

COUNCIL FOR SCIENCE & TECHNOLOGY

**LINKS BETWEEN KNOWLEDGE INTENSIVE SERVICES AND
THE
SCIENCE BASE**

Summary

1. The Council for Science and Technology (CST) has recently investigated the subject of links between Knowledge Intensive Services and the science base. This paper sets out CST's present views and makes recommendations for work which CST feels needs urgently to be done as part of any programmes put in place following the current Innovation and Lambert Reviews.

2. CST's investigations have served mainly to increase the Council's concern that not enough is known about how service providers operate and innovate in the UK. Knowledge intensive services (KIS) in particular are likely to be critical for the healthy economic future of the UK and of other advanced countries including those of the UK's EU partners.

3. CST understands the difficulties. Both inputs to and outputs from KIS can be intangible. It is much easier to concentrate on what can be measured easily. But if much of the future lies elsewhere it may pass us by unseen. We consider it vital that the lack of systematic information about KIS and how they operate and innovate be addressed.

4. We believe that at present we lack even a satisfactory language for discussing links between KIS and the science base. Furthermore, for many companies such links are likely to be indirect, often via a number of intermediaries, compounding the difficulty. There is no reason why indirect links should not work, but we need to know whether or not they are there, and if they are, to understand them.

5. But we believe that it is not useful to look further at the question of how KIS obtain ideas which they translate into services in isolation. It should be dealt with as part of a more general exercise of improving understanding of how services, including KIS, operate and innovate. Furthermore, although we are particularly concerned about the knowledge gap in relation to services, and this gap is partly explicable by differences between service outputs and manufacturing outputs, service and manufacturing activities are increasingly intertwined. Manufacturers and suppliers now frequently offer packages of goods and services in order to compete on unique value. Manufacturing accounts for a diminishing percentage of the output of advanced economies, but innovation in manufacturing, especially in high tech knowledge-based manufacturing, may often be the key stimulus for service innovation – for example new information services and new

healthcare services. It may be unhelpful to maintain a priori distinctions between services and manufacturing. Rather, we should seek to understand value added in modern innovative businesses whether they produce goods or services.

6. We have a number of specific recommendations for Government action:

I. Develop models which enable services, including KIS, to be taken into account explicitly in initiatives for encouraging and supporting knowledge-based innovation in services. For the reasons explained in paragraph 5, we believe that we need to look at value added without imposing a priori distinctions between services and manufacturing and to improve understanding of innovation in each, and in the development of products which involve both.

II. Study selected successful service sectors clusters in depth. We suggest looking at financial services and media (or possibly creative industries, including new media). Both financial services and media were identified by Porter in his recent report [name] as sectors within which the UK has developed strong clusters “but there is little systematic data on these clusters available.” This state of affairs needs to be remedied. Both financial services and media are, at least in part, KIS.

III. Carry out international comparisons for key sectors. There are suggestions that there may be better links between KIS and the science base in other countries with a stronger record of turning knowledge to use. Porter also notes¹ anecdotal evidence suggesting that the critical institutions which play a role in effective clusters are less numerous and less effective in the UK than in competing locations. Government cannot rely on anecdote. We recommend identifying a few sectors which have scope for growth in the UK, identifying countries which are competitive in these sectors and comparing the operation of networks involved in the value chain, and of the cluster institutions in the different locations.

IV. Take explicit account of services, including KIS, in current initiatives to support innovation and make maximum use of the information they generate to shed light on how service innovation works in the UK.

V. Gather systematic information about services in data gathering exercises in the UK and at EU level. In particular we believe that when the government studies the effects of the R&D Tax Credit Scheme it should ensure that service industries are looked at explicitly as well as traditional manufacturing. It will be important to

¹ Porter ME and CHM Ketels (2003) UK Competitiveness: moving to the next stage, DTI Economics paper no 3.

investigate as soon as it is practicable the uptake of the scheme in different sectors as well as the barriers that may prevent all industries taking part .

7. CST does not propose to carry out this work itself. We feel that it should be built into any programmes put in place following the Innovation and Lambert Reviews. But CST intends to return to this issue from time to time to see what progress has been made and whether the Government's work has revealed strategic issues for science and technology policy in the UK to which the Council should turn its attention.

The context

8. It is generally agreed that knowledge-based industries are key to future prosperity for advanced economies in a competitive globalised world.

9. The UK's strengths in generating knowledge and ideas within the science and engineering base are well-known. They should give the UK a competitive edge in developing successful knowledge-based industries. However the UK's weaknesses in turning ideas into successful products are equally well-known.

10. CST and others have previously looked at the reasons for this: weaknesses in knowledge transfer, lack of skills at higher and especially intermediate level, and other factors. Businesses, universities, schools and Government recognise that the culture needs to change. The increased science budget, the boost to knowledge transfer programmes, the Skills Strategy and other recent initiatives all put in place useful building blocks.

11. We need though to be sure that initiatives will address the right parts of the economy. Services now account for nearly 70% of UK output and their contribution is growing.

12. This does not mean that manufacturing can be ignored. Manufacturing may account for a decreasing direct percentage of the output of advanced economies, but innovation in manufacturing, especially high-tech knowledge-based manufacturing, can be an essential platform for the development of new services. Increasingly goods and manufacturers and service developers are offering packages of goods plus services (loans and aftercare with cars, information services to mobile phones, healthcare packages) as they seek to distinguish their offerings from others'.

13. Nevertheless, services account for the major part of UK output and less is known about how they are produced. Without a clear view about how services work, and how service providers innovate it is not possible to understand how well they are suited by framework conditions for operation in the UK and by Government programmes for supporting business innovation.

14. The lack of good information about how services work extends to our particular interest: where Knowledge Intensive Services obtain their ideas and skills from, how they go about innovation and whether conditions in the UK support the development and growth of competitive KIS.

15. We therefore decided to commission a study to look into this area. In view of the paucity of the evidence base we began with a scoping study, with the aim of identifying promising avenues for further, in-depth exploration.

16. The study was carried out by PREST. The draft final report of the study can be obtained from the CST Secretariat (020 7215 0395).

What have we found out?

17. Since the study was primarily a scoping study it could not be expected to answer all the questions we might ask. We are though disappointed at how little it has helped us move forward. There are a number of reasons for this, amongst which are:

- As noted above, there is a lack of systematic information about services. And where KIS are concerned, the consultants report: *“The study has found very little previous experience or accumulated wisdom to draw on in investigating the topic of KIS and the science base. Despite the recognition of the importance of KIS to the UK, the ways of fostering this sector and its innovative potentials are still largely unexamined.”*
- An associated problem seems to us to be the lack of an appropriate language for discussing knowledge acquisition and its successful exploitation by service providers, making it difficult for companies to engage with the issue.
- DTI defines innovation as “the successful exploitation of new ideas”. We particularly wished the study to focus on the breadth of knowledge and ideas that can be obtained from the science base, rather than on technology. Service innovation even in non-KIS businesses can of course be technology related. (for example, internet shopping). But for many knowledge intensive services whilst technology provides useful tools, it appears to unrelated to the ideas and skills they need to develop high value added services, even when these come from the science base. In the case of insurance services, for example, ideas can come from medical research, research on climate change, and advances in mathematics. The study found it difficult to get information on anything other than technology.

18. The study drew on a mix of information sources. A secondary analysis of the data from the third Community Innovation Survey (CSI3) covers a range of KIS, plus some other services, and manufacturing industry. Interview and other qualitative research was used to look in more detail at four KIS sectors: financial services, especially long-term personal insurance services, business

continuity services, environmental services and Informational Professional Services, especially Market Research and marketing. This small sample was chosen because all are knowledge intensive, but not all are necessarily technology intensive. From the sources of information that were available to it, the study found that *“both qualitative and quantitative studies indicate that the direct links between KIS firms and the science base are typically rather weak. One KIS sector - the R&D-oriented technical services - are outstanding in the survey analysis as users of knowledge from the science base (graduate human resources, information, and collaborative research).² The case study research was also able to identify some cases of strong links - in environmental services, and among larger companies. But these are exceptional. Far more commonly, linkages are weak or non-existent. This is particularly true for smaller firms, many of whom have no sense of the potential for such linkages, nor of how they might go about establishing them. They have no sense of how relevant expertise might be found, nor of the schemes that exist to support collaboration.”*

19. In short, the one sector which relies on knowledge of research fields for its existence has strong links with the science base. Other sectors do not, and most (though not all) firms within the sectors do not see this as a problem - or an opportunity.

What does this tell us?

20. It is possible that there is no real problem. Data from the Community Innovation Survey (CIS3) show clearly that service firms rely mainly on competitors, customers, and in-business expertise for innovative ideas. There is not necessarily anything wrong with this. Businesses must make use of private contacts. Provided that the networks of contacts up and down the value chain work well and the networks have the connections they need to the science base at some point, ideas and skills may flow from the science base to KIS and information may go back towards the science base perfectly well.

21. The Council feels however that there are strong reasons against complacency. We are concerned that we may be looking at an important opportunity missed. In reaching this view we have also drawn upon our own contacts in service sectors, the emerging conclusions from the Lambert Review, the DTI Third Economics paper which was commissioned from Michael Porter, an early draft of the Economic Analysis produced by DTI's Strategy Unit as part of DTI's Innovation Review (usually referred to for the remainder of this paper as “DTI Innovation Review”) as well as the PREST study.

- As noted above, the UK is notoriously weak at turning knowledge into viable goods and services. With some exceptions the general level of industry based R&D is low, as is capital investment. The

² The structure and functioning of these "anomalous" technical services is a topic that requires further research.

lack of interest in links with the science base amongst less technology intensive services may be an extreme case of the UK's general weakness in knowledge exploitation and innovative practices more generally.³

- It is also well-known that UK levels of productivity are below those of major advanced economies. As the economic paper produced in the context of the Innovation Review shows, this productivity gap is substantial and exists across almost all sections of UK manufacturing and services.⁴ The productivity gap extends to services such as financial services, in which the UK is regarded as internationally competitive. Low rates of technological or other science-based innovation are only one possible factor in low productivity. But they are a possible factor.
- UK companies tend to have lower capital investment rates as well as lower R&D investment rates than overseas competitors. In short, they sweat their assets more. There needs to be a move towards taking higher risks, in a well managed way, if the UK is to compete in future.
- Furthermore, the growing number of countries with both lower wages than the UK and a relatively well-educated population means that competition is moving up the value chain. Knowledge and innovation are key if the UK is to stay ahead.
- The PREST study suggests that those KIS businesses that do have links with the science base are particularly dynamic and successful innovators.
- The PREST study suggests that there may be better links between KIS and the science base in competitor countries. (The evidence is anecdotal.)
- The PREST study showed that there are UK businesses within the sectors that it examined which do see the need for links with the science base and which are dissatisfied with their ability to forge good links.
- Porter identifies financial services and media as two sectors which have generated successful clusters in the UK. Financial services reported dissatisfaction with their ability to form links with the science base to PREST. PREST did not look at media, but we note that the creative industries, which perhaps have some overlap with media, reported similar dissatisfaction to Lambert.

³ The level of R&D investment by UK service industries is lower than that of UK manufacturing. The level of UK service R&D is though around the EU average.

⁴ Services' share of the gap is in line with their share of total UK output. That is, services are not on average less productive than manufacturing, but because services comprise the majority of UK output, they are responsible for the major part of the productivity gap.

- Firms in two other sectors examined in the PREST study (environmental services and business continuity) claimed to be ahead of the science base. They were the leading edge. It is good news to find that firms can be at the leading edge. But could they get even further ahead by collaborating with the science base?
- Service sectors typically comprise a small number of large firms and a large (sometimes very large) number of small firms. Small firms generally have more difficulty than large firms in accessing knowledge and skills. Difficulties for small firms in general are likely to have a disproportionate impact on service sectors. Conversely, action to improve conditions for small businesses could have a particularly large impact – provided this action is framed to be suitable for service firms and they know about it.
- Differences in skills (DTI innovation review) per worker are a factor in the difference in productivity between the UK and France and Germany. Here PREST's analysis of the CIS3 data and survey work lead to the positive finding that KIS are particularly likely to employ graduates. But the consultants note that the picture is complicated:

“Graduates may be a large share of the staff of KIS, but this does not mean that most KIS firms pursue much of the way of a strategy in recruiting them. Specialist technical knowledge required for many KIS activities is simply not seen as a major function of University training, though there are exceptions here. Some sectors use Universities considerably for professional development and accreditation purposes (often in combination with professional associations) - but many do not. With a few exceptions where very specific technical skills were sought to allow a KIS to tackle a particular problem, the tendency in the sectors we studied was to treat University degrees as signifying general capability and commitment. Thus market research firms may be keen to gain social scientists and statisticians, but they showed little interest in recruiting people whose courses were more tightly specified to their business activities. (We are aware that in some other KIS sectors there may be more recruitment of people with relevant degrees, however.)”

Is there an opportunity to do better?

- We have found throughout this exercise that there is a tendency to confuse knowledge with technology. Technology, in the sense of tools and equipment, is the major or even sole science base related item of interest to many businesses, and they may well be satisfied with their availability and fitness for purpose. But the knowledge on which KIS depend may be intangible and businesses may see no relation between it and technology, even where it comes from the science base: quantitative maths, medicine (for life insurance firms), cryptography, environmental science, psychology and other

disciplines are all critical sources of knowledge for one or other of the KIS included in the PREST study.

- Currently available indicators of innovation performance do not capture aspects of innovation performance in services well. (DTI Innovation Review.)

22. CST therefore thinks the question of whether KIS get what they need from the science base is at present impossible to answer and needs further urgent investigation.

23. However, we feel that asking businesses directly and in isolation whether they get what they need from the science base, is not the right approach. As with attempts to involve service sectors in FOREsight, they do not engage.

24. We believe it would be more profitable to examine value chains in depth for different types of service, to see how, at different stages, value is added, where various inputs come from, and how and where the network of inputs eventually connects (if at all) with the science base. Where there are connections they may be highly indirect, at a number of removes from the business – perhaps even within the universities themselves e.g. links between engineering and materials science and design. There is nothing wrong in principle with indirect links. But we need to know whether or not they are there, and if they are, to understand them. We would then be in a better position to say whether opportunities are being missed, and if so, whether improving the situation implies Government action.

25. Looking at complex activity-specific networks is a large task. We consider that it would best be done as part of follow up to the Innovation and Lambert Reviews, and implementation of the Skills Strategy.

26. We have a number of specific suggestions:

I. Study successful clusters in depth

27. Porter reports that the UK is a relatively weak generator of clusters – “geographically proximate groups of interconnected companies, suppliers, service providers and association institutions in a particular field.” Recent economic theory, much of it generated by Porter, suggests that clusters can increase competitiveness by increasing the level of productivity at which constituent firms can operate, increasing the capacity for innovation and productivity growth, and stimulating new business formation. His report notes that the UK does have strong clusters in services, mentioning especially financial services and media, “but there is little systematic data on these clusters available.” This state of affairs needs to be remedied.

28. Both these sectors are, at least in part, KIS. Indeed, financial services were included in the PREST study. The study found some interesting examples of links with the science base – large life insurance firms, for

example seem especially proactive. It also found that that intermediaries and professional associations were the most important sources of information for KIS firms in general. And it found that companies want more from the science base.

29. Media industries were not included in the PREST study, but we note that the creative industries, which may in part overlap with media, reported difficulties in forging links with the universities in their responses to the Lambert Review.

30. We feel that much insight might be gained from examining how financial services and media (or creative industries) work, with the question of how the clusters as a whole and players within them obtain knowledge as one of the key questions. The purpose would be to build a more constructive language, discourse and models with which to look at service innovation.

II. International comparison

31. The PREST study suggests that there may be better links between KIS and the science base in other countries with a stronger record of turning knowledge to use. Porter also notes anecdotal evidence suggesting that the critical institutions which play a role in effective clusters are less numerous and less effective in the UK than in competing locations. Government cannot rely on anecdote. We recommend identifying a few sectors which have scope for growth in the UK, identifying countries which are competitive in these sectors and comparing the operation of networks involved in the value chain, and of the cluster institutions in the different locations.

III. Take explicit account of services, including KIS in current initiatives and make good use of the information that they generate.

32. KIS sectors are often dominated by small firms. The differences between large and small firms were underlined again and again in the PREST study. Small firms have a marked lack of connection to the science base even in areas of KIS work where the larger firms are active in trying to form links. The small firms are unaware of government programmes that could help them forge better links. We would anticipate that the Innovation Review will confirm that this finding applies generally to small firms. But it is important to note that any action undertaken to improve small firms' awareness of and ability to make use of government programmes, is likely to be disproportionately important for KIS. We recommend that services, including KIS, are specifically targeted in such programmes.

33. We note that the Skills Strategy gives high priority to involving small businesses in planning and delivering programmes. Here too, we hope that specific attention will be paid to services. (This does not mean that we wish the Skills Strategy to forget about large service firms.)

iv. Gather information more systematically about service industries.

34. We think that more attention needs to be given to collecting information about services in routine information gathering exercises within the UK and at EU level. We think it essential in particular that best use is made of the data on R&D tax credits to look explicitly at service activity. The R&D tax credit is an important new tool for encouraging UK businesses to invest more in research and development. No doubt the Government will be looking at its effect on business R&D in the near future. Because companies have to declare their R&D activities to obtain the tax credits we see this as a goldmine of accurate information. We had hoped to gain some insight from the PREST study into whether it might affect businesses which traditionally do not think of themselves as engaging in R&D. Are they looking at what they do to see whether it counts as R&D or as undertaking new types of activity? Unfortunately no information has been forthcoming. (We could not of course expect a statistical analysis from such a small survey.) We recommend that the Government take the earliest opportunity to

V. Gather systematic information about services.

36. Finally, the PREST study found “very little previous experience or accumulated wisdom to draw on in investigating this topic”. We recommend that Government and EU systematic information gathering needs to be reviewed to ensure that Government can better understand services, innovation in services and the framework conditions that could promote their contribution to the economy and well-being of the UK.

Is the split between services and manufacturing useful?

37. We are urging the Government to fill a specific gap in knowledge and to develop models which enable service sectors, including KIS, to be explicitly taken into account in initiatives for encouraging and supporting innovation.

38. But we are not convinced that it would be helpful to maintain a distinction between services and manufacturing innovation and to develop a separate model for service innovation. The differences between service provision and manufacturing provision, not least the intangibility of many service outputs, do partly explain the lack of information about and suitable models for discussing services. But the growing interdependence of service provision and manufacturing suggests to us that it would be better to aim for models which look at how value is added without imposing a priori divisions between manufacturing and services. We need to understand innovation in each, and the way in which the two interact. Maintaining the divide may simply stall discussion.

The Council for Science and Technology’s Future Role

39. We do not propose ourselves to carry out the work that we recommend. We feel that it should be built into any programmes put in

place following the Innovation and Lambert Reviews. But CST intends to return to this issue from time to time to see what progress has been made and whether the Government's work has revealed strategic issues for science and technology policy in the UK to which the Council should turn its attention.