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UK plc: Just How Innovative Are We?

Findings from the Cambridge-MIT Institute International Innovation Benchmarking Project

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The Cambridge-MIT Institute

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Findings from the Cambridge-MIT Institute International Innovation Benchmarking project

Over the last three years, the Cambridge-MIT Institute has funded a substantial study to benchmark innovation in Britain and America. An exceptionally high number of companies have co-operated in this research – over 3,600 to date – making it the most significant survey of its kind.

The researchers, from the Centre for Business Research at the University of Cambridge and the Industrial Performance Center at MIT have been measuring and comparing innovation resources (such as people and ideas), and effort (measured by innovation expenditure of various sorts). They have been looking at the resulting innovation outcomes (including numbers of patents) and performance (including the percentage of sales due to new products and services).

The aim of the study, "International Innovation Benchmarking and the Determinants of Business Success", has been to create for the first time a like-for-like comparison of what British and American companies do to make themselves innovative, and what impact it has on them. It is hoped that the findings, some of which are contained in this report, will shed light on a number of issues and questions, and provide a firmer evidence base for innovation policy-makers. The results come from interviews conducted with firms ranging from very small (those with 10 or more employees) right up to very large (those with over 1,000). The researchers questioned companies in the manufacturing and business services sectors, from those developing radar technology to those manufacturing components for car exhausts, and from pharmaceuticals start-ups to civil engineering consultancies.

The Cambridge-MIT Institute

- The work was funded by the **Cambridge-MIT Institute (CMI),** the joint venture between Cambridge University and the Massachusetts Institute of Technology. CMI's mission is to deliver education and research to enhance the competitiveness, productivity and entrepreneurship of the UK economy. It focuses on the interface between academia and industry, and is concerned with improving the effectiveness of the knowledge exchange process. **(www.cambridge-mit.org)**

The study was conducted by two research centres with a strong reputation in this area:

CBR

- **The Centre for Business Research (CBR)** is an independent research institution within the University of Cambridge. It began originally as the Small Business Research Centre, and to this day, the study of enterprise and innovation remain key areas of research, alongside work on corporate governance. **(www.cbr.cam.ac.uk)**

Industrial Performance Center

- **The Industrial Performance Center (IPC)** at the Massachusetts Institute of Technology is dedicated to the study of industries in the United States and throughout the world. Established in 1991, the Center brings together the intellectual resources of the Institute in a search for fresh insights into the nature and origins of successful industrial performance. **(http://web.mit.edu/ipc/www/)**

The survey has generated an enormous amount of data, and there is still much analysis to do. So the report here is not a complete account of the findings; rather it represents a start in sharing the research findings with others. Anyone interested in finding out more about the study should visit the Cambridge-MIT Institute website **(www.cambridge-mit.org)** or the CBR website **(www.cbr.cam.ac.uk)** for further information, or email **compete@cmi.cam.ac.uk**

This report was prepared for presentation at "UK plc: Just how innovative are we?", a conference held at the CBI Conference Centre, London, on 8 February 2006. At the conference, the following presentations based on this survey were made:

Hughes, A: Universities and business innovation;
Cosh, A: Innovation barriers and public support;
Fu, X: Innovation efficiency: a transatlantic comparison.

Research team

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IPC team: Jean-Jacques Degroof, Wei Gao, Sonya Huang.

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Contents

Project leader Dr Andy Cosh, presenting early findings from the Innovation Benchmarking survey at the CMI Summit 2004.

International Innovation Benchmarking

Introduction

Sustainable economic development in advanced economies is increasingly linked to innovation in products, processes, and services. A high level of innovative activity is widely perceived as a necessary (though not sufficient) condition for good jobs and wages. As Bruce Mehlman, US Assistant Secretary of Technology Policy, remarked in 2003: "America must never compete in the battle to pay their workers least, and it will take sustained innovation to ensure that we don't have to."

Yet in a world where work is increasingly outsourced and jobs exported offshore, economies are at risk of seeing vital innovative activities migrating overseas as well. It is therefore argued that for domestic economies to build and maintain innovative activities (and the good jobs associated with them), sustained investment in research and development is required, along with investment in the education of skilled professionals. In addition, the increasing complexity of the innovation process - and an increasingly open innovation system - requires closer collaboration between university and industry sectors and government policy.

University-industry collaboration

As readers of this report will doubtless be aware, the recent drive for higher innovative activity in advanced economies has resulted in much policy significance being attached to university-industry interactions – as is reflected in the following recent quotations from the UK and the US:

> *"The nation that fosters an infrastructure of linkages among and between firms, universities and government gains competitive advantage through quicker information diffusion and product deployment."*
>
> US Council on Competitiveness, 1998.

> *"We believe the United States' economic and political standing are fundamentally bound up in our capacity as a society to innovate. We believe companies that do not embrace innovation as a core business value will fall to global competition – and that innovation in universities and government is crucial to unleash America's national innovative capacity."*
>
> INNOVATE AMERICA, National Innovation Initiative, US Council on Competitiveness, July 2004.

> *"In an increasingly knowledge-driven global economy invention and innovation are critical to Britain's long term competitiveness. This requires a virtuous circle of innovation: from the very best in science, engineering, and technology in universities and science labs to the successful exploitation of new ideas, new science, and new technologies by businesses."*
>
> Investing in Innovation: A Strategy for Science, Engineering and Technology. DTI, HM Treasury, DfES July 2002.

> *"Harnessing innovation in Britain is key to improving the country's future wealth creation prospects…(Britain) must invest more strongly than in the past in its knowledge base, and translate this knowledge more effectively into business and public service innovation."*
>
> *"Securing the growth and continued excellence of the UK's public science and research base will provide the platform for successful innovation by business and public services."*
>
> Science & innovation investment framework 2004-2014 HM Treasury, DTI, DfES 2004.

In the UK, a policy concern with innovation and the potential role of universities in the innovation process has been driven by the view that the UK has been suffering from: business investment in research and development (R&D) that by international standards is low and declining; an alleged absence of an entrepreneurial culture in universities; apparent tensions between the commercialisation of knowledge and the university mission of teaching and research; commitment to openness in publication and scientific autonomy; and an overemphasis on university links with large, as opposed to small, firms.

This is, of course, not a new problem. As the economist Alfred Marshall wrote in 1919 in his seminal work, Industry and Trade, *"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."*

Policy focus

However, the renewed attention that this policy issue is receiving nearly a century later reflects a number of factors. There is growing recognition that, for national and local governments, universities are a source of key assets in the innovation economy (such as skilled people, ideas, etc). They attract other key

resources for economic development (including educated people, firms, venture capitalists, etc) and they are relatively immobile. For firms, universities can provide key inputs into innovation processes (possibly doing so at lower cost than commercial sources of knowledge). Finally, for universities themselves these relationships can represent a new source of revenue, as well as posing the conflicts and challenges set out above.

In the UK, the recent Lambert Review of Business-University Collaboration argued that the main limitations on university-industry linkages lay on the demand, rather than the supply, side. The Review recommended that it was necessary to raise business demand for research from all business sources, particularly from small and medium-sized enterprises (SMEs), and to enhance regional and local developmental interactions.

> *"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."*
>
> Lambert Review of Business-University Collaboration. December 2003.

The Lambert Review, therefore, recommended that government should seek ways of directing a higher proportion of its support for business R&D towards SMEs, and enhance the role of development agencies in facilitating business-university links, making it a priority to identify non-collaborating SMEs that have the potential to gain significant benefits from working with universities.

In parallel with the Lambert Review, the UK government has undertaken a major review of business support for innovation, and of science and technology policy, culminating in the Science & innovation investment framework 2004-2014, which has reiterated the need to enhance university-industry interactions.

The Need for a UK-US Innovation Survey

Common to all this work is the perception that the UK lags behind international rivals in various aspects of innovation activity, and in the patterns and scale of appropriate university-industry interactions. Adverse comparisons are drawn, in particular, between the performance of the UK and the US. But these comparisons are almost entirely based on aggregate comparisons of innovative activity - such as R&D inputs - or human resource flows, or outputs such as patents. The recent development of the European Harmonised Community Innovation Survey has allowed a much richer analysis of innovation activity patterns within the EU, but there is no such survey for the US.

The need for a new innovation exercise has been widely recognised in the US:

> *"One of the first things we must do is figure out how well we are doing. We need to measure differently and better. There are a lot of data on such S&T indicators as R&D expenditures, patents, the number of workers with technology degrees, and student math and science scores. But the US has no organised means of collecting information on innovation broadly."*
>
> *"The US needs to institute its own Innovation Survey. Only when we look at the big picture and find out where we really stand can we begin to put together all the pieces: technology, education, creativity, organisational innovation, workforce training."*
>
> National Innovation Policy: *An Urgent US Need*. Athena Alliance, (published in *New Technology Week*), May 2004

Hence the new survey whose findings we report on here: "International Innovation Benchmarking and the Determinants of Business Success". It clearly fulfils important needs in both the UK and the US by offering for the first time a like-for-like comparison of over 3,600 companies of all sizes on both sides of the Atlantic and what they do to make themselves innovative. It has been funded by the Cambridge-MIT Institute (CMI) and conducted by the Centre for Business Research at the University of Cambridge, and the Industrial Performance Center at MIT, as part of a wider collaborative research project on innovation.

This is the first ever survey specifically to compare and contrast UK and US innovation activity and performance, and indeed the first national survey of US innovation since the Carnegie Mellon Survey of 1994. It thus provides the first ever basis for assessing, at firm level, comparative innovation activity in the UK and the US. It also allows the development of a firmer evidence base for innovation policy based on differences between the two countries. In this report, we focus on a number of key issues, including:

- **Universities and business innovation.** How much do these firms tap into the knowledge base in universities through research collaborations or licensing? How highly, comparatively, do they rate their links with universities - or do they find their customers and/or their competitors more important as sources of knowledge?
- **Barriers to innovation.** What prevents firms from innovating? Is it the lack of suitable sources of finance, too long a pay-off period, or a shortage of skilled personnel?
- **Public support.** How many companies on both sides of the Atlantic use publicly funded business support schemes? How much financial support do they obtain and where does it come from?
- **Innovation efficiency.** How good are UK and US firms at transforming innovation resources (e.g. skilled manpower, the acquisition of patents and licences and R&D expenditure) into innovative goods and services?

International Innovation Benchmarking

Professors Alan Hughes (left) and Richard Lester (right), seen with broadcaster Kirsty Wark, discussing early findings from the Innovation Benchmarking survey at the CMI Summit 2004.

The Key Characteristics of the Innovation Benchmarking Survey

Before presenting the results on university-industry interaction, and as an essential background to the later sections, it is important to note the essential characteristics of the survey on which our findings are based. (See also the Appendix on page 22.)

The target sample size for this survey of innovation activity was 4,000 companies in total, to be drawn equally from the UK and US so as to compare and contrast innovation performance in the two countries. It covered all manufacturing sectors and selected business services sectors, such as advertising, management, technical and professional consultancy, and telecommunications. The sample was to be stratified by sector, with 60% of companies from manufacturing and 40% from business services; and by size, with 75% of companies with 10-499 employees and 25% of companies with over 500 employees. Firms employing fewer than 10 employees were excluded from the survey. In addition, 25% of the sample was to be from high-tech sectors, and 75% from conventional sectors. The survey was principally telephone based, and the fieldwork was carried out by IFF Research Ltd in the UK and the Center for Survey Statistics and Methodology at Iowa State University in the US.

The "International Innovation Benchmarking" Survey was designed to provide a full coverage of innovation activity metrics, including:

- innovation resources (such as people, ideas, finance, location, sources of information, innovation barriers, universities, competitive position, etc)
- innovation effort (e.g. motivation, innovation expenditures, R&D and scientific/technological staff, collaboration, managerial talent)
- innovation outcomes (patents, other methods of protection)
- and innovation performance (such as the percentage of sales due to innovated products, company growth and financial performance).

The survey questions included coverage of general company characteristics including:

- when and how the company was formed, who is running the company and with what business objectives
- innovation and new technology (innovation input and output measures, sources of knowledge, collaboration, innovation expenditures, barriers to innovation, the role of universities)
- principal products and competition (competition and competitive advantage, business constraints, customer base, geographic orientation)
- and finance and capital expenditure (accounting information, capex and funding sources).

Comparing Innovative Activity in the UK and the US: Grossing-Up versus Matched Samples

In using the survey data to compare innovative activity between the UK and the US, it is important to keep in mind the relative scale of the aggregate innovative efforts within which our sample companies perform.

In 2003 the US, which spent $285 billion on R&D, accounted for 42% of total OECD R&D; whilst the UK, which spent $34 billion, accounted for 5%. On the output side, the US accounted for 30% of the world total of cited scientific papers, whilst the UK accounted for 7%.

Similarly, in 2001 the US accounted for 34 % of worldwide triadic patents, and the UK for 5%. (The OECD has developed a set of indicators based on "triadic" patent families to reduce the major weaknesses of traditional patent indicators. Triadic patent families are defined as a set of patents taken at the European Patent Office, the Japanese Patent Office and the US Patent & Trademark Office that share one or more priorities (see Dernis and Khan, 2004). As is well known, adjusting these respective levels of activity by various macroeconomic aggregates still reveals substantial differences. Thus in 2003, the ratio of overall R&D to GDP was 2.6% in the US, compared to 1.9% in the UK, and the ratio of business sector R&D to value added was 2.6% in the US compared to 1.8% in the UK.

On the other hand, normalising scientific output by unit of R&D spend puts the UK ahead of the US. (See References on page 7 to OECD 2005a and 2005b, and HM Treasury et al 2004, page 20.)

One way to use our survey data would therefore be to produce similar aggregate estimates by using underlying business population data to gross-up our survey results. This is an important exercise from the point of view of estimating and comparing aggregate innovative activity. Another approach is a matched sample approach, to compare innovative activity across our sample companies controlling for company level characteristics which may affect such activity, such as size, sector and age. This allows a focus on microeconomic aspects of innovative activity, and permits statements to be made about the relative innovative activity of companies

(grouped for example by size and sector) controlling for these factors. In this report we focus on this matched sample approach. We will report in a separate publication on the analysis using grossed-up estimates.

The Matched Sample

The number and size class characteristics of the full sample and the matched sample are shown in Figure 1.1.

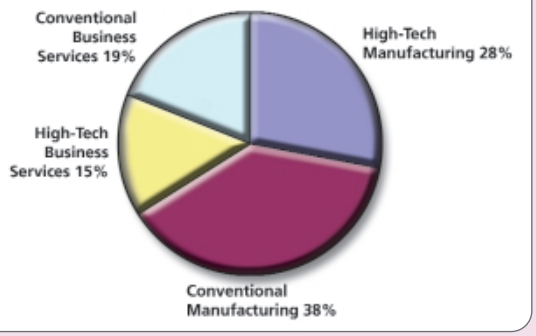
Fig 1.1 Survey Characteristics

	Full samples				Matched samples			
Employment	UK		US		UK		US	
Size	No.	%	No.	%	No.	%	No.	%
10-99	1409	66.2	951	61.8	769	66.9	786	68.4
100-999	531	24.9	375	24.4	248	21.6	231	20.1
1000+	189	8.9	214	13.9	132	11.5	132	11.5
TOTAL	2129	100	1540	100	1149	100	1149	100

Compared to the target samples of 2,000 by country, we obtained 2,129 respondents for the UK and 1,540 for the US. The lower response rate for the US partly reflects the higher cost of obtaining responses in that country. The effect of matching is to raise the proportion of the US sample in the lowest two size classes, which were relatively under-represented in the full achieved sample. Around sixty-six per cent of the matched sample is in the 10-99 size category, around twenty percent in the 100-999 group, and around 11% employ over 1,000 people.

Fig 1.2 shows the Sectoral Breakdown of the matched 'sample'. Two thirds are in manufacturing - made up of 38% conventional manufacturing and 28% high-tech manufacturing. One third is drawn from business services - of which 15% are high-tech business services, and 19% conventional business services.

Fig 1.2 Sectoral Breakdown in the Combined UK/US Matched Sample (N=2298)



Throughout the rest of this report, we use the term 'sample' to refer to this matched sample covering 1,149 companies in the UK and 1,149 companies in the US, and the term 'services' (whether high-tech or conventional) to refer to business services.

References

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CBI (2005) *Innovation Survey* 2005 CBI Innovation Brief, London, November

The role of universities in producing skilled graduates, and conducting research that could be a platform for innovation, is under the policy microscope.

Measuring University-Industry Linkages

University-industry interactions range from contract research to conferences.

Much of the current debate on university-industry links focuses on a narrow range of activities such as spin-offs and start-ups from universities and higher education institutes, and the licensing of intellectual property. But in this study, we have adopted a much wider approach, reflecting the fuller range of interactions captured in Fig 1.3. This was done deliberately in order to reveal that the importance of start-ups and licensing, apparent from the extensive qualitative literature in this area, is in fact relative.

Fig 1.3 University role is multi-faceted

Educating People
- Training skilled undergraduates, graduates & postdocs

Providing public space
- Forming/accessing networks and stimulating social interaction
- Influencing the direction of search processes among users and suppliers of technology and fundamental researchers
- – Meetings and conferences
- – Hosting standard-setting forums
- – Entrepreneurship centers
- – Alumni networks
- – Personnel exchanges (internships, faculty exchanges, etc.)
- – Visiting committees
- – Curriculum development committees

Increasing the stock of 'codified' useful knowledge
- Publications
- Patents
- Prototypes

Problem-solving
- Contract research
- Cooperative research with industry
- Technology licensing
- Faculty consulting
- Providing access to specialised instrumentation and equipment
- Incubation services

As Fig 1.3 shows, we group types of interaction into four categories. These include:

- educating people (training skilled undergraduates, graduates & postdocs);
- increasing the stock of 'codified' useful knowledge (problem-solving, patents and prototyping);
- problem solving (contract research, cooperative research with industry, technology licensing, faculty consulting, providing access to specialised instrumentation and equipment, incubation services);
- and finally what we call 'public space' functions. These are relatively neglected in the policy debate, but represent a distinctive set of activities in the innovation system. These activities and functions include forming and accessing networks; stimulating social interaction; influencing the direction of research processes among users and suppliers of technology and fundamental researchers; meetings and conferences; hosting standard-setting forums; establishing entrepreneurship centres; and promoting alumni networks and personnel exchanges (internships, faculty exchanges, etc) as well as joint industry-academia visiting committees and collaboration on curriculum development.

Contribution of University-Industry Interactions to Innovative Activity

We asked our sample companies to indicate which of a representative cross-section of the interactions shown in Fig 1.3 contributed to their innovation activity. We also asked them to indicate the importance of these interactions on a scale of 1-5, with scores of 4 and 5 being counted as 'highly important'. The answers are summarised in Figs 1.4 and 1.5.

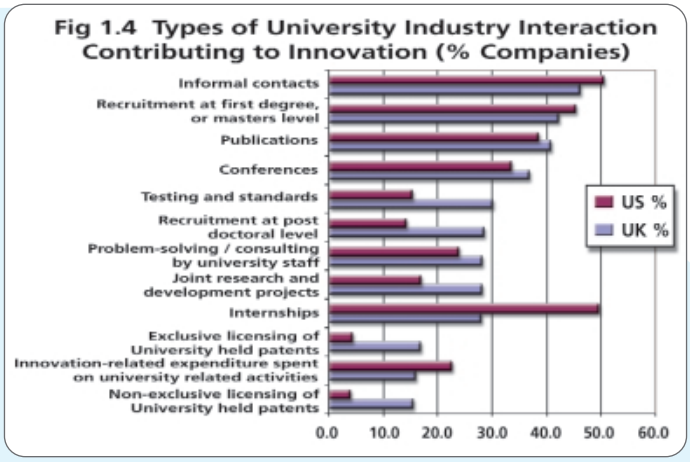


Fig 1.4 shows that both in the US and in the UK, companies are involved with universities across the full range of activities discussed above. Informal contacts are the most prevalent but, interestingly, the 'conventional' modes of university output – such as graduates, publications and conferences - are the activities most frequently cited as contributing to innovation. Licensing and patenting are amongst the activities least frequently cited in both countries. This shows the importance of covering the full spectrum of interactions, and not focusing too narrowly on those associated with patents or intellectual property.

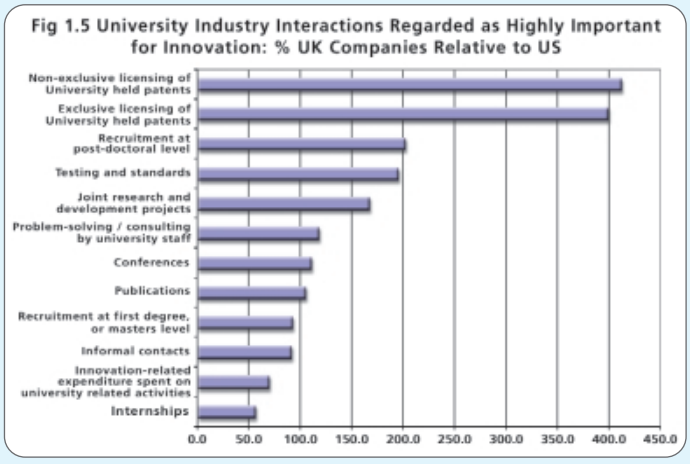


Fig 1.5 shows the relative frequency of responses which rated the interaction as highly important in the UK compared to the US.

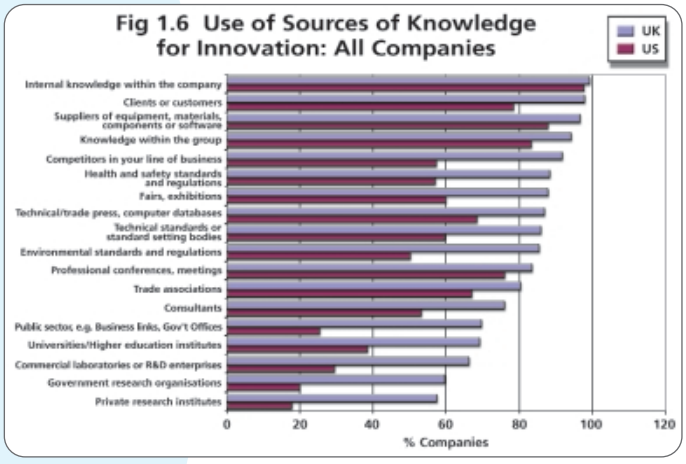
A value on the horizontal axis of more than 100 means that UK companies cite the contribution of an activity as highly important more often than the US, while a value of less than 100 means the reverse is true. The most striking feature of this chart is that in eight out of the 12 categories, a higher proportion of UK companies rate the contribution of universities as highly important. Recruitment of staff at post-doctoral level, for example, is much more frequently rated as important amongst the UK companies, as is the use of licensing (although as discussed above, licensing is a relatively low-frequency activity in both countries). A higher proportion of UK companies rate joint R&D projects with universities more highly.

In contrast, a much higher proportion of US companies makes use of internships and places a high importance on them. Moreover, a higher proportion of US companies spend some of their innovation expenditure on university-related activities, and US companies value the contribution of universities more highly in terms of graduate recruitment and informal contacts.

So, it emerges, in the US there is a relatively greater stress on the role of the university in educating people and in providing a 'public space' than there is in UK, along with a greater commitment of innovation-related expenditure to universities.

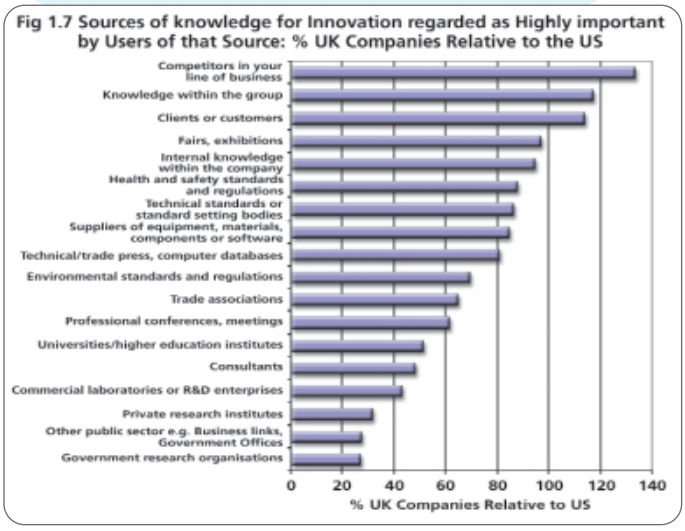
Universities as a Source of Knowledge for Innovation

We asked those companies in our sample that had carried out an innovation in the previous three years to indicate the sources from which they obtained the knowledge necessary for innovation. We also asked them, using the same scale as before, about the importance they attached to those sources. This analysis is useful because it helps keep in perspective the role of universities as sources of knowledge for innovation in the context of the innovation system as a whole.



The analysis is shown in Fig 1.6. The most striking feature is that in both countries, universities are ranked far down the table in terms of frequency of use. In both countries, the knowledge sources are dominated by industrial sources (customers, suppliers, competitors, and the internal pool of knowledge of the firm itself). Our large sample findings, drawn from over 1,149 UK companies, are consistent with other recent findings for the UK – for example, the CBI Innovation Survey 2005, which covered 162 UK companies, and a survey of 100 small manufacturing firms carried out for the Manufacturing Foundation and the British Chambers of Commerce (British Chambers of Commerce 2005).

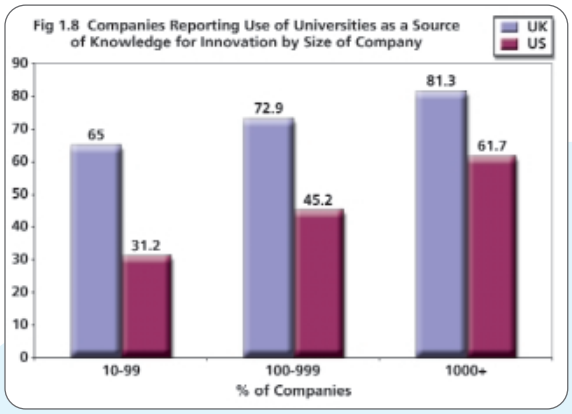
Another striking feature is that, in general, the UK firms are in all cases more frequent users of external sources of all kinds than their US peers. As Figure 1.6 shows, about two-thirds of UK companies used universities and other higher education institutions, compared to only one-third of US companies.

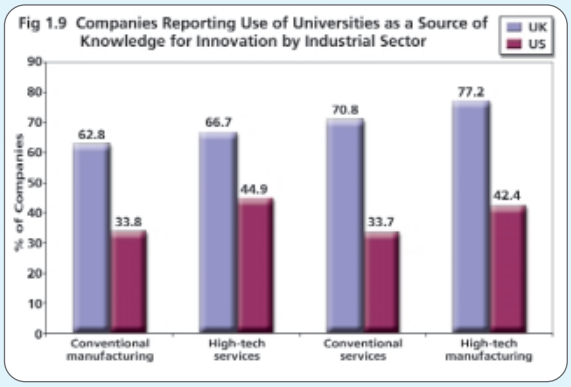


However when we compare the relative frequency of attaching high importance to a particular source of knowledge, the picture is reversed. Fig 1.7 shows the UK frequency of highly important ranking relative to the US. Only three of the relatives are over 100 - showing that UK companies ranked competitors, their own group, and clients or customers as highly important more frequently than US firms did. For all other sources of knowledge, the US users of information regarded the respective information source as more important - especially the public sector, university and private research institute sources.

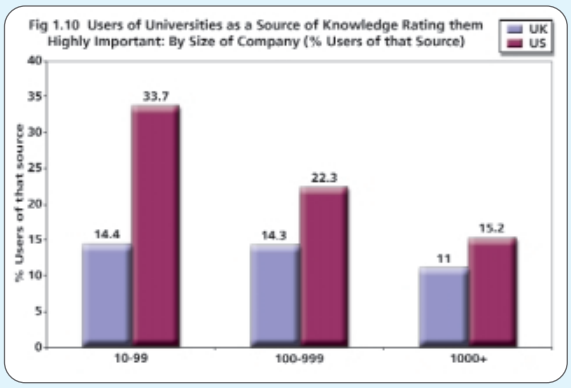
Cambridge University researchers showing their work to students and industry representatives at an open day.

In order to elaborate on the role of universities as sources of knowledge we disaggregated the results by size class and sector. Figs 1.8 and 1.9 reveal that the pattern of use is very similar across sectors and size class.

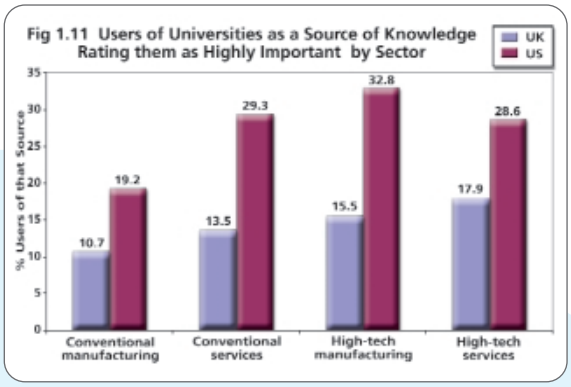




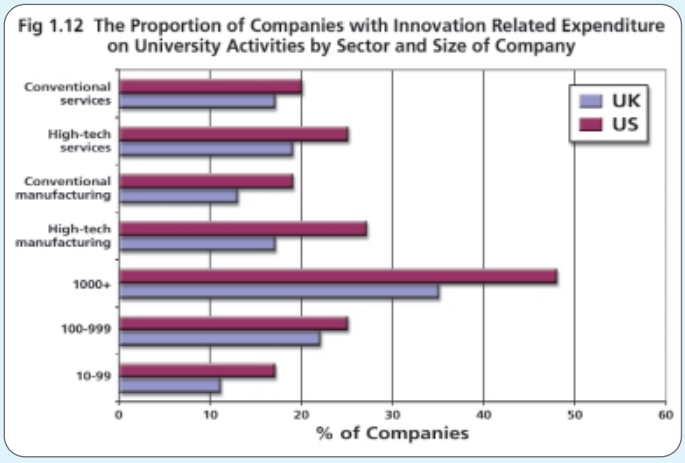
A different picture emerges in Fig 1.10 when we compare the value placed upon the interaction by size and sector.



The smallest companies in the US are much more likely to cite universities as a highly important source of knowledge relative both to larger US and small UK firms. It thus appears that the smallest firms in the UK are lagging considerably behind their US counterparts in attributing significant importance to universities as sources of innovation related knowledge. This is consistent with the findings of the Lambert review.



The findings by sector in Fig 1.11 show that in all sectors the same pattern holds, and that more US firms rate universities as highly important sources of knowledge than their UK peers. Another way of assessing the importance attached to a source of knowledge is the extent to which it is associated with innovation-related expenditure. We therefore compared innovation-related expenditures on university activities by size and sector in the UK and US. The results in Fig 1.12 show that in all sectors and size classes, US firms are more frequently carrying out innovation-related expenditure on university-related activities.



Taken together, the survey results on sources of knowledge reveal a more frequent, but much less intensive and valued, set of interactions between the business sector and the university sector in the UK than the US. They also reveal that in both countries, university interactions are quantitatively a small part of the overall pattern of knowledge flows for innovation.

Partnerships and Collaboration

Our final analysis in this section deals with the role of universities in partnership and collaborative arrangements with sample companies. Once again we locate these arrangements within the broader pattern of such collaborative activities undertaken by our sample companies.

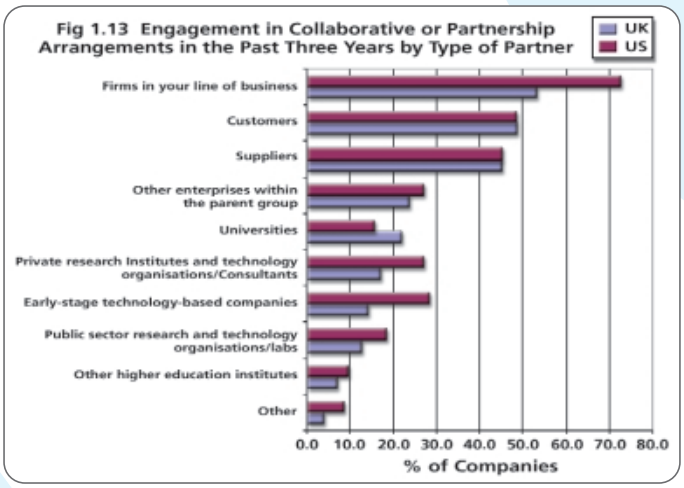
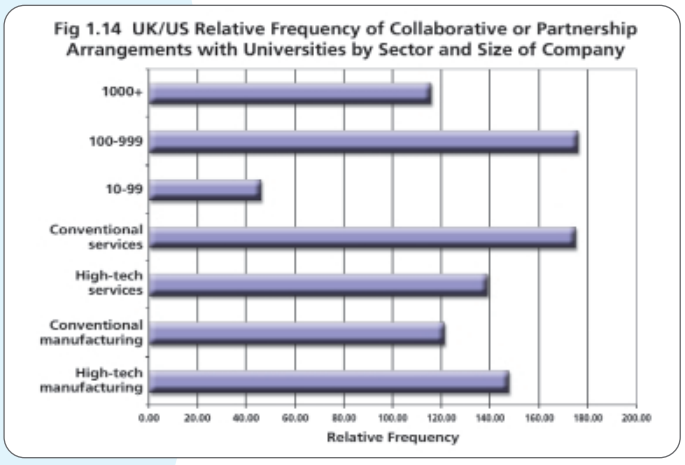


Figure 1.13 shows the frequency with which our sample firms engaged in collaborative or partnership arrangements in the three years prior to the survey. It shows, in keeping with our findings of the frequency of use of universities as sources of knowledge, that a significantly higher proportion of the UK sample collaborate with universities. US companies on the other hand are more likely to collaborate with early-stage technology-based companies, and with private research institutes and consultants. As with knowledge sources, our results reveal that other companies, competitors, suppliers and customers are the most frequent collaborators for our sample firms. Thus about half of our sample companies in each country collaborate with customers and with suppliers.



An analysis of the relative frequency of collaborative and partnership arrangements involving universities alone is shown in Fig 1.14 which also disaggregates the findings by size class and sector. A value on the horizontal axis of over 100 indicates a higher frequency in the UK compared to the US. In all sectors, and in the two larger size categories, UK firms are more likely to collaborate or partner. The striking exception is the smallest size category, where US firms are twice as likely to have entered into partnership or collaborative arrangements in the three years prior to the survey.

Summary Findings

UK and US companies are involved with universities across the full range of activities. Informal contacts are most prevalent and the 'conventional' modes of university output, in terms of graduates, publications and conferences, are the most frequently cited activities contributing to innovation. Licensing and patenting are amongst the least frequently cited in both countries.

Across a majority of university-industry activities, a higher proportion of UK companies rate the contribution of universities as highly important than is the case in the US. However a higher proportion of US companies spend some of their innovation expenditure on university-related activities, and US companies value the contribution of universities more highly in terms of graduate recruitment and informal contacts. The picture that emerges is of a relatively greater stress on public space and education roles in the US compared to the UK, along with a greater commitment of innovation-related expenditure.
In both countries knowledge sources for innovation are dominated by industrial sources (customers, suppliers, competitors, and the internal pool of knowledge of the firm itself). In general the UK firms in all cases are more frequent users of external sources of all kinds. In particular about two-thirds of UK companies, but only one-third of US companies, used universities/HEIs. UK companies also ranked competitors, their own group, and clients or customers as highly important sources more frequently than did US companies. For all other sources of knowledge for innovation, the US users regarded the respective information source as more important especially the public sector, university and private research institute sources.

Taken together, the survey results on sources of knowledge reveal a more frequent but much less intensive and less highly valued set of interactions between the business sector and the university sector in the UK than the US. They also reveal that in both countries, university interaction is quantitatively a small part of the overall pattern of knowledge flows for innovation.

A significantly higher proportion of the UK sample enter into collaborative and partnership arrangements with universities. US companies on the other hand are more likely to collaborate with early-stage technology-based companies and with private research institutes and consultants. As with knowledge sources our results reveal that other companies, competitors, suppliers and customers are the most frequent collaborators for our sample firms.

In all sectors, and in the two larger size categories, UK firms are more likely to collaborate or partner with universities. The striking exception is the smallest size category, where US firms are twice as likely to have entered into partnership or collaborative arrangements in the three years prior to the survey.

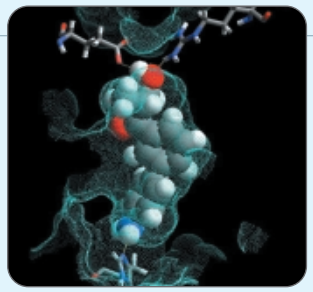
Case Study

Innovative companies: De Novo Pharmaceuticals

Computational drug discovery firm De Novo Pharmaceuticals is a small, high-tech services company. Spun out from the University of Cambridge Pharmacology Department in 2000, it uses proprietary drug discovery software to collaborate with other biotech businesses. Most of its customers are in the US, so in 2004 De Novo opened an office in California where two of its 17 staff are based.

As a high-tech small firm achieving the much desired policy goal of using the UK science base as a platform for innovation, is it receiving significant public support? "No," says Philip Dean, De Novo's chief scientific officer. "The only support we have really had is from UK Trade & Investment (the government organisation that helps companies in the UK doing business internationally.) They give us a small amount of financial support, but mainly help us access biotech clusters in the Unites States - like those in Boston and Washington - by setting up events at conventions where we can meet and network with businesses and potential customers."

De Novo is not yet profit-making, but it is busy. In 2005 it signed four new drug discovery partnership deals and raised new funding. In January 2006, it announced a drug discovery collaboration agreement with major US biotech firm Genzyme. As part of this, De Novo will apply its software, which designs novel molecular structures, to focusing on a target (implicated in a variety of diseases) of interest to Genzyme. Dr Dean says: "Companies treat us a bit like a think-tank: they come to us with a biological therapeutic target, ask us to design some compounds, and when we are confident of an answer we negotiate a contract with them."



De Novo's proprietary drug discovery software designs molecular structures.

Image courtesy of De Novo Pharmaceuticals

The firm has collaborated with both businesses and universities to develop new software and solutions. De Novo is currently working with a software firm on developing a piece of software so that it could be used on a much larger scale than at present. "And we had a major collaboration with [pharmaceuticals firm] Roche a couple of years back," says Dr Dean. "We were using our computers to design very large numbers of molecular structures to fit target sites and our work with Roche, which looked at a lot of chemical reaction types, helped solve the key question of how could we turn those theoretical designs into compounds that could actually be made at the lab bench."

Though Dr Dean says that much university research is of a different style to theirs - focusing more on fundamental issues, and less on how the research could be applied to solving problems - De Novo maintains its links with the University of Cambridge. It currently houses two PhD students who are working on solving some fundamental problems. Dr Dean says the company also found a collaboration with the Cancer Research Campaign and the University of Newcastle beneficial. "This gave us access to a lot of new data that they had, and we did not. It helped us solve a particular technical software problem which led to more potent compounds for them. Subsequently that software solution has been useful for us."

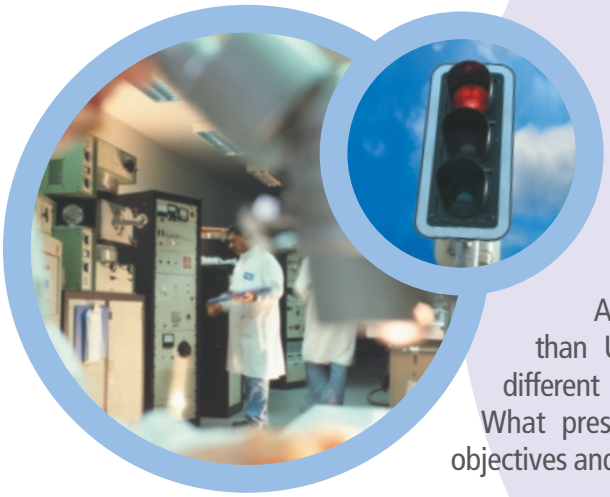


Image courtesy of TMD Technologies Ltd

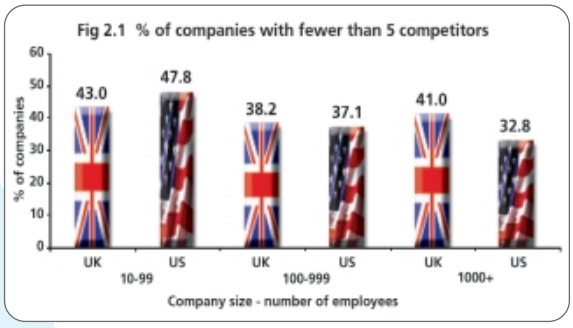
Innovation Barriers and Public Support

Are US companies facing different competitive pressures than UK companies? Do UK companies believe they have different competitive advantages than their US counterparts? What pressures do companies face in meeting their business objectives and in carrying out innovation on both sides of the Atlantic?

This section addresses these questions and examines whether the answers differ across different sizes of firms and parts of the economy. It also provides comparative findings on the level of public support for innovation and its impact on the companies that receive such support.

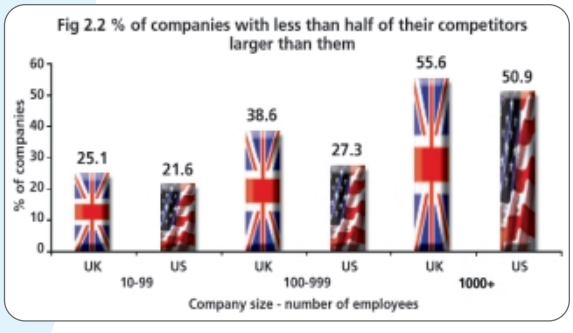
Competition

It is widely argued that a key factor in stimulating innovation is the threat posed by competitive rivalry. We therefore asked our sample companies about the number, nature and international location of their rivals. The data reveals that many businesses operate in concentrated, or niche markets with few competitors (Fig 2.1).

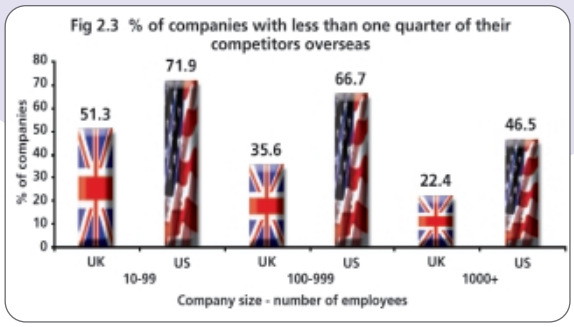


Amongst large businesses, a higher proportion of the UK sample believe that they have fewer than five competitors. On the other hand, for companies with less than one hundred employees the picture is reversed and there are more competitors in the UK.

The proportion of firms with fewer than five competitors declines with firm size in the US sample, but no clear size pattern can be discerned for UK companies.



As we would expect, as companies get larger a smaller proportion of their competitors are larger than them (Fig 2.2).

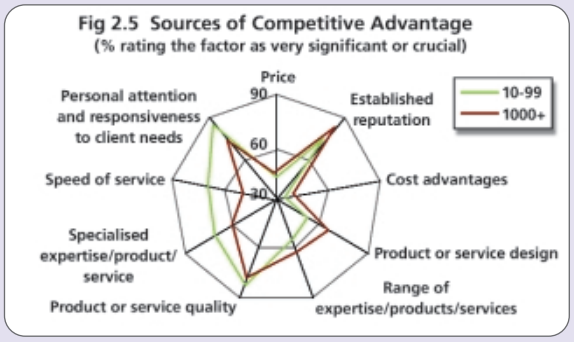


Across all size groups, a higher proportion of US companies have larger competitors than them compared with UK companies. On the other hand, UK companies are much more likely to face competition from overseas (Fig 2.3). The proportion of overseas competition rises with company size in both countries, but in the US it reaches the intensity of that faced by smaller companies in the UK only amongst the largest companies. Business services are less likely to face overseas competition than manufacturing firms, but in both sectors high-tech businesses are more likely to have overseas competitors than their counterparts in conventional industries. The exposure to overseas competition faced by UK smaller businesses may provide a greater spur to their innovative efforts. It also means, however, that they are likely to have to deal with the complexities of overseas trade much earlier than their US rivals who have a larger domestic market to exploit.

Sources of Competitive Advantage

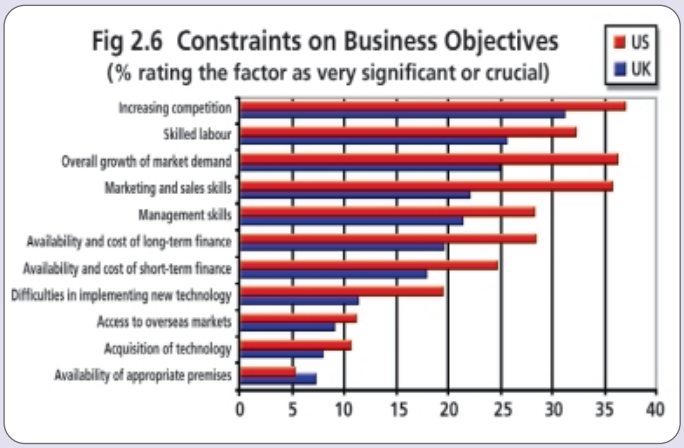
We asked our firms where they felt their competitive advantage lay. There is remarkable similarity in companies' views of what gives them competitive advantage on either side of the Atlantic. In (Fig 2.4) – the pattern is almost identical, but US companies score most factors somewhat more highly (particularly product design). Reputation, personal attentiveness and quality are scored very highly. Price and cost advantages, and marketing skills, are given little importance; and the other factors are in the middle.

When comparing large and small businesses in the UK, some differences emerge (Fig 2.5). Whilst they agree in their rating of reputation and product quality (high), and of price and cost advantages (low), they differ in their assessment of the other factors. Small firms stress the importance of personal attention, speed of service and specialised products, whilst large companies emphasise product design and range of products, or services. There is little here to suggest that the incentive to innovate is less, in competitive terms, in the UK than it is in the US.



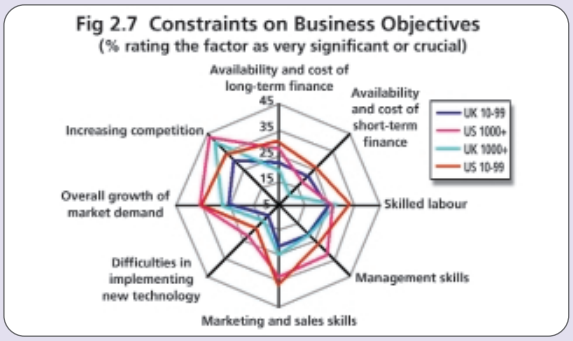
Constraints on Business Objectives

We asked our sample firms about constraints on meeting their overall business objectives. Interestingly, US businessmen feel that they face higher constraints on meeting their business objectives than do UK businessmen (Fig 2.6).



(They even feel this about management skills, despite the fact that they have higher qualifications than their British peers.) On the whole, though, the ranking of the constraints is similar – competition and lack of demand growth, along with skill shortages in labour, management and marketing, score most highly. US companies emphasise the market demand growth and marketing skills constraints much more. Finance constraints come next (both long-term and short-term) and these are also felt much more strongly in the US than in the UK.

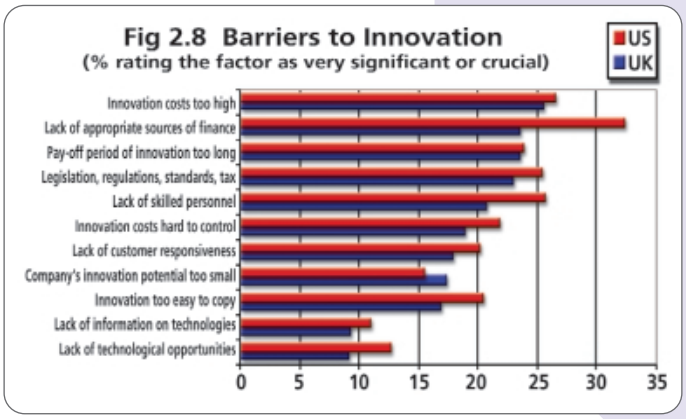
The finance constraint is felt more strongly by smaller businesses in both countries, but they are less concerned about increasing competition (Fig 2.7). In the US, small businesses are more concerned than large businesses about skilled labour shortages, but less concerned about management skills.

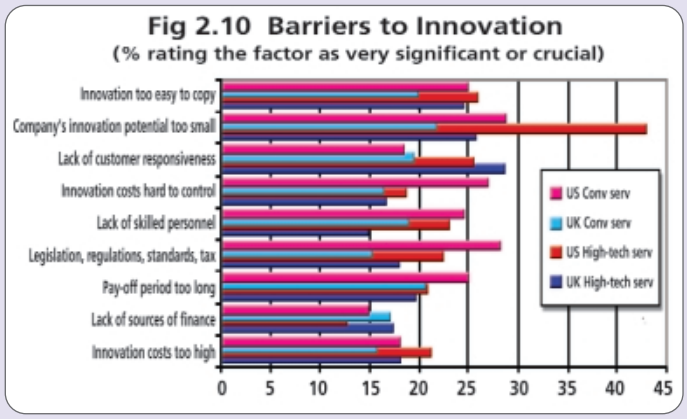


From the point of view of innovation, the pressure of constraints on high-tech industries is especially interesting. However, on both sides of the Atlantic high-tech companies feel these constraints less than the conventional firms. There are exceptions to this general rule. In particular, the finance constraints, both long-term and short-term, are greater for high-tech firms than for conventional firms in all cases other than in US manufacturing. Similarly, the growth of demand, marketing skill deficiencies, and difficulties in implementing new technology, are greater for high-tech firms than for conventional firms in all cases other than in UK manufacturing. Skilled labour shortages are very prominent for conventional businesses in the US.

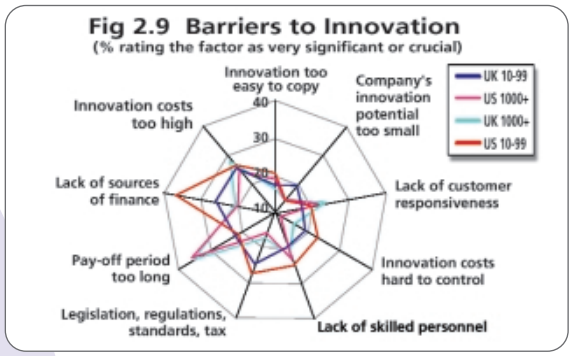
Barriers to Innovation

As the principal focus of this survey, sponsored by the Cambridge-MIT Institute, was on the innovation activities of the companies in both countries, one issue of concern was whether UK companies were placed at some disadvantage in their quest for innovation. We therefore asked about a full range of potential barriers to innovative activity. Surprisingly, in view of the emphasis placed on US superiority in this area, we find that a much higher proportion of US companies are concerned about finance for innovation – about one-third of US businesses say that this is a significant barrier to innovation, compared with less than a quarter of UK companies (Fig 2.8).





When we look across the size distribution of businesses we find that the finance constraint is much worse in the US for companies with fewer than 1,000 employees and worse still for those with less than 100 employees (Fig 2.9). The constraint is the same in the two countries for large businesses. These findings suggest that whatever the merits of arguments about financial market failure in the UK, they can hardly be used as an explanation for low comparative innovation performance to the US.



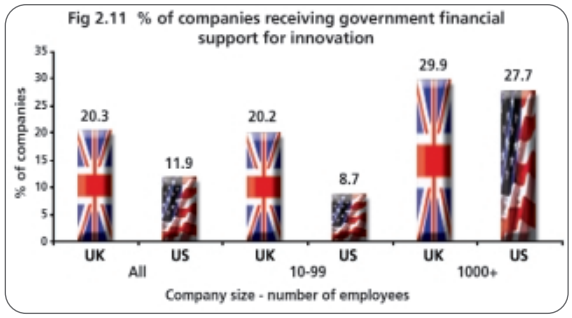
Other economic factors, such as innovation costs being too high, or difficult to control and the pay-off period being too long, are rated as high barriers. In each case the barrier is perceived as being higher amongst US companies. The length of the pay-off period is seen as a more significant barrier amongst large business (i.e. those with more than 1,000 employees) in both countries – about 35% of them see it as a very significant, or crucial, barrier compared with only 22% of small businesses (those with less than 100 employees). This may reflect short term stock market pressures on the larger compared to the smaller firms. On the other hand, the perceived ability of large businesses to control innovation costs reduces this barrier for them when compared with small companies. The economic factors are generally felt much more strongly by high-tech businesses, particularly in the US (Fig 2.10). High-tech services in both countries have particular problems with access to finance for innovation, and in the length of the pay-off period - which is consistent with the role of finance as a general constraint discussed earlier.

Despite much criticism of the damaging effect of excessive legislation, taxation and regulation in the UK – the CBI Innovation Survey 2005 found that a very large proportion of business felt that these were a hindrance to innovation - these factors are seen as higher barriers to innovation amongst US companies. This barrier is felt much more strongly amongst small business – for example, 28% of small companies in the US saw this as very significant, or crucial, compared with 16% of big business.

The shortage of skilled labour is also a greater barrier in the US, particularly for conventional businesses. Factors relating to customers' responsiveness to innovation, the innovation potential of the company and the ease with which innovation might be copied are seen as significant, or crucial, barriers to innovation by between 15% and 20% of companies in both countries.

Government Support for Innovation

The companies were asked whether they had received financial assistance for their innovation activities from central, or local, government within the past three years. Their answers reveal that this form of assistance is more widespread in the UK, where 20% had received financial support of this kind, compared with 12% of US companies (Fig 2.11).



Looking at companies with 1,000 or more employees the difference is much smaller – 30% for the UK compared with 28% for the US. It is amongst the small companies with fewer than 100 employees where the difference is most marked with

20% of UK companies having received assistance compared with only 9% of US companies. It should perhaps be noted that the CBI Innovation Survey 2005 found that government procurement practices in the UK hindered innovation, and it may well be that the US has a better record in this area, which was not covered by our survey. Of course, the impact of this support will depend on its magnitude. In order to assess this we present both the average amount received (median values in £000) and the amount received as a percentage of the R&D spend by the company over the same period. A very different picture emerges (Fig 2.12).

Fig 2.12 Financial assistance for innovation from government in last 3 years

Employment size	Amount received (£000)		Amount received as a % of R&D spend	
	UK	US	UK	US
10-99	40	194	11	38
100-999	100	375	6	39
1000+	750	1,667	6	5
All cos	75	417	10	28

Case Study

Innovative Companies: TMD Technologies Ltd

TMD started life before the Second World War as part of EMI (the high power klystron group) involved in developing the first airborne radars. Sixty-five years later, TMD is still a high-tech manufacturer. Based in Middlesex, it designs microwave tubes, high voltage power supplies and subsystems for radar, electronic warfare and communications, and for other applications including medical and laboratory use.

"For a small company, we generate a lot of bang for our buck," says the firm's technical director, Howard Smith. "We use local companies to supply components, we employ local labour and 70-80 per cent of our products are exported, so we are good for the UK. We are not asking for hand-outs, but when we have really good ideas for products for which we can see a market, it would be nice to receive some public support."

Mr Smith is talking about two recent instances in which he feels that accessing government assistance has been a puzzling or difficult experience. The company, which invests more than eight per cent of its sales in R&D, benefits from the R&D tax credit made available to Britain's smaller firms. "This is worth about 30 per cent," says Mr Smith. "Two years ago, I looked at an additional DTI scheme aimed at offering SME's about 30 per cent funding to help them develop a new product or process, but as the scheme disallowed the tax credit to which smaller firms are entitled, I couldn't understand what additional value it offered to them.

TMD also recently pursued public support when it wanted to set up a partnership with a UK university, a French university, a French company and an Italian company to develop a weather radar that could predict the violent rainstorms that cause flash floods. Mr Smith says, "We wanted to lower the cost of developing such a radar, so we looked at organisations like the Eureka network, which encourages pan-European research and development. Our French and Italian partners found they could

TMD staff test cathodes batches before use to guarantee good emission.

Image courtesy of TMD Technologies Ltd

obtain funding to participate quite easily: but when we asked the DTI about funding our participation, we were told that the money we were bidding for was extremely heavily over-subscribed and there was very little chance of us succeeding."

These setbacks have not stopped TMD however. Its own investment in R&D is more than doubled by customer-funded developments of products. "We work with clients in the UK, the Far East and the USA," says Mr Smith. It sometimes takes a long time for these products to come to fruition. "We approached one potential US customer in 1997 with an idea for a product, but they decided then that they could make it themselves. Six years later, they still couldn't do it, so they came back to us." The product is now in production, destined for use by the US military.

TMD also collaborates with many universities and research institutes, including Strathclyde, Nottingham, Lancaster and Oxford Universities, and CERN, the European Organisation for nuclear research. These collaborations include collaborative research to further technological advances, such as participation in the publicly-funded High Power Radio Frequency Faraday Partnership. Mr Smith describes the Faraday Partnerships as "the best thing the DTI has ever done for smaller firms."

The company also collaborates with universities by offering work placements to MSc students. "We are a specialist company and we need to recruit graduates with specialist skills," says Mr Smith. "We want to encourage universities to conduct research in areas that will equip students with the skills we will need in future."

Innovation Barriers and Public Support

Whilst only half as many small businesses in the US receive government financial assistance for innovation, the amount they receive is on average five times larger than that received by UK companies. It also represents a proportion of their R&D spending (38%) that is over three times greater than that for UK firms (11%). Therefore government activity in providing financial support for innovation amongst companies with less than 1,000 employees is not less in the US, but is more concentrated. The figures for large business show similar proportions of both those receiving support and the ratio of that support to their R&D spending – though the absolute level of support and of R&D spending are higher in the US sample of large companies.

It is clear from this discussion that UK companies receive a relatively high degree of support in terms of the extent of the support system. More UK companies get help. The intensity of that help is, however, much lower. This raises important questions about the degree and nature of selectivity in business support policy in the UK. Financial support within manufacturing was clearly targeted towards high-tech companies, particularly in the UK where 25.5% of high-tech manufacturers received support compared with 17.4% of conventional manufacturers (Fig 2.13).

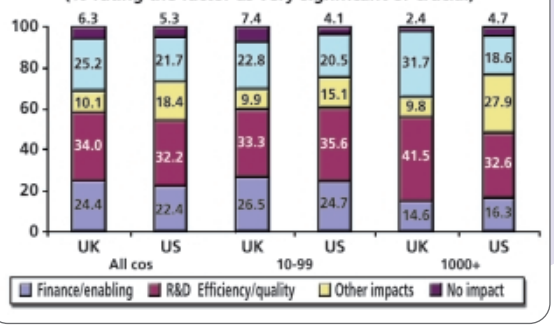
Fig 2.13 Financial assistance for innovation from government in last 3 years - by sector

Sector	% receiving support		Amount received (£000)		Amount received as a % of R&D spend	
	UK	US	UK	US	UK	US
High-tech manufacturing	25.5	13.5	60	375	11	29
Conventional manufacturing	17.4	11.6	46	417	10	20
High-tech services	28.7	18.2	200	556	7	27
Conventional services	11.9	5.6	75	208	13	42

However, the ratio of this assistance to R&D spending is 11% for high-tech and 10% for conventional businesses, compared with 29% for high-tech and 20% for conventional in the US. Within the service sector the picture is different. In both countries, support is given more frequently to high-tech businesses than conventional ones (29% against 12% in the UK and 18% against 6% in the US). In both countries, over twice as much is given to high-tech companies receiving this support compared with their conventional sector counterparts. However, the scale of R&D in the services sector is very much greater amongst high-tech firms than conventional business. As a consequence the ratio of government support to the company's R&D spending is much higher in the conventional sectors in both countries.

Finally, the businesses were asked an open question about the impact of this financial support from government towards their innovation activities. These responses have been classified within five broad headings (Fig 2.14).

Fig 2.14 Main Impact of Government support
(% rating the factor as very significant or crucial)



Fortunately, only about one in twenty wrote that it had had no impact on their business – or words to that effect! Small businesses were more likely to stress the impact on their company's ability to finance innovation and other activities – saying that either the innovation activity, or some other investment would have been postponed, or abandoned, without this support. About a third of businesses simply stated that it had enhanced their R&D and technological capacity, suggesting that it was additive. Large businesses were more likely to see the impact of this support on the wider aspects of the business in terms of product quality and reliability, or manufacturing efficiency. The other impact category covers a wide range of answers and was used more frequently by UK businesses, particularly amongst the large companies. These included workforce skills development, improved marketing and public image.

Summary

We find many similarities in the strengths and weaknesses of UK and US companies despite the greater international competition faced by UK firms. US companies are more concerned about financial constraints and the shortage of skills than their UK counterparts. UK government support for innovation is more widespread, but is spread more thinly than in the US.

Forced to stop. American and British firms have similar concerns about the constraints that hinder innovation.

Innovation Efficiency – a Transatlantic Comparison

Are US companies more innovative than their British counterparts? Do they produce more innovative goods and services than UK companies? If so, is it because US companies spend more on research and development (R&D) and have more staff specialised in R&D? Or is it because US companies are more efficient than UK companies in transforming innovation resources into innovative outputs?

Innovation, of course, is not just about R&D: a wide range of other factors such as design and marketing also matter, as the CBI found in its 2005 Innovation Survey. So what are the differences between US and UK companies in other innovation-related activities? This section addresses these questions and examines whether the answers differ across different sizes of firms, and different sectors of industry. It benchmarks firms' innovation performance against the transatlantic best practice frontier, and provides comparative findings on the innovation efficiency of firms.

Innovation Performance

In our survey, companies were asked whether their innovations had resulted in new or significantly improved:

- products or services
- process of producing their products or services
- or a new method of supply, storage or delivery of their products or services.

The companies were asked about both what might be termed "diffusion" innovations – e.g. ones that were new at least to the firm – and "novel" innovations, i.e. ones new to their industry. The findings showed that on average, the proportions of companies that have a new, or significantly improved, product or supply system are similar on both sides of the Atlantic. However, the US has a higher proportion of companies that have produced novel innovations than the UK. And as Fig 3.1 shows, there is a gap in process innovation between the US and the UK, where more US companies have introduced both diffusion innovations and novel innovations.

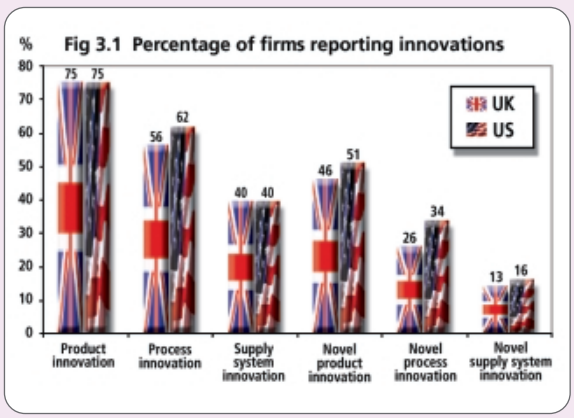
Across all size groups and all innovation types (e.g. product, process and supply), a higher proportion of US companies report that they have novel innovations than their peers in the UK.

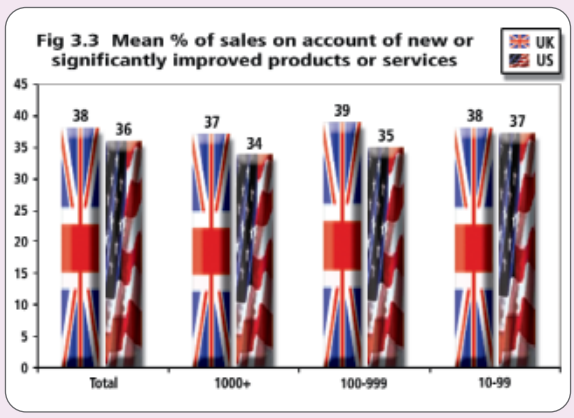
US companies have an overall lead in the manufacturing sector. The proportions of companies that reported novel product, process or supply system innovations are all greater in the US manufacturing sector than in the UK manufacturing sector. However, the gaps between the UK and the US services sectors are, in general, small. In the high-tech service sector, greater proportions of UK companies reported novel process and supply system innovations than did US companies. As Fig 3.2 shows, 39% and 21% of high-tech services firms in the UK reported novel process and supply system innovations, respectively, against 33% and 16% in the US.

Fig 3.2 Percentage of companies reporting novel innovations by sector

	Novel product innovation		Novel process innovation		Novel supply system innovation	
Sector	UK	US	UK	US	UK	US
High-tech manufacturing	48	56	17	32	9	13
Conventional manufacturing	41	46	25	34	10	17
High-tech services	59	64	39	33	21	16
Conventional services	41	43	31	37	19	20

Surprisingly, the average percentage of sales arising from new, or significantly improved, products and services is slightly higher in the UK than that in the US. This difference is, however, not statistically significant at the aggregate level (Fig 3.3).

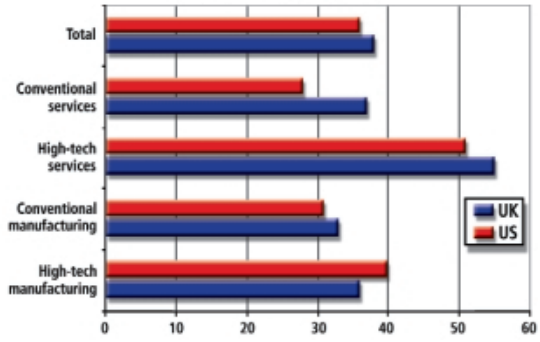




Innovation Efficiency – a Transatlantic Comparison

Breaking down the sample by industry sectors, UK companies have a significant advantage in the conventional services sector (e.g. advertising, management consultancy, etc). The average percentage of sales accounted for by new or significantly improved products or services was 37% in the last financial year, while for the US it was only 28% (Fig 3.4). The advantage of UK companies in this respect exists in both diffusion and novel innovations. US companies took a lead in the high-technology manufacturing sector. Here, the average percentage of sales arising from new products was 40% for US high-tech companies, 4% higher than that for the UK companies.

Fig 3.4 Mean % of sales on account of new or significantly improved products or services by sector



Innovation Inputs

Companies were asked whether they had engaged in research and development (R&D) in the last financial year, and other innovation-related activities over the last three years. Their answers reveal that, on average, a greater proportion of US companies engaged in research and development than UK companies (Fig 3.6).

Fig 3.5 Comparison of Innovation Inputs

	Firms engaged in R&D (%)	Average part-time R&D staff (Median)	Average full-time R&D staff (Median)	Average total R&D expenditure (£000)	Average R&D Sales ratio (%) (Median)	Average R&D Staff total employee ratio (%)
UK	71	4	2	2655	3.1	3
US	76	5	2	3250	3.3	4

However, the average level of innovation inputs - in terms of R&D expenditure and R&D staff - are similar on both sides of the Atlantic. This is the case both for absolute values (such as full time R&D staff and total R&D expenditure) and intensities (e.g. the ratio of R&D to sales, and the ratio of R&D staff to all staff).

On average, UK companies spend 3.1% of their turnover on R&D; and US companies spend 3.3%. US companies do, however, use significantly more part-time R&D staff than UK companies do (Fig 3.5).

Fig 3.6 Percentage of companies engaged in R&D

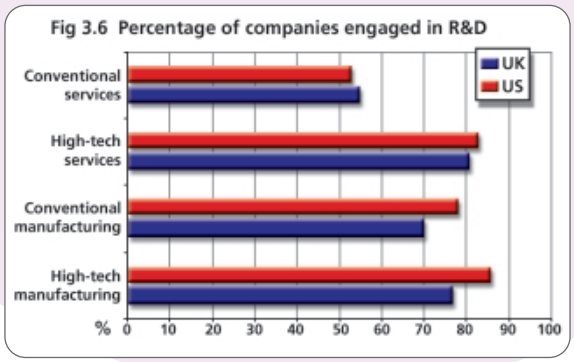
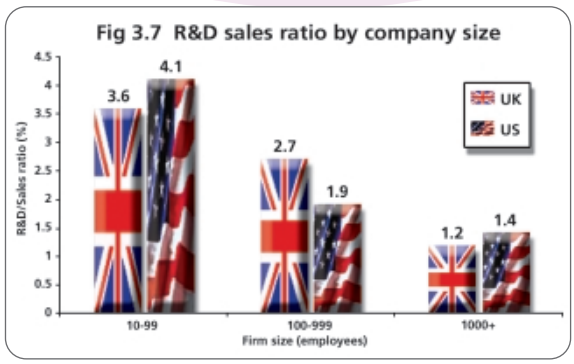
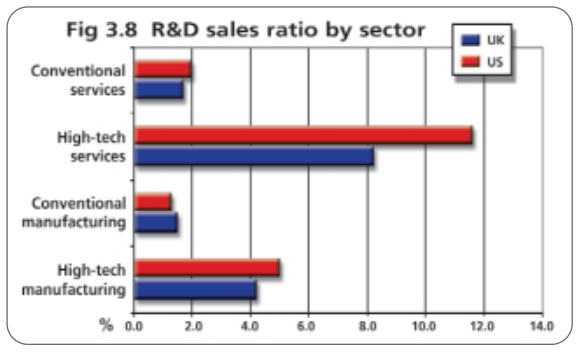


Fig 3.7 R&D sales ratio by company size



When comparing large and small businesses, some differences emerge (Fig 3.7). While the patterns of R&D / sales ratio are similar in both economies, US small businesses spend a significantly higher proportion of their turnover on R&D than their counterparts in the UK. UK medium-sized companies appear to be doing better than their US counterparts in this respect. This difference is, however, not statistically significant. Differences also emerge when we break down the sample by industry sectors (Fig 3.8). US companies in the two high-technology sectors spend more of their turnover on R&D than their counterparts in the UK.

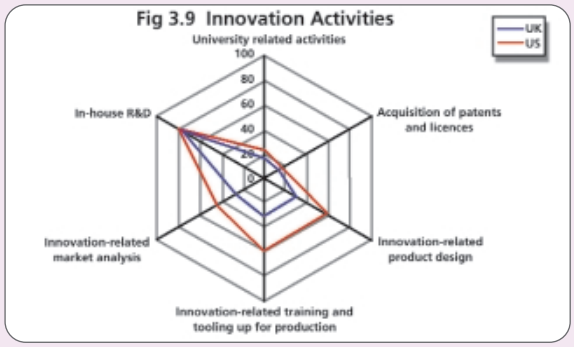
Fig 3.8 R&D sales ratio by sector



Innovation Efficiency – a Transatlantic Comparison

Structure of Innovation Activities

Innovation is not just about R&D. It can not be measured by R&D spending alone. There are a wide range of other activities that affect a firm's innovation performance. Innovation-related product design, training and market analysis play an important part in helping firms transform new ideas and new technologies into commercially competitive products. While the proportion of companies that spend on in-house R&D are similar on both sides of the Atlantic, significantly higher proportions of US companies spend on innovation-related product design, training, tooling-up for production, and market analysis. As Fig 3.9 shows, the percentages of US companies that spend on university-related activities and acquisition of patents and licences are also higher than those for the UK. And more US companies are engaged in innovation-related IT activity as well.

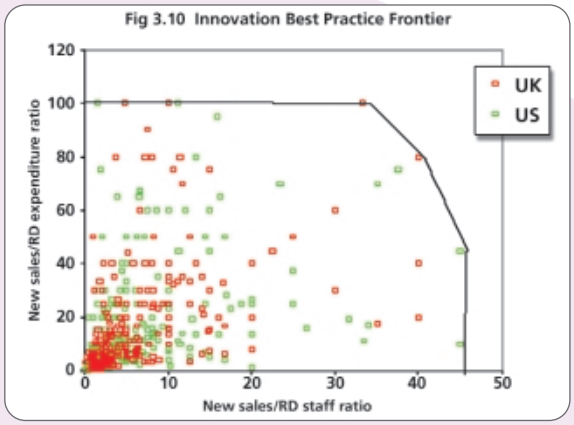


The US-UK gap in the wide range of innovation-related activities prevails across different industry sectors - with the only exception being in-house R&D in the high-technology service sector. This gap prevails across different size groups of firms as well, with the only exception being in-house R&D in medium-sized companies (i.e. those with between 100 and 999 employees). While medium-sized UK companies have similar levels of involvement in university-related activities and in the acquisition of patents and licences to US companies, the gap between them and US firms remains large in other innovation-related activities.

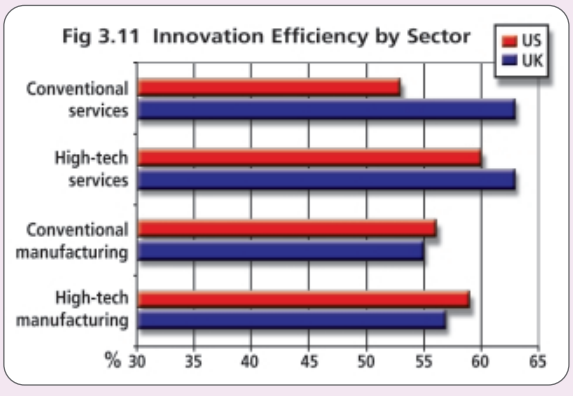
Innovation Efficiency

The efficiency of firms in transforming innovation inputs into commercially successful outputs plays a crucial role in determining a firm's innovation performance. We were able to compare the extent to which innovation inputs - in terms of R&D spend and R&D staff - were reflected in innovative sales, i.e. sales accounted for by new or significantly improved products. It should be noted, however, that in order to do this comparison, we cleaned the sample by excluding companies with missing values, those with zero percentage of innovative sales, and the 'outliers' – those companies with extremely different observations from the vast majority of others.

As a result, the valid sample for this analysis is slightly different from the sample used for most of the analysis in this report. So the results are not directly comparable to the rest of the results presented here. We constructed a 'best practice frontier' based on this reduced sample including both UK and US companies, and benchmarked the innovation performance of each company against the frontier (Fig 3.10). R&D expenditure and R&D staff are taken into account as innovation inputs; innovative sales are taken as a measure of innovation output. The scatter of points suggests considerable overlap between the innovative efficiency performance of the two countries.



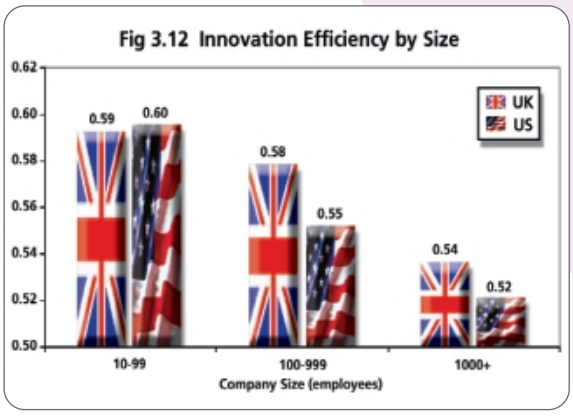
In a separate analysis not tabulated here, a comparison of the mean values and the percentiles shows, in fact, that there is no significant difference between UK and US companies in innovation efficiency. (This result is robust to different methods of estimating the position of the frontier and the relative position of the rest of the companies: the parametric Stochastic Frontier Analysis and the non-parametric Data Envelopment Analysis provide consistent results.)



When comparing companies in different industry sectors, UK conventional services companies appear to be more efficient in innovation than their US counterparts, while the differences in innovation efficiency in the remaining three sectors is not significant (Fig 3.11).

Innovation Efficiency – a Transatlantic Comparison

Within the US, small companies appear to be more efficient in innovation than large companies. The pattern across different size groups in the UK is similar to that in the US, but the differences are smaller (Fig 3.12).



Summary

The survey shows that levels of innovation inputs and outputs of UK and US companies are surprisingly similar despite the fact that novel innovators – i.e. those introducing an innovation new to the industry - are more widespread in the US than in the UK. Differences emerge, however, within industry sectors. US high-tech manufacturing companies and, in particular, high-tech services companies, spend more on R&D relative to sales, and high-tech manufacturers report a higher proportion of sales arising from new, or significantly improved, products.

The UK companies display a relative strength in the services sector. Here, they report more sales arising from new or significantly improved services, and they are more efficient in innovation than their US counterparts. Our survey results also suggest that the differences in innovation between the US and the UK are not in R&D spending and technology acquisition. They occur elsewhere in the wide spectrum of innovation-related activities, including innovation-related product design, training, market analysis and IT development.

Case Study

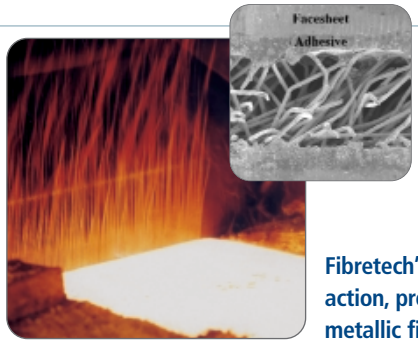
Innovative Companies: Fibre Technology Ltd

For 25 years Fibre Technology Ltd, based in Nottingham, has been using a patented technology to manufacture metal fibres. These are used in the refractory and construction industries to reinforce concrete, and in the automotive industry: Fibretech's stainless steel filaments are used as components in the exhaust systems of cars like the Mini Cooper S.

But it's a tough market for the small business, which employs 21 people. "We used to be in competition with just one other company," says the firm's technology manager, Lee Marston. "But in the last five years, we have seen five competitors spring up in China, where they have a lower cost base, less regulation to comply with, and access to cheaper raw materials, and another competitor in South Africa."

Seeing the increase in competition, in 2000 the company took the decision to diversify and innovate, widening its product range to offer not just the raw material - metal fibres – but more complex components. That was when Mr Marston, a metallurgist, was brought into the firm as technology manager, to develop its production processes.

Since then, Fibretech has developed a number of new products, collaborating mainly with other firms. "Because we are so small, we have to work with our customers," he says. "However, firms in the automotive industry tend to be quite innovative anyway as they are always looking for products and solutions that are better, and hopefully cheaper as well." In some cases, says Mr Marston, customers will fund the product development, in other cases they split the costs, or Fibretech foots the bill – "though as a small company, our budget is limited."



The structure of the metal 'sandwich'

Fibretech's plant in action, producing metallic fibres

Image courtesy of Fibretech

The government would like to encourage businesses to spend more on R&D and to work with research institutes to develop innovations. But it isn't always easy says Mr Marston. "Sometimes, making a grant application – especially for EU funding – is so complicated that you need to pay a consultant to do it for you, and then you have to spend some of the funding on their fee and commission. That can be quite a significant stumbling block for small firms," says Mr Marston.

However, a recent collaboration with Volvo Technology Transfer and researchers working on a Cambridge-MIT Institute project to develop an ultralight metal, has been a positive experience and one which may yet take Fibretech into new markets. The researchers have developed an ultralight stainless steel 'sandwich' material. Pilot production of it at Fibretech's plant has generated expressions of interest from automotive firms and European researchers looking at the development of future train systems. "In fact, we're currently putting in an application to our local regional development agency for a research and development grant. We'd like to explore the feasibility of producing it in larger quantities and in a continuous sheet," says Mr Marston, "if we can do so at the right price."

Appendix:

The International Innovation Benchmarking Surveys – UK and US

The Sampling Framework

The sampling frame chosen for the UK survey was the Dun & Bradstreet (D&B) UK database. This database is assembled from a number of sources including Companies House, Thomson Directories and press and trade journals. For the US, both the D&B US database and Standard & Poor's Compustat database were considered, but the larger number of available companies in the D&B database was the deciding factor in choosing D&B for the US as well.

The sectors covered by the surveys were all manufacturing, and the business services sectors. The latter include: post and telecommunications, computer and related activities, research and development, and other business activities excluding legal activities. We used R L Butchart's definition for high-tech industries from 1987 to further split the sample into high-tech and conventional sectors.

The sample was stratified by sector (high-tech manufacturing; conventional manufacturing; high-tech business services; and conventional business services) and employment size (10-19; 20-49; 50-99; 100-499; 500-999; 1,000-2,999; and 3,000+), with larger proportions in the smaller size bands. As in both countries the vast majority of businesses (more than 98%) are smaller firms employing fewer than 100 people, it was possible to take a sufficiently representative sample of the companies in the smaller size bands from the D&B database. But to get a large enough sample of companies in the larger size bands - of which there are fewer - we bought the records of all the companies in the larger size groups in the D&B database.

The Survey Instruments

A key purpose of the project was to carry out innovation surveys in both the UK and the US so as to compare and contrast innovation performance in the two countries. The intention was to use identical survey instruments bar country differences in language, currencies and markets.

The survey instruments were to cover questions on the following topics:

- General characteristics of the company;
- Innovation and new technology;
- Principal products and competition; and
- Finance and capital expenditure.

The survey instrument included 44 questions and 295 variables and a screener questionnaire was used to confirm the respondent's identity and eligibility.

The Surveys

The surveys were carried out March – November 2004 and the table below shows the outcome of the initial surveys.

UK		
Outcome	*Total*	*% of all sample*
Refused	4,666	34.7
Non response	5,193	38.7
Out of scope	1,485	11.0
Completed	2,091	15.6
Grand Total	13,435	100.0
In scope response rate		17.5
US		
Outcome	*Total*	*% of all sample*
Refused	2,843	24.9
Non response	3,734	32.7
Out of scope	3,329	29.1
Completed	1,517	13.3
Grand Total	11,423	100.0
In scope response rate		18.7

Towards the end of the survey period it became clear that there was a shortfall of survey responses from companies that employ 1,000 or more people and both survey samples were topped up in an attempt to boost the response rate. The additional sample companies in the UK were drawn from the R&D scoreboard in conjunction with the FAME database, and in the US the Compustat database was used to increase the number of available top-sized companies. So 535 companies from the United States and 540 from the UK were sent postal questionnaires during the spring of 2005.

This resulted in 38 completed questionnaires from the UK and 23 from the US, response rates of 7% and 4% respectively. The combined final achieved sample, including these additional firms was therefore 1540 for the US and 2129 for the UK.

Biographies:
About the presenters

Professor Alan Hughes is
- Director of the Centre for Business Research (CBR)
- Margaret Thatcher Professor of Enterprise Studies at Judge Business School and
- a Fellow of Sidney Sussex College

at the University of Cambridge. From 2000 to 2003, he was Director of the National Competitiveness Network of the Cambridge-MIT Institute. Professor Hughes' research interests are industrial and technology policy; the measurement of innovation; the growth, innovation, financial and acquisition characteristics of small and medium sized enterprises; analysis of the relationship between corporate takeovers, corporate governance, executive pay and business performance; training and business performance; measurement and evaluation of industrial and business support policy; and the relationship between law and economics in the analysis of corporate organisation and performance. In the past 10 years he has published over 200 books, articles and chapters in books on these topics.

Professor Hughes has been invited to provide policy advice and consultancy by amongst others HM Treasury, HM Revenue & Customs, the DTI, DfES, the Bank of England, Eurostat, the International Labour Organisation, the National Consumer Council, and the UN World Institute for Development Economics Research. In 2004 he was appointed by the Prime Minister to membership of the Council for Science and Technology, the UK's senior advisory body in this area.

Dr Andy Cosh is
- Assistant Director, and Director of the Programme on Enterprise and Innovation, at the Centre for Business Research (CBR)
- a Reader in Management Economics, Accounting and Finance and
- Senior Bursar of Queens' College

at the University of Cambridge. He obtained his PhD at the Faculty of Economics and Politics at Cambridge and was one of the founder members of University of Cambridge's Judge Business School. Prior to his current posts, Dr Cosh worked at HM Treasury and as a Research Officer at the Department of Applied Economics, Cambridge University. He has also acted and as a research consultant for the European Commission, Eurostat, OECD, British Bankers' Association, DTI, DfEE and DfES.

His most prominent research interests fall broadly into two categories. The first of these concerns corporate governance, executive remuneration – Dr Cosh authored the first article on UK executive pay in 1975 - and mergers and acquisitions.

His second major research interest is in the area of innovation, training and finance in small and medium-sized enterprises (SMEs). He is responsible for the regular surveys of the SME sector carried out by the CBR that have become the most important source of information about this sector of the British economy.

Dr Xiaolan Fu is
- Senior Research Fellow at the Centre for Business Research and;
- Project Leader of a £500K EPSRC project on 'The role of management practices in closing the productivity gap'

at the University of Cambridge. She has carried out research for the UN Conference on Trade and Development (UNCTAD), the Department of Trade and Industry, UK Trade & Investment, the regional institute for innovation (i10) and the People's Bank of China.

Dr Fu's research interests fall into two broad categories. The first of these concerns innovation economics, entrepreneurship, the linkage between management, innovation and business performance, and productivity and efficiency analysis. Her co-authored paper with Dr Cosh and Professor Hughes on "How much does informality in management matter for SME innovation?" was awarded the 2005 "European Best Paper Award" by the European Commission, Gate2Growth Network.

Her second major research interest relates to trade and foreign direct investment, export promotion, technology transfer and spillover, and regional economic growth and development. She is the author of 'Exports, Foreign Direct Investment and Economic Development in China', published by Palgrave Macmillan (2004). She has also published scholarly articles on regional economic development, regional innovation systems, innovatibility of SMEs, exports and productivity growth, and the relationship between management and productive efficiency.

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