reading, the term "universities" is used to mean all higher education institutions in the UK.

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Foreword

December 2003

Dear Chancellor,

My Review of business-university collaboration is intended to meet three objectives:

- To illustrate the opportunities that are being created by changes both in the way that business is undertaking research and development (R&D), and in the way that universities are opening their doors to new forms of collaboration with business partners.
- To celebrate the success of those businesses which are already collaborating successfully with university research departments, to their benefit and to the benefit of the economy more broadly. They are role models for the majority of companies which at present have no links with universities.
- To offer a wide range of ideas to stimulate debate and recommendations to help shape policy.

The biggest challenge identified in this Review lies on the demand side. Compared with other countries, British business is not research intensive, and its record of investment in R&D in recent years has been unimpressive. UK business research is concentrated in a narrow range of industrial sectors, and in a small number of large companies. All this helps to explain the productivity gap between the UK and other comparable economies.

However, there are reasons to be optimistic. Britain's relatively strong and stable economic performance in recent years will improve the climate for business investment of all kinds. Public spending on science is increasing significantly in real terms, and the UK's science base remains strong by international standards, whether measured by the quality or the productivity of its output. The R&D tax credit provides an important new incentive for business investment.

In addition, there has been a marked culture change in the UK's universities over the past decade. Most of them are actively seeking to play a broader role in the regional and national economy. The quality of their research in science and technology continues to compare well against most international benchmarks. Much more attention is being paid to governance and management issues.

Business is changing too. Growing numbers of science-based companies are developing across the country, often clustered around a university base. New networks are being created to bring business people and academics together, often for the first time. The UK has real strengths in the creative industries, which are also learning to cooperate with university departments of all kinds.

So this is a great time to be looking at the question of business-university collaboration in the UK. I am grateful to the Government for giving me the opportunity to take on this Review, and I hope that it will play a constructive part in what I am sure is going to be an important area of public policy in the coming few years.

The Review has concluded that although there is much good collaborative work underway already, there is more to be done. Universities will have to get better at identifying their areas of competitive strength in research. Government will have to do more to support business-university collaboration. Business will have to learn how to exploit the innovative ideas that are being developed in the university sector.

The Review makes a number of recommendations across a wide range of issues. It suggests that the most effective forms of knowledge transfer involve human interaction and puts forward a number of ways to bring together people from businesses and universities. It identifies a need for the Government to support university departments which are doing work that industry values and suggests that the development agencies could play a greater role in developing links between business and universities. It proposes ways to simplify negotiations over intellectual property and to improve the market signals between employers and students. It suggests that the university sector should develop a code of governance and that the Government should introduce a risk-based approach to the regulation of universities.

I would like to express my gratitude to Niki Cleal, who has led this project with flair and determination. She was admirably supported by Matthew Toombs, Tom Orlik, Shalini Okhai, Soumitra Mukerji and Jamie Mitchell. I could not have hoped for better colleagues.

Ideas for the Review have come from a large number of academics, business people, regional authorities and policymakers in the UK, continental Europe, the US, Japan and Australia. I am extremely grateful to them all for their help.

My colleagues and I are excited about the way that businesses and universities are already working together across the UK, and about the scope for substantial further collaboration in the future. We hope this Review will be seen as a useful part of this process.

I am copying this letter to the Secretaries of State at the Department for Trade and Industry and the Department for Education and Skills, to whom the Review is also reporting.

Richard Lambert

Executive summary

INTRODUCTION

Two broad trends are reshaping the way that companies are undertaking research around the world. The first is that they are moving away from a system in which most of their research and development (R&D) was done in their own laboratories, preferably in secret, to one in which they are actively seeking to collaborate with others in a new form of open innovation.

The second is that business R&D is going global. Multinationals are locating their research centres in their most important markets, especially if those markets happen to contain centres of outstanding research. Their home country is no longer the automatic first choice for their R&D investment.

These trends have big implications for universities, which are potentially very attractive partners for business. Good academic researchers operate in international networks: they know what cutting-edge work is going on in their field around the world. Unlike corporate or government-owned research facilities, university laboratories are constantly being refreshed by the arrival of clever new brains.

UK universities are in a good position to capitalise on these trends. They perform well by international standards in science and technology, and there is evidence that the quality of their research has risen in recent years. There has also been a marked change of culture in the past decade, with many universities casting off their ivory tower image and playing a much more active role in the regional and national economy.

There is much more to be done. Universities will have to get better at identifying their areas of competitive strength in research. Government will have to do more to support business-university collaboration. Business will have to learn how to exploit the innovative ideas that are being developed in the university sector.

DEMAND FOR RESEARCH FROM BUSINESS

The main challenge for the UK is not about how to increase the supply of commercial ideas from the universities into business. Instead, the question is about how to raise the overall level of demand by business for research from all sources. Measured against other developed countries, the research intensity of British business is relatively low – and the position has been deteriorating in recent decades. This has had an adverse impact on the overall productivity of the UK economy.

In 1981, the UK's total spending on R&D as a proportion of its gross domestic product was higher than that of any other member of the G7, with the exception of Germany. By 1999, it was lagging behind Germany, the US, France and Japan, and only just keeping pace with Canada. The business sector has been the biggest contributor to this relative decline.

The UK's R&D intensity is much higher than the international average in two broad areas – pharmaceuticals/biotechnology and aerospace/defence. It is below average in all other important sectors. The UK's business research base is both narrow and fragile, and is heavily dependent on the investment decisions of a dozen large companies mainly involved in pharmaceuticals and defence.

There are a number of possible explanations for the relative decline in R&D investment by British business over the past twenty years. These include a tendency to expand by acquisition rather than by organic growth, and a harsh environment for the manufacturing sector. However, there are now more hopeful signs.

The country's overall economic performance has improved relative to that of other developed countries, and public investment in R&D is increasing in real terms. On the business side, the weakness in terms of research intensity and innovation lies in mature industries, and the picture looks brighter when it comes to new industries and services, such as biotechnology or the creative industries.

The Review makes a number of proposals for building new networks among research-intensive businesses, and supports existing schemes for business-university collaboration such as LINK and Knowledge Transfer Partnerships. It suggests that the Government should seek ways of directing a higher proportion of its support for business R&D to small and medium-sized enterprises (SMEs).

The R&D tax credit provides an important new incentive for business investment. But it is not yet sufficiently well understood by business, and should be better marketed by the Government. The Review is not proposing any further tax breaks.

KNOWLEDGE TRANSFER

The best forms of knowledge transfer involve human interaction, and the Review makes several recommendations designed to encourage more frequent and easy communications between business people and academics. It suggests that research collaborations might be made easier to agree if model contracts could be developed on a voluntary basis to cover the ownership and exploitation of intellectual property (IP).

The Review strongly supports the Government's approach to so-called third stream funding which promotes knowledge transfer, and suggests that this funding should be increased in size and allocated in a more predictable fashion. It endorses the broad objectives of the Government's proposed new Knowledge Exchanges, but suggests that these goals could be achieved in a simpler way.

INTELLECTUAL PROPERTY AND TECHNOLOGY TRANSFER

UK universities have a strong science base, and there is significant potential to transfer this knowledge to business in the form of IP. These transfers take a range of different forms and have been growing at a rapid pace in recent years. Most universities have developed technology transfer offices, and staff numbers are rising rapidly. However, there are a number of barriers to commercialising university IP.

One is a lack of clarity over the ownership of IP in research collaborations. This makes negotiations longer and more expensive than otherwise would be the case, and it sometimes prevents deals from being completed.

The Review expresses concern that universities may be setting too high a price on their IP. Public funding for basic research, and for the development of technology transfer offices, is intended to benefit the economy as a whole rather than to create significant new sources of revenue for the universities. Even the most successful US universities tend to generate only small amounts of money from their third stream activities, and most acknowledge that their reason for engaging in technology transfer is to serve the public good.

It is important that the rewards from research collaboration should reflect the relative contributions of the parties to the partnership. Companies should have secure rights to the IP they want to commercialise, but it is also important that any deal on IP should not unreasonably constrain the university from publishing the results in a timely fashion, from doing further research in the same area, or from developing other applications of the same IP in different fields of use. It follows from both these points that there should be as much flexibility as possible in the distribution of IP rights between universities and business.

The Review argues that it would be helpful to have an agreed starting point for negotiations on research collaboration. It suggests that where public funding is involved, this starting point should be for universities to own any resulting IP, subject to certain conditions. For its part, industry should be free to negotiate licence terms to exploit it. When industry has made a significant contribution to the research, then business should be able to negotiate ownership of the resulting IP itself. The Review does not believe that the UK should introduce legislation giving ownership of IP to universities along the lines of the Bayh-Dole Act in the US.

A second barrier to commercialising university IP lies in the variable quality of technology transfer offices. Most universities run their own technology transfer operations, but only a few have a strong enough research base to be able to build high-quality offices on their own. So the Review recommends that the Government should use third stream funding to encourage the development of shared services in technology transfer on a regional basis. It also makes proposals for improving the recruitment and training of technology transfer staff.

Finally, the Review suggests that there has been too much emphasis on developing university spinouts, a good number of which may not prove to be sustainable, and not enough on licensing technology to industry. It puts forward ideas for changing the balance in the future.

REGIONAL ISSUES

Universities are playing an increasingly important role in regional economic development, and development agencies are taking an active role in building bridges between business and universities across the regions and nations. The Review recommends that the targets set for the English Regional Development Agencies should be changed, to give a greater emphasis to building such relationships.

The Review shows how universities are working together with local and regional agencies to develop their own science-based clusters. It recommends that the DTI should shift the pattern of regional support away from job creation schemes and towards more value-added programmes, including collaborative R&D projects with universities.

FUNDING UNIVERSITY RESEARCH

The Review considers the strengths and weaknesses of the current dual support system of university funding. On the one hand, it has helped to raise the quality and productivity of research in the UK. On the other, it has tended to homogenise the research efforts of the entire university system, by driving all universities to aspire to the same benchmarks. It may also have encouraged universities to take on more research work than they can sensibly afford.

From a business perspective, the Review suggests that the dual support system provides disincentives to business-university collaboration. The current system is being examined in two separate reviews. This Review proposes a number of principles that should be adopted to encourage world-class business research, and urges the Government to consider the balance between the two streams of dual support.

The Review accepts that public funding should be concentrated on world-class research. But the increased selectivity of funding will create a tension within the system. Research departments which are doing work that is of real value to business but which does not rank as world-class will get little support from the dual support system and may find it increasingly difficult to sustain themselves.

In addition, proximity matters when it comes to business-university collaboration. SMEs, in particular, find it difficult to work with research departments on the other side of the country. If resources are increasingly concentrated on a small number of world-class research departments, there is likely to be a negative impact on the level of business-university collaboration in the UK.

The Review suggests that the Government should take steps to fill this emerging funding gap. If business demonstrates that there is a clear need for a particular department to receive continued public support, that should be forthcoming.

There are a number of different channels through which such funding could be directed. One would be by expanding the scope and scale of the Higher Education Innovation Fund. Another would be by extending existing government schemes, such as LINK. The Review favours a bottom-up approach, by getting the development agencies to finance those departments that really can demonstrate strong demand from business for their research activities.

A final suggestion in this chapter is that it would be helpful to develop a league table of the world's best research-intensive universities. Such a table would provide academics with a valuable reality check, and would help policymakers to judge the success of their funding strategies.

MANAGEMENT, GOVERNANCE AND LEADERSHIP

Business is critical of what it sees as the slow-moving, bureaucratic and risk-averse style of university management. However, there have been significant changes for the better in recent years. Many universities have developed strong executive structures to replace management by committee, and have raised the quality of their decision-making and of their governance. Strategic planning and the process of resource allocation have been improved.

The Review suggests that the sector has reached a point where a voluntary code of governance should be developed, to represent best practice across the sector. It recognises that it will not be appropriate for all universities to comply with such a code: in such cases, they can explain in their annual report why their particular arrangements are more effective.

Universities are struggling with an uncoordinated and often unnecessarily burdensome system of accountability and regulation. Two ideas are put forward to address this problem. The first is that the use of hypothecated funding streams should be kept to a minimum. The second is that universities which can show they are well run should be subject to a much lighter regulatory and accountability regime than those which cannot.

Oxford and Cambridge play a crucial role in the economic as well as the intellectual life of the UK. Both have taken steps to modernise the way that they run themselves: both have more to do. The Review concludes that the future success of the two universities will best be achieved by change that is initiated and led from within.

SKILLS AND PEOPLE

Companies are broadly satisfied with the quality of the graduates they recruit, although there are some mismatches between their needs and the courses offered by some universities. Prospective students would benefit from clearer market signals than are now available about what has happened to graduates from particular courses, in terms of their employability and pay.

The new Sector Skills Councils (SSCs) give employers the opportunity to work together to identify their needs for particular skills. But employers may give up on the process unless the SSCs can have a more direct influence on university courses and curricula. The Review also suggests that the various funding bodies should take more account of the views of employers when deciding how to allocate their teaching funds.

Workplace experience is important to students, as is the opportunity to develop entrepreneurial skills. The Review highlights a number of good schemes that are designed with this in mind, and suggests that universities could be doing more to provide continuing professional development to business employees.

1 Introduction

1.1 Businesses around the world are changing their approach to research and development (R&D). For sound commercial and economic reasons, companies everywhere are cutting back their corporate laboratories and building collaborative research programmes with other partners – most particularly, with universities.

1.2 At the same time, global competition is having an impact on the way that both business and universities are approaching R&D. Multinationals are locating their research centres in their most important markets: their home country is no longer the automatic first choice. And universities are having to compete for talent and money with the best in the world.

1.3 These trends have implications for companies, for the university system, and for public policy. The issues which they raise are the subject of this Review.

1.4 The change is especially important for the UK, where research output from the universities compares well with the international competition, but business research does not. Properly managed, there could be significant opportunities for UK business to sharpen its competitive edge through these new partnerships.

1.5 Over the past ten years, there has been a marked change of culture in many British universities. They have cast off their old ivory tower image and are playing a much more active role in the regional and national economy. This Review has found clear evidence of the benefits which these developments have brought both to the university system and to British business.

1.6 Across the country, academic researchers are sharing ideas and best practices with their industrial counterparts. Through their collaborative efforts, they are gaining access to the most advanced equipment as well to financial support from industry. Research-intensive universities play a central role in the most dynamic economic regions of the UK, and it is rare to find a business cluster which is not associated in some way with one or more local universities.

1.7 The Review has come across dozens of companies in a wide variety of sectors which have gained significant economic advantages by working with universities to develop new ideas and innovations. Companies that are involved in such collaborations are more likely to broaden their range of good or services, open new markets or increase their market share than those that are not.[1]

1.8 Compared with higher education institutions in other European countries, British universities have made real progress in their efforts to work with business. And they also perform well in terms of high-quality research, whether measured by their output of research papers or by the number of citations and internationally recognised awards received by British scientists and technologists.

1.9 So the UK is well placed to capitalise on trends which, for reasons that will be explained, will give universities a more central role in research work of all kinds. But there is much more to be done. British universities will have to get better at identifying and communicating their areas of comparative research strength to a wide community, and at organising themselves in a way that will allow them to exploit their new opportunities in the most effective manner.

[1] *Community Innovation Survey (UK)*, DTI/ONS, 2001.

1.10 The Government will have to do more to support business-university collaboration, both by providing finance to back important work and by creating the kind of stable economic and regulatory background that will allow universities to develop sensible strategies over the long term.

1.11 Above all, many more companies will need to learn how to exploit the innovative ideas that are being developed in scores of departments across dozens of British university campuses. The story of British business over the past hundred years is littered with tales of missed opportunities: the failure to commercialise ideas which were developed in this country but were brought to the marketplace somewhere else; the inability to innovate and to keep pace with changing technology.[2] Today, the UK comes out badly in international comparisons of business investment in R&D. There are relatively few research-led businesses in the UK which can compete on a global scale, and they are heavily concentrated in the pharmaceuticals and aerospace-defence sectors.

1.12 The biggest single challenge when it comes to encouraging the growth of successful business-university collaboration lies in boosting the demand from business, rather than in increasing the supply of products and services from universities. Academic researchers are working much harder than in the past to reach out to business. Will companies respond to the opportunities?

1.13 This Review contains a number of recommendations aimed at smoothing out the bumps which can impede business-university collaboration. But its main purpose is to celebrate the success of those collaborations that are already working well, and to suggest to those companies that are not yet engaged in this effort that they are missing out on potentially important sources of innovation and growth.

THE NEW APPROACH TO BUSINESS R&D

1.14 During the past hundred years, the world's most successful technology companies did the bulk of their important research work in their own laboratories. The German chemical industry created the central research laboratory, which was replicated in the UK and the US. Internally generated research became a critical competitive advantage: only the biggest and the richest companies could afford to recruit the brightest researchers and to support them with enough money and time to develop brilliant new ideas.

1.15 Probably the best-known example of this was Bell Laboratories, the research arm of the US telephone monopoly, which achieved an astonishing record of success in basic and applied research during the post-war period. More recently, the most successful Japanese companies built their reputation for innovation and quality on the back of very high levels of investment in their own research departments.

1.16 But in recent years, the picture has started to change radically. Long-established technology companies have found themselves under attack from different competitors on many fronts. Companies that have only been in existence for a few decades have sprung to global prominence, often by exploiting other people's research. And "not invented here" has become a term of approval, rather than one of scorn. The reasons for the change are:

[2] "… numerous cases in which members of the small band of British scientific men have made revolutionary discoveries in science; but yet the chief fruits of their work have been reaped by businesses in Germany and other countries, where industry and science have been in close touch with one another", *Industry and Trade*, Alfred Marshall, 1919.

- As the complexity of products increases, firms are being forced to conduct research into a wider portfolio of technologies than they can possibly manage by themselves. It has become necessary to bring together a whole range of different scientific disciplines in order to make technological breakthroughs: it is no longer enough to be a leader in just one or two disciplines. Merck, which has one of the biggest research budgets of any company in the world, has stated that: "The cascade of knowledge flowing from biotechnology and the unravelling of the human genome – to name only two recent developments – is far too complex for any one company to handle alone".[3]

- Increasing global competition and technological change have forced companies to move away from vertical integration, to focus on their core strengths and to outsource a growing proportion of their activities. Responsibility for R&D has often been devolved from corporate headquarters down to individual divisions, and central laboratories have been cut back or closed. At the same time, companies have been increasingly willing to collaborate with outside partners of all kinds. The big research laboratories that used to be run by quasi-monopolies (such as AT&T, Xerox, BT, or IBM) have had to change their role in this environment.

- People and capital have both grown more mobile. Researchers have become much more willing to move from one laboratory to another, depending on where they see the most exciting opportunities. Venture capitalists have made it possible for research projects that once could only be financed by big companies to be spun out and developed in new start-up companies.

1.17 In this changing environment, universities are potentially very attractive partners for business. Good university researchers operate in international networks: they know where cutting-edge work in their field is going on around the world. Unlike corporate or publicly owned research facilities, university laboratories are constantly being refreshed by the arrival of clever new researchers in the form of students, postgraduates and teachers.

1.18 For this reason, governments in many countries are attempting to build bridges between business and universities. For example, Japan is seeking to develop the research capacity of its university system. The country has a high level of investment in R&D, but a large proportion of that work in the past has taken place within corporate laboratories. In the new world of open collaboration and multi-disciplined research, what was once Japan's great strength – its brilliant company-led research – could now be turning into a weakness.

1.19 The trend raises an important question for public policy. In the words of Henry Chesbrough: "The wealth of innovations that diffused out of these [corporate] laboratories since the 1960s is not likely to recur from those labs in the future, given the labs' shift in orientation away from basic research. The seed corn that will create the innovations of twenty years hence will have to be provided elsewhere in the society. Governments and universities will need to address this imbalance. Increasingly, the university system will be the locus of fundamental discoveries. And industry will need to work with universities to transfer these discoveries into innovative products, commercialised through appropriate business models".[4]

[3] *Merck Annual Report,* 2000.
[4] *Open Innovation*, Henry Chesbrough, 2003.

1.20 In recent years, the UK Government has increased the resources available to universities to fund their research, and has also provided a growing volume of funding specifically designed to encourage collaboration between universities and business – the so-called third stream activity which follows on from the two priorities of teaching and research. The questions for this Review are about what more should be done to support an increasing volume of such collaboration, and about what benefits these efforts can be expected to generate for business, the universities and, more generally, the public interest.

1.21 The Review starts by looking at reasons for the weakness in the demand from British business for research activities, and proposing possible ways of stimulating such demand. It then moves on to the supply side, and discusses the process of knowledge transfer through collaborative research, contract research, consultancy and university reach-out activities. The next section looks at best practice in the workings of technology transfer offices, along with such issues as the ownership of intellectual property, licensing, spinouts and funding for early-stage research.

1.22 The Review examines the regional and local economic impact of business-university interactions, including ways in which they can be supported by Regional Development Agencies. It then moves on to the critical issue of public funding for research. Different methods of funding can provide very different incentives for academics to collaborate with outside partners: the Review concludes that the existing mechanism sends out some perverse signals, and suggests some changes. The Review then considers the ways in which universities run themselves, and their relationship with Government. Are they as well organised and dynamic as they will need to be in order to manage their increasing resources and responsibilities? And does their relationship with central Government and the various funding bodies help or hinder them in the effective management of their affairs?

1.23 Finally, the Review looks at the extent to which universities equip undergraduates and postgraduates with the skills that business and the economy needs. It considers the role of work experience and of continuing professional development in building closer links between business and universities.

1.24 A number of general principles have emerged in developing this Review and in shaping its recommendations. In no particular order, they are:

- The best form of knowledge transfer comes when a talented researcher moves out of the university and into business, or vice versa. The most exciting collaborations arise as a result of like-minded people getting together – sometimes by chance – to address a problem. Encouraging academics and business people to spend more time together should be a high priority.
- Innovation processes are complex and non-linear. It is not simply a question of researchers coming up with clever ideas which are passed down a production line to commercial engineers and marketing experts who turn them into winning products. Great ideas emerge out of all kinds of feedback loops, development activities and sheer chance.[5] This is another reason why it is so critical to build dynamic networks between academic researchers and their business counterparts.

[5] A classic account of this process at work is to be found in *The Double Helix: A Personal Account of the Discovery of the Structure of DNA*, James Watson, 1968.

- Because of these complex relationships, it is very difficult to calculate the economic returns to academic research. The wide scope of the potential benefits, together with the often indirect channels through which they emerge, make it hard to assess the direct results of public funding in this area. However, the available evidence suggests the economic and social returns from public funding of university research are attractive, and certainly justify increasing investment in this area.[6] More money will be needed for the university system to reach its full potential.

- Diversity is good, both in mission and in funding. The type of business collaboration that would make sense for one kind of university might be either impossible or irrelevant for another: a less research-intensive university can play an extraordinarily valuable role in working with local business in a way that might make no sense to one of the big research universities. The more diverse its sources of revenue, the better placed is the university to shape its own identity and future strategy.

- Modern universities have to compete for talent and money in a global marketplace. The best brains will seek out the best opportunities for research and teaching, wherever they happen to be found in the world. It follows from this that public funding for research should seek to support and strengthen only the highest-quality work; distributing funding on any basis other than quality will weaken the whole system.

- However, proximity matters when it comes to business collaboration, especially for small and medium-sized enterprises (SMEs). Informal networks cannot easily be sustained over long distances, and even large companies may find it more efficient to work with research departments in their own locality. So it is very important that research departments with distinctive areas of expertise should continue to flourish right across the country.

- Transferring technology to business is not a way for universities to develop vast new sources of funding. Even the most successful US universities tend to get only a small part of their overall income from this activity. Public funding for university research is intended to support the generation and dissemination of new ideas; it should not be seen as a way for the universities to become rich.

- Business-university collaborations need careful and consistent management by both sides, and a number of joint programmes have failed for lack of such attention. Half the companies responding to a recent survey said they had difficulties in managing the relationship.[7] For their part, universities talk about the problems that can result from frequent changes in company strategies, or in the boardroom.

[6] *The Economic Returns to Basic Research and the Benefits of University-Industry Relationships*, SPRU – Science and Technology Policy Research, 2001.

[7] CBI survey of its 200 largest members undertaken for this Review, 2003.

- Governance matters. As universities become more involved in commercial activities of one kind or another, they will have to develop clearer ideas of their mission and firmer rules for dealing with potential conflicts of interest. They will need to build new kinds of relationships, and have a highly proficient approach to areas like financial control and human relations. New mechanisms will need to be established for setting institutional priorities.[8]

- Universities are more complex to manage than businesses. They have a variety of different stakeholders – academics, students, funders and others – all of whom must be persuaded to buy into the overall strategy. They have very limited freedom to set their prices, or to manage their costs, and they have to be ready to adapt their plans to meet changing public policies. But although they are not businesses, at least in the PLC sense, they need to be businesslike in the way they manage their affairs.

- In the course of its work, the Review has concluded that there are already too many pots of ring-fenced financing offered by the various funding bodies to universities. This severely limits the universities' freedom of action, and is the source of endless unnecessary frustration. There is a strong case for allowing a much greater degree of autonomy to those institutions that can show they deserve it.

- The Review is not supporting various proposals from business for new tax breaks. The new Research and Development Tax Credit is barely up and running. It is potentially very significant in scale, and it needs to be settled in and properly understood before any more such initiatives are proposed.

1.25 Companies and universities are not natural partners: their cultures and their missions are different. Universities and governments also find it hard to work together. Academics value their freedom and independence, resent their reliance on public funding and feel their efforts are not properly appreciated. An overriding aim of this Review is to suggest that there are benefits to be gained for business, the universities, and the economy as a whole by improving communications and developing a more trusting approach by all those involved.

[8] *Universities in the Marketplace*, Derek Bok, 2003.

2 Demand for research from business

2.1 Britain's poor record in turning its established strengths in basic research into marketable products and commercial success has long been a subject of concern. The Paris Exhibition of 1867, when Great Britain was awarded the palm of excellence in only ten of the ninety departments, was regarded as something of a national disaster.[1] This helped to give urgency to the movement in the second half of the century to create civic universities with the strong support of British industry.

2.2 But in the past twenty years or so, these worries have taken on a new intensity. As a share of gross domestic product (GDP), overall spending on research and development (R&D) in the UK has declined steadily over a long period, in marked contrast to the trend in most other developed countries. Business has been responsible for most of this relative weakness.

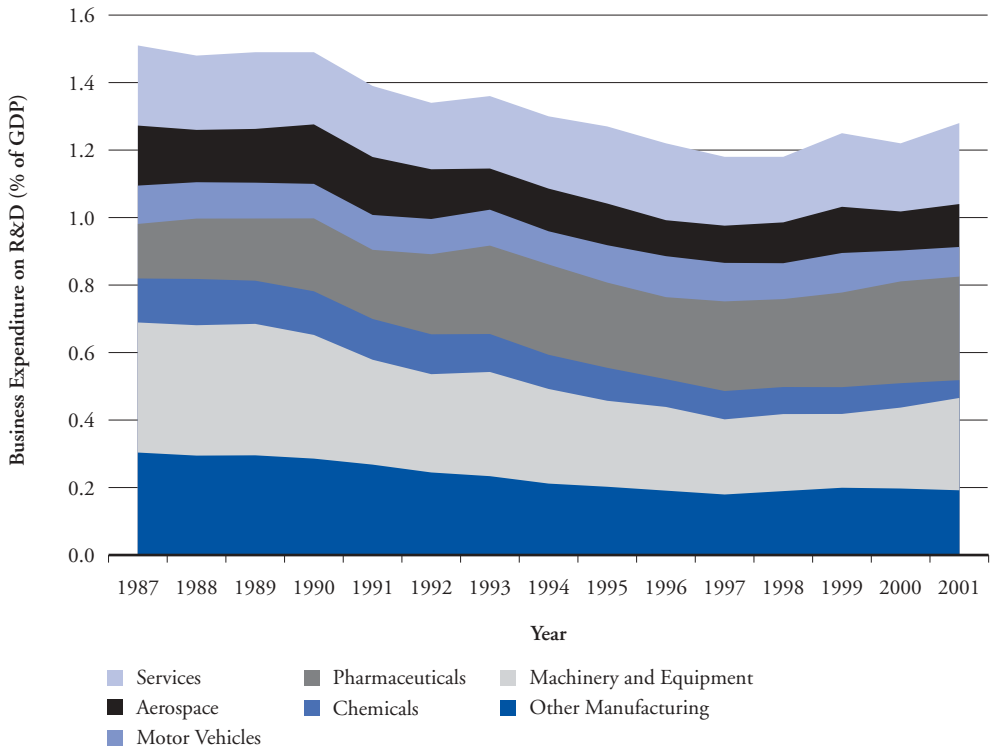
2.3 There is a well-established link between R&D, innovation and productivity, and there is ample evidence that the relative weakness of the UK's R&D spending over the last twenty years has played a measurable part in the country's disappointing productivity performance.[2] One conclusion of the review by Professor Michael Porter on UK competitiveness was that "current levels of UK innovation are insufficient to drive UK productivity growth and close the UK productivity gap versus key competitors".[3]

2.4 In 1981, the UK's total spending on R&D as a proportion of GDP was higher than that of any other member of the G7, with the exception of Germany. By 1999, it was lagging behind Germany, the US, France and Japan, and only just keeping pace with Canada.[4] Part of this was due to a relatively weak level of public sector spending on research. Growth rates in this category trailed behind those experienced by other developed economies during the 1990s.

2.5 But the biggest single contributor to the UK's relative decline has been the business sector. In the US, Japan and Germany, business investment in R&D picked up sharply in the latter part of the 1990s, but the rate continued to decline in the UK until around 1998. Further analysis of the data shows that almost the entire decline relative to other big economies during the mid-1990s took place within manufacturing industries.

[1] *The Universities and British Industry 1850-1970*, Michael Sanderson, 1972.
[2] *Bridging the Continental Divide*, Engineering Employers Federation, 2003.
[3] *UK Competitiveness: moving to the next stage*, Michael Porter, 2003.
[4] *Investing in Innovation: a strategy for science, engineering and technology*, DTI, HM Treasury and DfES, 2002.

Chart 2.1: UK Business expenditure on R&D as a percentage of GDP: industry breakdown



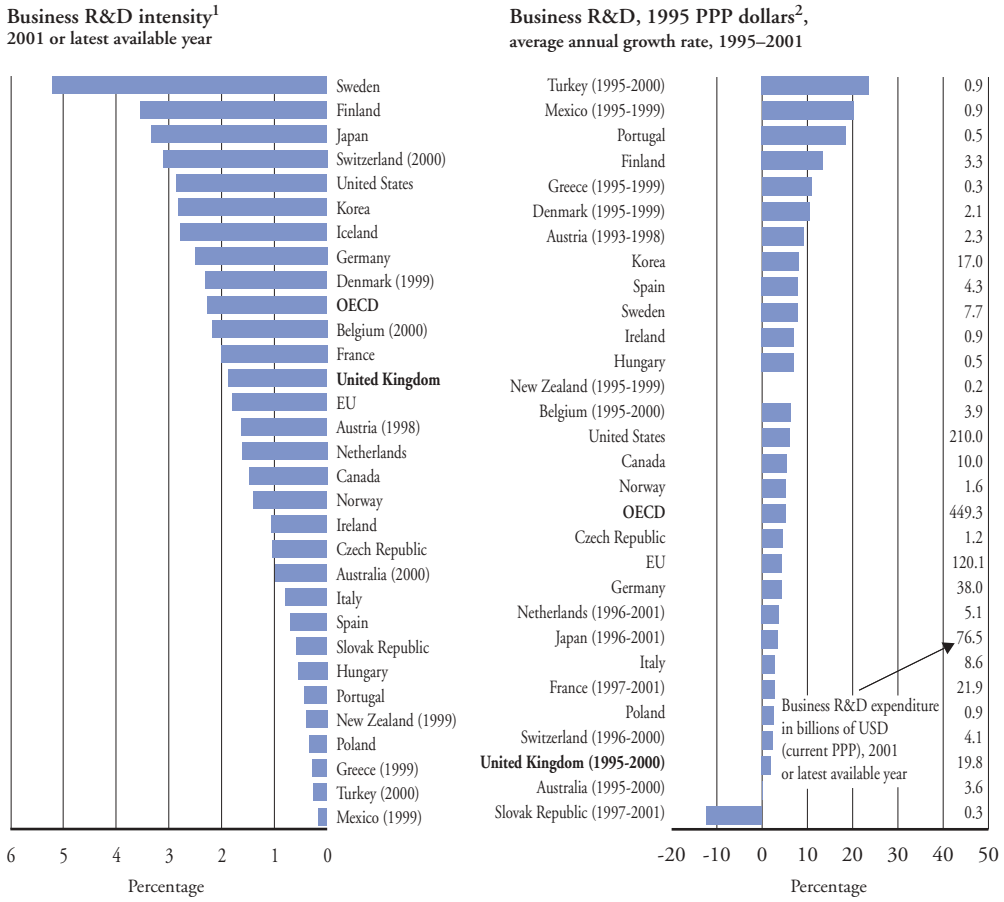
Source: OECD, Analytical Business Enterprise Research and Development, 2003.

2.6 Part of the UK's absolute decline can be accounted for by a sharp downturn in spending on defence R&D over the 1990s, from 0.5 per cent in 1989 to 0.2 per cent ten years later. But similar declines took place in other developed economies, and were more than offset by increases in other sectors.[5]

2.7 Compared with other OECD countries, the UK is close to the bottom of the scale in terms of average annual growth in business R&D, measured by purchasing power parities. And the level of business R&D intensity compares unfavourably with that of many other developed economies.

[5] *Investing in Innovation: a strategy for science, engineering and technology*, DTI, HM Treasury and DfES, 2002.

Chart 2.2: Business R&D

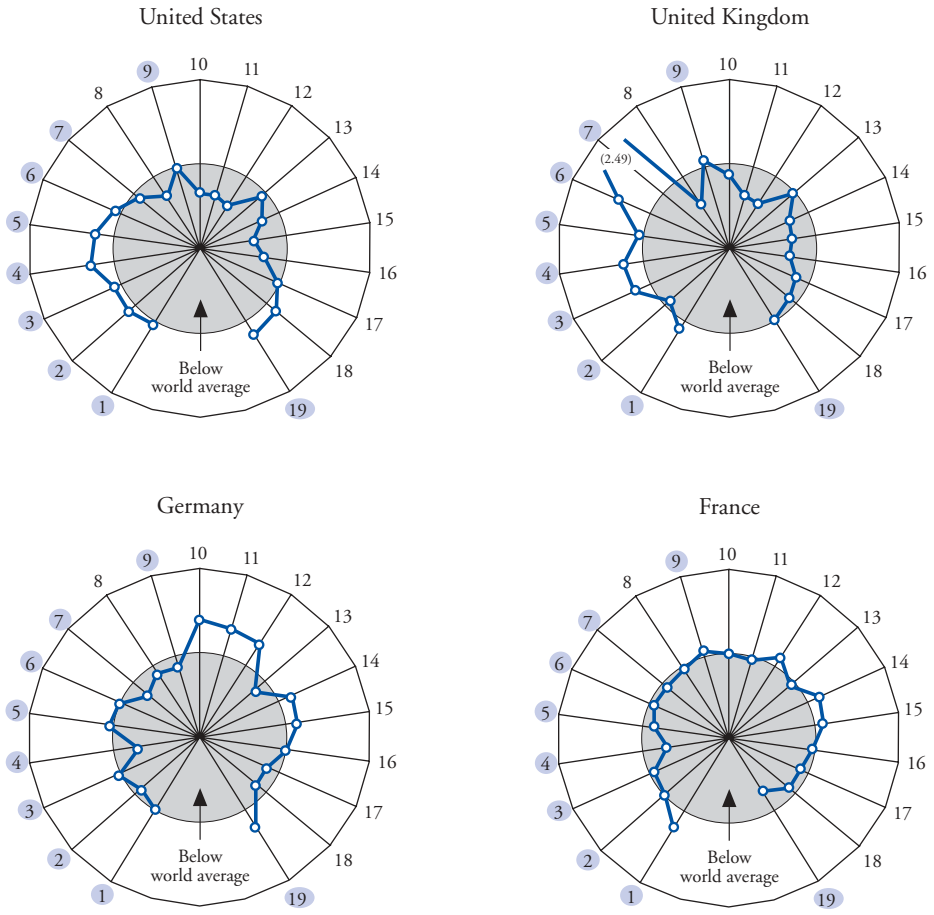


1. Business enterprise sector R&D expenditure as a percentage of value added in industry.
2. 1995 USD using purchasing power parities (PPP).
Source: OECD Science, Technology and Industry Scoreboard, 2003.

2.8 The UK's R&D intensity is much higher than the international average in pharmaceuticals and biotechnology, and in aerospace/defence. It is lower for all other major sectors and especially so in electronics and electrical, chemicals, engineering, and software and IT services.

2.9 This concentration is reflected in the national profiles of scientific specialisation, which are produced by the OECD and based on research publications. The data suggest that relatively little research work is going on in mature industries like metallurgy, chemical engineering or applied physics, whereas there is a positive explosion of new ideas in medicine and the life sciences. In contrast, a country like France, for example, is close to the OECD average in most of the sectors covered.

Chart 2.3: National profiles of relative scientific specialisation
Based on publications; 1998



x Biosciences, medical, clinical and pharmaceutical research

1. Microbiology & virology
2. Oncology
3. Gastroenterology & cardiology
4. Epidemiology, public health
5. Neurosciences, neuropathology
6. Medicine, miscellaneous
7. General & internal medicine
8. Analytical chemistry
9. Medical chemistry & pharmacy
10. Chemistry
11. General & nuclear physics
12. Applied physics
13. Optics, electronics, signal processing
14. Physical chemistry, spectroscopy
15. Materials science, metallurgy, crystallography
16. Chemical engineering, polymer science
17. Mechanical engineering, fluid dynamics
18. Computer & information science
19. Biomedical engineering

Source: OECD, based on data from OST

2.10 These data underline the fragility of Britain's business research base. A handful of large companies finances the bulk of research investment in the pharmaceutical and health sectors, one of the few areas of real research intensity in this country. All these companies are now global in character, and all have fewer cultural and intellectual ties with the UK than they did a decade ago. In the past, their decisions about where to invest in R&D were influenced in part by their UK roots. In future, there will be increasing calls on them to consider other parts of the world.

2.11 A few large companies also dominate the aerospace and defence sectors and they too have become much more international in their outlook and market ambitions in recent years. Companies like Rolls-Royce and BAE SYSTEMS are of critical importance to the overall research efforts of the country, and play a significant part in joint collaborations with a large number of British universities. They have substantially expanded the level of their activities outside the UK, especially in North America.

2.12 There is evidence that UK companies are already doing more of their research work outside the UK.[6] Multinationals are increasingly likely to locate their research centres in their most important markets, especially if those markets happen to contain centres of outstanding research. This is drawing an increasing volume of business R&D investment from around the world into the US. In addition, there have been waves of takeovers and mergers in the pharmaceutical and defence sectors during recent years, as the two industries have consolidated on a global scale. Further moves in this direction could put fresh pressure on the UK's research base.

2.13 Are these trends reversible? The answer requires some explanation of what might have caused them in the first place. There are a number of possible clues.

2.14 In the past ten years, there has been an extraordinary upheaval in the make up and performance of the top 12 UK-owned companies ranked by their investment in R&D.

Table 2.1: The top 12 UK-owned R&D investors

	UK-owned (1992)		UK-owned (2003)
1.	ICI (includes Zeneca)	1.	GlaxoSmithKline
2.	Glaxo	2.	AstraZeneca
3.	Shell	3.	BAE SYSTEMS
4.	GEC	4.	Unilever
5.	SmithKline Beecham	5.	BT
6.	Unilever	6.	Marconi
7.	BP	7.	Rolls-Royce
8.	British Aerospace	8.	Shell
9.	BT	9.	BP
10.	Wellcome	10.	Invensys
11.	Rolls-Royce	11.	Reuters
12.	Lucas	12.	Amersham

Source: DTI R&D Scoreboard

2.15 The three big pharmaceutical companies which appeared in 1992 have merged into one, GlaxoSmithKline. GEC has run into serious financial difficulties, and re-emerged as Marconi. Lucas has been taken over by a foreign company. BAE SYSTEMS and BP have both been involved in enormous acquisition programmes.

[6] *R&D Scoreboard*, DTI, 2002.

2.16 Most spectacular of all, ICI – which used to be the benchmark for corporate excellence in British business research – has disappeared from the list altogether. Its pharmaceutical side was spun off to form an important part of what is now AstraZeneca. Many of its former bulk chemicals businesses have been sold off, often to companies which had their headquarters and R&D decision-making outside the UK. Its overall financial structure has come under pressure. In the words of one observer: "Trends such as these have reduced business awareness of the research base, and individuals with a thorough and expert knowledge of the research base and how to get the best out of it are few and far between".[7]

2.17 It is also worth noting that two of the new companies on the list in 2003 – Reuters and Invensys – have themselves been involved in varying degrees of financial difficulty. A third, Amersham, has recently agreed to be taken over by General Electric of the US, although the intention here is that the enlarged GE Healthcare Technologies business will be based in the UK.

2.18 Acquisitions, consolidations, financial upheaval: this is not the kind of background which is likely to encourage a consistent long-term approach to research investment. And the pattern is not just confined to very large companies.

2.19 Relative to other countries, business in Britain has shown much more interest in growth by acquisition than in organic growth. This is despite evidence that suggests major acquisitions are often followed by a period of under-performance. Research shows that UK companies in the quoted engineering, automotive and aerospace sectors had spent more on acquisitions in recent years than they had on R&D and capital investment combined.[8]

2.20 This is not simply a consequence of Britain's shareholder-driven financial markets. The same piece of research makes comparisons with similar companies in the US, where the need to generate returns for shareholders is at least as pressing as it is in the UK, and it shows some striking differences. In 1999 and 2000, the UK companies invested only three-fifths as much on R&D and capital expenditure as they did on acquisitions. The US companies, by contrast, spent four or five times as much on these two items as they did on acquisitions.

2.21 There are several possible explanations for this apparently perverse behaviour. British manufacturing industry had a torrid time in the 1980s and 1990s, made worse by an overvalued exchange rate during Britain's membership of the Exchange Rate Mechanism up to 1992, and by the further strength of the exchange rate in the latter half of the decade. For some companies, research must have seemed like an optional extra in these difficult circumstances.

2.22 There are also questions about the capacity of British managers to absorb science and innovation into their operations. A benchmarking study by the OECD highlights "the issue of the educational profile of top managers in UK-owned firms, who have rarely been trained as scientists, in contrast with US executives, who have often both a PhD and a Master of Business Administration, or with their French counterparts".[9]

2.23 This may help to explain why large numbers of medium-sized companies in this country appear to have no contact with, or experience of, the university system. Various estimates have been made about how many UK companies have any interactions with universities: the figure is generally put at less than 20 per cent. Data produced by the Engineering and Technology Board for this Review show that compared with the rest of Europe, relatively few British companies cite co-operation with universities and public research organisations as one of their two most important ways of accessing advanced technology.

[7] Dr David Brown, Arthur D. Little.
[8] *R&D Scoreboard*, DTI, 2002.
[9] *Benchmarking Industry-Science Relationships*, OECD, 2002.

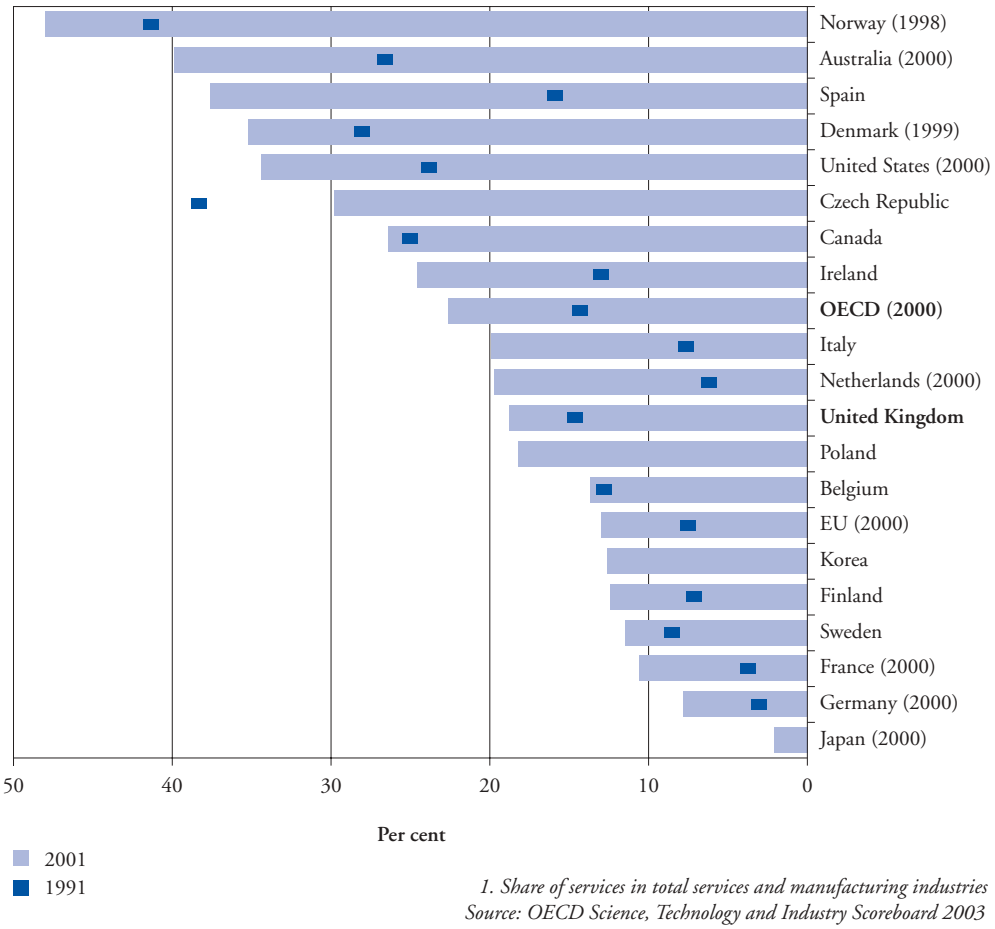
2.24 Another contributory factor to Britain's poor record is a continuing shortfall in the volume and quality of intermediate to advanced skills available to business. Among graduates, a lack of practical work experience and commercial understanding is frequently identified as a problem by employers.

2.25 Some commentators have also pointed the finger at a risk-averse, non-innovative approach to purchasing in the UK, particularly by the Government.[10]

2.26 Although the economic structure of developed countries has moved strongly towards the services sector, this still represents a much smaller share of business R&D than it does of overall GDP. In 2000, services in the OECD area accounted for around 22 per cent of total business investment in R&D, an increase of 8 percentage points over 1991.

2.27 Here too the UK's performance is unimpressive. Services represent less than 20 per cent of business R&D here, compared with more than 30 per cent in countries like Norway, Spain and the US, and the growth rate over the past decade has been modest.

Chart 2.4: Share of services in business R&D[1], 2001



1. Share of services in total services and manufacturing industries
Source: OECD Science, Technology and Industry Scoreboard 2003

[10] *UK Competitiveness: moving to the next stage*, Michael Porter, 2003.

2.28 The UK has a strong financial services sector, but most financial companies appear to have little interest in collaborating with universities other than in order to recruit bright graduates. A study by the Centre for the Study of Financial Innovation found that firms in the City of London are mainly engaged in short-term research projects that they can keep exclusively to themselves and use for short-term trading advantage.[11] This is not the kind of research that universities can or should provide.

2.29 Are there reasons for being more optimistic about the outlook for research investment over the next decade?

2.30 One hopeful sign is that the UK's overall economic performance relative to other developed economies has improved significantly in recent years. Michael Porter suggests there is clear evidence that high macroeconomic volatility depresses investment rates, and that such volatility in the past was greater in the UK than in continental Europe. A more stable environment might trigger a more ambitious approach to investment by UK managers.

2.31 A second positive indicator is that public spending on R&D has started to reverse a long period of relative weakness, and this should have a beneficial impact on innovation and productivity throughout the economy. Building the science and engineering base has been a priority for the present Government. Plans set in the 2002 Spending Review will lift the real growth in resources for the Science Budget, as delivered by the Office of Science and Technology, to an average of 10 per cent a year over three years. Other government departments also plan to spend significant amounts on science, engineering and technology.

2.32 Next, a growing proportion of UK business managers have had a university education. With luck, this will make it easier for them to develop new ideas and to interact with academics in the course of their work. The proportion of the whole labour force educated to degree level in the UK is 17 per cent compared to 28 per cent in the US. But among 18 to 30 year olds, the picture looks different. In England, the participation rate of students in higher education is around 43 per cent.[12]

2.33 As has already been mentioned, this Review has found evidence in the past few years of a marked change in culture on the part of many universities, which are actively reaching out to work in partnership with business. In most parts of the country, it is becoming easier for businesses to find their way on to the campus, and to identify academic partners with whom they can work.

2.34 Moreover, the data suggest that the main problem in terms of the lack of research intensity and innovation in the UK lies in established, mature industries. The picture looks brighter when it comes to the industries of the future, like the biotechnology and Information and Communication Technology (ICT) sectors, which almost invariably have their original roots in the university system, and so naturally see the universities as an attractive pool of human resources. As the OECD points out: "Hence, it is in these sectors UK industry is particularly innovative and competitive, while the more traditional activities suffer from a lack of technological vision and engineering skills".[13]

[11] *Quant and Mammon*, Centre for the Study of Financial Innovation, 1998.
[12] *The Future of Higher Education*, DfES, 2003.
[13] *Benchmarking Industry-Science Relationships*, OECD, 2002.

2.35 Finally, there is a growing volume of evidence to show that investment in research by both business and Government produces good economic returns. The R&D Scoreboard is one of many sources which shows a clear correlation between R&D intensity and sales growth and product innovation, as well as total shareholder returns. At the micro level, the Review has seen many examples of research collaboration leading to business success – in mature as well as in new industry sectors.

2.36 It is clear that much more needs to be done to persuade business of the economic benefits to be gained from innovation, and of working in collaboration with university departments to achieve this goal. This applies especially to SMEs, which have few resources to risk on reaching out to find new ways of developing products and services. The main goal of policymakers in this area must be to make it as easy as possible for such collaborations to occur.

BENEFITS TO BUSINESS OF COLLABORATING WITH UNIVERSITIES

2.37 Through the process of its consultations, the Review has identified six related ways in which businesses around the world have gained competitive advantage from working with universities – ranging from research-intensive universities which can claim world leadership in broad areas of their work to others which have more limited forms of knowledge and expertise.

- Access to new ideas of all kinds. The best academic researchers are truly international in their scope and range of knowledge. The chances are that they will be in touch with knowledge breakthroughs in their areas of speciality wherever they may be happening in the world. At a more local level, universities will have expertise and established networks in different departments which will be of real benefit to particular businesses.

- The ability to achieve excellence across a wider range of disciplines and through a much larger intellectual gene pool than an individual business could hope to create on its own. Procter & Gamble has set an internal goal of sourcing 50 per cent of its innovations from outside the company in five years, up from an estimated 10 per cent in 2002.[14] It argues that within its business it has several thousand scientists working on new ideas: outside there are 1.5 million. So why try to invent everything internally? Merck has said that it accounts for about 1 per cent of the biomedical research in the world. "To tap into the remaining 99 per cent, we must actively reach out to universities, research institutions and companies worldwide."[15]

- The ability to leverage the research dollar. Rolls-Royce works in partnership with a number of universities across the UK on specific segments of engine technology. Its partnerships have access to public funding which among other things means that they can do much more than the company would be able to afford if it was working on its own.

[14] *Open Innovation*, Henry Chesbrough, 2003.
[15] *Merck Annual Report*, 2000.

- A chance to spot and recruit the brightest young talent. Massachusetts Institute of Technology (MIT) believes that one of the motives of those corporations which invest in its industrial liaison program is the knowledge that this gives them about the best students who are passing through the system.
- The ability to expand pre-competitive research.[16] By working with universities and other companies, businesses can spread the risk and widen the range of their research horizons.
- Access to specialised consultancy. This has been growing rapidly in recent years: the latest Higher Education Business Interaction Survey suggests that universities' consulting income rose by nearly a quarter in 2000-01. The Review came across many different examples of such work, again ranging from the most to the least research-intensive institutions in the country.

2.38 There is a range of data to show that companies which use universities and other higher education institutions as a source of information or as a partner tend to be significantly more successful than those that do not. Table 2.2 shows, that among other things, they are more likely to have increased their market share, improved the quality of their goods and services and lowered their costs.

Table 2.2: The relationship between business performance and collaboration

	Increased range of goods and services	Opened new market or increased market share	Improved quality of goods and services	Reduced unit labour costs
Enterprises which do not use universities as a partner	42%	40%	46%	33%
Enterprises which use universities as a partner	82%	81%	85%	65%

Source: Community Innovation Survey, (UK), DTI/ONS, 2001.

2.39 This does not mean that working with universities necessarily leads to success. Perhaps successful innovators are less resource-constrained than other businesses, and so are more able to work with universities. But whichever way round it works, there does appear to be a clear correlation between business success and university collaboration. That impression was confirmed by the consultation exercise, and is reflected in some of the case studies in this Review.

[16] *Working Together, Creating Knowledge, The University-Industry Research Collaboration Initiative*, Business-Higher Education Forum US, 2001.

INCREASING THE DEMAND FROM BUSINESS

2.40 Most UK businesses have no experience of working with universities, and therefore no idea of the benefits that can arise from collaborating with them. Universities are working much harder than they did in the past to open their doors to outside partners, and later chapters will suggest ways in which this process could be taken further. But the most difficult question for this Review is about how to increase the demand from the business side.

2.41 Business leaders of research-intensive companies are the people best placed to tackle the challenge. They are the most effective champions of the benefits of business research, and they understand better than anyone else the commercial possibilities of the UK's science base. They should have an effective voice on the big questions about public funding and intellectual property, and about the strengths and weaknesses of the science infrastructure. Business itself needs to take the lead in sharing best practice in R&D investment and in encouraging the adoption of new technologies.

2.42 In the US, the Industrial Research Institute is an effective business organisation made up of industrial leaders in R&D, and its mission is to enhance the effectiveness of technological innovation in industry.[17] Among other things, it aims to strengthen the understanding of business issues by technological leaders as well as business leaders' understanding of the technological innovation process. It seeks to promote effective techniques for the organisation and management of R&D, and to foster cooperation on a worldwide basis with academia, Government and other organisations active in technological innovation.

2.43 The Review believes that there is a strong case for creating a group with similar objectives in the UK. It should be a dynamic forum created and led by leaders of R&D-intensive businesses and have a powerful voice on all the subjects covered in this Review.

Recommendation 2.1

The Review recommends that UK business should establish a high-level forum to enhance the effectiveness of technical innovation in business in the UK.

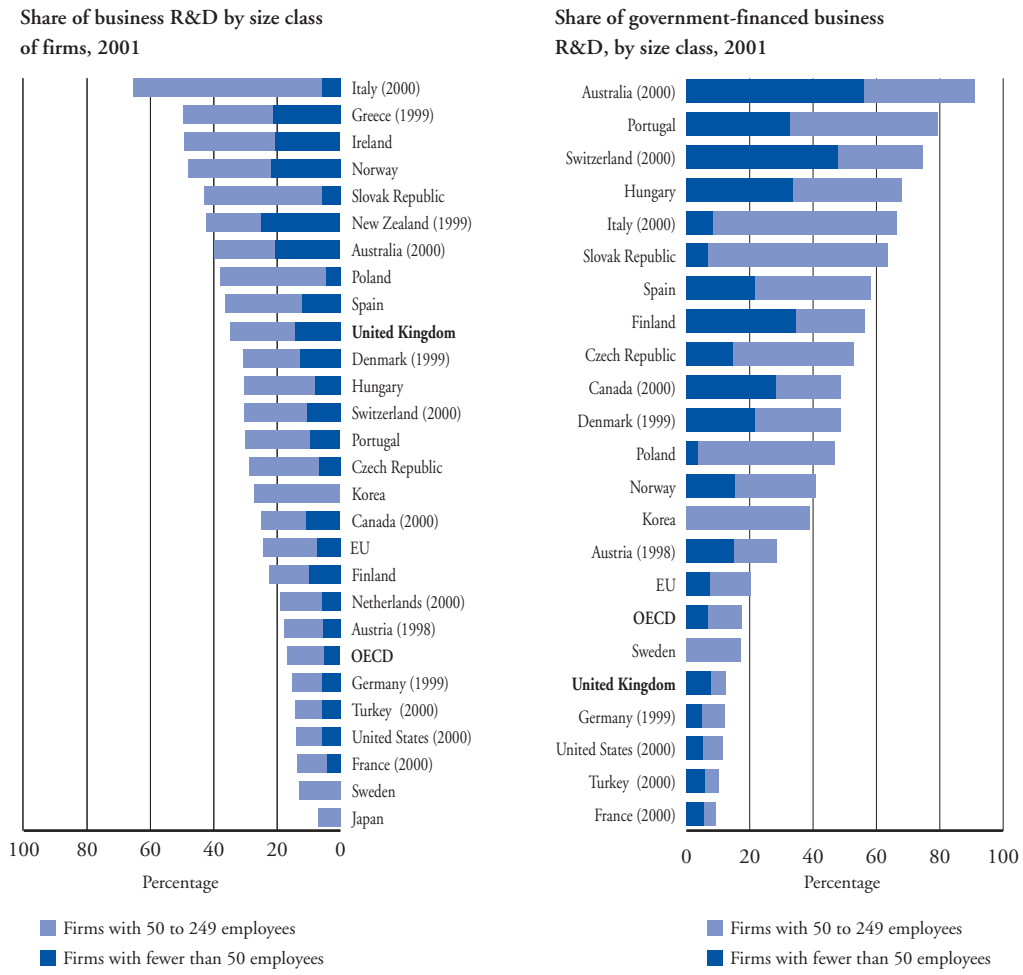
Chief executives of R&D-intensive businesses in the UK should agree its remit: it should be business-led and focused on the key issues for retaining and expanding high value-added business in the UK.

2.44 There is also a role for Government in promoting demand from business for the knowledge and ideas in the science base. Individual companies may not have the time or capacity to find out which of the many university research departments around the country are doing work that is relevant to their needs. This problem applies especially to SMEs, and it is one which Government can help to address.

2.45 At present, much the greatest share of government-financed business R&D in the UK is directed towards large companies. The same is true of other mature economies like the US, France and Germany. Yet compared with those of other countries, smaller companies in the UK are quite actively engaged in R&D: the proportion is well above the EU average.

[17] IRI website: www.iriinc.org.

Chart 2.5: Business R&D by size classes of firms



Source: OECD Science, Technology and Industry Scoreboard, 2003.

2.46 This may reflect the growth of high-technology industries in the UK, as well as the success of the creative industries, which include a large number of dynamic small companies. In any event, there is a clear message here for policymakers.

Recommendation 2.2

Government should seek ways of directing a higher proportion of its support for business R&D towards SMEs.

2.47 Part of the answer to increasing the demand from business lies in enhancing the role of the development agencies in developing links between business and universities. Development agencies should act as facilitators of business-university relationships by actively seeking out companies in their region which could benefit from working with universities. This applies in particular to SMEs which have not previously collaborated with universities but which have the potential to gain significant benefits from such partnerships. Many development agencies are already playing this kind of role, which is also addressed by this Review in the chapters on funding and the regions.

Recommendation 2.3

The Review recommends an enhanced role for the development agencies in facilitating business-university links. A priority should be to identify non-collaborating SMEs that have the potential to gain significant benefits from working with universities.

2.48 A further way to promote demand from business is to encourage a flow of business people into universities, and vice versa. These connections, formal and informal, are the starting point for many successful collaborations. and the benefits can be observed on campuses and in offices everywhere.

2.49 A number of government schemes already exist to encourage this process, and they need to be strengthened and better marketed. Knowledge Transfer Partnerships (KTPs), formerly known as the Teaching Company Scheme (TCS), is one example of a successful scheme that has promoted knowledge transfer between universities and business. A KTP brings together business in collaboration with universities, colleges and other research organisations. At the heart of each partnership is one or more KTP associates, a high-calibre graduate who is recruited to work in a business on a project that is central to its strategic development. A project may last from 12 to 36 months. The university partner provides its expertise and jointly supervises the project together with a representative from the company. The costs are part funded by Government with the balance being borne by the participating business. The total investment by Government in the TCS was £25m in 2002-03.

2.50 An evaluation of TCS was undertaken for the Government in 2001.[18] Based on a sample of interviews with university and business partners involved in TCS programmes, it concluded that:

- 44 per cent of business partners had not previously collaborated with a university.
- 75 per cent of businesses regarded the programme as strategic to their business.
- 38 per cent of businesses introduced a new technology and a further 45 per cent introduced a significant advance in technology.
- 50 per cent of the companies interviewed expected their programme to have a positive effect on future sales and profitability.
- 54 per cent of associates stay with the company.
- 94 per cent of businesses would recommend the TCS to other companies.

[18] Unpublished analysis commissioned by the DTI from SQW Ltd.

2.51 This Review received many positive comments from business and university partners which have been involved in the scheme, as illustrated by the case study below.

Case Study: Knowledge Transfer Partnerships (formerly TCS) – James Leckey Design

James Leckey Design is a small company located in Belfast, specialising in the design of equipment for children with disabilities. It identified an opportunity to improve its product design process – taking advantage of the latest academic expertise at the School of Engineering at the University of Ulster.

Working with the School of Engineering, the company established a TCS programme to help create an in-house design capability with the resources to take products from concept to production. TCS associates from the School of Engineering pioneered new design methods to improve the aesthetics, functionality and ease of manufacture of new and existing products.

As a direct result, the company has been able to introduce three new innovative products, several new processes, and substantially improve existing products. The new design procedures and technologies developed during the programme have delivered longer-lasting benefits – enabling the launch of four new product ranges since completion.

Staff at the university have benefited from their involvement in the planning and implementation of the new design facility, in particular gaining first-hand experience of using sophisticated 3D design tools.

2.52 The evaluation also showed that awareness amongst business of the scheme was low. Given the benefits which it brings to business, the Review concludes that better marketing of the scheme to business is required. At the time of the evaluation, approximately 90 per cent of TCS programmes were undertaken with SMEs and 50 per cent of them involved universities and businesses in the same region. Therefore one way of achieving this may be to increase the regional focus of the scheme.

Recommendation 2.4

The Review recommends that the Government should continue to support Knowledge Transfer Partnerships (formerly TCS) but that the programme should be better marketed to businesses. Increasing the regional focus of the scheme would allow it to be tailored more closely to the needs of local businesses.

2.53 Faraday Partnerships, another government initiative, aim to encourage businesses to engage with the science base. These alliances include businesses, universities, Research and Technology Organisations, professional institutes and trade associations. There are now 24 partnerships involving over 60 university departments, 27 independent research organisations, 25 intermediary organisations and more than 2,000 businesses – large and small. The core activities of the partnerships include the two-way exchange of information between business and universities, collaborative R&D and development projects, technological and dissemination events. The Review concluded that Faraday Partnerships can play a valuable role as an intermediary between business and universities.

2.54 The LINK Collaborative Research scheme is the main government mechanism for promoting collaboration in pre-commercial research between business and the research base. It provides a framework enabling Research Councils and government departments jointly to stimulate innovation and wealth creation through managed programmes of collaborative research. Government currently spends some £43m per year, with business more than matching this funding. An independent strategic review recently concluded that the scheme provided good value for money and had led to substantial economic benefits for participating companies.[19] Since it began in 1986, it is estimated to have increased the profits of participating companies and raised employment levels by 15,000 to 25,000.

2.55 Some businesses find the application process bureaucratic, and complain about drawn-out negotiations over intellectual property. But while more needs to be done to reduce barriers to access, there has been real progress in the recent past. A model LINK contract has been made available to all partners by the Office for Science and Technology (OST) in conjunction with the Association for University and Industry Links (AURIL) and the Confederation of British Industry (CBI) and the time from application to project start has been reduced from 52 to 22 weeks. The strategic review recommended that LINK be expanded and it is clear that the LINK scheme is well regarded by both business and university users.

2.56 This Review was asked to examine the effectiveness of measures such as the R&D tax credits on business demand for research and skills. The Government introduced the credit for small companies in 2000 and extended it to large companies two years later. The tax credit enables companies to claim tax relief on 50 per cent of their qualifying R&D expenditure in the case of SMEs and on 25 per cent for larger companies.

2.57 It is too early to tell whether the tax credits will have a significant influence on business demand for university research. However it is already clear that the operation of the tax credits in relation to research undertaken for business in UK universities is not well understood. A recent survey of 178 medium-sized companies found that only 9 per cent had applied for the tax credit this tax year; 29 per cent said they had not looked into the scheme, 7 per cent believed the procedure was too complex and 55 per cent felt that it was not appropriate for their business.[20]

2.58 Both SMEs and large companies can claim the R&D tax credits on work that they contract out to UK universities.[21] OECD data show that the tax subsidies available to business for R&D investment in the UK are relatively generous compared to those in many other countries, and that subsidies for large British companies rose faster than in all but two other OECD countries between 1995 and 2001.[22] The Review concludes that the R&D tax credits should be better marketed, and if necessary simplified, in order to improve their take-up by business. In the meantime, it is not proposing any further tax breaks.

Recommendation 2.5

The Government should market the R&D tax credits better in order to increase their take-up by business.

[19] *Strategic Review of LINK Collaborative Research*, Report of the Independent Review Panel, 2003.
[20] Survey of take-up of R&D tax credit among 178 companies with annual turnover between £5m and £500m per annum, KPMG, 2003.
[21] Details of the R&D tax credits can be found on the Inland Revenue's website at www.inlandrevenue.gov.uk.
[22] *OECD Science, Technology and Industry Scoreboard,* OECD, 2003.

2.59 Many businesses commented that while individual government schemes to promote knowledge transfer were welcome, the number of different schemes often caused confusion. The DTI has recently undertaken a review of its business support products. This is a welcome development that should simplify and bring greater coherence to the government schemes in this area. The DTI has also undertaken a review of its innovation policy and announced that it will be introducing a new business-focused technology strategy. This is intended to provide a more strategic approach to its expenditure on knowledge transfer by focusing on cross-sectoral technologies rather than support for specific industries.

2.60 In conclusion, the lack of demand from UK business for the knowledge and skills in universities is a challenge. There needs to be a much greater awareness of the benefits that can come to companies as a result of working alongside enthusiastic university researchers.

3 Knowledge transfer

3.1 Public spending on the teaching of students in higher education amounts to over £3bn per annum and on research in universities the figure is over £2bn. Transferring the knowledge and skills between universities and business and the wider community increases the economic and social returns from this investment. This process is referred to as knowledge transfer.

3.2 This chapter examines the role of networks, sponsored students, contract research, collaborative research and consultancy in promoting knowledge transfer. It assesses the impact that these activities have on businesses and universities, provides case studies of good practice, identifies the barriers that exist and proposes recommendations to overcome these constraints. It also examines the role of universities' business liaison offices in promoting these activities as well as that of the Government's third stream funding. The next chapter covers the "harder" side of knowledge transfer, including intellectual property, and technology transfer by licensing and through spinout companies.

NETWORKS AND PERSONAL INTERACTIONS

3.3 The Review has concluded that the best forms of knowledge transfer involve human interaction. A large number of collaborations between business and universities come about as a result of chance meetings between academics and business people.

3.4 Forums that bring academics and business people together are likely to increase the chance that people with common interests and goals will find innovative ways to develop partnerships. The Science and Industry Councils in the North East and the North West are good examples of networks where senior industry executives and university vice-chancellors can meet to address regional issues.

3.5 Many business people sit on university governing councils, but relatively few academics sit on company boards. A large number of UK-based companies have very little understanding of science at board level. Companies are being encouraged to widen their pool of non-executive directors, and could gain valuable expertise by reaching out to the university sector.

Recommendation 3.1

Universities UK (UUK) and the Standing Conference of Principals (SCOP) should establish a list of academics with relevant qualifications who are interested in becoming non-executive directors on company boards, and should arrange training for them in this role.

3.6 Just as it is beneficial for academics to spend time in businesses, so it would be helpful for more business people to take part in university life. The proposals in the higher education white paper that all those who teach in universities should obtain a teaching qualification by 2006 could prove counterproductive in this respect.[1] Busy executives will be deterred from lecturing in universities if they have to obtain a qualification to do so.

[1] *The Future of Higher Education*, DfES, 2003.

Recommendation 3.2

The Department for Education and Skills should exempt business people from the requirement to undertake training to lecture in universities.

3.7 As part of a longer-term agenda, UK universities would benefit if they developed much closer relationships with their alumni. Business schools and US universities have built extensive alumni networks, which provide them with access to their graduates in companies around the world as well as to large amounts of financial support. Such links can be invaluable in providing first points of contacts for universities with businesses. Business schools use them to find summer work placements for their students – universities could easily do the same.

3.8 Some university departments are also developing networks with their graduates. Cambridge University's computer laboratory has created a graduate association that focuses explicitly on developing a network of its computer science graduates. The graduate association not only provides the laboratory with funding but also gives the department access to a valuable network of graduates working in business.

Recommendation 3.3

Universities, departments and faculties should develop their alumni networks in order to build closer relationships with their graduates working in the business community.

SPONSORED STUDENTS

3.9 Some businesses sponsor individual students. This approach is particularly common in service and the creative industries. American Express has recently introduced a new initiative at Sussex University. Every year thirty IT graduates will have the chance to work part-time for the company, while also studying for a part-time IT Masters degree at the University. The graduates will be paid an annual salary and will get commercial experience from working with company staff on projects in the IT sector. The company will recruit some of the best graduates from the scheme and will access a steady stream of talented IT graduates. Both sides gain from the collaboration.

3.10 The case study of Edinburgh Crystal also highlights the business benefits that can be achieved when business and universities collaborate in this way.

Case Study: Edinburgh Crystal, Wolverhampton University and Edinburgh College of Art

Edinburgh Crystal knew that to guarantee its long-term survival it would have to find a younger market. That meant new designs.

At the same time Wolverhampton University's School of Art & Design was looking for ways to develop links with industry. When the School's Head of Glass met Edinburgh Crystal management at a trade event in 1994 it marked the start of a fruitful collaboration.

With Edinburgh College of Art also involved, the Edinburgh Crystal Masters Design Scholarship programme was created. The students work at the company full time on 12 to 15-month placements. The company contributes to bursary funding and academic supervision costs. A three-monthly review process culminates in an external exam leading to the Masters degree.

Case Study: Edinburgh Crystal, Wolverhampton University and Edinburgh College of Art *(continued)*

Edinburgh Crystal's operations director said: "We wanted to get a more contemporary feel to our glass design in a market which was then still very traditional. We felt this programme would impact positively on our design department and stimulate the product development process. This continual stream of students encourages us to push design and production possibilities, keeping us highly competitive". Students' work has fed directly into the company's branded range, The Edge, launched nearly three years ago, and several Masters students have gone on to become full-time employees.

The School's Head of Glass said: "It's almost impossible for an academic programme to simulate a commercial creative environment, but in collaborations like this students are exposed to market realities. They mature quickly as designers".

3.11 There are many more businesses in the UK which could benefit from working with university departments and students. The difficulty lies in raising awareness in businesses of the expertise that exists in the UK's universities.

3.12 The London Technology Network (LTN) is an example of a project supported by the Higher Education Innovation Fund (HEIF) that provides valuable connections for academic researchers and businesses, and advises companies about how London's universities can help them to achieve their goals.

Case Study: London Technology Network

London Technology Network (LTN) is a not-for-profit company, funded by HEIF to link companies worldwide with the technology expertise within London's universities.

Launched in 2002, LTN has recruited around 100 business fellows from London's leading science and technology research departments, funding them for half a day a week. A business fellow's job is to map the expertise available in his or her department and be ready to talk to industry. This gives LTN knowledge of, and access to, over 4,000 research scientists and their students.

The LTN helps business to understand when and how to work with universities. Companies are often uncertain about the type of problem that academics can help them solve. LTN staff work with business technology managers to define projects where working with a university can be of significant value. Company requests are passed on to appropriate business fellows and technology transfer offices within the universities. LTN staff then work with the university scientists to help them develop appropriate responses. LTN runs a series of monthly networking events, attracting on average 70 attendees.

A senior manager of a global R&D company summarised LTN's value to industry: "There are some 40 universities in London and they do all kinds of research. Trawling over all of them would take forever, but this way we can go along to a meeting, get together with other companies and have direct contact with the researchers…It's very useful – and it's very well run".

CONTRACT RESEARCH, COLLABORATIVE RESEARCH AND CONSULTANCY

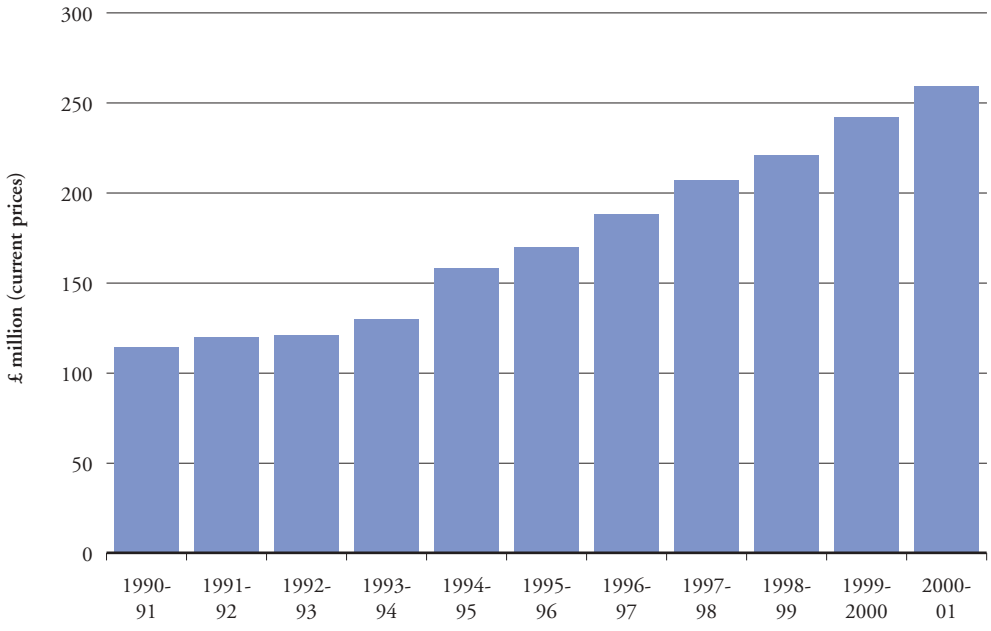
3.13 Contract research, collaborative research and consultancy are three forms of collaboration between business and universities. In contract research, the business pays the university researchers to undertake a specific piece of research on its behalf. The business will receive the results of the research but is not actively involved in the work other than in commissioning it. Companies often use contract research for specific pieces of near-market research and testing, and universities will tend to charge at least the full economic cost for this work.

3.14 In collaborative research, the business and university researchers work together on a shared problem. Collaborative research tends to be more fundamental or pre-competitive in nature than contract research. Industry scientists and engineers will work alongside academic scientists and engineers on the research project. The research is co-funded by business and the university or a public sector body such as one of the Research Councils.

3.15 Consultancy takes the form of expert advice or analysis services. In practice the difference between consultancy and contract research is blurred – but the general distinction is that in consultancy the academic provides advice to the business rather than actually conducting research.

3.16 In 2000-01, business signed 10,951 research contracts with universities worth £261m according to the Higher Education Business Interaction Survey.[2] Of these around 4,000 contracts were signed by SMEs. The average research contract signed by SMEs was for £8,500, compared to £32,800 for larger companies. Chart 3.1 shows how the amount of industry expenditure on research grants and contracts in UK universities has increased over the last decade.

Chart 3.1: UK industry expenditure on research grants and contracts in UK universities



Source: Office of Science and Technology (2003) based on data from the Higher Education Statistics Agency

[2] *Higher Education Business Interaction Survey 2000–01,* HEFCE, 2003.

INTERNATIONAL COMPARISONS

3.17 Consistent international comparisons are difficult but what data exist suggest that in the late 1990s business funded 7.2 per cent of total R&D spend in UK universities for contract and collaborative research. This is above the EU avarage, the US (6.0 per cent) and Japan (2.4 per cent), but below that of Belgium (10.6 per cent) and Germany (9.7 per cent).[3]

CONSULTANCY

3.18 The total income for universities in the UK from consultancy was estimated at around £100m in 2000-01.[4] The real figure may be considerably higher, as much consultancy undertaken on a private basis between academics and companies can go unrecorded. Research-intensive universities do the highest proportion of consultancy work. On average they worked with 175 firms, compared to 125 for medium and 110 for lower research-intensive universities in 2000-01. The data also indicate a significant increase since 1999-2000 in the number of companies assisted by medium and lower research-intensive universities.

CURRENT UK UNIVERSITY POLICIES

3.19 Universities are free to determine their own consultancy policies in the UK – the only guidance available is from the Association of University Research and Industrial Links (AURIL) and UUK.[5] There is a wide variety in current practice. Institutional limits on the time academics are allowed to spend on consultancy range from 20 days (Oxford Brookes) to 50 (Aston and Swansea) per year. Some of the more research-intensives set their limits at 30 days (Imperial, Leeds), while others do not have a precise figure at all (King's College London, Bristol) but make it clear that academic duties and the university's interests must be put first.

Case Study: US policies – MIT

Consultancy is much more of a core activity at MIT than it is in UK universities. The opportunity to perform consulting work is built into its faculty employment contract, which only covers nine months of the year. The rest of the time can be filled by consultancy work. MIT provides strong financial incentives to academics to bring in industrial research income. It also removes teaching responsibilities for those who bring in more than $2m, and administrative responsibilities for more than $4m. MIT recognises the need for clear policies to avoid conflicts of interest within this framework.

BENEFITS FROM GREATER CONSULTANCY

3.20 Consultancy is one of the simplest ways for business to interact with universities and draw on their research. SMEs can become involved for relatively low fees, and the terms are simple to arrange. For larger companies, consultancy offers the chance to get to know a researcher before deciding whether to set up larger research contracts. In particular, increasing consultancy may be

[3] *Austrian Federal Ministry of Economy and Labour* (2001), based on OECD, EU and other national data, *Benchmarking Science-Industry Relationships*, OECD, 2002.
[4] *Higher Education Business Interaction Survey 2000–01*, HEFCE, 2003.
[5] *Optimising Consultancy*, Universities UK and AURIL, 2001.

one way to bring more companies into contact with universities. It may increase the volume of research collaboration, with many contracts originating from consulting relationships. It may also improve the effectiveness of technology transfer, as more than 50 per cent of licences go to companies known by the academic, and consultancy increases the pool of companies an academic is exposed to.

3.21 The main barriers to greater consultancy in the UK seem to be the time limits set by individual institutions, the lack of reward structures for academics who bring in extra research income as a result of consultancy, and a general academic culture that does not recognise the value of this kind of work.

3.22 Increasing academic consulting activities will improve the links between academics and business, but the appropriate amount will vary according to the mission and strengths of the university. A single policy on academic consulting activities for all universities would not work.

3.23 The case study below shows how Eurotunnel benefited from involving Imperial Consultants in the design of the Channel Tunnel.

Case Study: Imperial College Consultants and Eurotunnel

Imperial College Consultants (ICON) provides industry, commerce and governments worldwide with direct access to Imperial College's expertise and facilities in science, technology and medicine. ICON experts worked on the design of the Channel Tunnel. Multi-disciplinary teams assisted the construction consortium (TML) during the construction of the Tunnel. ICON provided specialist advice on the design life of concrete, tunnel linings, grouting, rail track fittings and electrical installations. Having Imperial Consultants involved from the outset helped Eurotunnel to meet the challenges of such an enormous and complex engineering project in a cost-effective way and provided the company with access to vital specialist skills that were not available to it in-house.

CONTRACT RESEARCH

3.24 From the university's perspective, contract research can lead to longer-term collaborative research projects. It also helps university researchers to keep up-to-date with the latest developments in professional practice and to gain external research income. From the business perspective, many large companies have cut back their corporate R&D laboratories and smaller businesses often have limited financial resources to conduct their own R&D. Contract research in universities can be a flexible and cost-effective way for companies to undertake research. The case study of Concert & Celtic Harps illustrates this point. It shows how a small company has managed to achieve far more by working with a local university than it could ever have hoped to achieve on its own.

Case Study: Concert & Celtic Harps

Concert & Celtic Harps is a small company based in Ceredigion, West Wales, producing bespoke concert and Celtic harps. The owner wanted to expand his business and decided to seek advice from Cardiff University.

Concert & Celtic Harps commissioned a market research study from Cardiff University. The university identified worldwide potential for the company if it could introduce innovative harp designs at competitive prices. However in order to produce competitively-priced, high-quality instruments, the company needed help to develop new designs, to source and use novel materials and to identify and adopt innovative manufacturing techniques.

The company got in touch with Know-How Wales, a business support service which brokers and assists in creating links between companies and academia. Know-How Wales identified the Manufacturing Engineering Centre at Cardiff University as the most appropriate source of expertise. The Manufacturing Engineering Centre developed a prototype of a Celtic harp and a manufacturing system to mass-produce harps without any loss of quality. The prototype Celtic harp has received a very positive response from leading harpists.

The managing director of Concert & Celtic Harps, says: "We have succeeded in retaining the acoustic qualities of the instrument, whilst creating a marriage between traditional and new technologies. We now have plans to dramatically increase output. This project has provided the impetus for the launch of a community company, Telynau Teifi, and the creation of new sustainable jobs in this part of rural Wales".

3.25 The main question about contract research concerns the price that universities should charge business for such work. This issue was thoroughly examined by the Transparency Review which established a methodology to determine the full costs of research and other publicly funded activities in higher education.[6] This Review supports its recommendation that universities should implement robust costing mechanisms. This will enable them to identify and charge at least the full economic costs for the contract research that they undertake for business.

CONFLICTS OF INTEREST

3.26 When academic consultancy or contract research is carried out on behalf of industry, universities must adopt clear policies to avoid conflicts of interest. Publicly-funded research must not be compromised in a bid to secure a consultancy agreement or contract research. Unfavourable research results must not be suppressed in return for future contract or consultancy income. Even the perception of possible conflicts of interest could prove to be extremely damaging to the reputation of the university and company concerned. The Review was impressed by the clarity of US universities' policies on conflicts of interest and believes that UK universities have some way to go to develop such clear policies.

Recommendation 3.4

Where they do not exist, clear codes of conduct to avoid conflicts of interest in carrying out research with business should be developed by universities.

[6] Full details on the Transparency Review can be found on the Joint Costing and Pricing Steering Group website at www.jcpsg.ac.uk.

COLLABORATIVE RESEARCH

3.27 Collaborative research projects in universities are often co-funded by business and the public sector. The most significant public sponsors of collaborative research projects are the Research Councils, but the Department of Trade and Industry/Office of Science and Technology, the European Union, the National Health Service and other government departments also co-fund a significant amount of research alongside industry.[7]

3.28 Large companies are consolidating their relationships with university research departments. Whereas in the past they may have had scores of short-term research contracts with different departments across the country, today many prefer a small number of substantial long-term collaborative research partnerships.

3.29 Collaborative research often involves academic researchers working alongside company employees on shared projects. The contributions of each side to the partnership will vary, but the company may provide long-term secure funding along with company data, staff and equipment. In return the university department will offer access to skilled researchers and an international network of academics.

3.30 A pioneering example of this type of relationship is the Rolls-Royce network of University Technology Centres (UTCs). Many other multinationals, for example British Nuclear Fuels, BAE SYSTEMS, and GlaxoSmithKline have also developed this type of longer-term strategic relationship.

3.31 The Review has concluded that collaborative research is one of the most effective forms of knowledge transfer. By working together on shared problems, the business and university develop mutual trust and share information. They are therefore more likely to make the real breakthroughs.

[7] *Higher Education Business Interaction Survey 2000–01*, HEFCE, 2003.

Case Study: Rolls-Royce University Technology Centres

Rolls-Royce UTCs are world-class research centres which are located at universities and address the future technological needs of the company. Each UTC deals with a specific piece of engine technology. For example, the UTC at Sussex University concentrates on experimental and theoretical investigations into the cooling and sealing of advanced gas turbine engines.

The university researchers benefit from long-term funding, and from working on practical challenges with access to the company's equipment and results. The university-based group often works alongside the company's own research and engineering teams. Researchers publish cutting-edge research in their chosen field. In the last five years, university staff working with Rolls-Royce have published over 280 conference proceedings and papers.

Rolls-Royce gains by significantly increasing its research and technological capacity. The UTCs have become an integral part of the company's strategy, providing support for all stages of technology activities ranging from pre-competitive research through to in-service products. The UTCs also provide a pool of skilled staff, many of whom are subsequently recruited.

Both the company and the university researchers emphasise that this type of strategic partnership encourages the development of long-term working relationships and trust. This leads to greater sharing of information and knowledge – which benefits the university, the company and the wider economy as research and knowledge is translated into real-world technological improvements. According to Rolls-Royce: "This model of close working has proved substantially and demonstrably more effective than the company's previous approach of more ad-hoc, less focused, relationships with academia".

3.32 Another example of a large-scale strategic relationship involves BAE SYSTEMS. A Systems Engineering Innovation Centre (SEIC) is being established on the Loughborough University campus with support from the company and the East Midlands Development Agency. The SEIC will be a national centre of excellence for systems engineering. By 2006, it is anticipated that it will have more than 70 professionals from the company and the university, undertaking joint research, teaching and providing knowledge and technology transfer services to the East Midlands.

3.33 Small technology-based businesses can also benefit substantially from this kind of collaborative partnership. Thomas Swan Co. is a small privately owned company based in the North East that develops and sells specialty chemicals. The company actively seeks out new materials, processes and technologies based on the latest scientific breakthroughs in universities. Thomas Swan Co.'s research collaboration with the Department of Materials Science and Metallurgy at Cambridge University illustrates the significant benefits to both partners from collaborative research, and the way in which these relationships are often established as a result of personal contacts.

Case Study: Thomas Swan Co. and Cambridge University's Department of Materials Science and Metallurgy

Thomas Swan Co. first established a relationship with Cambridge University's Department of Materials Science and Metallurgy when the company donated some equipment to the department. As a result, a company representative met two professors by chance and the idea of a research collaboration on carbon nanotubes was discussed.

Carbon nanotubes are a new material that are set to have a major impact on the composite and aerospace industries in addition to their longer range potential for molecular scale electronics. Thomas Swan Co. asked the university research team to develop a scaleable, unique production method for carbon nanotubes.

The project has been a success. From the company's perspective, the department provided access to first-rate researchers whose expertise in the area of polymers proved the ideal basis for the venture. Seven patents have been filed since 2001 and these have been licensed through the university's technology transfer office to Thomas Swan Co. The company is scaling up the production process with a view to selling the new material, and further developments from Cambridge are already influencing the design of the Phase II and III plants.

The department has benefited from the training of three post-doctorate researchers, one of whom has subsequently gone on to work for Thomas Swan Co., and has published five papers so far. The project also indirectly supports other projects in the department because Thomas Swan Co. has allowed access to its nanotube technology.

Both the university and the company emphasise that the success of their partnership depends on the long-term and two-way nature of their relationship and the trust that develops over time. Each partner contributes to the research collaboration and shows understanding and flexibility towards the priorities and objectives of the other.

BARRIERS TO COLLABORATIVE RESEARCH

3.34 When establishing collaborative research partnerships it is important to determine at the outset the ownership and exploitation rights for any intellectual property (IP) that may be generated. Business and universities both report that negotiations on the terms and conditions of IP ownership and exploitation can be extremely lengthy and costly.

3.35 Model contracts have been developed by AURIL and the Confederation of British Industry (CBI) for research collaborations that are established under the Government's LINK programme.[8] These contracts have succeeded in reducing the length of time spent negotiating terms and conditions.

3.36 However, for research collaborations between universities and individual businesses that are not working through the LINK programme, no such model contracts exist. Smaller companies may be deterred from establishing such research partnerships because of the high legal costs and time involved.

[8] LINK is the Government's main programme to promote collaborative research with the science base.

3.37 This problem could be addressed by making a small set of model research collaboration contracts available to businesses and universities to be used on a voluntary basis. Model contracts which covered the main approaches to IP ownership, management and exploitation could be used to speed up negotiations. There is strong support for this idea among both universities and businesses.

Recommendation 3.5

AURIL, the CBI and the Small Business Service (SBS) should produce a small set of model research collaboration contracts, for voluntary use by industry and universities.

- A range of model agreements should be developed, setting out various approaches to IP ownership, management and exploitation rights including, but not limited to, ownership of the IP by the university with non-exclusive licensing or exclusive licensing to industry.
- The model contracts should be agreed by the main representative bodies. They could be distributed through the same means: to universities through AURIL and UUK and to industry through the CBI and the SBS.

Case Study: The Cambridge-MIT Institute (CMI)

The Cambridge-MIT Institute (CMI) started operations in the summer of 2000 as a joint venture between the two universities. Financed largely by the UK Government with some £65m of grant funding, the objective was to make a step change in the UK's approach to knowledge exchange between universities and business. MIT has an extraordinary reputation as a hub of entrepreneurial activity, and the hope was that its skills could be brought alongside those of one of Britain's great universities to the benefit of the whole economy.

With the promise of support for five years, critics say that the project got off to a poor start: its objectives were not set with sufficient rigour, and its internal controls were weak. Earlier this year, it launched a new strategic plan and took on a new leadership. Its life has been extended by a year, at no cost to the public, and it is now working on a range of innovative ideas aimed at improving the effectiveness of knowledge exchange, educating future leaders and developing programmes for change in universities, industry and government.

CMI argues that without programmes that foster in-depth and interpersonal business-university engagement, the contribution such collaborations can make to the economy is likely to be modest. It is now building a series of what it calls knowledge integration communities, which bring together graduates, academics, other universities, companies, suppliers and government agencies to work together from the very start on specific knowledge transfer projects. Examples include an attempt to design a silent aircraft, and research into pervasive computing and nanotechnology.

CMI's success will be judged by the sustainability of its programmes at the end of the six-year period, by its success in building a bridge between two of the world's great universities and – above all – by its ability to develop new types of partnership between businesses and universities across the UK to the benefit of the whole economy. After a disappointing start, the Review is impressed by its current agenda.

ROLE OF UNIVERSITIES IN PROMOTING BUSINESS-UNIVERSITY COLLABORATION

3.38 Universities' role in their cities or regions has grown considerably over the last few decades. The Review team visited many universities across the UK and was consistently impressed with the efforts that most are making to engage with the wider community.

3.39 This happens in a variety of ways and at many different levels. Vice-chancellors often have links with the CEOs of major local companies, with chambers of commerce, with their development agency and with NHS Trusts and other community service providers in their region. Academics work with individual businesses through consultancy, contract or collaborative research services. University careers services co-operate with the businesses which wish to recruit their graduates or provide work placements for their students.

UNIVERSITY BUSINESS OR CORPORATE LIAISON OFFICES

3.40 Partly in recognition of the number and complexity of these relationships, many universities have developed corporate or business liaison offices, with a specific remit to act as the interface with business. These offices have taken on an increasing number of tasks as universities' engagement with their wider community has developed. These include developing networks of businesses; marketing the research strengths of the university; advising on consultancy agreements and contract research; arranging complex collaborative research agreements or major joint ventures.

3.41 There is no single model for a university business or corporate liaison office. Some take in knowledge transfer and technology transfer activities, while others keep the two activities separate and have established specialised companies to manage technology transfer. The appropriate approach will vary depending on the needs of local business, the mission of the university, and the focus of the local economy.

3.42 Universities are complicated institutions, and businesses can find it very difficult to find their way around. SMEs in particular can be put off if there is no obvious point of entry to the university's resources. Businesses generally welcome clear first ports of call on the campus. According to the latest Higher Education Business Interaction Survey, 80 per cent of universities now provide dedicated enquiry services for SMEs.[9] In addition, some regions are adopting a regional approach. Knowledge House in the North East and I10 in the East of England are both projects funded by HEIF that provide information through a single website on the research strengths, expertise and services offered by the regions' universities. A regional approach seems appropriate for this kind of service, since a national database would run the risk of being overly cumbersome.

[9] *Higher Education Business Interaction Survey 2000-01*, HEFCE, 2003.

Case Study: Knowledge House

Knowledge House promotes links and knowledge transfer between universities and industry – especially SMEs – in the North East of England. Established in 1995, the organisation works closely with the Universities of Durham, Newcastle, Northumbria, Sunderland, Teesside and the Open University in the North.

Knowledge House provides a single point of access for business people to access the skills, expertise and resources available in the universities across the North East. It also works with organisations such as the North East Chamber of Commerce and the RDA to promote the benefits of university collaboration to regional industry.

GOVERNMENT SUPPORT FOR KNOWLEDGE TRANSFER ACTIVITIES

3.43 The Government introduced a specific stream of funding to support knowledge transfer in the university sector in England in 1999. Third stream funding has also been introduced in Wales, Scotland and Northern Ireland. This funding has been administered by the Funding Councils through numerous separate initiatives. In England, these have included the Higher Education Reach Out to Business and the Community Fund, the Higher Education Active Community Fund, University Challenge Funds, Science Enterprise Challenge and HEIF.

3.44 The Government has announced that it will consolidate HEIF as a permanent third stream of funding for universities, with public investment in England rising to £90m per year by 2005-06.[10]

3.45 Third stream funding has enabled universities to build up their capacity to:

- Engage in networking and other outreach events with businesses, including SMEs.
- Market their research and teaching to business.
- Establish business liaison and technology transfer offices to provide advice and to negotiate consultancy, contract and collaborative research and licence agreements.
- Establish spinout companies.
- Provide entrepreneurship training for science and engineering graduates.
- Provide work placements for students in industry.

3.46 The Government's commitment to funding third stream activity has generated culture change and increased capacity within the universities to engage in knowledge transfer activities. The Review received many comments on the scale and scope of third stream funding, on the method of allocation, and on the need for certainty about future third stream funding levels.

SCALE OF THIRD STREAM FUNDING

3.47 The vast majority of the respondents to this Review felt that the Government's investment in third stream funding has helped to increase the flow of knowledge and ideas from the science base into business and the wider community.

[10] *Investing in Innovation: a strategy for science, engineering and technology,* DTI, HM Treasury and DfES, 2002.

3.48 The data from the Higher Education Business Interaction Survey show that collaboration between business and universities is generally on an upward trend. This in itself does not prove that the increased interaction has come about as a result of the Government's investment in the third stream. However, at the micro level the Review came across numerous individual examples of research contracts, licence deals and spinout companies that had been established as a direct result of the Government's investment. A number of the case studies in this chapter are projects that have been funded through HEIF in England – for example Knowledge House and the London Technology Network. Companies that have used these services have spoken highly of them. The Review has concluded that the investment in third stream funding has been effective at encouraging greater knowledge transfer from the science base.

3.49 A difficult question for the Government concerns how much investment in third stream funding is required. Given the long time lags and convoluted paths that technology and ideas take to reach the marketplace, it is extremely difficult to quantify the economic returns from this investment.

3.50 Many universities claim that even at £90m per annum by 2005-06 in England, third stream funding will still be small in comparison to the £1bn research funding provided by the Higher Education Funding Council for England and an estimated £800m provided by the Research Councils to English universities in 2003-04.[11] They argue that more third stream funding will increase the flow of ideas from the science base into business and the wider community. There is a strong consensus on this issue among both research-intensive and less research-intensive universities.

3.51 Businesses are often not aware of the different funding streams that flow to universities. However the CBI has publicly welcomed the third stream and called for the Government to increase its investment to £150m per annum. Sir Gareth Roberts, who recently undertook a review of research assessment on behalf of the Funding Councils, has similarly concluded that if the Government increased its investment in third stream funding, the amount of knowledge transfer from the science base would also go up.[12]

Recommendation 3.6

The Review recommends that the Government should continue to invest in a permanent and substantial third stream of funding, while simultaneously monitoring and evaluating the outputs from its investment.

The Review agrees with Sir Gareth Roberts and the CBI that third stream funding should be increased to around £150m per annum in England in the future, in order to increase the flow of knowledge and ideas from the science base into business and the wider community.

[11] Estimates provided by the Higher Education Funding Council for England and from the Research Councils. The Research Councils have a UK-wide remit therefore the figure for England is an estimate.

[12] Sir Gareth Roberts stated in his evidence to the House of Lords Science and Technology Committee on Science and the Regions that he felt that third stream funding ought to be at least double the £90m. Minutes of Evidence of the Science and Technology (Sub-Committee II), March 13, 2003.

SCOPE OF THIRD STREAM FUNDING

3.52 The Review believes it is important that third stream funding enables a broad range of activities – from reach-out to SMEs through to contract research, licensing and spinouts. Third stream activities are not likely to generate large sources of funding for universities. For some activities, such as collaborating with SMEs, many of the benefits go to the outside world rather than to the university. There is a particularly strong case for continued support of these activities from third stream funding.

3.53 There are many excellent examples of collaborations involving the creative industries and universities or colleges of art and design.[13] Policymakers must ensure that policies aimed at promoting knowledge transfer are broad enough to allow initiatives such as these to grow and flourish, and that the focus is not entirely on science and engineering.

3.54 The Review supports the Government's current approach of setting broad guidelines for third stream funding and leaving it to universities themselves to decide their third stream priorities. Some activities may be best organised at a national level – for example there is a need to provide training for business liaison professionals.

KNOWLEDGE EXCHANGES

3.55 The Review was asked in the higher education white paper to comment on proposal to establish around twenty Knowledge Exchanges.[14] The Review has found that there is no clear understanding within the university sector or within business of the specific objectives of these exchanges.

3.56 The draft guidelines for the second round of HEIF invited less research-intensive institutions to develop proposals for additional funding to become a Knowledge Exchange which demonstrate:

- Excellent work in both knowledge transfer and skills development, and strong relationships with employers and businesses in those areas of the public and private sectors relevant to the university's own knowledge transfer strengths.
- That the funding will lead to substantial improvement in what the institution or consortium can achieve in terms of knowledge transfer.
- Strong support from employers and good partnerships with stakeholders, including the relevant RDA and Sector Skills Councils.
- How the proposal fits into the RDA strategy and helps serve the local and regional economy.
- A capacity and willingness to work in collaboration with other universities and colleges to spread good practice and help improve their performance.

[13] *Royal College of Art in Business*, Royal College of Art, 2003.
[14] *The Future of Higher Education*, DfES, 2003.

3.57 The Review supports the broad objective of the Knowledge Exchanges but believes that the same objectives could be achieved in a simpler way. Establishing a small, separately hypothecated source of finance for Knowledge Exchanges would bring disproportionate audit and accountability burdens and leave the university with little flexibility. A simpler approach would be to mainstream the money set aside for Knowledge Exchanges into the funding stream for less research-intensive universities.

THE ALLOCATION MECHANISM

3.58 Many universities believe that the bidding process for third stream funding is time-consuming and provides little certainty about future payments. One result is that staff are often employed on short-term contracts, which makes forward planning difficult.

3.59 The Review supports the Government's broad definition of the scope of activities supported by third stream finance and the idea that universities should develop their own strategies for developing such projects. The Review would like to take this approach one step further, providing greater certainty about future third stream funding levels for those universities that can show that they are performing against their third stream strategy and reducing the administrative burden associated with repeated bidding rounds.

3.60 This could be achieved in at least two ways:

- Forward-looking business plans could be drawn up by universities themselves. They would set out their third stream strategy for the following three years, and identify the milestones to be achieved. Universities that delivered against their plans in year one would automatically receive their second and third year allocations without having to re-bid for the money. Those that were not successful in meeting their benchmarks would need to remain in dialogue with the Funding Councils on an annual basis.
- Allocations could be made on a formulaic basis, with relevant metrics being developed to measure such activity. Any such basket of metrics should capture the full spectrum of third stream activities, from working with SMEs through to consultancy, contract and collaborative research, licence and spinout activity. Such metrics would need to be carefully developed and calibrated so as not to distort the behaviour of universities in a way that could be counterproductive.

3.61 Further work is needed to assess the relative merits of these two approaches. The Review favours a move to a multi-year allocation based on a university's business plan, while more work is undertaken to develop a basket of metrics that might in the future provide the basis for a more predictable way of allocating funds. The Scottish Funding Council has already stated its intention to allocate third stream funding using metrics.

Recommendation 3.7

The Review recommends that third stream funding should be allocated for three years on the basis of universities' business plans for their third stream activities. Universities that meet their third stream benchmarks in year one would automatically receive their second and third year allocations.

Simultaneously work should be undertaken by the Funding Councils to develop a basket of metrics that might in the future provide the basis for a predictable way of allocating funds on a formulaic basis.

In summary, if knowledge transfer is to achieve its full potential in the UK, the Review recommends that third stream funding should be substantial, permanent and allocated in a way that enables universities to make long-term plans for these activities.

4 Intellectual property and technology transfer

INTRODUCTION

4.1 Intellectual property (IP) refers to the legal form of protection for inventions, brands, designs and creative works. The four main types of IP rights are patents, copyright, designs and trademarks. Most technology transfer from universities involves patents, so this Review uses IP to refer to them. However, other forms of IP also play a role in business-university collaborations, especially in the creative industries.

4.2 The exploitation of IP created in universities has an important role to play in improving UK innovation.

- The number of patents issued to business and universities has increased rapidly in the US, EU and Japan since the mid 1980s. The highest levels are found in the most innovative countries such as the US, Sweden and Finland. In many industry sectors, businesses will not invest in research and development (R&D) to develop early stage technologies without a patent to guarantee them exclusive rights to commercialise their work.
- Patent application numbers in the UK are low and have been falling relative to the US, France and Germany, mainly because of its low investment in R&D.[1] The UK's investment in R&D is heavily concentrated in the pharmaceutical industry, which has a high propensity to patent. So its low level of patent output is especially worrying.
- The UK has a strong science base which is highly productive in creating "pure" research outputs such as publications and citations. There is significant potential to transfer this knowledge to industry through IP.
- Universities account for only a small share of the UK's patents each year. The highest proportion is in Scotland where, partly due to low industry investment in R&D, universities file around 10 per cent of patent applications. This is more than double the proportion across the UK.[2]

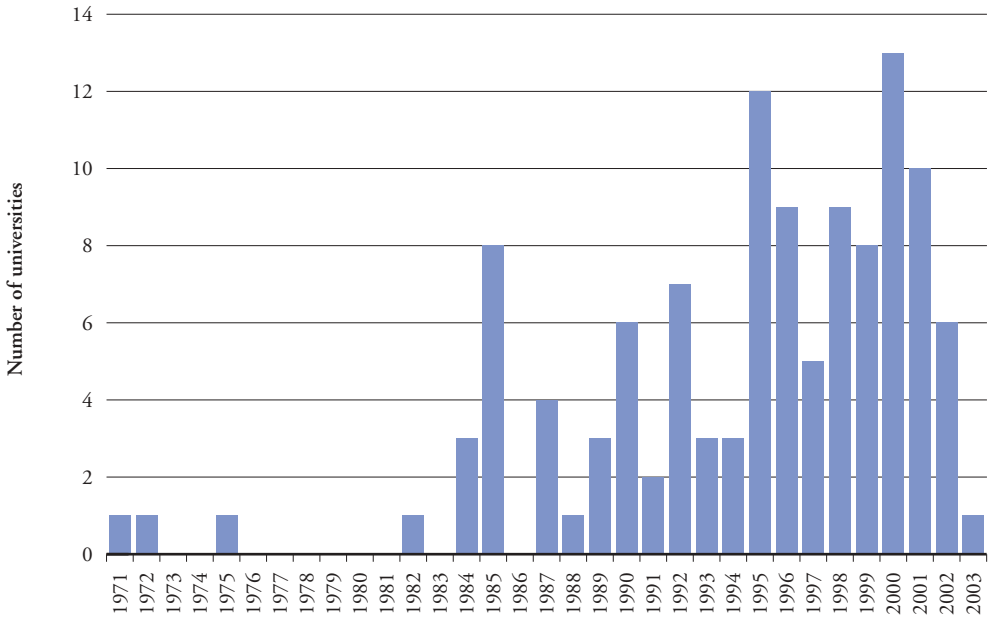
4.3 Universities transfer their IP to the market in many ways. These include collaborating with business on research projects and agreeing at the outset exploitation rights on any IP created, and making deals with companies to exploit IP already developed in university research. The first approach depends on experienced negotiators from both parties agreeing terms and conditions for IP within an adequate framework. The second also requires dedicated expertise in licensing, spinout creation, venture capital, market research, marketing and IP management. Universities have set up specific infrastructures to provide these highly specialised skills.

[1] Steve Nickell and John Van Reenan in *Technological Innovation and Economic Performance*, edited by Benn Steil, David Victor, Richard Nelson, 2002.

[2] *Higher Education Business Interaction Survey 2000-01*, HEFCE, 2003 and *Patent Office Annual Facts and Figures 2000-01,* Patent Office, 2001.

4.4 Commercialisation activities in the university sector have substantially increased in the last five years. Chart 4.1 shows that many universities created technology transfer offices only in the late 1990s; now 80 per cent have at least one dedicated person and staff numbers are still rising by almost 25 per cent per annum.[3] Licensing rates and income increased during this period. This trend has been driven mainly by public investment in schemes to promote business-university collaboration and entrepreneurship, such as the Higher Education Innovation Fund (HEIF), Science Enterprise Centres (SEC) and University Challenge Funds (UCF).

Chart 4.1: Year in which university started technology transfer activities



Source: UK University Commercialisation Survey Financial Year 2002, UNICO, NUBS, AURIL, (2003)

4.5 However Michael Porter's report argues that the UK is still relatively poor at commercialising its research and identifies this as a barrier to UK innovation.[4] This is despite the UK's international lead in publications and citations. It also shows that US patenting by UK-based entities, a reliable indicator of world-class innovation output, is characterised by a low representation of universities and other public institutions. The proportion is significantly lower than in France, for example. Of the 25 UK institutions that were issued the most patents in the US between 1997 and 2001, the overwhelming majority were foreign-owned multinationals with research bases in the UK. No UK university came close to making this list.

4.6 The need for better technology transfer has also been recognised by a number of industry sectors. Two recent reports on the state of UK biotechnology identify a need to strengthen university technology transfer offices if the UK is to become a global leader in biosciences.[5]

[3] *UK University Commercialisation Survey Financial Year 2002*, UNICO, AURIL, NUBS, 2003.
[4] *UK Competitiveness: moving to the next stage*, Michael Porter, 2003.
[5] *Improving Health, Improving National Wealth*, Bioscience Innovation and Growth Team, 2003. *UK Biotechnology Industry*, House of Commons Trade and Industry Select Committee, 2003.

4.7 A warning: the impact of technology transfer activity on the direction of research – whether it be towards short-term applied or long-term research – needs to be monitored carefully. Recent reports from the Royal Society and the Science and Technology Policy Research Unit (SPRU) raise the concern that greater emphasis on developing IP in universities may divert research priorities towards short-term business needs.[6] However it is worth noting that the US universities that are best at technology transfer also have strong reputations for long-term research. They protect IP rights primarily to make it clear to industry what they have invented.

LOOKING TO THE US

4.8 Internationally, the UK lags behind the US in its expertise in technology transfer, although the UK is ahead of much of the rest of Europe.[7] US universities started commercialising their research much earlier than those in the UK, and their relationships with business are therefore more mature. An indication of this is the amount of licence income US universities earn as a proportion of their investment in research: the proportion is almost three times higher than for UK universities, and on the same basis the number of licences that yield revenue is around 40 per cent higher.[8]

4.9 However the experience of US universities demonstrates that technology transfer is not usually a large revenue generator. A number of US universities started with that aim, but found it impossible to make significant amounts of money and so changed their objectives.[9] MIT, Stanford and Yale all now state that their main reason for engaging in technology transfer is to improve the public good – that is, to create the greatest possible economic and social benefits from their research, whether they accrue to the university or not.

4.10 Many UK universities are still seeking large financial returns, which is unrealistic and is likely to reduce the broader benefits of their research. Public funding for technology transfer offices in universities is not intended to generate large new revenue streams and the US experience shows that it will rarely do so. Its main purpose is to enable universities to maximise the wider impact of their research.

4.11 The Review identified a number of barriers to commercialising university IP.

- Lack of clarity over ownership of IP in research collaborations. Both business and universities report significant difficulties in agreeing IP ownership terms for research collaborations.
- Variable quality of technology transfer offices. Business reports problems with the professionalism of some technology transfer offices and some universities say that they find it difficult to acquire certain resources such as marketing skills, market research, licence negotiation expertise and spinout experience.

[6] *Keeping Science Open*, Royal Society, 2003. *University Patenting and its Effects on Academic Research*, SPRU, 2003.

[7] *UK Biotechnology Industry*, House of Commons Trade and Industry Select Committee, 2003, also argued that "the UK is still some way behind the US in this area [technology transfer]." *Benchmarking Industry Science Relationships*, OECD, 2002, shows the UK is ahead of most other EU countries on a range of technology transfer indicators.

[8] *UK University Commercialisation Survey Financial Year 2002*, UNICO, AURIL, NUBS, 2003.

[9] *Universities in the Marketplace*, Derek Bok, 2003.

- Too little licensing and too many unsustainable spinouts. There is a strong view from both business and universities that in recent years the balance of commercialisation activities has moved too far towards spinouts, driven by the availability of University Challenge Funds and an undue emphasis on the part of Government on spinouts as a source of employment creation.

LACK OF CLARITY OVER IP IN RESEARCH COLLABORATIONS

4.12 The UK's university patenting and licensing framework is well developed by international standards. For example, Denmark, Germany and France all brought in legislation in the late 1990s to allow institutions to claim ownership of IP created by their researchers – a position most UK universities had reached ten years earlier. Cambridge University alone in the UK leaves its academics with ownership of IP from research that is not funded by a grant tied to a project. The university is now reconsidering this position.

4.13 When a research project is fully funded by the university and public sponsors, such as the Research Councils and Funding Councils, there is no question of business owning any IP that results. On the other hand, when a university carries out contract research that is fully funded by industry, the company will usually own any resulting IP.

4.14 However it is much more difficult to agree the ownership of IP in research projects that have been funded by both universities and industry. Most business funding for university research is in this form. IP ownership is often strongly contested in these research collaborations, because the sponsors have different interests in the rights to exploit and use the IP. Universities say that they need ownership to ensure that their future research is not held back. Industry often argues that it needs ownership to protect the investment which will be required to develop the IP into a commercial product.

4.15 There is no clear framework in the UK for IP negotiations to help the two sides balance their competing interests. Government, Research Councils and Funding Councils all devolve responsibility to universities to negotiate terms on a case-by-case basis. Several sets of guidelines have already been produced to build awareness of IP issues in research collaborations.[10] These have helped to raise awareness, but business and universities still report problems agreeing IP ownership. Other surveys confirm that clarity over IP in research collaborations is a priority for business.[11]

4.16 This lack of clarity increases the time and cost involved in negotiating research collaborations and prevents some deals being completed. Many universities and businesses say that disagreement over IP ownership is a major barrier to research collaborations. The costs of protracted negotiations in some cases can be high, both financially and in tying up staff. This in itself deters some organisations, especially SMEs, from trying to collaborate with universities in research. But more important, several businesses and universities have failed to reach agreement and walked away from collaborations because they found it too difficult to reach agreement on IP ownership.

4.17 A number of businesses also comment that some universities overvalue their IP. This has stopped several businesses agreeing deals with universities. Increases to third stream funding announced by the Government will reduce the financial pressure on universities to make their knowledge transfer operations self-sustaining. But it is important that universities do not overvalue their IP and as a result prevent deals from being completed.

[10] *Managing IP Effectively*, Patent Office, AURIL, UUK, 2002. *Partnerships for Research and Innovation*, CBI, 2001.
[11] *Promoting Effective Collaboration in Business and Higher Education*, CBI, 2003.

4.18 Maximum creative use of IP allows the full economic potential of a research collaboration to be unlocked. The business sponsor needs to have the rights that are required to bring the technology to the market. But universities also have important interests. Publication of their research results is of benefit to the wider scientific community. Continuing research in the same field may lead to new scientific developments. Universities may also want to explore other applications and uses of the IP in different scientific fields. Recent reports from the CBI, the Royal Society and the Patent Office confirm that these freedoms are important.[12] If business negotiates full ownership of IP with strong restrictions on university use, this may reduce the total economic impact of the IP in the future.

PROPOSED SOLUTION

4.19 A large number of businesses and universities feel that lack of clarity over IP ownership is a major barrier to business-university collaboration. The model research contracts recommended in Chapter 3 could help to speed up discussions on the details of contract terms. But they will not bring clarity to negotiations over IP ownership.

4.20 The Review has identified a number of objectives for improving the management of IP in research collaborations:

- It would be useful to establish a simple set of ground rules for IP ownership, which would be the default position on which to build most negotiations.
- There should be maximum flexibility in the use of IP, to stop it being locked up in a way that limits its exploitation across as wide a range of areas as possible.
- At the same time, the Funding Councils and Research Councils should make it clear to universities that public funding is intended to promote the public good rather than to raise revenues.
- Academics should continue to receive incentives from universities to produce commercial IP.
- Companies should have secure rights to the IP they want to commercialise.
- Ownership should be proportionate: the party which makes the biggest contribution (intellectual as well as financial) should have first rights on the IP ownership.

4.21 The Review believes that the best way to meet these objectives is to introduce an IP protocol. This would provide simple ground rules for negotiations and encourage the flexible use of IP by both universities and business. In most cases universities make a significant contribution to collaborations, so the default position should be that they own the IP. But companies could own the IP whenever their contribution is significant.

4.22 It is unlikely that the protocol would affect negotiations for strategic relationships between large companies and universities. These are usually designed to benefit both parties, and involve significant contributions from each. The likely impact would be highest on SMEs and those larger businesses that have fewer relationships with universities, and on universities that have less developed industry research links.

[12] *Partnerships for Research and Innovation*, CBI, 2001. *Keeping Science Open,* Royal Society, 2003. *Managing IP Effectively*, Patent Office, AURIL, UUK, 2002.

4.23 Any agreement on the ownership of IP will cover the process by which it can be defended in the event of a legal challenge. The costs of defending IP in this way can be high, and business often has more experience of the process than do universities. However, the evidence from the US is that IP can be fully protected wherever the ownership happens to lie, and business can be given rights to defend its commercial interests even if it does not own the associated IP.

Recommendation 4.1

The Funding Councils and Research Councils, in consultation with universities, the CBI and other industry groups, should agree a protocol for the ownership of IP in research collaborations.

IP protocol main features:

- The common starting point for negotiations on research collaboration terms should be that universities own any resulting IP, with industry free to negotiate licence terms to exploit it.
- But if industry makes a significant contribution it could own the IP.
- Whoever owns the IP, the following conditions need to be met:
  1. The university is not restricted in its future research capability.
  2. All applications of the IP are developed by the company in a timely manner.
  3. The substantive results of the research are published within an agreed period.
- On all other terms the protocol should recommend flexibility where possible to help ensure that the deal is completed.
- The Funding Councils and Research Councils should require universities to apply the protocol in research collaborations involving funding from any of the Councils.

4.24 The main change introduced by the protocol is that it would set a starting point for negotiations. This should lie with the universities because they usually make the most significant financial contribution to collaborations. Industry often gains significant financial leverage from university collaborations. For example, the Engineering and Physical Sciences Research Council estimates that it provides twice as much funding as industry on average for co-sponsored projects.[13]

4.25 Industry often makes significant non-financial contributions that would also need to be taken into account, such as the sharing of equipment, technologies and intellectual know-how. Whenever the non-financial contributions are significant, they should be recognised in the negotiations.

4.26 According to the protocol, universities would automatically own IP if industry only provides a small contribution to the research. In this case, a benefit of the protocol is that negotiation costs would be significantly reduced.

4.27 The protocol also contains a small number of conditions on ownership to encourage the maximum creative use of IP. These should apply whoever owns the IP.

[13] Engineering and Physical Sciences Research Council, analysis of its grant database, 2003.

US APPROACH

4.28 This is not a recommendation that the UK should follow the US approach of introducing legislation to give ownership of IP to universities, and it is not intended to create the same effect by other means. The 1980 Bayh-Dole Act moved IP ownership from federal research sponsor to research institutions, in order to provide incentives for the institutions to play an active role in commercialisation. The Act also affected industry co-sponsored research, by requiring that universities own IP from all their federally-funded research. So even if the federal Government funds only 40 per cent of the full economic costs of a research project and industry contributes the other 60 per cent, title to the IP automatically rests with the university.

4.29 Bayh-Dole was introduced in a very different environment to that of business-university relationships in the UK, where universities have controlled IP from publicly-funded research since 1985. According to companies already involved in research collaborations with British universities, introducing similar legislation in the UK today would present greater risks to existing collaborations than it would bring benefits by improving clarity in negotiations for new projects.[14]

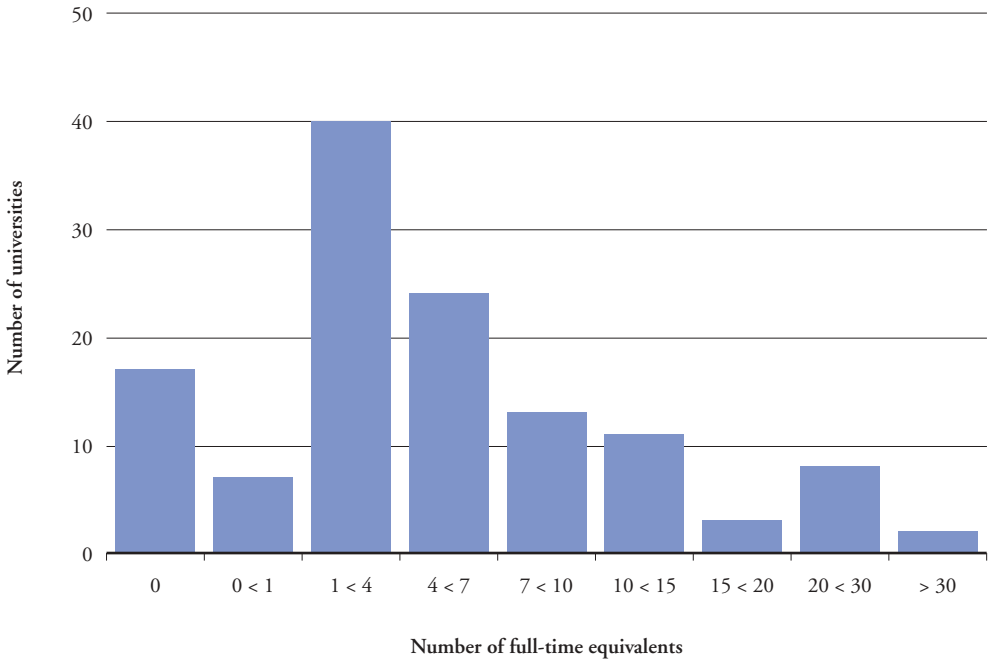
VARIABLE QUALITY OF TECHNOLOGY TRANSFER OFFICES

4.30 Businesses report widely varied experiences of university technology transfer offices. Some are said to be of high quality and managed professionally. The same names come up regularly. Others are harder to deal with, less business-friendly and less practised in commercialisation.

4.31 These differences in quality are partly due to experience. Many universities are new to technology transfer and half have less than four dedicated staff (see Chart 4.2). Scale is also important: 65 per cent of universities had no patents granted to them in 2002 and therefore had a different order of demand for technology transfer expertise compared to the five universities that generated over 20. Chart 4.3 shows the steeply skewed distribution of patent grants between universities.

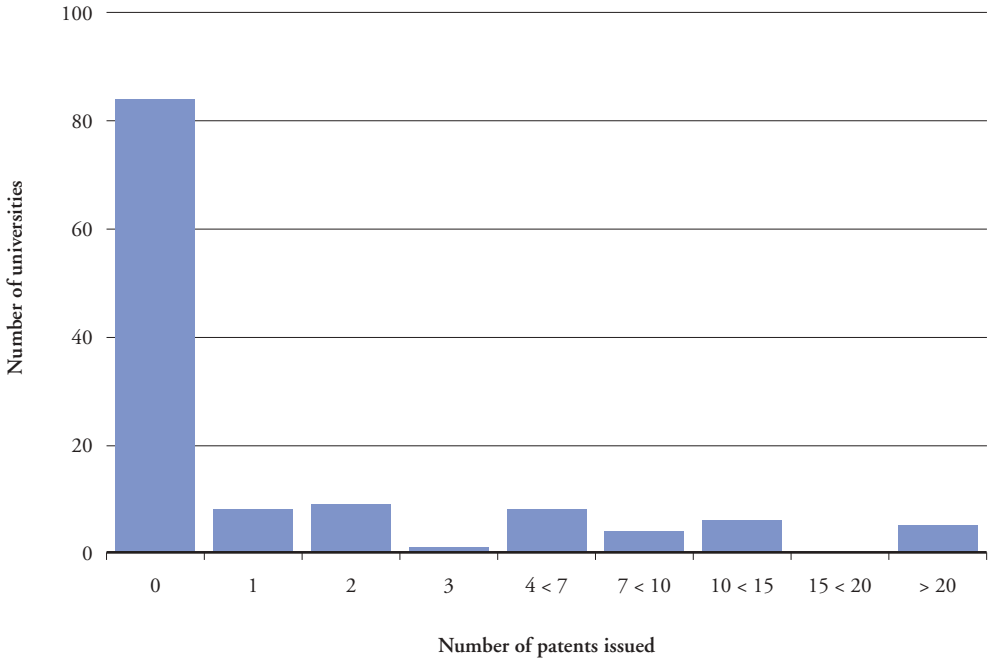
[14] The House of Commons Trade and Industry Select Committee reached a similar conclusion in its report *UK Biotechnology Industry*, 2003. The OECD report *Turning Science into Business*, 2003, argues that legislation is not the only means for improving clarity and coherence in managing IP in universities; where it has been used, the main impact has been to raise awareness of and support for university technology transfer offices.

Chart 4.2: Number of full-time staff employed in technology transfer activities in 2002



Source: UK University Commercialisation Survey Financial Year 2002, UNICO, NUBS, AURIL, (2003)

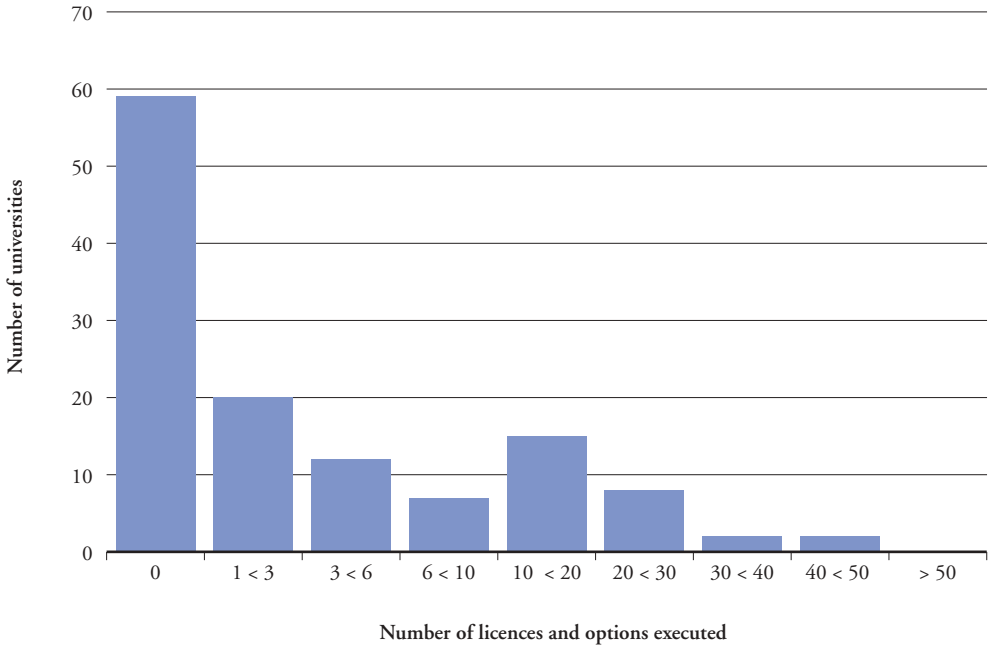
Chart 4.3: Number of patents issued to UK universities in 2002



Source: UK University Commercialisation Survey Financial Year 2002, UNICO, NUBS, AURIL, (2003)

4.32 Technology transfer is difficult and requires a wide and specialist set of skills. So it is hardly surprising that some universities have problems building professional offices on their own. Protecting and managing IP requires specific legal knowledge. Licensing needs a combination of market awareness, subject-specific knowledge, marketing and negotiating skills. Spinout creation requires entrepreneurship skills, links with business angels and venture capitalists, business planning, management and company formation expertise. These skills are difficult to find in a small group of people and are expensive to buy in. Chart 4.4 shows that a small number of universities have built up most licensing expertise.

Chart 4.4: Total number of licences and options executed in 2002



Source: UK University Commercialisation Survey Financial Year 2002, UNICO, NUBS, AURIL, (2003)

4.33 There appears to be a minimum efficient size for running commercialisation activities within universities. A 1998 NHS report estimates that average revenues from technology transfer at leading US and UK universities are 2.5 per cent of their research income.[15] MIT's revenues are still only 3 per cent of its research income. The same report then estimates that R&D expenditure of £20m per year is necessary for critical mass in technology transfer, that is, to cover the costs of a professional office. Applied to the UK university sector, less than 25 per cent of universities would meet this threshold, yet 80 per cent are now trying to run their own operations.

4.34 There are a number of things that can be done to address this problem. Training is important to increase the skills of those involved. But increasing collaboration between the most experienced universities would make the biggest difference. Those universities negotiating the most licence deals and creating the most spinouts will have the greatest experience of technology transfer, and can help other universities to move forward. Developing shared services in technology transfer with other universities in the region is the best way to make this type of collaboration happen. The recent Bioscience Innovation and Growth Team report comes to a similar conclusion.[16]

[15] *The Management of Intellectual Property and Related Matters, An Introductory Handbook for R&D Managers and Advisors in NHS Trusts and Independent Providers of NHS Services*, NHS, 1998.

[16] *Improving Health, Improving National Wealth*, Bioscience Innovation and Growth Team, 2003.

Recommendation 4.2

Government should use third stream funding to support regional shared services in technology transfer.

Shared services main features:

- Non-prescriptive – universities in each region should agree themselves how to set up and shape the services, and the role that each institution should play.
- Third stream funding should provide financial incentives to create shared services in technology transfer. Funding available to less research-intensive universities to provide specialist expertise in-house should be reduced.
- The most research-intensive universities should be involved where possible to build on existing expertise.
- Most knowledge transfer services should be kept in the university, including contract negotiation for consultancy and collaborative research and reach-out to business. Some technology transfer staff should remain on-site to act as contact points for university researchers on technology transfer and IP issues.
- Development agencies should support the universities in delivering the shared services.

4.35 Table 4.1 gives some examples of services that could be covered by this proposal and others that are delivered most effectively by individual universities.

Table 4.1

Shared services could include:	Services staying in-house could include:
• licensing negotiation. • market research for new technologies. • IP marketing. • IP management. • spinout creation.	• raising academic awareness of IP issues. • negotiating collaborative research contracts. • reach-out to business. • consultancy contracts.

4.36 Not all universities can provide their own independent, professional and experienced technology transfer facilities. But until now, third stream funding for setting up and building these offices has gone to universities rather than to collaborative ventures. HEIF has contributed to this, with less than 20 per cent of awards being granted to collaborations between universities. The draft guidelines for the next round of HEIF, which were put out to consultation in July this year, provide a disincentive for universities to collaborate. They put a cap on the amount of money that can go to each university and make no allowance for collaborative bids.

4.37 Funding can be used to change these incentives and enable technology transfer services to be delivered both within individual universities and in collaborations. The recommendation is not to close down technology transfer offices in any universities – technology transfer staff need close links with researchers to gain their support for commercialisation, to find out about new technologies in the research pipeline, and to locate potential industry customers in their specialist field. Universities with existing technology transfer infrastructure should maintain those services that depend on working with inventor academics.

4.38 However some of the more specialised commercialisation services would be provided more effectively if universities collaborated rather than worked alone. Many regions have already started moving in this direction – the challenge is to take existing collaborations on technology transfer further. A number of regions have already developed shared services in the most specialist areas of technology transfer, particularly spinout creation. In many cases the development agencies have played a significant enabling and funding role, and they should continue to support the development of wider shared services. For example:

- Advantage West Midlands set up Mercia Spinner, led by Warwick and Birmingham Universities, to provide shared spinout support services for the universities in the region.
- One NorthEast's Science and Industry Council helped establish NSTAR, which also provides regional shared services for spinout creation.
- South East England Development Agency established Enterprise Hubs to provide business incubation for its region's spinouts.
- The Welsh Development Agency is creating a network of Technium centres across Wales partly to provide incubation facilities for spinouts.
- Yorkshire Forward set up CONNECT Yorkshire to provide regional support for spinout creation and incubation.

TECHNOLOGY TRANSFER RECRUITMENT AND TRAINING

4.39 Greater collaboration in technology transfer should help improve commercialisation across the university sector. But technology transfer is people-intensive, and as activity grows the total number of staff required will continue to increase. So training is also important to improve the overall quality of technology transfer.

4.40 The market for training in technology transfer and knowledge transfer was examined last year by the Business Interface Training Provision (BITS) review for the DTI.[17] This found that the market was too small to attract business interest in providing training, and that universities tended to allocate insufficient funds. The skill mixes required to manage both technology transfer and knowledge transfer are wide-ranging and many universities find it difficult to recruit staff with all the necessary skills. So the review recommended that Masters in Business Administration and diploma courses be established to train existing staff in these skills. Such courses should be privately run but with some public subsidy.

4.41 The DTI has recently announced an extra £1m for the provision of training in this area. This is to be welcomed, but it is insufficient to deliver the recommendations of the BITS review. Existing schemes show that public funding specifically for technology transfer training can be effective in improving skills and networks – the PRAXIS program run by the Cambridge-MIT Institute is an excellent example. But such programmes are also on a much smaller scale than envisaged by BITS.

Recommendation 4.3

The Government should increase the level of funding for technology transfer and knowledge transfer training to stimulate the development of new training courses.

[17] *Business Interface Training Provision (BITS) Review*, Oakland Innovation and Information Services, 2002.

4.42 The most successful technology transfer offices in the US – such as those at MIT and Columbia – place strong emphasis on recruiting staff with substantial industry experience, and find it difficult to teach the negotiation and deal-making skills learnt in industry to new staff. The UK has many fewer people with industry experience in similar posts, and technology transfer offices tend to be staffed by academics or university administrators. The business view is that it would be easier to negotiate deals with individuals who had more of a commercial background. A major barrier to recruiting experienced entrepreneurs or industry executives into university technology transfer offices is salary, so as third stream funding is increased, universities should offer more competitive rates of pay to attract individuals with industry background and experience.

Recommendation 4.4

As third stream funding increases, university technology transfer offices should actively seek to attract individuals with industry background and experience.

4.43 One important strength of the US is found in the Association of University Technology Managers (AUTM), the national representative body for university technology managers. A highly professional body, AUTM offers accredited courses that provide a range of training options for people involved in commercialisation. By supporting quality across the board, AUTM gives all universities the ability to raise their skills and experience. It also has strong industry involvement, with almost 50 per cent of its membership coming from business. This helps improve universities' understanding of the needs of business and vice versa, through building networks for knowledge transfer.

4.44 While the UK does have representative bodies for similar groups, they offer few training courses, have little industry involvement and do not seem to be as effective at sharing best practice around the university sector. There may be lessons that they can learn from AUTM in these areas. A recent House of Commons investigation into strengthening the UK biotechnology industry also concluded that UK universities needed to do more to promote best practice in technology transfer.[18]

Recommendation 4.5

UK organisations representing technology transfer should look to AUTM to see what lessons can be learnt in terms of providing quality training, increasing industry involvement and sharing best practice.

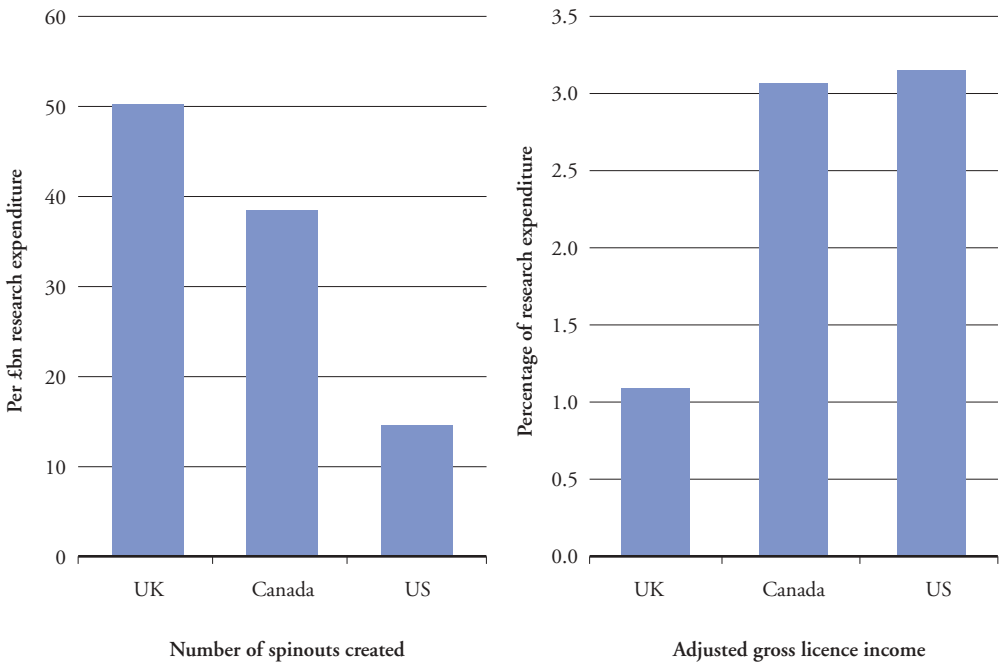
TOO LITTLE LICENSING AND TOO MANY UNSUSTAINABLE SPINOUTS

4.45 Before the mid 1990s, university spinouts were rare and most technology transfer involved licensing to industry. But in the late 1990s, university attitudes towards entrepreneurship changed rapidly, driven in part by the ready availability of private and public finance for high-tech start-ups. The balance shifted towards creating spinouts. This change has had a positive impact on the culture of the university system by helping to improve perceptions of commercialisation on the part of university management. It has led to some successful companies being created. But there are signs that the pendulum has swung too far and that too many spinouts are now being created, some of low quality.

[18] *UK Biotechnology Industry*, House of Commons Trade and Industry Select Committee, 2003.

4.46 The number of spinouts created each year grew rapidly in the UK between 1996 and 2001.[19] Despite a fall in 2002, many more spinouts are created as a proportion of research expenditure than in the US and Canada (see Chart 4.5). But these high spinout rates come at a cost to licensing. Chart 4.5 also shows that the UK has a long way to go to catch up with the US in the total income received from licensing. In the US, 4,058 new licences were agreed in 2001 and 494 spinouts were formed. In the UK, the latest numbers are 648 and 158.[20] That is, nine new university technologies are licensed for every spinout that is formed in the US, compared to only four in the UK.

Chart 4.5: Number of spinouts created and licence income in 2002



Source: UK University Commercialisation Survey Financial Year 2002, UNICO, NUBS, AURIL, (2003)

4.47 As this chart indicates, many US universities focus strongly on licensing as opposed to spinouts. MIT is a prime example, and is one of the most successful universities at technology transfer in the world. Unlike many UK universities, MIT has no business incubation activities at all. The strategy of the technology licensing office (TLO) is to encourage as many invention disclosures as possible from faculty members by minimising the barriers to disclosure – currently MIT discloses about 450 inventions per year. MIT's TLO then licenses these inventions as non-exclusive or exclusive licences to industry and local venture capital firms. Rather than getting involved in the complexities of spinout formation, the TLO provides a shop window for industry to view its IP and agrees as many licence deals as possible.

[19] The spinouts created in 2001 account for 31 per cent of the total number formed in the five years to 2002 – *UK University Commercialisation Survey Financial Year 2001*, UNICO, NUBS, 2002.

[20] US data from AUTM Financial Year 2001 report, UK data from *UK University Commercialisation Survey Financial Year 2002*, UNICO, NUBS, AURIL, 2003.

4.48 Some UK universities also have high licensing levels, but they are in the minority. For example, Oxford University has transferred more IP to the market than perhaps any other university in this country, thanks to its high licensing rates. The case study below shows some of the benefits of licensing to industry, which include fast access to new technologies often on an exclusive basis, leading to new products and services, increased revenue and possible employment growth.

Case Study: Isis Innovation and Hymatic Engineering

Oxford University's Isis Innovation is one of the country's most prolific technology transfer offices when it comes to agreeing licensing deals. Since 1997 it has entered into 160 such agreements on university technology. Although it does not prescribe the balance between spinouts and licensing in any way, over two-thirds of its technologies are licensed to existing firms. Last year, Isis agreed 37 licences and formed seven spinouts.

One such licence deal was made with UK-based Hymatic Engineering. This involved a new technology for cooling satellite sensors that came from research in the university's Department of Engineering Science. Hymatic is one of the few companies in the world with the engineering capability to use this technology in the construction of cooling sensors. Its ability to turn the new technology – a unique non-contact dynamic piston seal – into a manufacturing reality has created a cooler with no mechanical wear and a very long life. The company has further developed this technology for use in portable detectors for nuclear monitoring at customs ports.

Hymatic estimates that the new technology resulting from this licence deal will help it generate around £6m additional revenues between 2001 and 2006.

4.49 Licensing is less resource-intensive than spinning out new companies – both in terms of people and funding – and has a higher probability of getting technology to market. It is often the quickest and most successful way of transferring IP to industry, and has the advantage of using existing business expertise rather than building this from scratch.

4.50 The fact that some licences may go to non-UK resident companies is no reason to prefer spinouts to licensing. Wherever the IP ends up, licensing improves universities' links with business. Making the university sector more internationally competitive will help UK-based businesses get more from their own university collaborations.

4.51 A widely held view in business and universities is that too many spinouts have been created in the last five years and that a large number of them will not succeed in the long term. Some of the spinouts have been highly successful in attracting outside investment and in creating new jobs and wealth for their region. One recent example is the Edinburgh University spinout Wolfson Microeconomics, which raised £69m in an initial public offering.

4.52 But the quality of spinouts varies widely among different universities. The best way to judge quality is by looking at the ability of a spinout to attract external private equity. This indicates whether there is real market interest in the new company. At one end, Oxford University has attracted private capital to 95 per cent of its spinouts since 1997. But almost a third of the universities that created spinouts in 2002 did not bring in external equity for any of their new companies.[21] This strongly suggests that some of the public funding invested in recent years has not been sufficiently focused on quality. In the future, public funding should be concentrated on high-quality spinouts, as measured by their ability to attract funds from the private sector wherever this is possible.

[21] *UK University Commercialisation Survey Financial Year 2002*, UNICO, NUBS, AURIL, 2003.

Recommendation 4.6

Government should set clear guidelines for third stream funding to rebalance commercialisation activities towards licensing. In particular, it should:

Increase the availability of proof of concept funding.

Proof of concept funding is used to establish whether a new technology is commercially viable or not. It is the first stage in transferring IP to the market, and is needed for both licensing and spinning out. The level of investment is normally up to £50,000 per invention.

Reduce the availability of seed funding, and use public seed funds to draw in private finance wherever possible.

Third stream seed funding is used to provide early stage investment in spinouts. The level of investment is normally up to £250,000 per invention. Private finance should be brought in alongside such funding wherever possible, so that the spinouts can be tested in the marketplace. But some spinouts in some regions may find it more difficult to attract private funding early on, since the venture capital and angel networks in the region are less well developed than in others. The best spinouts from these regions should receive seed funding.

4.53 University Challenge Funds (UCFs) were set up in 1999 to provide proof of concept and seed finance to develop promising university IP. Some £61m was raised in two investment rounds including £40m public funds. The scheme was intended to encourage the development of IP that could either be licensed to industry or used to create a spinout. But in practice resources were strongly focused on early stage investments in spinouts. In 2001, over 70 per cent of the Funds' investments were between £100,000 and £250,000 in value – more than is normally required for proof of concept funding.[22] The availability of UCF funding has been one of the main drivers of the increased spinout activity since 1999.

4.54 The rationale for using public funds to support proof of concept activity is much stronger than for early stage investments in spinouts. Proof of concept is necessary for both licensing and spinouts. Whichever commercialisation route a university takes, it will need to prove the concept of the technology before its gets any outside company or investor interested. With limited public resources, making more small investments in proof of concept activity offers better value than concentrating funding on larger early stage investments in spinouts. Focusing resources on proof of concept activity would help universities concentrate on increasing the throughput of their technology transfer, and provide incentives for them to use the fastest, least resource-intensive route to market.

4.55 Private investment is difficult to attract into proof of concept funding, precisely because the potential of the technology cannot be known before this preliminary work has been done. Many universities have a need for proof of concept funding that they cannot meet from their existing resources. This lack of finance is a barrier to licensing, since industry generally needs to see that the concept has been proved. Other reviews have also recognised the difficulties in licensing technology before the concept has been proven.[23] The Scottish Executive, through Scottish Enterprise, already provides specialist funding for this activity by way of its proof of concept scheme.

[22] *Annual Report of University Challenge Funds*, Office of Science and Technology, 2000-01.
[23] *UK Biotechnology Industry*, House of Commons Trade and Industry Select Committee, 2003.

4.56 It is easier to attract private investment into early stage seed funding for spinouts. Private finance provides an important quality measure and should be used to decide which spinouts to pursue wherever possible. Some universities have established close relationships with venture capital firms and angel investors that reduce their need for public seed finance. The case study of IP2IPO is a good example of this kind. Others have redirected their public seed funds to act as a lever for private investment – the London Colleges' seed fund is an example of this. But some regions have less well-developed networks of business angels, industry investors and venture capital than others. In some cases this will prevent high-quality spinouts from these regions attracting early stage private investment.

4.57 A number of university spinouts that have already received some public funding are likely to fail in current market conditions. However, managers of UCFs report that their best spinouts are attracting more funds to help them grow, and some universities are now seeking to raise their own funds to support these new businesses. HM Treasury launched a consultation in July this year into whether the UK would benefit from a version of the US Small Business Investment Companies. If introduced, they could play an important role in bridging the early stage funding gap in the future, and they should be designed so that they can provide finance for university spinouts as well as other high growth start-ups.

Case Study: IP2IPO

IP2IPO, an investment company, has recently struck a number of deals with UK universities to set up partnerships for commercialising their IP. The first was with the University of Oxford, where in return for an investment of £20m, IP2IPO has acquired 50 per cent of the university's interest in spin-out companies and technology licences based on IP created at the chemistry department until 2015. This was followed by agreements with Southampton University, King's College London and the University of York's Centre for Novel Agricultural Products. They involve a commitment to invest funds in early stage technologies created at the university, while providing management support and expertise to aid the commercialisation process.

The Southampton University partnership is an example of how universities can find private support for spinouts without depending on public funds. In 2002 IP2IPO committed to investing £5m over four years to commercialising the university's IP, and most of its investments so far have not involved public funding. The company says that speed is vital in bringing together academics, the university IP, management and investment, and that this is much easier to achieve with its own funds in a close university partnership. IP2IPO also believes that quality of management is often more important than the level of funds invested and always makes this a priority.

ACTIVE em is one spinout that has benefited from this process and is the first from IP2IPO's Southampton partnership. Based on electro-magnetic sounding technology, it offers new offshore oil survey capabilities, with significant potential to reduce oil companies' exploration risks. Forming the spinout and investing seed capital took less than three months after IP2IPO initially identified the opportunity. It then helped recruit a senior oil industry executive as manager. A few months later the company secured its first multi-million dollar order, and within six months it had raised its second round of finance.

Case Study: the Combined London Colleges University Challenge Seed Fund

The London Business School, University College London, King's College London and Queen Mary University of London applied together for University Challenge Funds for pre-seed financing of non-life science university spinouts. They received £3m from Government and each put in £250,000. After investing amounts from £25,000 to £250,000 in six spinouts, the management has restructured its approach to investing. Too many of the companies coming to them had not yet proved the technical, let alone the commercial, possibilities of the concept.

With £2.5m left to invest, the fund is now taking the following three-stage approach to spinout opportunities:

- Up to £5,000 is given to most ideas that stand up to a simple review. The money is used to write an initial plan, often with the help of an objective outsider. Taking the money means agreeing conditions for further funding.
- Up to £20,000 is then available for proof of concept funding, usually alongside other grants.
- Finally, up to £175,000 is made available for a spinout that has proved the commercial viability of its proposition, but only as matched funding alongside an outside investor.

This new approach will direct more funding towards proof of concept activity, to develop a commercial plan for as many new technologies as possible. The fund will then use its close relationships with the London Business School and a number of angel networks to choose the best commercial plans to support.

5 Regional issues

5.1 Universities are playing an increasingly important role in regional economic development for a number of reasons.

- In the past, the relatively low cost of doing business in the UK has been one of its important competitive advantages. In the future, it will need to move up the value chain, and compete on its abilty to innovate. Universities must play a central part in this process.
- The decline of manufacturing and the rapid expansion of higher education have transformed the relative economic importance of universities within their cities and regions. Fifteen years ago, Nottingham was a manufacturing centre – engineering, tobacco, Boots – and the university had around 8,000 students. Today, much of the old manufacturing has gone and the city's universities have around 46,000 students. The same story is repeated all over the country. In 1999-2000, UK universities generated directly and indirectly over £34.8bn of output and over 562,000 full-time equivalent jobs throughout the economy.[1]
- In many parts of the UK, universities form a critically important part of the science base. For example, the eight research-active universities in Yorkshire and Humber spent over £240m on research and development in 1999, one of the highest levels in the UK. But the annual spending by business in the region was far below the national average, and it was one of the lowest recipients of government investment in R&D outside the university sector. Small wonder that the region is determined to improve the connections between its universities and its industrial base.
- More often than not, research-active universities are to be found at the heart of successful business clusters. Oxford and Cambridge are the most spectacular examples, but there are many others across the country, and more are developing.

5.2 Increasing the level of collaboration with business strengthens the role of universities in their regional economies. So the proposals put forward in previous chapters should help regional economic development across the UK. Each region has a number of universities with different strengths that can attract talent, investment and professional services, raise the quality of education and skills, enrich intellectual life and serve as an entry point for the latest international thinking. Strengthening their links with industry should help raise the competitiveness of firms in each region.

5.3 However business-university collaborations are also affected by specific regional conditions. Three that are particularly important are: the capacity for development agencies to support business-university collaboration at a regional level; the role of business clusters in developing business-university networks; the level of business investment in R&D in the region.

[1] *The Future of Higher Education*, DfES, 2003.

REGIONAL INSTITUTIONS

5.4 A strong regional identity has proven to be an increasingly important factor for competitiveness in many countries. In the UK, Michael Porter argues that competitiveness has been held back by the centralised system of government spending; that investment is less well adapted than in other countries to regional and local opportunities and needs; and that private sector leaders are less willing to engage in local efforts if important decisions affecting the quality of their business environment are made in London.[2]

5.5 Scotland, Wales and Northern Ireland recognised this problem long ago by establishing their own development agencies.[3] A critically important moment for the English regions came in 1998, when eight new public sector bodies were set up under the Regional Development Agencies Act, aimed at increasing regional output and reducing regional disparities. A ninth agency, the London Development Agency, was established for similar purposes the following year.

5.6 All these agencies were created to give business a greater voice in determining regional economic priorities, and are chaired by senior industry executives. They have long-term economic strategies that identify the specific areas where their region needs most support. These can include anything from skills, transport and urban renewal to employment, enterprise and innovation. The strategies also set out the steps which they intend to take in order to address these issues.

5.7 All the development agencies recognise the importance of innovation and R&D to their long-term competitiveness. The North West Development Agency and One NorthEast decided to set up Science and Industry Councils to provide high-level advice from business and universities on the regions' science priorities. The Councils are impressive bodies with strong industry representation. They have both made progress in driving forward a regional science agenda. The South East, London and the East of England set up equivalent bodies more recently, while the other RDAs are establishing their own models.

5.8 Most RDAs are making significant investments in science and innovation – see Table 5.1. Many of the highest investments are being made in those regions with the lowest levels of research activity. The wide per capita variation reflects in part the regeneration and infrastructure projects which were inherited by each agency at the time that it was established.

[2] *UK Competitiveness: moving to the next stage*, Michael Porter, 2003.

[3] The Scottish Development Agency became Scottish Enterprise in 1991. The Welsh Development Agency was set up in 1976. Invest Northern Ireland was created in 2002 as a result of an amalgamation of three previous agencies.

Table 5.1: RDA budgets 2002-03 and investments in SET

RDA	2002-03 Allocated Budget		SET Related expenditure	
	£m	£ per capita	£m (estimated)	Budget %
West Midlands	209	39	37	18
East of England	82	15	10	12
East Midlands	107	25	9	8
London	286	39	15	5
North West	283	40	39	14
North East	208	80	60	29
South East	109	14	10	9
South West	100	21	10	10
Yorkshire	206	41	50	24
Totals	1590	32	240	15

Source: RDA's submission to House of Lords Science and Technology Committee report: Science and the RDAs, 2003

5.9 One of the most effective ways in which development agencies can promote innovation is by building business-university collaborations. As publicly-funded organisations which are business led, they are well placed to act as a bridge between business and universities. This is reflected to some degree in all their economic strategies, but the level of support and resources invested varies between the regions and nations. The North East has given universities a central place in its strategy and has directly funded five major new collaborative research facilities. In other parts of the country, development agencies have played a wide variety of roles investing in and facilitating business-university collaborations.

Case studies – Development agencies as a bridge between business and universities

- Facilitator. The merger between the University of Manchester and the University of Manchester Institute of Science and Technology (UMIST) will create a world-class research-intensive university with 30,000 students, 9,000 staff and a combined income of £420m. The merger supports a number of priorities in the North West Development Agency's economic and science strategy, such as the need for a top-class chemistry research facility and support for business clusters, skills and job creation. Accordingly the agency has agreed to contribute £30m "to provide regeneration and development in the city centre as a beacon to draw research-related business."
- Intermediary. Irvin-GQ is a medium-sized company that manufactures military parachute systems. Lacking the R&D facilities of the big defence contractors with which it competes, it approached Know-How Wales (part of the Welsh Development Agency) in 2000 to explore ways of engaging with academic institutions. The agency helped it set up a technical advisory board by identifying relevant departments in local universities and making introductions. The results have included a number of Teaching Company Scheme projects and relationships with three Welsh universities. The company now employs 330 people, some 30 of whom are graduates, compared with 150 at the start of the relationship with Know-How Wales. Its sales have climbed to around £18m.

Case studies – Development agencies as a bridge between business and universities *(continued)*

- Plugging gaps. The photonics research facility in Ipswich was once part of BT and then owned by Corning. The US company withdrew from its UK base early in 2003, threatening the future of this centre for world-class research in data transmission by optical fibres. The East of England Development Agency stepped in with funding of £750,000, which together with support from the DTI and the Engineering and Physical Sciences Research Council will enable the facility to be retained in the region. The centre will now support both university and business research and development in the same location, with university and industry researchers working in close proximity. It is already collaborating with a wide range of universities from within the region and elsewhere.
- Brokering contacts. The South East of England Development Agency has adopted a brokerage approach to knowledge transfer, recognising that existing strengths in the region's private and higher educational sectors require only a light touch to be brought together. Work with the mathematics department at Royal Holloway, University of London, for example, has brought international security firms to Surrey by drawing on academic expertise in cryptography.
- Building networks. SEEDA, with global partners, is also investigating the possibility of developing international networks for its universities and businesses by setting up an International Institute for Innovation and Entrepreneurship. The aim is to broker global contacts for the region's knowledge-intensive institutions by supporting visiting professors, exchange programmes and access to international markets and by sharing best practice.
- Helping to establish clusters. Scotland's computer games industry is made up of around a dozen development studios and five new start-ups, employing some 500 creative people and turning over an estimated £15m. Scotland's competitive strength comes from the close relationship between the industry and academia, in particular through programmes pioneered by the University of Abertay Dundee (UAD). Identifying an opportunity in the mid-1990s, UAD now offers undergraduate and postgraduate courses in software and computer games technology. Supported by Scottish Enterprise, the UAD programme has been augmented by the opening of the International Centre for Computer Games and Virtual Entertainment, which among other things enables companies to test products from concept phase right through the development cycle.

5.10 Development agencies can also promote business-university collaboration by supporting national schemes. The higher education white paper set out plans to give the RDAs a significant role in the distribution of third stream funding in England.[4] They will be asked to work with universities as they draw up funding applications, and to evaluate how each proposal fits with their regional economic strategy. This should increase the links between universities and RDAs in knowledge transfer, and encourage the agencies to seek out businesses that could benefit from collaborating with universities.

5.11 While broadly welcoming this range of RDA involvement, many businesses and universities are concerned that some agencies do not have the necessary level of skills and expertise for working on knowledge transfer. Raising the quality and breadth of their work in this area must be a priority.

[4] *The Future of Higher Education*, DfES, 2003.

DEVELOPMENT AGENCIES' TARGETS AND MILESTONES

5.12 The development agencies already support business-university collaborations in a number of ways. This needs to be reflected in their targets and performance measurement systems.

5.13 However in England the RDA targets are monitored quarterly by the DTI, while business-university relationships typically take a longer period of time to produce results. RDAs already have a target for innovation that recognises the need to build collaborations. But the short-term nature of this target means that the work undertaken to support collaborations may not be recognised.

5.14 The RDAs argue that this discourages them from building strategic relationships between business and universities, where the benefits may take several years to come through. This problem has been highlighted in a recent House of Lord's Select Committee report.[5] Unless their targets are adapted to reflect longer-term investments in science, engineering and technology, RDAs may find it increasingly difficult to invest in innovation in their regions.

5.15 RDAs are also measured against specific milestones, some of which are common to all RDAs and some of which they set themselves. There are currently no core milestones that recognise the importance of building business-university collaborations. So even the efforts of those RDAs that are active in this area are not assessed in the performance monitoring process. Chapter 2 of the Review recommends that this role should be enhanced. To reflect this new activity, all RDAs should set a specific milestone for building business-university collaboration. For example, RDAs could be assessed on their ability to assemble collaborative research funding, and on the number of beneficial contacts they initiate between universities and industry.

Recommendation 5.1

RDAs should have targets that promote building business-university collaboration.

1. **Their core outcome target for innovation should reflect the long time lag between R&D and economic impact.**
2. **All RDAs should set a specific milestone for building business-university links.**

The Scottish, Welsh and Northern Irish development agencies should also consider whether their targets adequately promote building business-university collaboration.

CLUSTER POLICY – THE BENEFITS OF PROXIMITY

5.16 Many regions have dynamic clusters that provide a source of competitive advantage to firms and that promote economic growth. Universities are at the heart of several of these groupings, providing research and skills. Several government reports since 1998 recognise the importance of clusters to economic development, and the role of universities in promoting them.[6]

[5] *Science and the RDAs: SETting the regional agenda*, House of Lords Select Committee on Science and Technology, 2003.

[6] For example, *Our Competitive Future*, DTI, 1998 and *Opportunity for All*, DfEE, DTI, 2001.

5.17 Some of the most successful clusters in the US developed around universities doing relevant high-quality research.

- Silicon Valley grew around the four main Bay Area universities – Stanford University and the University of California at Berkeley, San Francisco and Davis.[7] Hewlett-Packard, the pioneer Silicon Valley firm, for example, was founded by two Stanford graduates.
- The high-technology cluster at Cambridge, Massachusetts was built around its big universities. In 2000 the eight research universities in Boston provided a $7.4bn boost to the region's economy, generated 264 new patents and granted 280 licences to private enterprises.[8]
- Austin, the state capital of Texas, used its academic strength to draw in the Microelectronics Computer Technology Consortium and SEMATECH in the 1980s. This helped create a high-technology cluster that employs around 100,000 people in some 1,700 high-technology companies.

5.18 Knowledge-intensive clusters can be found all over the world. This is because companies in all sectors benefit from being close to organisations with which they collaborate. Universities form the cornerstone of many successful clusters by attracting knowledge-intensive businesses around their strong research base and a ready supply of skilled graduates. For companies, the benefits include special access, closer relationships, better information and powerful incentives, as well as the opportunity of networking with other businesses in similar fields. As a cluster grows and the network effects multiply, it becomes more and more attractive for new businesses to join.

5.19 Businesses are clear that proximity does matter. Personal contact is the best form of communication, and distance affects the capacity of firms to collaborate with universities. This applies to large firms in strategic university relationships as well as to SMEs with a more regional outlook. Research by Arthur D. Little on behalf of the RDAs confirms this point: "Physical proximity is important in scientific collaboration. The era of the Internet does not remove the need to build relationships by personal contact, even if they can then be sustained through electronic means. Indeed … the importance of proximity is growing, because of an increasing need for companies to look outside for technology, ideas and co-operation."[9]

5.20 The most successful relationships between universities and industry involve people from both organisations working closely together throughout the research programme. Business-university research partnerships need to be closely linked to navigate the evolutionary cycles, incremental improvements and chance events that go with strategic research.

5.21 The University of Warwick maintains strong links with business on its own campus. As well as developing the Warwick Manufacturing Group, where people from business mix freely with university researchers, the university has a number of departments working to facilitate these relationships. Informal contacts are also built through board-level appointments of university personnel to industry bodies and companies, and vice versa.

[7] *The Bay Area's Research Institutions: How an Extensive Research and Development Infrastructure Drives the Region's Innovative, Knowledge-Based Economy*, Bay Area Science and Innovation Consortium (BASIC), 1999.
[8] *Engines of Economic Growth*, The Association of Independent Colleges and Universities in Massachusetts, 2003.
[9] *North West Science and Daresbury Development Study*, Report to the Government Office for the North West, Arthur D. Little, 2001.

5.22 Proximity is especially important for SMEs, which do not have the time or knowledge to identify relevant expertise a long way from home. So it is important that SMEs around the country should continue to have close access to research departments which are generating valuable ideas for the regional economy. Some high-technology SMEs look to world-class university departments for their collaborations, but even these will chose universities in their region wherever possible.

5.23 Evidence from the Community Innovation Survey (CIS) shows that proximity matters to firms of all sizes.[10] Table 5.2 sets out the results of an analysis of the CIS data on UK-based firms that collaborate with universities. It shows that firms with local markets chose to work with a local university in almost 90 per cent of their collaborations. Firms with regional or national markets chose to collaborate with their local universities between a third and a half of the time. Even companies with international markets work with their local universities in a quarter of their collaborations.

Table 5.2: UK business-university collaborations split by market size of company and university location

Type of firms' largest market	Location of University		
	Local	National	Overseas
Local	88%	12%	0%
Regional	47%	53%	0%
National	37%	47%	16%
International	26%	48%	26%
All	36%	46%	18%

Source: Community Innovation Survey, (UK), DTI/ONS, 2001

5.24 Clusters that have reached critical mass need relatively little support or maintenance. One of the highest growth clusters in the UK is the Cambridge area, where high-technology employment approximately doubled to 32,000 jobs in over 300 firms between 1986 and 1998. Over this period, the proportion of employees working for small firms significantly increased and the software and biotechnology sectors grew faster than others. It is reported that all of the new high-technology firms are at least indirectly related to the university.[11] Since 1998 the East of England Development Agency has had to do little to support this Cambridge phenomenon. A recent report shows that Oxford also has one of the highest growth rates in high-technology employment, amounting to some 37,000 people at the end of 2001.[12]

5.25 But for regions outside the golden triangle, with fewer strong clusters already in place, the opposite is true. Table 5.3 is taken from a report into the UK's clusters produced for the DTI in 2001.[13] It shows the strongest clusters in selected areas in terms of the clusters' geographical significance and the depth of their links with industry, universities and other institutions. While the report shows that most regions have strong groupings in some areas, the most knowledge-intensive clusters with the highest R&D activity and closest university links are concentrated in the East and South East. By contrast, Wales and the North East have nationally significant manufacturing clusters, but less knowledge-intensive activity.

[10] *Community Innovation Survey (UK)*, DTI/ONS, 2001.
[11] *The Cambridge Phenomenon Revisited*, Segal Quince Wicksteed, 2000.
[12] *Enterprising Oxford: The Growth of the Oxfordshire High-Tech Economy*, Oxfordshire Economic Observatory, 2003.
[13] *Business Clusters in the UK – a First Assessment*, Trends Business Research, 2001.

Table 5.3: Cluster strengths in selected regions and nations

Region	Cluster	Stage	Depth	Employment	Significance
East, South East	ICT/electronics	established	deep	growing	international
	Pharma/biotech	established	deep	growing	international
	R&D activity	established	deep	growing	international
	Software development	established	deep	growing	international
North East	Chemicals	established	deep	declining	national
	Automotive	established	shallow	growing	national
	Electronics	established	unknown	growing	national
	Metal processing	mature	unknown	declining	national
South West	Aerospace	established	deep	declining	international
	Antique dealing	established	deep	growing	international
	Marine industries	established	deep	growing	national
	Tourism	established	deep	growing	national
Wales	Opto electronics	embryonic	deep	growing	international
	Tourism	established	deep	growing	national
	Electronics	established	unknown	growing	national
	Automotive	established	unknown	stable	national

Source: Business Clusters in the UK, Trends Business Research, (2001)

5.26 There are internationally excellent universities across the UK, but internationally significant knowledge-intensive clusters are concentrated in a few regions. Not all of the UK's research-intensive universities have been able to develop successful business clusters. If universities outside the East and South East of England are to succeed in doing this, they need to be actively supported in their efforts at local and regional level. York University is one institution that has taken this approach and started working with local and regional bodies to develop its own science cluster.

Case Study – Science City York

Science City York is a project led by York City Council and the University of York to create business growth and high-quality employment, and to build York's reputation as a centre of scientific and technological excellence. The main thrust of the strategy has been to promote three knowledge-based clusters around the university, in bioscience, ICT and digital industries, and heritage and arts technology.

The university and city council recognised that they needed to work together to create the conditions to allow high-technology businesses to flourish. The university's science park provides incubator space for new start-ups, while the council helps to link businesses with legal, financial and marketing professionals.

Science City York has helped create 1,800 new jobs and 30 new businesses in its first four years, and it is forecasting a total of 18,000 new science and technology-based jobs by 2021. York's high-technology sector now includes over 240 companies, and the three clusters already employ as many as those employed in tourism in the city. The Science City York clusters provide more than 10 per cent of the jobs available in York and employment growth in the clusters is growing at a current rate of 7 per cent each year.

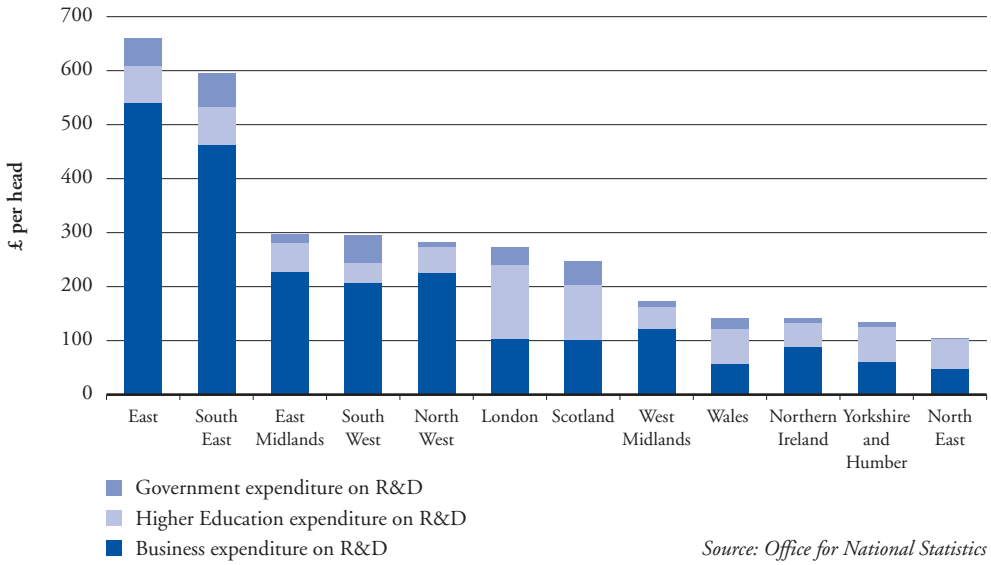
5.27 Some international examples show how much a region can achieve if it actively promotes cluster formation, whatever its original industry base. The University of Oulu in Finland used its research base and strong links with local and regional government to build a new industrial cluster around the university. In little more than 10 years it helped turn the small traditional manufacturing city into the home of one of Europe's most successful high-technology clusters. Nokia is the best-known company to have grown in a region which now has the fifth highest R&D intensity out of the 211 economic regions in the EU.[14]

REGIONAL INVESTMENT IN R&D

5.28 There is a clear correlation between a region's R&D intensity and its economic prosperity. Chart 5.1 shows spending on R&D across the regions and nations alongside the latest figures for gross value-added in Chart 5.2. The South East and the East of England are well above average on both measures, with the East of England among the top 10 research-intensive regions in the EU. Among the English regions, the North East lags behind the field both in terms of R&D investment and gross value-added.

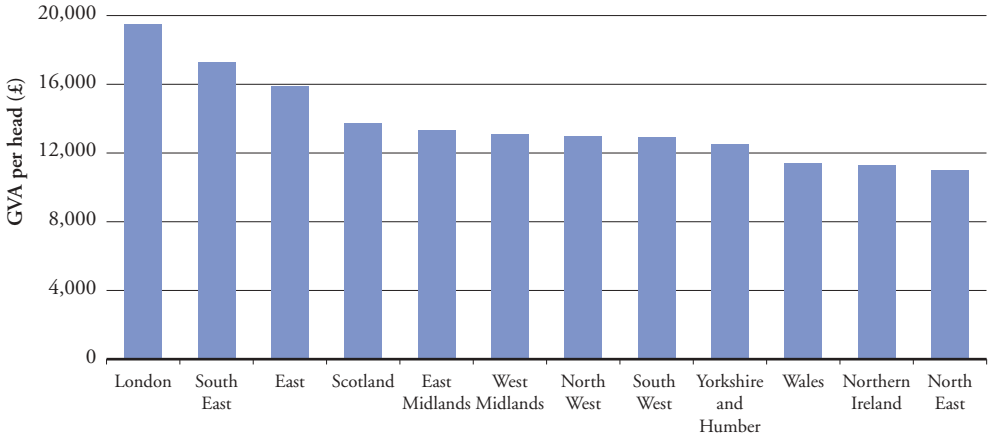
[14] *Science and Technology Indicators*, Eurostat, 2003.

Chart 5.1: Regional investment in R&D across the UK in 2001



Source: Office for National Statistics

Chart 5.2: Regional gross value-added per head in 2001

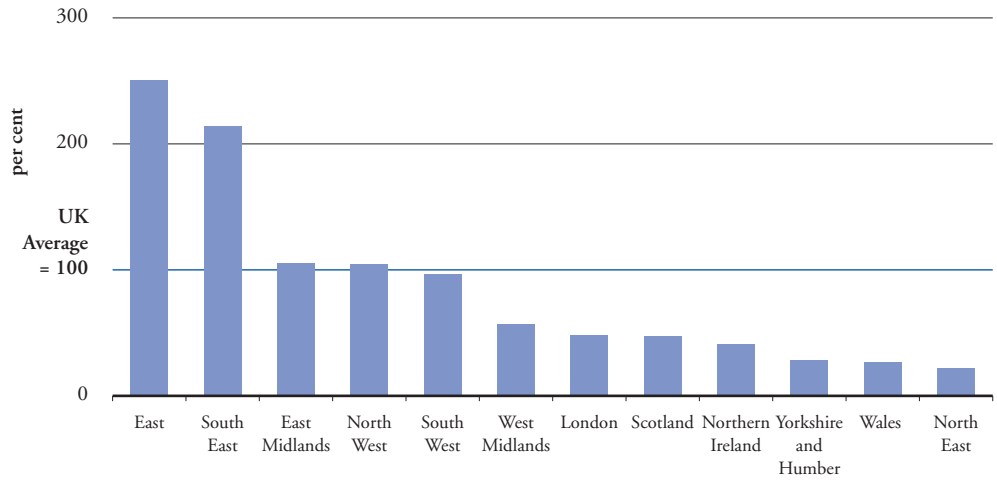


Source: Office for National Statistics

5.29 Regional differences in R&D expenditure are mainly a result of business investment. Across the UK, business invested a total of £11.5bn in R&D in 2000, over three times more than the higher education institutions. Chart 5.3 shows that this investment was substantially concentrated in the East and South East, with the North East, Yorkshire and Humber and Wales receiving below 30 per cent of the UK average. This reflects the decisions of an overwhelming majority of large, research-intensive companies to locate their activities there. Three-quarters of the UK's 100 most research-intensive firms are located in the South East, East and London.[15]

[15] *The R&D Scoreboard 2003*, DTI, 2003, analysis by Frontier Economics, 2003.

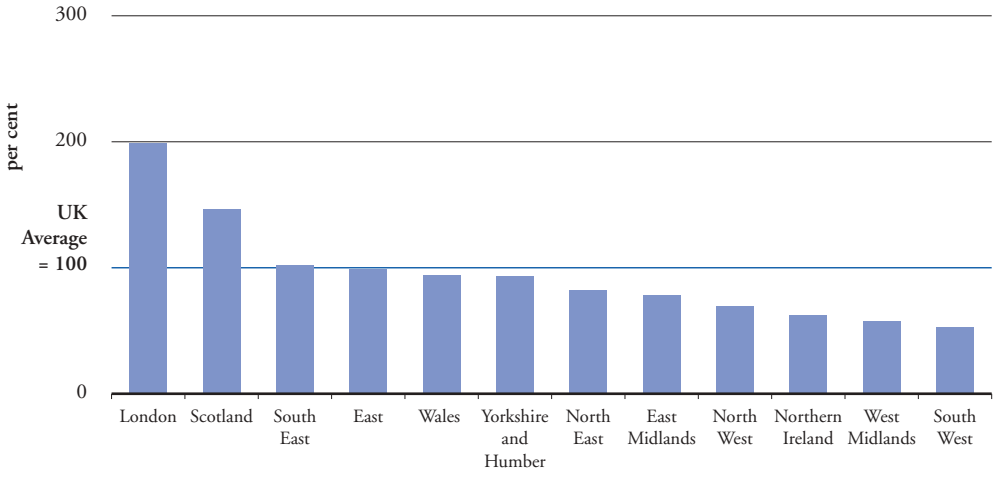
Chart 5.3: Business expenditure on R&D in 2001 – £ per head as a percentage of the UK average



Source: Office for National Statistics

5.30 Chart 5.4 shows that higher education expenditure on R&D is greatest in London and Scotland relative to their population size, and like business investment in R&D it is more concentrated in the East and South East than in the other English regions, Wales and Northern Ireland.[16] However the concentration is less strong than with business investment. But the regional differences in business and higher education investment in R&D combine to make the total level of research collaborations highest in London and the South East.[17]

Chart 5.4: Higher education expenditure on R&D in 2001 – £ per head as a percentage of the UK average



Source: Office for National Statistics

[16] *Funding Research Diversity*, Universities UK, 2003, argues that these disparities will increase following the changes to HEFCE's QR distribution set out in the higher education white paper.

[17] Higher education-business interaction data for 2001-02, HEFCE, 2003.

5.31 With significant business and higher education investment in R&D and several internationally important knowledge-intensive clusters, the South East has the strongest conditions in the UK for growth in high-technology fields. Indeed, the counties with the fastest growth in high-technology manufacturing and services in England are heavily concentrated in the golden triangle of research-based universities. Of the counties with the highest proportion of employees in the high-technology sectors, Cheshire is the furthest north (Table 5.4).

Table 5.4: High-tech manufacturing and services employment and growth

	Employees in high-tech manufacturing and services			Growth in employees in high-tech manufacturing and services	
	1991-2000	**% of all employees**	**Number**	**1991-2000**	**% growth**
1	Berkshire	21.3	94,000	Oxfordshire	82.5
2	Cambridgeshire	15.3	51,650	Berkshire	64.6
3	Oxfordshire	15.2	48,000	Wiltshire	40.6
4	Warwickshire	15	32,750	Cambridgeshire	28.9
5	Hertfordshire	14.7	72,950	Buckinghamshire	26.9
6	Buckinghamshire	14	47,800	Surrey	24.2
7	Cheshire	13.9	61,800	East Sussex	18.1
8	Wiltshire	13.9	38,650	Shropshire	15.1
9	Bedfordshire	13.5	30,000	Greater London	14.7
10	Surrey	13.1	73,950	Nottinghamshire	13.1
	England	10.4	2.26m	England	3.8

Sources: Oxfordshire Economic Laboratory: ONS

5.32 Some RDAs are supporting business-university R&D projects, to increase the level of business-relevant research in their region. The case study of One NorthEast below is one example. Another is Northern Ireland's development agency – Invest NI – that has set up its own programme to encourage business-university R&D projects. Its Start Programme provides financial assistance to companies trying to develop an industrial research project with a university. It can be used for up to 50 per cent matched project funding, to a maximum of £2m per project. The last evaluation of the scheme in 2001 concluded that it was responsible for an additional 9 per cent increase in business R&D expenditure and an additional 50 per cent increase in business investment in strategic research, when measured as a percentage of GDP in Northern Ireland.

Case study: North East centres of excellence and Regional Selective Assistance

One NorthEast is investing £200m over five years to develop five sector-based research centres of excellence. The funds will be used to build new research infrastructure and to provide matched funding for collaborative business-university research projects in the centres. The region's Science and Industry Council developed the idea, which is to focus support on a small number of research priorities. Research by Arthur D. Little and others was used to choose which sectors to support.[18] The main criteria were the strength of the existing research base and the level of business demand.

The North East also receives business support funding through the DTI's Regional Selective Assistance scheme. Some £39m was offered to businesses in the region in 1999-2000.[19] In the past this funding has been used to subsidise inward investment from manufacturers. But the RDA is now concentrating on developing regional skills as a way of attracting new businesses. The research-based universities in the region, led by Durham and Newcastle, are central to that strategy.

The North East receives a large share of English RSA because it has relatively high unemployment levels. However the RDA cannot use selective assistance to support investment in business-university collaborations, because the scheme's rules make it difficult for knowledge-intensive businesses to get grants.

REGIONAL SELECTIVE ASSISTANCE

5.33 One important channel of UK regional business support is Regional Selective Assistance (RSA). This scheme was designed in the early 1970s to reduce unemployment rates in disadvantaged areas, and it is still used to support private investment that creates or safeguards employment. Projects are only eligible for RSA when they involve capital investment, are in disadvantaged areas, have a positive regional economic impact and create or safeguard jobs. The capital projects most likely to receive funding are the ones that support the most jobs, and these will often be in businesses that spend little on R&D and innovation.

5.34 The English RDAs distribute half of the budget for England's RSA scheme, while the DTI is responsible for offers above a certain level. The development agencies in Scotland, Wales and Northern Ireland administer their own schemes themselves. RSA is at least partially managed by development agencies across the UK so that it can be used to support their economic strategies. Several development agencies have made it a priority in their strategies to promote knowledge-intensive clusters and businesses, and to support the region's infrastructure for collaborative R&D projects with universities. But the development agencies have not been able to use RSA to support many of these projects.

5.35 In a study of the English part of the scheme earlier this year, the National Audit Office (NAO) found that RSA amounted to more than £300m in the three years to 2001-02, with the great majority going to manufacturing industry.[20] Drawing on data up to 1998, the NAO found that the scheme's overall effects on productivity had not been large, that it probably produced fewer jobs than had been expected, and that it had mainly supported businesses that were not knowledge-intensive. The DTI assessed the scheme as relatively poor value for money in generating productivity improvements up to 1998.

[18] *Realising the Potential of the North East's Research Base*, Arthur D. Little, 2001.
[19] *Enterprise Policy in the Regions*, House of Commons Trade and Industry Select Committee, 2001.
[20] *The DTI: Regional Grants in England*, National Audit Office, 2003.

5.36 In the last three years, the DTI has made some changes to the way RSA is administered. These aimed to shift the focus of the scheme from supporting as many jobs as possible to higher quality projects that have a wider economic benefit. This would make more knowledge-intensive companies eligible for funding. But the NAO report suggested that these changes have not been as effective at improving support for knowledge-intensive businesses as had been intended. The DTI is looking at the scheme again as part of its review of business support.

5.37 The Review believes that RSA should be able to support knowledge-intensive clusters and businesses, as well as helping to build a region's infrastructure for collaborative R&D projects with universities. The scheme needs to be changed to make it easier for development agencies to use it to support their regional economic priorities.

Recommendation 5.2

The Government should change RSA so that it can support more knowledge-intensive clusters and businesses, and be used to help build a region's infrastructure for collaborative R&D projects with universities.

6 Funding university research

6.1 Businesses look for a number of different qualities when they are considering research partnerships with universities. The ways in which university research departments are financed make a critical difference to their ability to meet the sometimes conflicting needs of their business partners.

6.2 The first and most important requirement for business is a critical mass of research – an overall science base which excels in depth, range and quality. The scale of a country's overall investment in research and development (R&D) has a direct relationship with the dynamism and productivity of its economy: as a general rule, countries and regions which do not invest much in research will generate less value-added and have a poorer productivity record than those which do. So businesses have a real interest in the scale of the science base in the countries where they operate.

6.3 Second, companies benefit from access to world-class research: from being able to work alongside academic researchers who are at the cutting-edge of their discipline. The very largest companies can afford to build partnerships anywhere in the world: BP has major relationships with Stanford, Massachusetts Institute of Technology (MIT), Caltech, Berkeley and Princeton in the US, Tsinghua in Beijing as well as with Cambridge University and Imperial College in the UK. However, most businesses will find it more convenient to work with top-class researchers closer to home, and so have an interest in the development of a range of world-class research departments in the UK.

6.4 Companies can also benefit greatly from research work which is not necessarily world-class in terms of its ambition and scale but which is relevant to their fields of activity and helps them to create innovative products and services. They may also be interested in work that will take them closer to the marketplace.

6.5 Proximity also matters, especially to small and medium-sized companies (SMEs). Even big businesses find it harder to collaborate with university departments on the other side of the country than they do with those that are within easy reach of their base. Small companies do not usually have the time or money to build partnerships with university departments that are not located in their neighbourhood. So business across the UK would not be well served by a university system which concentrated all its research expertise in the south eastern corner of England.

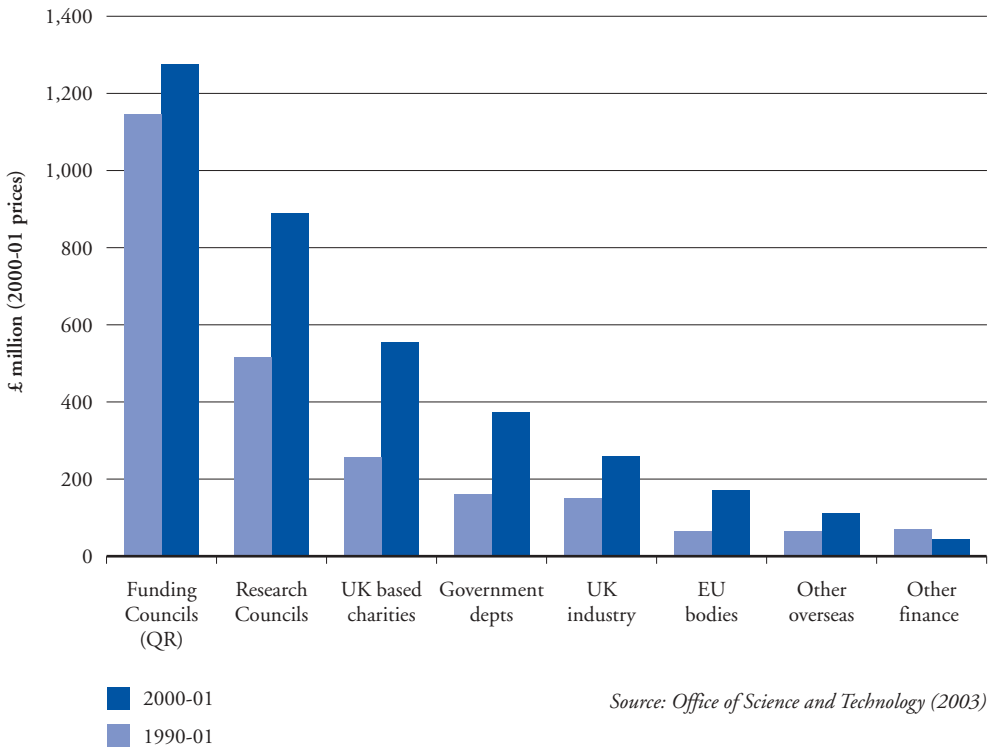
6.6 Accessibility is another quality which is of great importance to business, again especially for small companies. Universities are complex and sometimes rather forbidding institutions. Companies need to be able to find their way on to the campus, and discover what relevant work is being done there. Ideally, they should find partners who share a sense of entrepreneurial excitement.

6.7 In many ways, businesses and universities do not make easy bedfellows. They have different values and different missions. They work on different time-scales towards different objectives under different management systems. Building a culture that allows the two to come together in a creative fashion requires a considerable commitment from both sides, and an infrastructure that can sustain the relationship.

THE UK RESEARCH FUNDING SYSTEM

6.8 University research departments in the UK have five main sources of funding. Chart 6.1 shows how these have developed over the last decade.

Chart 6.1: Comparison of sources of university research funding in the UK in 1990-91 and 2000-01 (constant prices)



Source: Office of Science and Technology (2003)

6.9 The Government provides the two largest streams of funding, through what is known as the dual support system. The first comes from the Funding Councils, and is generally known as quality related or QR funding. There are four Funding Councils in the UK, the Higher Education Funding Council for England (HEFCE), the Scottish Higher Education Funding Council (SHEFC), the Higher Education Funding Council for Wales (HEFCW) and the Department for Employment and Learning, Northern Ireland (DELNI). QR funding is intended to pay for the salaries of permanent academic researchers, the costs of training new researchers, the resources to build research capabilities and the freedom to pursue a certain amount of blue-skies research. Since it comes in the form of a block grant, it also gives the university the ability to shape its overall research strategy. QR funding is allocated on the basis of past performance as measured by the Research Assessment Exercise (RAE), a peer review process that ranks a wide range of different subject areas.

6.10 The second part of the dual support system comes from the Research Councils, mostly in the form of project grants which are allocated to particular researchers in response to proposals for programmes to carry out future work. Here again the grants are allocated by way of a peer review process. There are seven Research Councils: the Biotechnology and Biological Sciences Research Council (BBSRC), the Council for the Central Laboratory of the Research Councils (CCLRC), the Economic and Social Research Council (ESRC), the Engineering and Physical Sciences Research Council (EPSRC), the Medical Research Council (MRC), the Natural Environment Research Council (NERC) and the Particle Physics and Astronomy Research Council (PPARC). In addition, the Government announced in the higher education white paper its intention to convert the Arts and Humanities Research Board into a fully-fledged Research Council by 2005.[1] In May 2002, Research Councils UK (RCUK) was established. This provides a formal structure to encourage interaction and collaboration between the Councils.

6.11 The charity sector provides the third most important stream of finance to universities in the UK. The best known example is the Wellcome Trust, which awarded over £330m in grants to UK universities in 2000-01, including more than £120m on the Joint Infrastructure Fund, the Science Research Investment Fund, and other major building and equipment contributions.

6.12 The fourth largest source is other government departments – which includes significant contributions from the Ministry of Defence and the Department of Health.

6.13 The fifth largest source of research funding in the UK's universities comes from business and industry in the UK. In 1990-91, UK industry spent £114m on research in UK universities – equivalent to 6% of universities' total research income. By 2000-01, this had increased to £259m – 7% of total research income.[2]

6.14 Chart 6.1 shows that over the last decade there has been far greater real terms growth in funding from the Research Councils than from the Funding Councils. It also illustrates the increasing importance of third-party research income, particularly from charities, government departments and industry. In 1990-91, approximately 30 per cent of total university research income came from third-parties: a decade later, in 2000-01, this had increased to 40 per cent.[3]

6.15 Another much more modest source of public funding – so called third stream funding – is aimed at promoting the transfer of knowledge from university research departments into the business and wider communities. In England, this has taken the form of the Higher Education Innovation Fund (HEIF.) Among other things, HEIF money has been used by universities to finance their business liaison and technology transfer offices, and to support spinouts and other business ventures. The Government plans to increase the size of this fund to £80m in 2004-05 and £90m in 2005-06.

THE DISTRIBUTION OF RESEARCH FUNDING

6.16 The distribution of funds to individual institutions varies for each research funding stream. Table 6.1 shows the 15 English universities in receipt of the most research funding from three of the main research funding streams in 2000-01.

[1] *The Future of Higher Education*, DfES, 2003.
[2] *Resources of Higher Education Institutions*, Higher Education Statistics Agency (HESA) 1990-91 and 2000-01.
[3] Third-party research income is all income from charities, government departments, industry, EU, overseas and other sources.

Table 6.1: Distribution of research funding in England for QR funding, Research Council grants and industrial research grants and contract income

	RESEARCH FUNDING STREAM		
	QR funding, Higher Education Funding Council for England	**Research Council Grants**	**Industrial research grants and contracts**
1	Oxford	Cambridge	Imperial College
2	University College London	Oxford	Oxford
3	Cambridge	University College London	Cranfield
4	Imperial College	Imperial College	Nottingham
5	King's College London	Manchester	The Open University
6	Manchester	Southampton	Cambridge
7	Birmingham	Birmingham	King's College London
8	Leeds	Sheffield	University College London
9	Sheffield	Leeds	Southampton
10	Bristol	Nottingham	Leeds
11	Southampton	Bristol	Birmingham
12	Nottingham	King's College London	Loughborough
13	Newcastle-Upon-Tyne	UMIST	Sheffield
14	Liverpool	Leicester	Manchester
15	Warwick	Liverpool	Newcastle-Upon-Tyne
Total funding allocated to the 15 universities in receipt of the most funding from that stream.	£514m	£399m	£146m
Total research funding for all universities in England from that stream.	£847m	£581m	£215m
Percentage of total funding for a particular stream going to the top 15 English universities.	60.7%	68.6%	68.0%
Source:	*QR allocations, HEFCE, 2000-01.*	*Research Council grants, HESA 2000-01.*	*Industry funded research grants and contracts, HESA 2000-01.*

6.17 Note the close similarity between those institutions that receive QR funding and those that receive funds from the Research Councils. Also note the heavy concentration of all three funding streams on the top 15 universities.

6.18 Many of the same universities also appear in industry's top 15 research universities, but in a rather different order. A few institutions appear on industry's list of favourites that are not featured in the other two – for example Cranfield and Loughborough. This suggests that the priorities of business may be rather different from those of Government.

STRENGTHS AND WEAKNESSES OF THE PRESENT SYSTEM FROM A BUSINESS PERSPECTIVE

6.19 UK investment in R&D within higher education in 2001 was 0.4 per cent of GDP which places the UK 14th out of 29 OECD countries.[4] Public spending on science – both within the university system and more broadly – is rising significantly in real terms. The UK, with 1 per cent of the world's population produces 9 per cent of the world's scientific publications and over 10 per cent of citations.[5] This suggests that the overall performance of the UK's academic science base is strong.

6.20 A relatively small number of the country's research-intensive universities are securing a rising share of research funding. This puts them in a better position to compete for the best talent in the world, and produces some economies of scale – especially in those areas of "big science" where infrastructure is expensive. Higher ranked departments appear to produce more papers and citations per pound of public money invested than do those that receive lower grades under the RAE.[6]

6.21 On an international scale, UK universities are still struggling to hold their own against the enormous resources and talent that are found in the research-intensive universities of the US. However, the UK is on an improving path relative to most other countries.

6.22 In addition, UK universities have changed their approach to working with business over the past ten years. Academics are more likely to welcome the chance of working with industrial partners than used to be the case: in this respect, there are signs of a marked change of culture across most campuses in the UK.

6.23 This trend has been driven in good measure by money. Universities have been forced by economic circumstances to hunt around for new sources of cash and equipment, putting a new emphasis on business partnerships. Third stream funding, although relatively modest in size, has provided an incentive to build relationships with business. In addition, the development of new science-based businesses – especially in biosciences and information technology – has created fresh opportunities for researchers to work with business.

6.24 A new role model, the entrepreneurial academic, has appeared on many campuses and some of them have become rich as a result of their efforts in consultancy, or by creating and subsequently selling spinout companies.

6.25 For all these reasons, the opportunities for creative partnerships between business and universities have significantly increased in recent years. The quality of departmental research work has been raised by the RAE and by the efforts of the Research Councils. And third stream funding has made it easier for this new knowledge to be disseminated more broadly across business and the economy at large. But from a business perspective, there are still a number of drawbacks in the current approach to funding.

[4] *OECD Science, Technology and Industry Scoreboard*, OECD, 2003.
[5] *Funding Research Diversity*, Evidence UK, 2003.
[6] Unpublished analysis undertaken by the Cabinet Office, 2002.

WEAKNESSES IN THE CURRENT FUNDING SYSTEMS

6.26 The first lies in the way that the RAE operates. QR funding is one of the most important sources of funding for universities, both because of its size and because it comes in the form of a block grant. This allows vice-chancellors some freedom to allocate resources where they see fit. So it is not surprising that nearly all universities do everything they can to improve their performance in the RAE rankings.

6.27 The assessment is intended to recognise world-class research undertaken with business partners, as well as other forms of academic excellence. In practice, however, the assessment panels tend to concentrate on purely academic benchmarks, such as output in important journals. This may be partly because this kind of output is what most interests the people who sit on the peer review panels. It is also because such work is easier to measure than business collaboration. An article in an academic journal has by definition been through a rigorous process of assessment even before it appears, and can be judged against similar work from other sources. It is much harder to define what constitutes world-class research undertaken with business partners.

6.28 This bias has an impact on the way that research departments operate. Given the choice between producing an academic paper and working with industry, an ambitious academic is more likely to take the former option: that way lies extra funding for the department, and an increased chance of promotion. The Review came across a number of cases where departments had deliberately decided not to work with business in order to concentrate all their efforts on raising their RAE rankings.

6.29 In addition, the importance attached to QR funding has tended to homogenise the research efforts of the university system. Less research-intensive universities invest large amounts of time and money in preparing for the RAE even though they may have very little hope of gaining significant extra funding as a result. Instead of concentrating on their own areas of comparative advantage – which may be of real value to their local and regional economy – they strive to be measured against a world-class benchmark.

6.30 Another criticism by business of the RAE is that it fails to give sufficient weight to multi-disciplinary research. Because the assessment is undertaken by a large number of panels divided up on the basis of subject areas or units of assessment, it can be difficult to reward work that cuts across different disciplines – precisely the kind of research that is of increasing importance to business.

6.31 There are broadly similar concerns about the ways in which the Research Councils operate. One of them, the Engineering and Physical Sciences Research Council (EPSRC), has made a particular effort to develop collaborative projects with business. It says that such work represents around 40 per cent of its current research programmes, up from just 13 per cent a decade ago. Other Research Councils have much less exposure to the business sector, with relatively few active business people on their boards.

6.32 No doubt it is easier for the EPSRC, which covers the engineering sectors, to develop collaborative links than it is for, say, the Particle Physics and Astronomy Research Council. All the Councils have mechanisms for funding research in collaboration with industry. These include set-piece schemes which are often funded jointly with the DTI, such as LINK and Knowledge Transfer Partnerships; network-type projects such as the Faraday Partnerships; funding for joint business-university projects; and the financing of PhD students in the workplace.

6.33 All the same, there is a view in business that Research Councils taken as a group could do more to build collaborative links with business. There are also complaints that the Councils' efforts to break out of their individual specialisation and develop multi-disciplinary research projects have not gone far enough. One of the main aims of Research Councils UK is to address these issues urgently.

SELECTIVITY

6.34 There are different views among businesses about the case for concentrating a growing share of public funding on a small number of research-intensive universities. Some of the very large multinationals would like the process to go even further, arguing that the UK can only afford a very small number of truly world-class research departments.

6.35 But it is not just small companies that take the opposite position. Others are concerned that selectivity will lead to growing regional imbalances, and may take resources away from promising new fields of research. Building up the so-called golden triangle of research-intensive universities in the south east at the expense of the rest of the country would restrict competition among researchers and make it harder for other universities to break their way into the top division.

6.36 The greatest worry is that research departments which are doing work that is of real value to business but which do not rank highly on the RAE will find it increasingly difficult to sustain themselves. Universities like Cranfield and Loughborough attract a significant volume of business investment but only a relatively modest proportion of QR funding. Many of the post-1992 universities (the former polytechnics) have their roots firmly embedded in their local business communities but get very little support from the dual support system. Increasing selectivity of funding will make their task even harder and is likely to have a negative effect on the overall amount of business-university collaboration.

6.37 The globalisation and growing costs of scientific research suggest that the arguments for greater selectivity in favour of world-class research departments will continue to strengthen. But this approach needs to be balanced by a broader view of the reasons for the public support of university research. Other forms of funding need to be developed to support alternative forms of excellence and emerging fields of research, as well as to ensure that all the regions and nations can share in the economic and intellectual benefits of R&D.

POLICY RECOMMENDATIONS

6.38 Two separate reviews are currently under way on the workings of the dual support system. Sir Gareth Roberts has undertaken a review of the RAE on behalf of the Funding Councils.[7] Also the Office of Science and Technology (OST) has recently consulted on options for implementing proposals for universities to recover the full economic costs of their research.[8]

6.39 The outcome of these two separate reviews will have profound implications for the funding of university research in the UK. Not surprisingly, they have stirred up a passionate debate across the whole higher education community. This Review recommends that the Government should now take stock of the outcome of both reviews together in deciding on the future direction of research policy and funding in the UK. Without attempting to prejudge the outcomes, there are some business considerations which will need to be taken into account in the debate.

[7] *Review of Research Assessment*, Final Report, Sir Gareth Roberts, 2003.
[8] *The Sustainability of University Research: a consultation on reforming parts of the dual support system*, Office of Science and Technology, 2003.

6.40 Over the past decade growth in Research Council funding has significantly outstripped the growth in QR funding. The increasing imbalance between the two funding streams has led some observers to question the present dual support system. Business has a real interest in the sustainability of strong university departments, and in public funding which supports creative and innovative research.

6.41 This Review supports the Government's principle of dual support – that is, of having two separate funding streams. However the Review also believes that the relative size and shape of the two funding streams may need to be adjusted as the research base and its users' needs develop and change over time. There is clearly a balance to be struck between providing stability of funding on the one hand, and on the other, providing a dynamic and competitive research funding system that supports new and emerging fields of research and researchers. This Review believes that in the light of the two recent reviews, the Government should now consider whether it has got the balance between the two funding streams right.

Recommendation 6.1

The Government should now take stock of the proposals in the review of research assessment and in the review of the sustainability of university research. It should consider the conclusions of these two reviews together when deciding on the future direction of research funding and policy in the UK.

From a business perspective, there are some principles that the Government should take into account in assessing the proposals contained in these reviews.

- World-class excellence across all types of research should be recognised and rewarded by the RAE and Research Council peer review processes. Excellent research undertaken with industry or other users should be recognised as being of equal value to excellent academic research.
- There should be significantly more business input into the priority setting, decision-making and assessment panels of both of the peer review processes.
- The processes should be flexible and dynamic, capable of supporting new ideas and talent wherever they are found.
- Funding should be allocated in a way that actively supports multi-disciplinary research.
- The processes should be as simple and unbureaucratic as possible and should support the long-term sustainability of the research base.
- Greater weight should be attached to the importance of disseminating research to a wider audience outside academia in an accessible format.

The Government should consider the relative size of the Funding Council and Research Council funding streams and whether the present system provides the appropriate balance between giving institutions stable research funding and promoting a dynamic and competitive research base.

6.42 All this implies significant changes in the workings of the Research Councils as well as of the RAE. Developments along these lines will help to encourage a broader and deeper approach to relationships between business and universities in the UK. But there are limits to the scope of this change. The dual support system is intended to support excellence in research, measured against a high benchmark. If its scope were broadened radically, public resources would be spread too thinly across the university system, putting the research-intensive universities at a disadvantage in the competition for global research excellence.

INTERNATIONAL COMPARISONS

6.43 Different countries have adopted different models for funding research. In the UK, the majority of government funding for research is allocated to universities through the dual support system. The Government also provides significant support for research direct to companies through the R&D tax credits. The perception is that the UK research funding system has tended to favour investment in basic research over applied research. Although a number of factors drive a country's innovation performance, the statistics suggest that the UK is strong in basic research but less good at bringing ideas to the market. The UK has a citation rate that is 53 per cent higher per capita than Germany, but Germany makes 230 per cent more patent applications per capita than the UK.[9]

6.44 Germany is unusual in retaining public sector research establishments as a substantial part of its system. The German federal and regional Governments invest in a significant amount of industrially relevant research through the Fraunhofer Society and its network of 57 Fraunhofer Institutes. Each institute carries out contract research for the public sector and for industry, including SMEs which lack the critical mass to conduct their own R&D. The Institutes focus on eight priority areas: materials technology, production technology, ICT, microelectronics and microsystems, sensor systems, energy and construction, environment and health, and technology forecasting – all areas of strategic relevance to the German economy. The federal and regional Governments together invested 365m euros in 2002 in the Institutes. In addition they provide project grants alongside the EU and industry.

6.45 The US federal Government spent $19bn on research in US universities in 2001 – split 78 per cent on basic research and 22 per cent on applied research. This represents an enormous investment in applied knowledge.

US investment in university research

Twenty years ago, total research spending in the both the UK and the US represented around 2.4 per cent of each country's GDP. But in the following two decades, their paths have diverged sharply. By 2001, US spending was up to 2.8 per cent of GDP, while the UK share had declined to 1.9 per cent.

University-based research plays a critical role in the US system of technological innovation, and funding has grown at a rapid pace in real terms.[10] Much the biggest share – roughly three-fifths – comes from the federal Government, which put a total of $19.2bn into university research in 2001. The largest increase in federal funding since 1970 has come from the National Institutes of Health, and more recently the Department of Defense has also been increasing its contribution.

Industry funds around 7 per cent of total research spending in US universities, and has been the fastest growing source of funding for academic R&D over the last 35 years. Over a fifth of total university spending on R&D last year was classified by the National Science Foundation as applied research – an enormous investment in applied knowledge.

[9] *Eurostat Technical Indicators*, 2003. The UK made 133 patent applications per million inhabitants to the European Patent Office, compared to 145 for France and 310 in Germany in 2001.

[10] *The Impact of Academic Research on Industrial Performance*, National Academy of Engineering, 2003.

US investment in university research *(continued)*

One of the great strengths of the US university system lies in the scale of its endowment funds – endowment income and unrestricted gifts have been another rapidly growing source of research funding in recent years. Research by the Sutton Trust emphasises the growth of overall endowment funds.[11] Twenty years ago, Harvard was the only university with an endowment of more than $1bn, whereas now there are 39 institutions. Oxford and Cambridge would each come in at around 15 on the US list, but no other UK university would make it into the top 150.

Cutbacks in state funding and the setback in the stock market mean that many US universities are less prosperous than they were. However, their financial resources still look daunting when seen through UK eyes. The University of Southern California, for example, has set up a war chest to recruit 100 star academics in the next three years. It has put aside $100m for the purpose.

AN EMERGING FUNDING GAP

6.46 The Review has identified an emerging gap in the funding and support for university departments around the country which are undertaking research that is directly relevant to business but which are not receiving significant funding through the dual support system. If the concentration of QR funding continues, university departments working with industry may be under threat. The case study of the University of Greenwich and GlaxoSmithKline (GSK) illustrates this point.

A Case Study: The University of Greenwich and GlaxoSmithKline

GlaxoSmithKline (GSK) spent more than £2.6bn on R&D in 2002, with almost half of its research being carried out in the UK. In the UK, although more than 70 per cent of its collaborations are with 5 and 5* RAE-rated departments, the company works with many 3A and 4 rated departments at universities which have developed "niche" areas of research activities directly relevant to its needs. One of these, the Wolfson Centre for Bulk Solids Handling Technology at the University of Greenwich, claims to be the only research centre in the UK that concentrates on the technologies of storing and handling powdered and granular solid materials in bulk. Its work is truly multi-disciplinary, embracing chemical, mechanical, civil and process engineering. In addition to companies in the pharmaceutical sector such as GSK, the centre has developed a wide range of collaborative links with organisations in the chemicals, oils, food and minerals sectors, in research on solids handling.

GSK and the Wolfson Centre were partners in the Quality in Particulate Manufacturing initiative which had both government and industry funding. The benefits that accrued to GSK included the development of unique test instruments for powder segregation and degradation, and relevant data input into predictive models of pharmaceutical development. Substantial cost savings were made using this research in the design of more robust powder processes.

The Wolfson Centre has a 3A RAE rating. If Greenwich's research funding is cut because of a fall in its QR funding it may be difficult for it to maintain its basic research and associated technology transfer activities.

[11] *University Endowments – a UK/US Comparison*, Sutton Trust, 2003.

6.47 Even if the RAE assessment process is reformed to reward collaborative research with industry, it will be years before university departments around the country see the benefits. The next RAE is unlikely to take place until 2007 or 2008.

6.48 There is a tension between funding world-class research, where concentration of research funding makes sense, and funding research that is relevant to business, where a broader distribution of resources is desirable. Table 6.1 showed that the funding from the dual support system is highly concentrated on the top 15 English universities. For business-university collaboration, proximity matters. Business-university collaboration would not be well served by a university research funding system that increasingly concentrated more resources on fewer universities. If more small and medium-sized companies are to work with universities on research and innovation then a broader distribution of resources is desirable.

649 This Review has therefore concluded that a new stream of funding should be developed to ensure that business-relevant research is supported more broadly across the regions and nations of the UK. However, two points are worth emphasising.

6.50 First, this new funding should not come at the expense of world-class research at the UK's research-intensive universities. The increase in spending on such research in recent years may be just enough to keep them competitive on a global scale. Public resources are limited and the Government will need to consider the recommendations of this Review in the context of the Spending Review. But investment in research departments which can show that they have strong backing from business will bring significant economic returns.

6.51 A second important point is that Government should not be in the business of subsidising industry's near-market research. Companies should pay at least the full economic cost of contract research, and should be looking to universities for help in their research efforts rather than in their product development.

Recommendation 6.2

The Government should create a significant new stream of business-relevant research funding, which would be available to support university departments that can demonstrate strong support from business.

Demand for the funding from business would need to be assessed but funding in the region of £100m-£200m could be an appropriate starting point.

ADMINISTERING THE NEW BUSINESS-RELEVANT RESEARCH FUNDING

6.52 The objective of this proposed new business-relevant research funding stream is to encourage greater collaboration between businesses and universities across the UK, and ultimately to increase productivity and economic growth. The funding would provide matched finance to those university departments which can demonstrate that they are doing research projects that are of proven value to business. In particular, it would be highly desirable to support collaborative research projects that brought SMEs into the world of research and innovation.

6.53 There would be various possible ways of distributing such funding. One approach would be to broaden the scope of HEIF. Currently HEIF provides universities with funding to build their capacity to engage in third stream activities. But it does not support actual research projects. Its remit could be broadened so that it could provide universities with funding to support collaborative research projects with business. The Review has some concerns about this method of distribution. First HEIF is allocated to universities, and the proposed new funding is intended to support university departments which are doing business-relevant research. Second, such an approach would be driven by the supply side. The risk would be that the researchers would decide on the collaborative projects themselves and seek out industrial partners whose interests matched theirs rather than the other way around.

6.54 Another possible approach would be to expand significantly the scope of some existing government schemes, such as the LINK programme. This is the Government's principal mechanism for promoting partnership in pre-competitive research between industry and the research base. Government departments and the Research Councils fund collaborative research between industry and universities on a matched basis. The Review supports the LINK programme, which plays a very important role in promoting collaboration between industry and universities. However LINK is a national, not a regional, programme. The priorities are determined by the Government's Foresight process to meet the needs of the national economy. The proposed new funding stream needs to be demand-led and capable of supporting departments that are doing valuable work for business, but which do not necessarily attract significant funding through the dual support system.

6.55 The Review suggests that the best vehicle for distributing such funding would be the Regional Development Agencies (RDAs) and their equivalent bodies in Scotland, Wales and Northern Ireland. The RDAs are business-led, and close to the market. They are well positioned to judge whether research projects have sufficient business support. In Chapter 5 this Review recommends that the RDAs should be set the specific target of encouraging business-university collaboration, and having access to funding to support such efforts should make a real difference to their ability to help broker new relationships. The new funding would be allocated to the RDAs through their single pot allocation, which would ensure that those regions with low levels of business R&D – and therefore with the most need to encourage greater business-university collaboration – would receive the largest shares of the new money.

6.56 The metrics would be simple, and entirely business-led. University departments would need to demonstrate to their RDAs evidence of successful collaboration with business in the past and – more important – would need to produce clear evidence, in the shape of financial commitments, that companies wanted to work with them on collaborative projects in the future. The RDAs would determine which collaborative projects and university departments they wished to support in line with their economic strategy. They would provide the university departments with matched industrial funding on a sliding scale, geared to how close the project was to being commercialised. Near-market research would get much less public funding than would basic or strategic research work.

6.57 It is difficult to gauge the likely demand for such funding. However, it would need to be sizeable in order to balance the increasing selectivity of the dual support system. Something roughly comparable in scale to the expanded HEIF – that is, about £100m-£200m a year in England – might be an appropriate starting point.

6.58 Their critics say that some RDAs do not have the capacity to create dynamic relationships in this way. But the Government could offer a stick as well as a carrot. RDAs which failed to hit their targets on business-university collaboration might have the money taken away from them and handed over to more successful authorities.

Recommendation 6.3

There are a number of possible ways to allocate the new business-relevant research funding stream including an expansion in the scope of HEIF, an expansion of existing schemes such as LINK, or allocation through the RDAs and their equivalent bodies in Scotland, Wales and Northern Ireland.

The Review's preferred approach is to allocate the new funding stream to the RDAs through their single pot allocation, and to provide them with targets on promoting business-university collaboration.

- RDAs would match fund the contribution by business to collaborative research projects on a sliding scale. For basic and strategic research, RDAs would match the business contribution: for near-market research, the support would be lower.
- RDAs would prioritise the applications from university departments by considering the likely economic impact of the research and the fit with their regional economic strategies. They might prioritise applications involving previously non-collaborating SMEs.
- If the Government invests less than the proposed £100m-£200m in England, the priority should be to support university departments which are doing work of value to business, but which do not receive significant QR funding through dual support.

Any new increase in the budgets of the English RDAs would lead to a consequential increase in the budgets of the devolved administrations. It would be for the devolved administrations to decide how to allocate any such increase in their budget. However, the Review hopes that they would consider the recommendations in this report in deciding how to allocate any such increase.

6.59 There are good international examples of this sort of regional matched fund, which have had positive effects on business R&D. The New York State Office of Science, Technology and Academic Research (NYSTAR) has developed 15 state-wide research centers in specific technology areas, selected on the basis of existing industrial strength and university research excellence. They link together university researchers and draw matched industrial funding with the aim of increasing the economic impact of university research. To date NYSTAR estimates that over $1bn revenues, cost savings and capital expenditures have been achieved by participating companies, from a state investment of $40m.

6.60 In addition, New York State has invested $250m in five centres of excellence in bioinformatics, photonics, environmental systems, nanoelectronics and IT. The selection of these five disciplines was industry-driven. For example, the photonics centre of excellence is based around the University of Rochester, where there is a strong cluster of imaging related companies including Eastman Kodak, Corning and Xerox. The state has leveraged its investment by 3:1 with contributions from private sector and other contributions – providing New York State with over $1bn in new investment in state of the art multi-disciplinary research centres.

6.61 The Review is not proposing that the new funding would support only businesses from within the university's region. An RDA might decide that work undertaken in a university department for national and international companies had important economic impacts for its region – for example by attracting significant inward investment or generating a wider economic cluster – and could therefore decide to support it.

6.62 The School of Biological and Molecular Sciences at Oxford Brookes University, provides a possible example.

Case Study: Oxford Brookes University and the Brewing Industry

The School of Biological and Molecular Sciences at Oxford Brookes University received an RAE rating of 3A in 2002, and does not receive HEFCE QR research funding, even though it hosts a number of internationally recognised research groups. Within this School, the Brewing Yeast Research Group has established an international reputation.

The research program at Oxford Brookes University has made an important contribution to the understanding of brewing yeast cell biology and its exploitation in the production of alcoholic beverages. The research programme has been funded by the European Union and a number of charitable trusts associated with the brewing industry. It has also received significant financial support from the brewing industry through CASE PhD studentships with Scottish Courage and Coors Brewers, UK (formerly Bass Brewing) and fully sponsored PhD studentships with South African Breweries and Scottish Courage. The research has attracted more than £1m funding.

The School's research activity and the supporting infrastructure relies heavily on private sector funding. This limits the extent to which it can pursue the full scope of its research interests, as underpinning hypothesis-driven science does not attract industrial funding. The lack of HEFCE QR funding also prevents continuity of employment for more senior research team members. It is likely that this will damage the long-term prospects for industrial collaboration, representing a loss to the UK and to the brewing industry.

The head of manufacturing at Scottish Courage commented: "The main area of expertise at Oxford Brookes University relates to yeast, which is the fundamental basis of brewing. Our collaborative work with the school has allowed us to understand the scientific basis of our process, challenge traditional systems, and optimise the way we make use of our yeasts to make better quality products."

GLOBAL BENCHMARKING

6.63 Government policy is to finance university research in such a way as to ensure that the UK has a number of institutions able to compete with the best in the world, but it has no yardsticks against which it can measure its success in this endeavour. British universities are still much too inclined to benchmark themselves against each other, failing to recognise that in a global marketplace what counts is how they stand up against the best in the world.

6.64 A league table of the world's best research-intensive universities would provide the Government with a way of assessing its research funding efforts. It would provide academics with a valuable reality check, and help vice-chancellors in their efforts to win the support of their colleagues and the Government for their strategic plans. Such an index need not be too difficult to create. It could be based on a combination of research citations, peer review, and the views of research-led multinational business.

Recommendation 6.4

The Russell Group of universities should encourage the development of a league table of the world's best research-intensive universities. This could well be produced by the private sector: the Sutton Trust is one group which is already considering the possibility.

7 Management, governance and leadership

7.1 The higher education white paper announced that the Review would ask business for its views on: "The present governance, management and leadership arrangements of higher education institutions and their effectiveness in supporting good research and knowledge transfer and providing relevant skills for the economy".[1]

7.2 Business told the Review that universities could be more dynamic in their approach to collaboration. The perception is of a sector that can be slow-moving, bureaucratic and risk-averse. One business leader, describing a collaborative research project, said: "It took three years to get off the ground and required old-style influencing and persuading to bring all the necessary university people to agreement. While this was just possible for a company of our size, it would have been impossible for small and medium-sized enterprises".

7.3 With over 165 higher education institutions in the UK, there is inevitably a wide range of governance structures, as well as of management qualities. This is most visible when comparing pre- and post-1992 universities.[2] The older universities were, historically, run as communities of scholars. Their management and governance arrangements were participatory: senates and councils were large and conservative. In the last ten years, there has been a gradual movement towards a more executive style of management, already common among post-1992 institutions. The new universities have constitutions that plainly differentiate management from governance: the vice-chancellor has a chief executive officer mandate, and governance is the responsibility of a small 12-24 person, lay-dominated, independent governing body. Oxford and Cambridge have a unique set of governance and management issues and these are addressed separately at the end of this chapter.

7.4 The Review asked the Committee of University Chairmen (CUC) for examples of best practice in management and governance across the sector, and carried out a number of case studies. The results at these universities are impressive. There have been marked changes for the better over the past decade in the way that universities are run.

7.5 Yet while the direction of reform in the sector is right, the pace varies widely. The next decade will present new challenges, as institutions compete on a much wider stage and as they continue to expand their third stream activities. So there needs to be a renewed effort to ensure that both management and governance are fit for modern times.

EXECUTIVE MANAGEMENT

7.6 Many universities are developing strong executive structures to replace management by committee. With well-defined lines of responsibility, clearly delegated authority and cohesive management teams of academics and administrators, this approach allows for dynamic management in an environment where decisions cannot wait for the next committee meeting. This need not be at the expense of collegiality. A culture of consensus is not only achievable, but is a priority for many vice-chancellors running executively-managed institutions.

[1] *The Future of Higher Education*, DfES, 2003.

[2] Most pre-1992 universities were established by a royal charter granted through the Privy Council; their constitutions are laid down in the charter and statutes of the institution. Post-1992 universities were established by, and their constitutions laid down in, the Education Reform Act 1988, as amended by the Further and Higher Education Act 1992.

7.7 At the centre of many well-run institutions is a small senior management team of academics and administrators. Meeting every one or two weeks, this group debates and approves contentious issues prior to implementation or referral to council. Cabinet-style teams, bringing together administrators and academics, appear to be an effective form of executive management, while maintaining the collegiality of committee-based structures.

Case Study: Dynamic decision-making

The University of Strathclyde was one of the first universities to shake up the way it made decisions. In its 1986 assessment of effective decision-making following the Jarratt Report[3], it concluded that the traditional approach "presented formidable obstacles to change" and that "'hard times' demand 'hard choices' which would require a more focused administration".[4] Over the next decade, the university consolidated schools and departments into four major faculties, devolved budgetary authority and responsibility to deans, reduced the number of committees, and created a University Management Group (UMG) of academics and administrators.

Strathclyde's UMG demonstrates a number of important best practices with regard to management teams. First, they meet either weekly or bi-monthly to ensure important decisions that need consultation are not delayed unnecessarily. Second, they are made up of senior managers from both the academic and administrative sides of the university. Third, they practise cabinet-style, collective decision-making. Individuals act in the interest of the institution and not that of the group they represent. In Strathclyde, the five deans of the university all sit on the UMG, and, unusually, two lay members of the governing body (the chair and the treasurer) and the head of the student union are invited to attend. The collective and transparent nature of executive management at Strathclyde has created a broad level of trust in the senior team.

7.8 A further component of effective management is a simple management structure. It is not uncommon for vice-chancellors to have dozens of direct managerial reports, both academic and administrative. Reporting structures matter less in collegial, committee-based systems, but the more executively run an institution, the more reporting lines need to be rationalised and clarified. This has led many institutions towards sweeping changes in the number of schools, faculties or departments, and to cut back the number of reporting lines in the university administration.

7.9 Devolution to academic units has also been a constant theme. Although not a pre-requisite of effective management, as the example of the University of Warwick demonstrates, devolving power to schools, faculties or departments can be a powerful agent for change in institutions that are seeking to create a more entrepreneurial culture.

[3] *Recommendations of the Committee of Vice-Chancellors and Principals Steering Committee for Efficiency Studies in Universities*, Sir Alex Jarratt (Chair), 1984-85.

[4] *Creating Entrepreneurial Universities*, Burton R. Clark, 1998.

Case Study: Reorganisation and devolution

Effective management is impossible without an appropriate organisational structure. Before a recent review, the vice-chancellor and registrar of Oxford Brookes University had 16 and 27 direct reports respectively. Now they have merged 15 schools into eight, and reduced the 27 administrative functions down to six directorates. Similarly, Imperial College London used to have 25 departments reporting direct to the Rector, whereas it now has five faculties. Warwick reduced 30 departments to four faculties.

At the same time, many universities are devolving authority down to academic units. The University of Southampton moved budgetary responsibility down to schools as long as 30 years ago, and many others are now doing the same. The University of Bristol has recently consolidated 49 budget holders into seven and devolved decision-making to the faculties. Clearer reporting lines have made management simpler, and delegating authority has made it easier to make resource allocation choices. King's College London, which shifted to a devolved budgeting structure around five years ago, found that academics were prepared to take difficult decisions about their budget priorities, even proposing the closure of a loss-making department.

As with the private sector, devolution is not always appropriate. Warwick, consistently one of the most entrepreneurial universities in the country, remains committed to a centralised management structure. While decentralising some aspects of financial management, Warwick believes it is vital for every unit to be part of the team. The head of every cost centre is a member of the university's Steering Committee and is thus involved in all aspects of university decision-making and planning on a weekly basis.

7.10 Many universities are reorganising their structures and delegating authority out of committees and into the hands of academic and administrative managers. The results are more rapid decision-making and more dynamic management. Other universities should follow this lead and borrow from best practice in the sector.

7.11 As part of the process of management improvement, well-run universities are appointing more professionally qualified and accredited staff, often from the private sector. Directors of human resources, estates management, marketing and communication are commonplace in leading universities. And in many cases, the role and position of the finance director has been elevated to a direct report to the vice-chancellor, indicating the increasingly important role of the finance function. To reflect these changes, some institutions are breaking with traditional and out-moded perceptions of their administrations and relabelling their administrative staff as "professional services" or "directorates".

7.12 The development and implementation of successful human resource strategies are among the most important tasks facing modern vice-chancellors. Yet despite government initiatives to support training and professional development, universities can and should do much more.

Case Study: Innovative human resource strategies

In the 1980s and early 1990s, there were relatively few directors of human resources in the sector. And with that came antiquated human resource practices. Southampton, for example, required staff to write to a committee if they wanted a pay rise. Today, however, it has one of the most active professional development programmes in the country, with an estimated 1.7 per cent of annual salary expense reinvested in human resources, annual appraisals and objective-setting. It also offers an innovative management programme, run by Ashridge Management College, designed to prepare and develop academics with managerial potential.

Strathclyde's professional development strategy includes inductions for all new lecturers, training for all department heads and an innovative programme, *Leaders for Tomorrow*, that delivers a strategic overview of the university and the sector to aspiring deans and senior administrative officers. Strathclyde has received an Investors in People award, and maintaining this award is a key performance indicator in its strategic plan.

Strathclyde has also recruited from the private sector to support its transformation. To capture the best talent, Strathclyde's pay structure is competitive, with liberal use of level 6 professorial pay scales and elements of discretionary compensation.

MODERN GOVERNANCE

7.13 Universities have also strengthened their systems of governance. Spurred on by the Dearing Report, they have been conducting reviews of their governance structures and processes.[5] But despite some excellent examples, institutions are generally not reforming fast enough to reflect their increased size and complexity, and their larger funding requirements.

7.14 Dearing recommends that each governing body should systematically review its effectiveness at least once every five years, and publish the outcomes in its annual report. The CUC states that almost every university has now carried out such a review, with most institutions making structural changes as a result. With a few exceptions, the council is now the unambiguous ultimate decision-making body and, as at 2000, the average size of governing bodies in England was 33.[6]

7.15 Very few pre-1992 universities have managed to meet Dearing's recommendation that governing bodies should have a maximum of 25 members, despite widespread agreement that larger bodies are less effective. The lack of constructive debate and low level of individual accountability in large councils is frustrating for both management and members, and attendance at each meeting is rarely above 70 to 80 per cent. Effectiveness requires high levels of engagement and individual responsibility and accountability, which is difficult to achieve with too many individuals in one room.

[5] *Higher Education in the Learning Society*, Report of the National Committee, 1997.
[6] *Review of University Governance 1997-2000*, Committee of University Chairmen, 2000.

7.16 Some claim there are benefits associated with a large membership, namely access to a wide pool of expertise and influence. But there are other ways to achieve this goal. Oxford Brookes, for instance, has created a court, a ceremonial body that connects the institution to a range of individuals and stakeholders.[7] Similarly, the University of Wales, Lampeter, after reducing its governing body from 60 to 24 members, created a court at which an array of constituents is represented. Courts, which are a feature of older universities, should not have constitutional authority – council must remain the unambiguous governing body. However, a well-run court can provide valuable links to the outside world. The University of Sheffield, on the other hand, sought to increase its interaction with outside experts by recruiting them directly on to committees. These experts are not members of the council, although they may be suitable candidates in the future.

7.17 The following case study shows that early reviews have focused on the inputs to governance, such as structures and processes. But to test effectiveness, governing bodies need to measure the outputs of their performance against objectives, and only then adjust the inputs.

Case Study: Effectiveness reviews

The first wave of effectiveness reviews focused on the structure of governing bodies. In a 1993 review, Southampton clarified the relationship between court and council to ensure that council was the ultimate decision-making body, reduced the size of the governing body from 49 to 37 members, and halved the number of committees.

Sheffield reduced the size of its council from 69 to 35 members. Before the change, the executive dominated proceedings and the council was largely a passive body. Now issues are fully debated, attendance is much higher and individual members feel more accountable. A further reduction in the future has been discussed. The University of Sussex found that its 44-member governing body was ineffectual. After reviewing the governance of NHS Trusts, where boards have only 11 members, Sussex settled on a governing body with 25 members, 15 of whom are independent and have particular skills (the introduction of business people on to council has had an important impact). The smaller body is more engaged, with a higher quality of discussion, and attendance is now close to 100 per cent at every meeting.

The merger of Manchester University and UMIST demonstrates what can be achieved with a fresh start. The new university will have a smaller council (renamed the Board of Governors) of 25 members, with a lay majority, which will be responsible for setting the university's strategic vision and objectives and monitoring the performance of management. The court (to be renamed the General Assembly) remains, but its role will be focused on external stakeholder relations and scrutiny at the strategic level.

A few universities have undertaken second effectiveness reviews. For Warwick, this review focused less on structure and more on process, with a particular effort now under way to ensure the quality and minimise the quantity of paperwork (for some institutions, council papers can be measured by the foot). Sheffield's second review focused on the frequency of meetings, training and development of members, and on clarifying matters delegated to management.

The next generation of reviews, however, need to start with a clear definition of the governing body's responsibilities. In its submission to this Review, Liverpool John Moores University describes the governing body as "responsible for the educational character of the institution, for approving its strategic plan, and for its financial position. It ensures that the institution meets all of its legal and social responsibilities, and it monitors the performance of the executive management in general of the university against the approved plan". The questions that governing bodies should be asking in their effectiveness reviews are: "What are our objectives?" and "How well do we perform against them?".

[7] The Dearing Report concluded that courts should not have constitutional authority over councils, which must be the unambiguous governing body of an institution. Courts' roles are usually limited to the consideration of annual reports.

7.18 In some institutions, as the following case study shows, individual committees and the senate also undertake effectiveness reviews. As a result, they are rationalising committee arrangements and processes. But while structures are relatively easy to change, culture takes much longer. A risk-averse mentality prevails, with managers prone to take decisions to committees in order to cover their backs. Universities need to find ways to encourage managers to take more responsibility without referring decisions to the safety blanket of committees.

Case Study: Rationalising committee structures

With decision-making being devolved to executive management teams, many universities are restructuring their myriad of committees. However, the speed of reform varies greatly. Older universities, with a longer tradition of participatory government, tend to take longer, particularly in achieving the support of the academic community. Strathclyde, which started early, took most of a decade to rationalise its committee structures.

Not all reform is slow. Aggressive restructuring at Liverpool John Moores removed an estimated 300 committees and working groups, leaving only eight formal committees focused exclusively on the detailed business of the governing body. And to ensure they work well, these committees are subject to an "annual self-assessment of effectiveness against their terms of reference and protocols". Radical steps are also being taken at Southampton, which is merging most of the committees of senate and council into a slim-line unitary structure. Breaking down traditional barriers between academics and managers, the detailed governance work of council will now be the responsibility of six new policy committees, made up of lay members of the governing body, professional service staff and academic staff. Ad-hoc working groups, rather than a larger body of permanent committees, will be called upon for projects with a limited time span.

7.19 A key role of the governing body is to approve management's strategy and measure performance against plan. The Higher Education Funding Council for England (HEFCE) requires every English university to produce a five-year plan, but too many of these are formulaic reproductions of what the university believes the funding council wants to see. Entrepreneurial universities are thinking more independently, developing long-term strategies to suit their circumstances and under-pinning them with clear operational plans and key performance indicators (KPIs). Many universities do not make such an explicit link between strategy and KPIs. But KPIs are not only important to measure performance against plan, they also allow the institution to compare its performance with its peers. As each university develops its own set of KPIs, there will be greater scope for benchmarking across the sector.

Case Study: Strategic planning and performance measurement

Liverpool John Moores's strategic plan for 2003-08 has been built on the identified mission and values of the university. The strategy is broken down into four business processes, each with distinctive aims, implementation plans and KPIs. In a step to ensure that meeting these targets remains the highest priority, the university has appointed a director of excellence, who sits on the executive board, with this specific responsibility.

7.20 The CUC publishes a guide for members of governing bodies that covers both information and best practice.[8] However, there is not as yet a concise statement of good governance for the higher education sector. While there have been important developments over the last ten years, the Review believes the sector must do more to advance its governance arrangements. A voluntary code would improve the perception of university management and governance, but more importantly it would act as a catalyst to spread best practice across the sector. Adopting a code would also be a clear demonstration of professional and modern university management.

7.21 It should be the sector's responsibility to develop such a code of governance. To support this, the Review has constructed a draft, attached as Appendix II. This code is based on discussions with various institutions and individuals, together with a review of best practice in the private sector and the higher education sector nationally and internationally. Australia has recently developed a set of university governance protocols which is to be enacted into law, the private sector in the UK published a new code on corporate governance following the Higgs Review, and the CUC's own guide covers many important areas.[9] A code that draws on all these insights will provide a powerful framework for the sector.

Recommendation 7.1

The Review recommends that the CUC, in consultation with the sector and Government, develops a concise code of governance representing best practice across the sector. The draft, attached as Appendix II to this report, should be seen as the starting point for drawing up the code.

While the code should remain voluntary, all institutions should disclose in their annual report when their governance arrangements do not conform to the code, and explain why their particular governance arrangements are more effective.

7.22 While a concise code provides the basis for institutional governance, it does not measure the effectiveness of governing bodies and regular reviews are therefore essential. Future effectiveness reviews should measure performance against the responsibilities of the governing body and propose change accordingly. To match the pace of change in the sector, these reviews need to be undertaken more regularly than the five years recommended by Dearing.

Recommendation 7.2

Each governing body should systematically review its effectiveness in carrying out its obligations to all stakeholders every two or three years.

These reviews should take into account the stated objectives of the governing body, the performance of the institution against key performance indicators, evaluations of senior management and the results of effectiveness reviews of senate and committees.

To ensure transparency, the methodology and results should be published in the university's annual report and on the internet.

[8] *Guide for Members of Governing Bodies of Universities and Colleges in England, Wales and Northern Ireland*, Committee of University Chairmen, 2001.

[9] *Our Universities – Backing Australia's Future*, Department of Education, Science and Training, 2003; *Review of the Role and Effectiveness of Non-executive Directors*, Derek Higgs, 2003; *The Combined Code on Corporate Governance*, Financial Reporting Council, 2003.

LEADERSHIP

7.23 The vision and management skills of the vice-chancellor, more than any other individual, determine the future shape and success of a university. The role of the vice-chancellor is now more akin to that of a chief executive officer in an operation turning over hundreds of millions of pounds each year. The challenge of developing and implementing sustainable long-term strategies and financial plans requires considerable managerial and strategic – as well as academic – leadership.

7.24 The recruitment process for vice-chancellors was inward looking and in the past lacked transparency. Councils would develop a list of candidates based on whom they knew and their academic credentials. Today, the process is usually more open and professional, and many institutions ensure this by using outside recruitment consultants. This has led to some exciting appointments, with some vice-chancellors being recruited from the private sector and abroad.

7.25 However, not enough is done to prepare and train potential vice-chancellors from within the sector. Even the most senior administrators and academics in this country do not have all the requisite skills to be a vice-chancellor: deans often lack a sector-wide strategic view and pro-vice-chancellors usually have limited experience in managing large budgets.

7.26 Leadership is also an important quality for the chair of governing bodies. There is an impressive degree of commitment and drive from many in this group of unpaid non-executives. The chair is responsible for the leadership of the governing body, ensuring members work together and that the body operates effectively. Many chairs also talk of themselves as the vice-chancellor's "boss", setting their objectives and measuring their performance.

7.27 Given the demanding nature of the job, it is no surprise that the incoming chair of the merged University of Manchester will be paid. There is a widespread view that lay members of council should remain unpaid. However, the experience at Manchester, as well that of other sectors like health, suggest that in the future there may be more examples of paid chairs and possibly lay members in general.

7.28 It is not always possible for individual universities to provide professional development and leadership training for its senior managers and members. The Leadership Foundation, an idea developed by Universities UK (UUK) and Standing Conference of Principals (SCOP), will play an important role. Planning to be operational by January 2004, it aims to "identify and meet the sector's key leadership and management needs". The Top Management Programme of the Higher Education Staff Development Agency, along with the CUC's governors' training programme, will be rolled up into the Foundation.

Recommendation 7.3

The Review supports the Leadership Foundation as an initiative to address the sector's need for high-quality leadership and senior management.

- The Foundation should focus its efforts as much on future vice-chancellors as current ones.
- Development programmes and training should be implemented with third parties rather than created and supplied internally.
- The Foundation should develop programmes to support council chairs in their increasingly challenging roles.

A BREAKDOWN OF TRUST

7.29 A side effect of a modern university's far-reaching role and breadth of activities is the increased number of stakeholders who hold the institution to account. The result is an uncoordinated and often unnecessarily burdensome system of accountability and regulation. Two independent reports have highlighted the need to reduce the accountability burden on universities.[10] While a number of the recommendations from the Better Regulation Task Force report have been implemented, progress has been slow.

7.30 At the same time, there has been a marked increase in the Government's use of hypothecated funding to achieve its strategic objectives, creating more regulatory pressures and accusations from the sector of micro-management. HEFCE, for example, is currently running between 40 and 50 separate funding initiatives on behalf of government departments.

7.31 Universities in the UK are operating on the margin – of 131 institutions in England, for example, 47 ran operating deficits in 2002, with the remaining 84 averaging only a 2.2 per cent surplus on revenue. This puts pressure on universities to chase every available pound of funding. With each new funding stream comes new regulatory burdens. In 2003, HEFCE is budgeting to channel 14 per cent of its funds through hypothecated schemes. About half of these funding initiatives were "top-sliced": that is, the cash to fund them originally came from a reduction in core funding, rather than from additional government funds. In such cases, universities are often required to apply and account for money that had previously been delivered to them through the core grant. The unintended consequence of central government initiatives is that the sector is in a defensive mood and feels micro-managed.

7.32 In Scotland, the Scottish Executive, through the Scottish Higher Education Funding Council, makes less use of hypothecated funding, and this is one factor contributing to a much closer, more respectful relationship between the funders and Scotland's universities. The other perhaps more important factor is that with only a relatively small number of institutions, it is easier to build close and trusting relationships. Similar considerations apply in Wales and Northern Ireland.

7.33 Public funding needs to be carefully supervised and institutions held to account. But the level of burden is often disproportionate to the money involved, and policies can be untargeted. In many cases, initiatives are designed around the lowest common denominator and all universities, however well-managed, are treated in the same way. The constant layering of new initiatives on top of old, often uncoordinated across government departments and agencies, creates an overly complicated regime.

[10] *Better Accountability for Higher Education*, PA Consulting Group, 2000; *Higher Education: Easing the Burden*, Better Regulation Task Force, 2002.

Recommendation 7.4

The Review recommends that the Government and all funders should minimise the use of hypothecated funding streams.

- Funders should continue to consolidate individual funding into larger streams, more proportionate to the necessary level of bureaucracy and regulation.
- Smaller hypothecated funding streams should, where possible, be allocated on a metrics or formulaic basis, rather than by bidding.
- Funders should minimise audit requirements on hypothecated funding streams.
- "Top-sliced" funding streams should have a limited life of no more than three years, after which they should be rolled back into core funding, unless policy is explicitly renewed.

7.34 The overarching problem, however, comes down to a matter of trust. The Government does not seem to have enough confidence in the way that universities run themselves to give them extra funding without strings attached. Some of this is justified – the sector has in the past suffered from poor management and a lack of strategic thinking. Yet if universities are to become more creative and play their full part in regional and national economies, then ways must be found to give them more room to develop a strategic vision and take entrepreneurial risks.

RISK-BASED REGULATION

7.35 Government needs to have confidence that universities can be relied upon to meet the needs of their broad range of stakeholders and deliver against government objectives. In return, universities need to feel that if they do conduct their affairs efficiently, they will be given a greater degree of freedom and flexibility than they currently enjoy.

7.36 By adopting a code of governance, a university will go part of the way to demonstrate its commitment to this goal. However, confidence in an institution will also be affected by its financial soundness, by the quality of its managers, and by its success in meeting other targets such as teaching quality, access and so on.

7.37 The concept of risk-based regulation is increasingly being recognised in both the private and public sector. The Financial Services Authority moved to a risk-based approach to regulation in 2000, focusing its resources, and therefore the regulatory pressure, on higher-risk companies. The NHS, with the possible introduction of star ratings, may bring "earned autonomy" to high performers. And in the Local Government Bill 2003, the powers and freedoms of local authorities are to be linked to performance – high performers, as rated by the audit commission, will be rewarded with greater freedoms.

7.38 It is time to consider a risk-based approach to regulating the university sector. Those universities which are well governed, which have sound financial management and which meet performance targets should expect a much lighter burden of regulation than those which fail to meet these benchmarks. In the longer run, a robust system of risk assessment could also be used to grant greater financial freedoms to the best-run universities. This would allow institutions real scope to manage their own destinies.

7.39 The funding councils already collect much of the information needed to assess these risks. HEFCE, for example, categorises institutions into four classes of institutional risk and focuses additional attention on high-risk institutions. The objective should be to develop, without additional auditing burden, a risk scorecard for each university that can be used by every funder or regulator in the sector.

7.40 There are a number of ways to provide a lighter touch: restrictions could be removed from the funding council's financial memorandum; annual monitoring statements could be reduced; audit requirements for hypothecated funding removed. These restrictions and requirements, as well as certain hypothecated funding initiatives, would be applied only to high-risk institutions. Elsewhere, the Quality Assurance Agency could vary the intensity of its institutional audit so that well-run universities had a lower burden. Research Councils could vary the frequency and intensity of their "dip-test" audits based on the risk scorecard of the institution. The DTI, RDAs and, if possible, the NHS, EU and charities, should also be encouraged to differentiate accountability burdens based on an institution's risk assessment.

Recommendation 7.5

The Review recommends that funders and agencies should apply a significantly lighter-touch regulatory and accountability regime to well-run universities.

One agency should be responsible for risk assessments on behalf of all funders and regulators. In time, assessments should be published. Risk should be assessed on:

- Adherence to the sector's code of governance (see Appendix II).
- Quality of management.
- Financial soundness.
- Institutional performance measured against key performance indicators (such as teaching, research, third stream and so on) set by the governing body, as well as other broad policy goals (as set by Government).

In the longer-term, well-run universities should receive greater financial freedoms, such as the freedom to move funding across budget lines and longer, multi-year funding cycles.

7.41 If universities are encouraged to take on a slightly more entrepreneurial mission, the risks of institutional failure will also increase somewhat. Relatively few universities have run into serious financial problems in recent decades; it is possible that more will do so in today's more complex and demanding environment.

7.42 As has been the case in the past, universities that require central government support due to financial failure should expect consequences that, in all likelihood, would involve a restructuring of their management teams and, probably, their governing body, as well as possible consolidation within the sector.

OXFORD AND CAMBRIDGE

7.43 Oxford and Cambridge work largely outside the governance systems which apply to most universities. The reasons include the important role of independent colleges in the affairs of both universities, and the fact that they come under separate parliamentary legislation.

7.44 Both universities play a crucial role in the economic as well as the intellectual life of the nation. Both of them are centres of important business clusters: the Cambridge phenomenon is well known, and Oxford has also played a significant part in developing what has become one of the most dynamic business regions in the country.[11] Both universities have built successful partnerships with some of the world's leading multinational companies.

7.45 In recent years, Oxford and Cambridge have taken important steps to modernise the way that they run themselves. Oxford's departments and faculties have been organised into a divisional structure, enabling clear leadership for interaction with industry, especially in the three science divisions and also with social science and the humanities. Four external members have been appointed to the governing council of the university, and the council's committees have been restructured. The university has rationalised and modernised its approach to the ownership of intellectual property. A university-wide financial management system is now being installed, which will greatly improve the process of resource allocation across the university.

7.46 Cambridge has found it more difficult to make organisational changes, but it too is now making progress. The first two external members of the university's governing council are likely to be appointed over the next year. The vice-chancellor's office is being strengthened by the appointment of five pro-vice-chancellors, who will oversee planning and resources, education, research, personnel, and special responsibilities. The financial function is being enhanced and rationalised, with the role of the treasurer and the secretary general being subsumed into the finance director's office. The Oracle financial management system is now operating successfully. The number of votes required to call a ballot at the Regent House has been increased[12], and consideration is being given to changes in the university's cumbersome approach to intellectual property.

7.47 This represents real progress. However both universities recognise that there is much further to go, and are aware of continuing external pressure to change. Top universities face a global competition for talent and money, which will become more intense in the years ahead. They have to be able to respond in a timely fashion to new demands, to develop long-term strategies and to allocate their resources in an efficient manner.

7.48 The challenges for Oxford and Cambridge include:

- The need to build a new relationship with the colleges, which protects their academic and social strengths but which prevents them from blocking decisions that are in the interests of the university as a whole.
- The need to speed up their decision-making processes and coordinate their processes in order to make them more effective partners with business.
- The need to generate significantly more money than they are likely to get from public funding in order to pay their academics a more competitive wage, to develop their research strengths, to cover their teaching costs, and to subsidise talented students where necessary.
- The need to make further progress in modernising their governance and management structures, so that the Government and the public can trust both universities to manage the increased public funding that they will certainly need if they are to retain their current position – let alone to strengthen it.

[11] *Enterprising Oxford: The Growth of the Oxfordshire High-tech Economy*, Oxfordshire Economic Observatory, 2003.
[12] The Regent House is the governing body and electoral constituency of the university. There are at present over 3,000 members, comprising the current teaching and administrative staff of both the university and the colleges.

7.49 Cambridge has a new vice-chancellor, and so will Oxford next year. Both of them should be given the support of the Government and of the public as they set out the agenda for which they will be accountable. There is no doubt that there is a broad public interest in the success of these two universities. But that is most likely to be served by change that is initiated and led from within.

7.50 Somewhere in the future, there is a deal to be made. The universities need to demonstrate that they can run their affairs efficiently, and to develop a long-term strategy which has the support of the academics and the colleges. They must galvanise their alumni and make bursaries available where needed to support talented students. In return, they should be given greater freedom to run their own affairs.

7.51 The longer-term objective must be to ensure that in 25 years' time Oxford and Cambridge are still numbered among the world's leading universities.

Recommendation 7.6

In three years' time, the vice-chancellors of Oxford and Cambridge should take stock of the progress of reform, and agree with the Government what further steps will be necessary for the two universities to sustain their global position.

8 Skills and people

8.1 Around 300,000 adults left UK universities with a qualification in 2001. Two-thirds of those whose first workplace was known entered employment in the UK, and a large proportion of this group went to work in the private sector.[1] This represents a significant flow of knowledge and information from the university sector into UK businesses every year.

8.2 The Review recognises that the role of universities is to educate students, rather than to train them for the specific needs of businesses. But it is important for the UK economy that students leave universities with skills that are relevant to employers.

8.3 Companies in general are broadly satisfied with the quality of the graduates they recruit. However, there are some concerns:

- There is a mismatch between the needs of industry and the courses put on by universities in particular areas.
- Some businesses find it difficult to enter into a strategic dialogue about their current and future skill requirements, because there is no mechanism for them to engage with the university sector as a whole.
- Most businesses that have links with universities for course development do so on an individual basis, and although these links are often effective, they are limited to larger companies and cover particular business needs.
- Companies that specialise in some areas of science, engineering and technology (SET) are finding it difficult to recruit graduates of a suitable quality.

IMPROVING MARKET SIGNALS

8.4 Universities put on courses to meet student demand. A survey of students shows that decisions about their preferred course of study and university are based upon a number of factors, which include intrinsic enjoyment of the subject, reputation of the course and the university, location, quality of teaching, entry requirements and employment prospects.[2]

8.5 In an ideal market, courses that are of value to employers would result in higher wages and greater employability, leading to greater student demand in those subjects. However, it is difficult for employers to send signals to students about the value that they place on particular courses. Employability data are only published at university level rather than on a departmental basis, and do not contain information about jobs or salaries. This is not particularly helpful for prospective students. They would benefit from much clearer market signals, which would include a better picture of where the graduates from a particular course find work, and how much they earn.

[1] *First Destinations of Students Leaving Higher Education Institutions 2001/02*, Higher Education Statistical Agency, 2003 (note: this data excludes non-EU domiciled students).
[2] *Providing Public Information on the Quality and Standards of Higher Education Courses*, Segal Quince Wicksteed, 1999.

8.6 The Government proposes to provide students with more information on the quality of university courses by setting up a website of Teaching Quality Information containing summaries of the findings of external examiners, data on students' entry and exit qualifications and first job destinations, and from 2005, the results of a national student survey on students' learning experience.[3] The Review believes that, in addition, more information should be provided to students on the economic consequences of their course choices. This will become increasingly important if they start to contribute a greater proportion of their costs of tuition.

8.7 These data must be published in a way that is generally accessible. A survey of students shows that prospectuses and open days are the most important influences in determining the choice of the largest proportion of students.[4] Other published information and guides are much less influential. So this new information should be published in university prospectuses, rather than as a stand-alone guide where it is less likely to be used.

8.8 More detailed information about employability should provide a means for employers to inform prospective students of the value that they place on graduates from particular disciplines. The Roberts review, *SET for Success*, found that uncompetitive salaries were deterring many talented students from pursuing careers in science, engineering and technology.[5] If employers in these fields want to employ more graduates they will have to pay them more.

Recommendation 8.1

Funding Councils should require universities to publish information in their prospectuses on graduate and postgraduate employability for each department (or faculty, if datasets are too small) by 2006.

This information should include:

- Employability statistics and first destination data – to allow students to see whether particular courses are likely to be useful for specific careers.
- Starting salary data – to give students an indication of the value that employers place on graduates from particular courses.
- Other information relevant to specific disciplines.

IDENTIFYING SKILL NEEDS

8.9 Businesses in certain specialised disciplines, such as medicine, engineering and architecture, express their skill needs through professional bodies which define the academic requirements of courses. A number of employers say that these mechanisms for accreditation, particularly in subjects such as engineering, can serve as a "dead hand" by constraining innovation and making it difficult for universities to respond more quickly to specific business needs.

8.10 Foundation degrees are vocationally-orientated courses which require employer involvement in their design and delivery. They are positioned at sub-degree level, and should provide a means for employers to engage with universities to meet their needs for specific vocational skills at this level.

[3] *Information on Quality and Standards in Higher Education*, Higher Education Funding Council for England, 2003.

[4] *Providing Public Information on the Quality and Standards of Higher Education Courses*, Segal Quince Wicksteed, 1999.

[5] *SET for Success – The supply of people with science, technology, engineering and mathematics skills*, Sir Gareth Roberts, 2001.

8.11 In order for the university sector to be able to respond to the needs of businesses, it is important that businesses are able to define their skill needs collectively, based upon robust data, and articulate them in a coherent way.

8.12 Sector Skills Councils (SSCs) were announced in 2001 to encourage employers to take action collectively to meet their skill needs at a sector level. They are independent bodies that are formed and led by employers representing a sector of economic importance. Their role is to tackle the skill and productivity needs of their sector, by identifying their skills gaps at all levels including graduate and postgraduate, and taking action to meet those needs.

8.13 In order to launch an SSC, employers present a formal proposal to show that they represent an employment base of economic or strategic significance, and that they have the backing of significant employers in their sector. If successful, they are awarded a five-year licence on condition that they meet certain criteria, which include providing labour market intelligence on current and future skill needs, and getting employers to take individual or collective action to meet the sector's skill priorities.[6] Most SSCs are the successors of previous National Training Organisations which were less regulated and did not cover university-level skills. In return for representing the employers' viewpoint, SSCs receive £1m core funding per annum from the Government, and are assured of influence over the relevant bodies supplying the courses. To date, four SSCs are fully licensed, and five are being piloted as "trailblazers".

Examples of two SSCs, and their board-level representatives

e-skills is the SSC for IT, telecoms and contact centres. Its board includes European or UK chief executives of IBM, Accenture, HP, Microsoft, Oracle and T-Mobile as well as the heads of IT at BT, Sainsburys and Morgan Stanley.

Skillset is the SSC for the audio-visual industries. Its board has senior-level representation from the BBC, ITV, Channel 4, Five, Sky, United International Pictures, Twentieth Century Fox, key trade associations and the entertainment unions.

8.14 Each region addresses its skill needs through the development of a Framework for Regional Employment and Skills Action (FRESA). This is a plan developed by the Regional Development Agency (RDA) in conjunction with a core group of regional partners, to address skills and employment needs within the region. Most FRESAs have been drawn up with involvement from universities and include measures for dealing with university-level skill gaps. Some FRESAs also include SSCs as core partners. It is important that SSCs are effectively integrated into the FRESA process, so that they can enter into a dialogue about their graduate and postgraduate skill needs at a regional level.

8.15 SSCs offer the opportunity for employers collectively to voice their concerns about their future skill needs. This is a welcome development. However, in order to effect change in university courses and curricula, SSCs need to have a dialogue with universities. It is not clear that a mechanism exists for this to happen. Some SSCs are frustrated that they cannot get universities to listen to their needs for graduate skills, and have warned that employers will give up on the process if they are not given real influence.

[6] *The Sector Skills Development Guide,* DfES, 2001, http://www.ssda.org.uk/pdfs/sscdguide.pdf.

Recommendation 8.2

The Government should ensure that SSCs have real influence over university courses and curricula. Otherwise, they will fail to have an impact on addressing employers' needs for undergraduates and postgraduates.

MEETING THE NEEDS OF THE ECONOMY

8.16 Public investment in undergraduate teaching in England is running at £3.4bn in 2003-04, and is allocated to universities on the basis of student demand and historic cost of teaching. This is backward-looking and does not take account of the economic and social returns of courses. There is evidence that the overall return to society of this investment in undergraduate teaching continues to be positive, because the salary premia of graduates over non-graduates has been maintained in the face of a continuing expansion in student numbers.[7] But the same evidence also shows considerable variations in returns between different subjects. Although this evidence does not fully represent the social contribution made by graduates entering the public and voluntary sector because it is based only on salary data, it nevertheless shows that employers do not give equal value to graduates in different disciplines.

8.17 Employers from the creative, media and IT sectors are particularly concerned that the recent explosion of courses in their subject areas has resulted in many that do not equip students with the intellectual, specialist or transferable skills that they need to pursue a career in those industries.

8.18 Providing students with more information about employment prospects should help make them more aware of the value that employers place on specific courses. However, this may not be enough to make the university system responsive to the needs of the economy. It takes at least three years to educate a typical graduate, which means that there will be a long time lag between prospective applicants making use of employability data to inform their course choices, and the resultant change in the number of graduates entering the labour market.

8.19 There is, therefore, a need for funding bodies to take more account of the views of groups who benefit from skilled graduates, such as employer-led bodies, to ensure that the system of funding undergraduate teaching is sufficiently responsive to produce graduates with skills that the economy needs.

Recommendation 8.3

HEFCE should ensure that its forthcoming review of the teaching funding method for universities:

- **Takes account of the views of employer-led bodies and representatives from the public and voluntary sector rather than funding courses solely on the basis of historic cost.**
- **Considers whether the UK university system is producing the right balance of graduates in the disciplines that the economy needs.**

The other funding councils should also consider these issues.

[7] *The Returns to Education: Evidence from the Labour Force Surveys*, Walker and Zhu, 2001.

IMPROVING EMPLOYABILITY

8.20 Many employers would like graduates and postgraduates to have a wider set of skills to bring into the workplace. Evidence suggests that a large proportion of the initial skill-deficiencies reported by employers relate to skills and knowledge that are best acquired on the job.[8] So it is important to increase the opportunities for students to gain experience of working in businesses.

8.21 It is also important for students – particularly science students – to develop entrepreneurial skills to allow them to exploit their innovations and develop the commercial potential of their work. To address this issue, Science Enterprise Centres have been set up, using government funding, at 13 centres involving over 60 universities nationwide. Their mission is to stimulate scientific entrepreneurship by teaching relevant skills to science and technology students, and by helping students and staff develop the skills required to establish and sustain start-ups based on innovative ideas. This is an excellent initiative. The Government is also looking at the feasibility of establishing a Council for Graduate Entrepreneurship, to encourage more students and graduates to set up their own businesses, and provide support to them

Case Study: The Entrepreneurship Centre at Imperial College, London

The Entrepreneurship Centre at Imperial College, London was launched in September 2000 with £2m Science Enterprise Centre funding from the Government. This has been supplemented by £500,000 raised in corporate sponsorship from a range of business partners.

The aim of the Entrepreneurship Centre is to embed entrepreneurship within the culture of the university and provide faculty and students with the skills to take technical ideas to market. It provides core courses in entrepreneurship to final year students studying a wide range of subjects including medicine, engineering and science, as well as postgraduate MBA, MSc and PhD students.

8.22 There are strong incentives for large companies to take on students for work placements, as a way of both obtaining high-quality people at low cost and recruiting and retaining the best talent. Many large companies already run substantial internship programmes and have established links with careers services, demonstrating that they are clearly aware of these benefits.

8.23 So any initiatives to encourage work placements might achieve more impact if they were targeted at SMEs, which have fewer resources to devote to such schemes and may not recognise the value of employing graduates. There are substantial benefits to both students and employers from undertaking work placements in SMEs. Students can expect greater responsibility than they might be given in a larger company, while employers can bring in fresh, highly motivated minds, to tackle their business problems at low cost.

[8] *How Much does Higher Education Enhance the Employability of Graduates?,* Mason et al, 2003.

Case Study: TecMark – a student work placement transforming an SME

TecMark is a small company specialising in developing hygiene products, including disinfectants for health organisations and hospitals. Traditional hand disinfectants are alcohol-based, and the unpleasant feel and smell together with the skin irritation caused by the alcohol lead to poor usage, and so to hospital-acquired infections.

TecMark took on a chemistry undergraduate during her summer holidays through the Shell Technology Enterprise Programme (STEP). Her task was to develop a second-generation formulation for the company's existing oil-based hand disinfectant. During the eight weeks the undergraduate spent at TecMark, she discovered a process that delivers the disinfectant as a solid concentrate. This not only cuts shipping costs and makes it difficult for competitors to recreate the product through analysis, but also eliminates the environmental implications of shipping hazardous liquids. In addition, the process cut manufacturing costs by 75 per cent, potentially saving the company £1m.

The director of TecMark (now called Saifer), said that the undergraduate's work was "the fundamental breakthrough that we needed – it's safe to say she helped save the company". Eventually the new disinfectant could be introduced into UK hospitals where it could save many lives.

8.24 Two effective methods of encouraging students to work in SMEs are described below. The first shows the benefits of a structured national scheme to give undergraduates projects that tackle specific business problems of SMEs. The second highlights the important role that careers services can play in forming alliances with local businesses to encourage more students to work locally. This is an issue that was raised in the Harris Review of Higher Education Career Services.[9]

Case Study: STEP – providing project-based placements to students in SMEs

The Shell Technology Enterprise Programme (STEP) is a nationwide scheme which provides placements for undergraduates, mostly during their summer vacations, to work on a project in an SME that meets a specific business need. All students receive a skills assessment package and three days' training from their local provider (usually a business support agency or university), to enable them to record the transferable skills learnt during their placement. Many businesses receive contributions towards the cost of the placement from local business support agencies, which play an active role in helping them define the project, and in quality-assuring it.

There is strong demand for STEP – in the summer of 2003 it received inquiries from over 12,000 students and 2,000 businesses – but the scheme currently has the capacity to support only 1,400 students. It is run from a national office through a network of local and sub-regional providers, and represents good value for money – the total public cost of the 1,400 placements, including subsidies to businesses, was around £3m in 2003.

An independent assessment of STEP has shown that students who had undertaken their placements obtained jobs much more quickly than non-STEP graduates. The 2002 STEP exit survey showed that 75 per cent of participating companies had employed graduates on a regular basis, and of those companies, 71 per cent were more likely to consider doing so after participating in STEP.

More recently, STEP has been piloting methods of tailoring the basic scheme to meet specific regional or sector needs. An example is the Micro-STEP scheme, designed in conjunction with the East Midlands Development Agency, to encourage more recent start-ups and small businesses to take on graduates.

[9] *Developing Modern Higher Education Careers Services*, Sir Martin Harris, 2001.

Case study: University of Manchester & UMIST Careers Service – reaching out to SMEs

The University of Manchester & UMIST Careers Service is well known for its work with graduate recruiters from large companies. It is also keen to develop partnerships with smaller companies in the region, not only for the opportunities that SMEs can offer to students, but also because it believes that it has a responsibility to engage with local business to support the economic performance of the region.

The careers service has developed a range of initiatives to encourage this, many of which involve working with other universities in the region and with the RDA. These include:

- Involving SMEs in curriculum development. The careers service has created 27 mostly accredited Career Management Skills modules to help students develop transferable skills. These often involve specific projects to meet the needs of local SMEs.
- Partnering with the local RDA to take a regional and sectoral approach to supporting SMEs. A collaboration of 13 careers services in the region has created an online brokerage service which has advertised over 50,000 student placements and graduate jobs in their region, many of which are in SMEs. The group has also developed a scheme to place graduates in micro-businesses in the creative and cultural sector, and is piloting a graduate mentoring programme with SMEs in the environmental sector.
- Creating a partnership with other careers services and business support units in the region – North West Business Access (NWBA) – to help SMEs access resources at universities. NWBA visits SMEs to find out what their business needs are, and then suggests an intervention from universities that could help business growth. Examples of interventions include a graduate job, student placement, or link to an academic department.

Examples of successful outcomes for SMEs as a result of these initiatives are:

- MEDINET, an SME which develops software for the pharmaceutical supply chain, wanted to investigate opportunities for expansion into the European market. The careers service worked with MEDINET to scope out a project and offered it to four students on a University of Manchester bioscience CMS module, all of whom had language skills. The project delivered the right business outcome for the company by producing an excellent piece of market research for very little cost, and provided an appropriate environment for students to practise their skills and develop their employability.
- Opticus is a small business specialising in fibre-optic communications. Following a consultation with an NWBA adviser, the managing director attended an NWBA seminar on e-business delivered by a UMIST academic and recruited two University of Salford students to develop a company website and produce powerpoint presentations for marketing. The managing director said: "NWBA completely changed my approach to e-business and the potential of using university students to develop my business".

COLLABORATIVE TRAINING

8.25 Businesses can benefit significantly by taking on PhD students to undertake R&D projects, not only because they obtain highly skilled people but also because they gain access to academic contacts and knowledge. The students benefit from higher stipends and improved employability skills as a result of their experience in industry.

8.26 Research Councils fund a range of formal schemes to encourage collaborative training. Two notable examples include:

- Collaborative Awards in Science and Engineering (CASE): PhD projects undertaken in conjunction with industry, with the students spending a minimum of three months working in industry. In a variation of these, known as Industrial CASE, businesses have the right to place funds with an academic partner of their choice.
- Engineering Doctorate: a four-year PhD programme for engineers that involves spending three years working on industrial research projects, and one year receiving specialist technical and managerial training similar to that received by MBA students.

Case study: Rolls-Royce sponsorship of an Engineering Doctorate student

A Rolls-Royce sponsored project on in-service health monitoring of electrical machinery was recently completed by an EngD researcher at Manchester University. This resulted in technology transfer into the company and the recruitment of a fully-trained staff member.

During his EngD, the researcher was integrated into a Rolls-Royce project team and spent over half his time in the company developing a novel approach to machine monitoring; this was followed up in a series of prototypes. Based on his analysis of the machine performance, he was able to provide valuable feedback to the design team and make a significant contribution to understanding and solving operational problems in the development phase. In addition, the researcher was able to call on specialist skills and facilities within the university as specific issues arose in the project.

This researcher has since entered full-time employment with Rolls-Royce. Programmes such as the EngD are clearly beneficial to recruitment, with the established relationship between the researcher and the company allowing the student to be immediately productive on joining the company.

8.27 The Engineering and Physical Sciences Research Council (EPSRC) is currently piloting a method of allocating its funding for collaborative training (which covers Knowledge Transfer Partnerships, CASE and EngD, and Masters level training) to universities in a block grant, on the basis of a business plan. Universities will have to state what types of collaborations they will undertake, and how they will secure industry support and involvement in these collaborations within their business plan. This is an excellent way of allocating collaborative funding, since it requires universities to engage more strategically with businesses to deliver results that meet both their needs.

CONTINUING PROFESSIONAL DEVELOPMENT

8.28 An increasing number of universities are providing continuing professional development (CPD) to business employees. This is an important form of knowledge transfer. Businesses can raise the skill levels of their workforce and learn about the latest academic ideas, while universities gain access to the latest developments in professional practice. Such courses can also generate a valuable source of income for universities.

8.29 Universities are not at present large providers of CPD – the Council for Industry and Higher Education estimates that they currently account for around £250m out of a £23bn market.

Case study: Liverpool John Moores University – providing CPD opportunities for staff in businesses

Liverpool John Moores University (JMU) has a long history of providing CPD to a wide range of businesses in Merseyside and beyond. A large expansion of corporate training programmes is a strategic priority for the university. Examples of its approach include:

- Staff in the Faculty of Business and Law are currently working with a number of organisations to develop the skills of their managers through a programme which is accredited by the university. The faculty specialises in providing tailor-made programmes which have received national commendation from the Quality Assurance Agency for Higher Education, and are developed and delivered in partnership with the employing organisation.
- Schools within the Faculty of Business and Law are playing an important role in developing resource-supported learning and e-learning. A range of text-based resources for over 60 modules in business and management has been created, the majority of these modules being available in e-supported learning format.
- A particularly innovative initiative is the Master of Enterprise scheme, involving staff in the Faculty of Business & Law working with four other universities in the North West. Using funding from the RDA, these institutions have developed over 20 postgraduate web-based modules designed to meet the management development needs of SMEs. The delivery style is one of blending information gained from the web-based modules with regular discussions involving SME employees/owners with similar interests and challenges. There is co-ownership of the modules (and of their intellectual property) by the five universities, and a system of credit transfer has been created to allow learners to move around the region to study at areas of particular expertise.

Case study: Tesco and the University of Westminster

In October 2001 Tesco and the University of Westminster pledged to work together in partnership to offer a training environment in merchandise planning. Westminster offered Tesco the opportunity to receive graduate-level training from the only recognised centre of excellence for merchandise planning at degree level in the country, while Tesco offered paid work placements and commercial experience to five undergraduates in the second year of their degree course.

Tesco's 60 merchandise planners benefit from campus-based training at different skill levels. The Business Placement Scheme for Westminster undergraduates – taking up to five students each year – gives practical work experience, with active training and development and access to all of Tesco's resources, while the students work in a commercial department.

8.30 Overall, and contrary to some suggestions, universities are doing a good job in meeting the needs of businesses for skilled graduates and postgraduates in most areas. But more needs to be done by both universities and businesses to work together to meet the continuing demands of the economy. The Government also needs to ensure that the structures within which universities operate are sufficiently responsive to encourage these collaborations to occur.

Appendix I

Terms of reference

1 The full terms of reference for the Review are to:

- Identify the benefits to business of greater interaction with higher education, how this can be promoted and how any barriers holding back business demand for universities' knowledge and skills outputs can be addressed.
- Examine the national, regional and local economic impacts of business-university interactions, including how Regional Development Agencies and Sector Skills Councils can best support such interactions.
- Assess the lessons to be learned from business-university interaction across a range of countries and from best practice across the UK.
- Analyse how business employers can better communicate their skills requirements to a responsive university sector and how they can improve the attractiveness of career paths to graduates and postgraduates, especially in technology.
- Examine the effectiveness of measures such as the research and development tax credits on business demand for research and skills.
- Ask business for its views on the present governance, management and leadership arrangements of higher education institutions and their effectiveness in supporting good research and knowledge transfer and providing relevant skills for the economy.

Appendix II

Draft code of governance

The Review has recommended that the sector, led by the Committee of University Chairmen, should develop a concise code of governance. The following is a suggested draft, but it is up to the sector to develop its own code. If the Government chooses to tie freedoms and flexibilities in part to the code, it will need to agree the final version.

ROLE OF GOVERNING BODY

1 Every institution should be headed by an effective governing body, which is unambiguously and collectively responsible for overseeing the institution.

2 The governing body should meet sufficiently regularly, and not less than once a quarter, in order to discharge its duties effectively. Members of the governing body should attend and actively participate at every meeting.

3 The institution's governing body should adopt a Statement of Primary Responsibilities, which should include:

- Appointing the vice-chancellor as chief executive of the institution and putting in place suitable arrangements for monitoring his/her performance.
- Approving the mission and strategic vision of the institution, long-term business plans, key performance indicators (KPIs) and annual budgets, and ensuring these meet the interest of stakeholders.
- Monitoring institutional performance against plan and approved KPIs, which should be, where possible, benchmarked against other institutions.
- Establishing and monitoring systems of control and accountability, including financial and operational controls and risk assessment, and clear procedures for handling internal grievances and for managing conflicts of interest.

4 This Statement should be published widely, including on the internet and in the annual report, along with the identification of key individuals (that is, chair, deputy chair, vice-chancellor, and chairs of key committees) and a broad summary of the responsibilities that the governing body delegates to management.

5 All members should exercise their responsibilities in the interests of the institution as a whole rather than as a representative of any constituency. The university should maintain and publicly disclose a register of interests of members of the governing body.

6 The chair should be responsible for the leadership of the governing body, and ultimately responsible to stakeholders for its effectiveness. The chair should ensure the institution is well connected with its stakeholders.

7 The vice-chancellor should be, effectively, chief executive of the institution, responsible for the day-to-day management and accountable to the governing body. The governing body should make clear, and annually review, the executive authority delegated to the vice-chancellor.

STRUCTURE AND PROCESSES

8 The governing body should be of sufficient size that the balance of skills and experience is sufficient to meet its primary responsibilities. However, the governing body should have a maximum of 25 members.

9 The governing body should have a majority of independent members, defined as both external and independent of the institution.

10 Appointments should be managed by a nominations committee, normally chaired by the chair of the governing body. To ensure rigorous and transparent procedures, the nominations committee should prepare written descriptions of the role and the capabilities required for a new member, based on a full evaluation of the balance of skills and experience of the governing body. Vacancies should be advertised publicly. When appointing a new chair, a full job specification should be produced, including an assessment of the time commitment expected, recognising the need for availability at unexpected times.

11 The chair should ensure that new members receive a full induction on joining the governing body.

12 The governing body should be supplied in a timely manner with information in a form and of a quality appropriate to enable it to discharge its duties.

13 The secretary to the governing body should be responsible for ensuring compliance with all procedures and for the appropriateness of papers, both quality and quantity, for the governing body to consider. All members should have access to the advice and services of the secretary to the governing body, and the appointment and removal of the secretary should be a matter for the governing body as a whole.

EFFECTIVENESS AND PERFORMANCE REVIEWS

14 The governing body should undertake a formal and rigorous evaluation of its own effectiveness, and that of its committees, at least every two to three years. Effectiveness should be measured both against the Statement of Primary Responsibilities and its compliance with this code. The governing body should revise its structure or processes accordingly.

15 In reviewing its performance, the governing body should reflect on the performance of the institution as a whole in meeting long-term strategic objectives and short-term KPIs. Where possible, the governing body should benchmark institutional performance against the KPIs of other universities.

16 The governing body should ensure that the senate/academic board and all committees of senate and governing body make statements of primary responsibilities and carry out regular effectiveness reviews.

17 The results of effectiveness reviews, as well as the university's annual performance against KPIs, should be published widely, including on the internet and in its annual report.

18 This Code should be voluntary. However, if a university chooses to depart from the Code, an explanation should be published in the annual report.

Appendix III Summary of recommendations

CHAPTER 2 – DEMAND FOR RESEARCH FROM BUSINESS

Recommendation 2.1

The Review recommends that UK business should establish a high-level forum to enhance the effectiveness of technical innovation in business in the UK.

Chief executives of R&D-intensive businesses in the UK should agree its remit: it should be business-led and focused on the key issues for retaining and expanding high value-added business in the UK.

Recommendation 2.2

Government should seek ways of directing a higher proportion of its support for business R&D towards SMEs.

Recommendation 2.3

The Review recommends an enhanced role for the development agencies in facilitating business-university links. A priority should be to identify non-collaborating SMEs that have the potential to gain significant benefits from working with universities.

Recommendation 2.4

The Review recommends that the Government should continue to support Knowledge Transfer Partnerships (formerly TCS) but that the programme should be better marketed to businesses. Increasing the regional focus of the scheme would allow it to be tailored more closely to the needs of local businesses.

Recommendation 2.5

The Government should market the R&D tax credits better in order to increase their take-up by business.

CHAPTER 3 – KNOWLEDGE TRANSFER

Recommendation 3.1

Universities UK and the Standing Conference of Principals should establish a list of academics with relevant qualifications who are interested in becoming non-executive directors on company boards, and should arrange training for them in this role.

Recommendation 3.2

The Department for Education and Skills should exempt business people from the requirement to undertake training to lecture in universities.

Recommendation 3.3

Universities, departments and faculties should develop their alumni networks in order to build closer relationships with their graduates working in the business community.

Recommendation 3.4

Where they do not exist, clear codes of conduct to avoid conflicts of interest in carrying out research with business should be developed by universities.

Recommendation 3.5

The Association for University Research & Industry Links (AURIL), the Confederation of British Industry (CBI) and the Small Business Service (SBS) should produce a small set of model research collaboration contracts, for voluntary use by industry and universities.

- A range of model agreements should be developed, setting out various approaches to IP ownership, management and exploitation rights including, but not limited to, ownership of the IP by the university with non-exclusive licensing or exclusive licensing to industry.
- The model contracts should be agreed by the main representative bodies. They could be distributed through the same means: to universities through AURIL and Universities UK and to industry through the CBI and the SBS.

Recommendation 3.6

The Review recommends that the Government should continue to invest in a permanent and substantial third stream of funding, while simultaneously monitoring and evaluating the outputs from its investment.

The Review agrees with Sir Gareth Roberts and the CBI that third stream funding should be increased to around £150m per annum in England in the future, in order to increase the flow of knowledge and ideas from the science base into business and the wider community.

Recommendation 3.7

The Review recommends that third stream funding should be allocated for three years on the basis of universities' business plans for their third stream activities. Universities that meet their third stream benchmarks in year one would automatically receive their second and third year allocations.

Simultaneously work should be undertaken by the Funding Councils to develop a basket of metrics that might in the future provide the basis for a predictable way of allocating funds on a formulaic basis.

In summary, if knowledge transfer is to achieve its full potential in the UK, the Review recommends that third stream funding should be substantial, permanent and allocated in a way that enables universities to make long-term plans for these activities.

CHAPTER 4 – INTELLECTUAL PROPERTY AND TECHNOLOGY TRANSFER

Recommendation 4.1

The Funding Councils and Research Councils, in consultation with universities, the CBI and other industry groups, should agree a protocol for the ownership of IP in research collaborations.

IP protocol main features:

- The common starting point for negotiations on research collaboration terms should be that universities own any resulting IP, with industry free to negotiate licence terms to exploit it.
- But if industry makes a significant contribution it could own the IP.
- Whoever owns the IP, the following conditions need to be met:
  1. The university is not restricted in its future research capability.
  2. All applications of the IP are developed by the company in a timely manner.
  3. The substantive results of the research are published within an agreed period.
- On all other terms the protocol should recommend flexibility where possible to help ensure that the deal is completed.
- The Funding Councils and Research Councils should require universities to apply the protocol in research collaborations involving funding from any of the Councils.

Recommendation 4.2

The Government should use third stream funding to support regional shared services in technology transfer.

Shared services main features:

- Non-prescriptive – universities in each region should agree themselves how to set up and shape the services, and the role that each institution should play.
- Third stream funding should provide financial incentives to create shared services in technology transfer. Funding available to less research-intensive universities to provide specialist expertise in-house should be reduced.
- The most research-intensive universities should be involved where possible to build on existing expertise.
- Most knowledge transfer services should be kept in the university, including contract negotiation for consultancy and collaborative research and reach-out to business. Some technology transfer staff should remain on-site to act as contact points for university researchers on technology transfer and IP issues.
- Development agencies should support the universities in delivering the shared services.

Recommendation 4.3

The Government should increase the level of funding for technology transfer and knowledge transfer training to stimulate the development of new training courses.

Recommendation 4.4

As third stream funding increases, university technology transfer offices should actively seek to attract individuals with industry background and experience.

Recommendation 4.5

UK organisations representing technology transfer should look to the US Association of University Technology Managers to see what lessons can be learnt in terms of providing quality training, increasing industry involvement and sharing best practice.

Recommendation 4.6

The Government should set clear guidelines for third stream funding to rebalance commercialisation activities towards licensing. In particular, it should:

1. Increase the availability of proof of concept funding.

Proof of concept funding is used to establish whether a new technology is commercially viable or not. It is the first stage in transferring IP to the market, and is needed for both licensing and spinning out. The level of investment is normally up to £50,000 per invention.

2. Reduce the availability of seed funding, and use public seed funds to draw in private finance wherever possible.

Third stream seed funding is used to provide early stage investment in spinouts. The level of investment is normally up to £250,000 per invention. Private finance should be brought in alongside such funding wherever possible, so that the spinouts can be tested in the marketplace. But some spinouts in some regions may find it more difficult to attract private funding early on, since the venture capital and angel networks in the region are less well developed than in others. The best spinouts from these regions should receive seed funding.

CHAPTER 5 – REGIONAL ISSUES

Recommendation 5.1

Regional Development Agencies should have targets that promote building business-university collaboration.

- Their core outcome target for innovation should reflect the long time lag between R&D and economic impact.
- All RDAs should set a specific milestone for building business-university links.

The Scottish, Welsh and Northern Irish development agencies should also consider whether their targets adequately promote building business-university collaboration.

Recommendation 5.2

The Government should change Regional Selective Assistance so that it can support more knowledge-intensive clusters and businesses, and be used to help build a region's infrastructure for collaborative R&D projects with universities.

CHAPTER 6 – FUNDING UNIVERSITY RESEARCH

Recommendation 6.1

The Government should now take stock of the proposals in the review of research assessment and in the review of the sustainability of university research. It should consider the conclusions of these two reviews together when deciding on the future direction of research funding and policy in the UK.

From a business perspective, there are some principles that the Government should take into account in assessing the proposals contained in these reviews.

- World-class excellence across all types of research should be recognised and rewarded by the Research Assessment Exercise and Research Council peer review processes. Excellent research undertaken with industry or other users should be recognised as being of equal value to excellent academic research.
- There should be significantly more business input into the priority setting, decision-making and assessment panels of both of the peer review processes.
- The processes should be flexible and dynamic, capable of supporting new ideas and talent wherever they are found.
- Funding should be allocated in a way that actively supports multi-disciplinary research.
- The processes should be as simple and unbureaucratic as possible and should support the long-term sustainability of the research base.
- Greater weight should be attached to the importance of disseminating research to a wider audience outside academia in an accessible format.

The Government should consider the relative size of the Funding Council and Research Council funding streams and whether the present system provides the appropriate balance between giving institutions stable research funding and promoting a dynamic and competitive research base.

Recommendation 6.2

The Government should create a significant new stream of business-relevant research funding, which would be available to support university departments that can demonstrate strong support from business.

Demand for the funding from business would need to be assessed but funding in the region of £100m-£200m could be an appropriate starting point.

Recommendation 6.3

There are a number of possible ways to allocate the new business-relevant research funding stream including an expansion in the scope of Higher Education Innovation Fund, an expansion of existing schemes such as LINK, or allocation through the Regional Development Agencies and their equivalent bodies in Scotland, Wales and Northern Ireland.

The Review's preferred approach is to allocate the new funding stream to the RDAs through their single pot allocation, and to provide them with targets on promoting business-university collaboration.

- RDAs would match fund the contribution by business to collaborative research projects on a sliding scale. For basic and strategic research, RDAs would match the business contribution: for near-market research, the support would be lower.
- RDAs would prioritise the applications from university departments by considering the likely economic impact of the research and the fit with their regional economic strategies. They might prioritise applications involving previously non-collaborating SMEs.
- If the Government invests less than the proposed £100m-£200m in England, the priority should be to support university departments which are doing work of value to business, but which do not receive significant quality related funding through dual support.

Any new increase in the budgets of the English RDAs would lead to a consequential increase in the budgets of the devolved administrations. It would be for the devolved administrations to decide how to allocate any such increase in their budget. However, the Review hopes that they would consider the recommendations in this report in deciding how to allocate any such increase.

Recommendation 6.4

The Russell Group of universities should encourage the development of a league table of the world's best research-intensive universities. This could well be produced by the private sector: the Sutton Trust is one group which is already considering the possibility.

CHAPTER 7 – MANAGEMENT, GOVERNANCE AND LEADERSHIP

Recommendation 7.1

The Review recommends that the Committee of University Chairmen, in consultation with the sector and Government, develops a concise code of governance representing best practice across the sector. The draft, attached as Appendix II to this report, should be seen as the starting point for drawing up the code.

While the code should remain voluntary, all institutions should disclose in their annual report when their governance arrangements do not conform to the code, and explain why their particular governance arrangements are more effective.

Recommendation 7.2

Each governing body should systematically review its effectiveness in carrying out its obligations to all stakeholders every two or three years.

These reviews should take into account the stated objectives of the governing body, the performance of the institution against key performance indicators, evaluations of senior management and the results of effectiveness reviews of senate and committees.

To ensure transparency, the methodology and results should be published in the university's annual report and on the internet.

Recommendation 7.3

The Review supports the Leadership Foundation as an initiative to address the sector's need for high-quality leadership and senior management.

- The Foundation should focus its efforts as much on future vice-chancellors as current ones.
- Development programmes and training should be implemented with third parties rather than created and supplied internally.
- The Foundation should develop programmes to support council chairs in their increasingly challenging roles.

Recommendation 7.4

The Review recommends that the Government and all funders should minimise the use of hypothecated funding streams.

- Funders should continue to consolidate individual funding into larger streams, more proportionate to the necessary level of bureaucracy and regulation.
- Smaller hypothecated funding streams should, where possible, be allocated on a metrics or formulaic basis, rather than by bidding.
- Funders should minimise audit requirements on hypothecated funding streams.
- "Top-sliced" funding streams should have a limited life of no more than three years, after which they should be rolled back into core funding, unless policy is explicitly renewed.

Recommendation 7.5

The Review recommends that funders and agencies should apply a significantly lighter-touch regulatory and accountability regime to well-run universities.

One agency should be responsible for risk assessments on behalf of all funders and regulators. In time, assessments should be published. Risk should be assessed on:

- Adherence to the sector's code of governance (see Appendix II).
- Quality of management.
- Financial soundness.
- Institutional performance measured against key performance indicators (such as teaching, research, third stream and so on) set by the governing body, as well as other broad policy goals (as set by Government).

In the longer-term, well-run universities should receive greater financial freedoms, such as the freedom to move funding across budget lines and longer, multi-year funding cycles.

Recommendation 7.6

In three years' time, the vice-chancellors of Oxford and Cambridge should take stock of the progress of reform, and agree with the Government what further steps will be necessary for the two universities to sustain their global position.

CHAPTER 8 – SKILLS AND PEOPLE

Recommendation 8.1

Funding Councils should require universities to publish information in their prospectuses on graduate and postgraduate employability for each department (or faculty, if datasets are too small) by 2006.

This information should include:

- Employability statistics and first destination data – to allow students to see whether particular courses are likely to be useful for specific careers.
- Starting salary data – to give students an indication of the value that employers place on graduates from particular courses.
- Other information relevant to specific disciplines.

Recommendation 8.2

The Government should ensure that Sector Skills Councils have real influence over university courses and curricula. Otherwise, they will fail to have an impact on addressing employers' needs for undergraduates and postgraduates.

Recommendation 8.3

The Higher Education Funding Council for England should ensure that its forthcoming review of the teaching funding method for universities:

- Takes account of the views of employer-led bodies and representatives from the public and voluntary sector rather than funding courses solely on the basis of historical cost.
- Considers whether the UK university system is producing the right balance of graduates in the disciplines that the economy needs.

The other funding councils should also consider these issues.

Appendix IV

List of contributors to the review

The contributors to the Review included the organisations listed below. This report does not reflect the views of any particular contributor.

HIGHER EDUCATION INSTITUTIONS IN THE UK

Anglia Polytechnic University
Aston University
Bath Spa University College
Birkbeck College
Bolton Institute of Higher Education
Bournemouth University
Brunel University
Cambridge – MIT Institute
Cardiff University
City University
Coventry University
Cranfield University
Cumbria Institute of the Arts
Glasgow Caledonian University
Goldsmiths University of London
Harper Adams University College
Havering College
Imperial College London
Institute of Education, University of London
King's College London
Lancaster University
Leeds Metropolitan University
Liverpool John Moores University
London Institute
London Metropolitan University
London School of Economics and Political Science
Loughborough University
Manchester Metropolitan University
Napier University, Edinburgh
Newcastle College
North East Wales Institute of Higher Education
Northbrook College
Northumbria University
Open University
Oxford Brookes University
Queen Margaret University College
Queen Mary University of London
Queen's University Belfast
Robert Gordon University
Royal College of Art
Royal Holloway, University of London
Sheffield Hallam University
St Helens College
Surrey Institute of Art & Design
University College London
University of Aberdeen
University of Abertay Dundee
University of Bath
University of Birmingham
University of Bradford
University of Brighton
University of Bristol
University of Cambridge
University of Central England
University of Central Lancashire
University of Derby
University of Dundee
University of Durham
University of East Anglia
University of East London
University of Edinburgh

University of Exeter
University of Glamorgan
University of Glasgow
University of Gloucestershire
University of Greenwich
University of Huddersfield
University of Kent
University of Leeds
University of Leicester
University of Lincoln
University of Liverpool
University of Luton
University of Manchester
University of Manchester Institute of Science and Technology
University of Newcastle upon Tyne
University of Nottingham
University of Oxford
University of Paisley
University of Reading
University of Salford
University of Sheffield
University of Southampton
University of St Andrews
University of Strathclyde
University of Sunderland
University of Surrey
University of Sussex
University of Teesside
University of the West of England
University of Ulster
University of Wales, Aberystwyth
University of Wales, Bangor
University of Wales College of Medicine
University of Wales, Lampeter
University of Wales Swansea
University of Warwick
University of Wolverhampton
University of York
York St John College

BUSINESSES

Accentus
Advent Venture Partners
Amtri
Arup
AstraZeneca
Avecia
BAE SYSTEMS
Bank of Scotland
Barclays
Boots Group
BP
British Broadcasting Corporation
British Nuclear Fuels
British Technology Group
BT Group
Caparo Group
Corus Group
CXR Biosciences
Cyclacel
Diageo
Ford Motor Company
GKN
GlaxoSmithKline
GUS
Herald Investment Management
HSBC
IBM United Kingdom
Intel
Intellectual Partnerships Consulting
IP Business Consultants
J Sainsbury
J. C. Bamford Excavators
Jaguar
Javelin Ventures
Johnson Matthey
KPMG
Mahseer
MG Rover Group

Microsoft
mmO2
Morgan Stanley
Northern Foods
ORLAU Publishing
Oxagen
Oxford Innovation
PA Consulting
Pera International
Pilkington
Premier Farnell
PricewaterhouseCoopers
Prudential
QinetiQ
Quester Capital Management
Ranmore Consulting Group
Rentokil Initial
Rio Tinto
RolaTube Technology
Rolls-Royce
Schlumberger
Scottish Courage
ScottishPower
Severn Trent Water
Shell UK
Siemens
Smith & Nephew Group
Standard and Poor's
Sussex Place Ventures
Taylor Woodrow
Tesco
Tetronics
The BOC Group
The Generics Group
The Royal Bank of Scotland
Unilever
WHSmith

PROFESSIONAL BODIES/ RESEARCH COUNCILS/ OTHERS

Advanced Control Technology Club
Arts and Humanities Research Board
Association for University Research and Industry Links
Association of British Insurers
Association of Business Schools
Association of Graduate Careers Advisory Services
Association of Heads of University Administration
Association of Independent Research & Technology Organisations
Association of the British Pharmaceutical Industry
Association of University Teachers
Better Regulation Review Group
BioCity Nottingham
BioIndustry Association
Biotechnology and Biological Sciences Research Council
British Chambers of Commerce
British Library
British Standards Institution
British Venture Capital Association
Building Research Establishment
Campaign for Cambridge Freedoms
Campden & Chorleywood Food Research Association
Centre for Scientific Enterprise London
Centre for the Study of Financial Innovation
Chemical Industries Association
Committee of University Chairmen
Confederation of British Industry
Council for Academic Freedom and Academic Standards
Council for Industry and Higher Education

Council for the Central Laboratory of the Research Councils
Crystal Faraday Partnership
Design Council
Economic and Social Research Council
Engineering and Physical Sciences Research Council
Engineering and Technology Board
Engineering Employers' Federation
e-skills
Faraday Advance
Federation of Small Businesses
Foundation for Management Education
Graduate Group
Higher Education Funding Council for England
Higher Education Funding Council for Wales
IMPACT Faraday Partnership
INSIGHT Faraday Partnership
Institute for Public Policy Research
Institute of Biology
Institute of Directors
Institute of Physics
Institution of Electrical Engineers
Judge Institute of Management, Cambridge
Leatherhead Food International
Licensing Executives Society
Lodestone Innovation Partners
London Higher Education Consortium
Manchester Chamber of Commerce & Industry
Medical Research Council
MIDAS, Manchester Investment & Development Agency Service
Mini-Waste Faraday Partnership
National Council for Work Experience
National Institute of Economic and Social Research
National Physical Laboratory
Natural Environment Research Council
North West Business Leadership Team
North West Chemical Initiative
Northwest Science Council
North West Universities Association
Nottingham University Business School
Oxford SAID Business School
Particle Physics and Astronomy Research Council
PowdermatriX Faraday Partnership
PRIME Faraday Partnership
Pro-Bio Faraday Partnership
Qualifications and Curriculum Authority
Research Councils UK
Royal Academy of Engineering
Royal College of Music
Royal Society of Chemistry
Royal Society of Edinburgh
Royal Veterinary College
Russell Group of Universities
Save British Science Society
Science and Industry Council of the North East of England
Science, Engineering and Manufacturing Technologies Alliance
Scientific Instrument Research Association
Scottish Higher Education Funding Council
Sector Skills Development Agency
Shipbuilders & Shiprepairers Association
Skillset
Small Business Council
Small Business Service
Smith Institute for Industrial Mathematics and System Engineering
Standing Conference of Principals
Step Enterprise
Sutton Trust
Ufi
UHI Millennium Institute
UK Trade & Investment
University Companies Association
Universities Scotland
Universities UK
Wellcome Trust

INTERNATIONAL

Alcatel, France

Boston University, USA

Centre for National University Finance, Japan

Columbia University, USA

Commonwealth Department of Education, Science and Training, Australia

Ecos Corporation, Australia

European Industrial Research Management Association

Finnish Academy, Finland

Fraunhofer Institute for Production Systems and Design Technology (IPK), Germany

Geron, USA

Humboldt University, Germany

IPAL, Germany

Massachusetts Institute of Technology (MIT), USA

Ministry of Education, Culture, Sports, Science and Technology, Japan

National Institutes of Health, USA

National Science Foundation, USA

NetHawk, Finland

New York State Office Science Technology and Academic Research (NYSTAR), USA

Pond Venture Partners, USA

QB3, USA

Regional Technology Alliance, USA

Rensselaer Polytechnic Institute, USA

San Francisco State University, USA

SEMATECH, USA

Stanford University, USA

Tekkes, Finland

The Australian National University, Australia

The EVITech Open Polytechnic, Finland

The University of Sydney, Australia

The University of Texas, USA

The University of the Western Cape, South Africa

The University of Tokyo, Japan

Tokyo Institute of Technology, Japan

University of California, Berkeley, USA

University of Massachusetts, USA

University of Olu, Finland

University of Wisconsin, USA

Vinnova, Finland

DEVELOPMENT AGENCIES

Advantage West Midlands

East Midlands Development Agency

East of England Development Agency

Invest Northern Ireland

London Development Agency

North West Development Agency

One NorthEast

Scottish Enterprise

South East England Development Agency

South West of England RDA

Yorkshire Forward

Welsh Development Agency

GOVERNMENT

Council of Science and Technology

Department for Employment & Learning Northern Ireland

Department for Education and Skills

Department for Enterprise, Trade and Investment, Northern Ireland

Department of Agriculture and Rural Development, Northern Ireland

Department of Health, Social Services and Public Safety, Northern Ireland

Department of Trade and Industry

HM Treasury

Office of Science and Technology

The Army

The National Assembly for Wales

The Patent Office

The Scottish Executive

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