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DTI OCCASIONAL PAPER NO. 9

Innovation in Services

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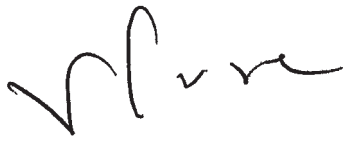
Foreword

This series of papers brings together emerging evidence and thinking on services innovation in the UK. Innovation is one of the five drivers of productivity growth alongside skills, investment, enterprise and competition. The findings of these studies will contribute to help ensure the DTI and the Government has a robust evidence base to inform innovation policy, in line with the DTI's remit to '*create the conditions for business success and help the UK respond to the challenge of globalisation*'.

Research conducted for this report emphasises the importance of non-technological innovation in the economy. One of the findings is that the full utilisation of technology often requires firms to use it in an innovative way and this is often accompanied by changes in the skill mix and organisational changes. Knowledge of the customer, i.e. the 'demand side' of the equation is particularly important as many services are simultaneously created and consumed at the same time. In some instances, co-ordination across several organisations is necessary to facilitate innovation, for example, in making better use of airport runway space. This project also highlights several well-known areas of importance for innovation policy such as the diffusion and adoption of technologies.

The findings are relevant to thinking about innovation throughout the economy. Increasingly, firms do not consider themselves to be 'services' or 'manufacturing' but providing solutions for customers that involve a combination of products and services. Improving understanding of services innovation complements the better-established knowledge of manufacturing innovation.

I believe the evidence gathered in this collection of studies will contribute to a greater understanding of innovation for policy purposes. In addition to ongoing work at the DTI and in the research community, the Technology Strategy Board[1] is running a series of workshops in particular service sectors covering financial services, retail and logistics, design services, the services "wrap around" manufacturing and environmental services.



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1 See http://www.dti.gov.uk/innovation/technologystrategy/tsb/

1 Introduction

The 2003 DTI Innovation Review noted that innovation policy has been traditionally focussed on the manufacturing sector and that service sectors had received less attention. Until recently the academic study of services innovation was an area of neglect. Miles (2000)[2] described services innovation as having '*Cinderella status ... being neglected and marginal*'.

Services innovation has seen a surge of interest in recent years. The December 2006 EU Competitiveness Council adopted conclusions on Innovation Policy that identified services and non-technological innovation as a strategic priority.[3] The UK Council for Science and Technology has stressed the need to better connect services to both to the science base and Government.[4] In late 2006, Ireland released a consultation paper calling for development of specific policies for services innovation and it was a key theme of the Finnish EU presidency.[5]

Challenges in measuring innovation, particularly the dimensions stressed in services innovation, make it hard to assess adequately UK innovation performance. The National Endowment for Science, Technology and the Arts (NESTA, 2006)[6] claim that past policy work has focused on the 'supposed' innovation gap between the UK and other countries such as the US, but they argue that this may miss forms of innovation not captured in traditional measures – so-called 'hidden innovation'. Similarly, the Organisation for Economic Co-operation and Development (OECD, 2005)[7] noted that conventional indicators often poorly reflect innovation in sectors such as knowledge intensive services, where the UK shows considerable strengths.[8]

To help inform the evidence base in this area the DTI commissioned new analysis from leading authors in the field, which make up the remaining chapters of the paper:

- Chapter 2: Changing understanding of innovation in services: from technological adoption to complex complementary changes to technologies, skills and organisation
  Bruce Tether and Jeremy Howells, Manchester Business School

- Chapter 3: Managing service innovation
  John Bessant and Andrew Davies, Imperial College, Tanaka Business School

2 Miles, I. (2000) 'Services innovation: coming of age in the knowledge-based economy', *International Journal of Innovation Management*, Vol 4. No. 4, pp 371-389.

3 See http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/intm/91989.pdf

4 See www.cst.gov.uk

5 See http://www.forfas.ie/publications/show/pub242.html

6 See http://www.nesta.org.uk/informing/policy_and_research/highlights/innovation_gap_report.aspx

7 OECD (2005) 'Economic Survey of the United Kingdom 2005'.

8 A recent study also suggests that UK intangible investment is similar to investment in tangible assets, see Marrano, M. and Haskel, J. (2006) 'How Much Does the UK Invest in Intangible Assets?', Queen Mary University of London, Working Paper No.578.

- Chapter 4: Innovation in experiential services – an empirical view
  Chris Voss and Leonieke Zomerdijk, London Business School

- Chapter 5: Services and the innovation infrastructure
  Bruce Tether and Silvia Massini, Manchester Business School

The papers bring diverse perspectives to the study of innovation. Tether and Howells highlight the importance of non-technological innovation in specific service sectors. The papers by Bessant and Davies and Voss and Zomerdijk provide a wealth of case studies and examples that illustrate both the nature of innovation in services and the heterogeneity of what services innovation can mean. Empirical work by Tether and Massini provides new evidence of how firms across the UK interact with the knowledge infrastructure.

The remainder of this introduction draws on these papers to consider:

- The nature of service innovation (Section 1.2)
- Services and the innovation infrastructure (Section 1.3)
- UK innovation policy and services (Section 1.4)

1.2 The nature of service innovation

THE NATURE OF SERVICES

The study of services innovation immediately poses the question of how a 'service' should be defined. From a conceptual standpoint there are a variety of views. Crespi et al (2006)[9] review the literature and conclude:

> *'...it is often useful to think of services as either intermediation activities, such as transport, that arise because consumers want to separate production and consumption, or contact services, such as haircuts or medical services, where production involves the consumer directly and where the output of the activity is embodied in the consumer ... ...an important aspect of a service is the 'jointness' of production and consumption – i.e. that goods can be produced meaningfully without consumers (think of a firm producing a car), whereas services require jointness (a haircut, or repairing a car).'*

These characteristics already suggest broad areas of importance for the study of innovation in services, notably the interactive role of the consumer and the challenge of defining and measuring output (i.e. the embodied nature of output rather than physical, more readily codifiable output).

9 Crespi, G., Criscuolo, C., Haskel, J. and Hawkes, D. (2006) 'Measuring and Understanding Productivity in UK Market Services', *Oxford Review of Economic Policy*, Volume 22, No. 4.

The description above also hints at the considerable heterogeneity of services with respect to knowledge and capital intensity. Miles (2000)[10] argues that the contrasts within the service sector are as significant as those differentiating the sector from manufacturing: *'... the sector includes the most concentrated, knowledge-intensive, and IT-intensive sectors in modern industrial economies (banking, professional services, etc.), as well at the least (retail, cleaning etc.)'*.

From a statistical perspective, modern economies are comprised primarily of services. According to the ONS national accounts the combined service sectors account for around 75 per cent of output in the UK, covering the categories of:

- Distribution, hotels and catering;
- Transport storage and communications;
- Business services and finance; and
- Government and other services.

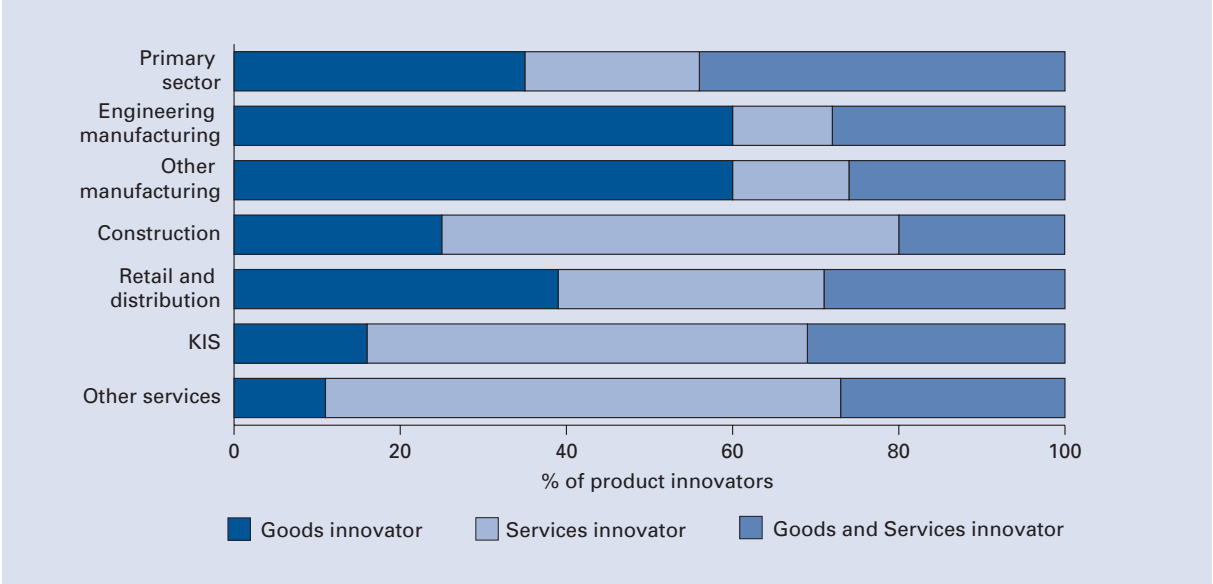
The remaining share of output is made up of manufacturing, energy, construction and agriculture.

While national accounts data and associated classifications are the basis for much empirical analysis, the patterns of sub-aggregated sectors need to be carefully constructed to consider the economic characteristics that are relevant for innovation. Evidence from the Community Innovation Survey confirms that firms across sectors innovate in both services and goods. Around a quarter of innovators in manufacturing undertake a combination of goods and services innovation, while around 40 per cent of the innovators in retail and distribution describe themselves as primarily goods innovators (see Figure 1.1 below).[11]

10 Miles, I. (2004) 'Innovation in Services', *The Oxford Handbook of Innovation,* Oxford University Press, Chapter 16.

11 The data are based only on those firms that answered the survey and that undertook innovation in services and/or in goods during 2002–2004.

Figure 1.1: Analysis of goods and services innovation



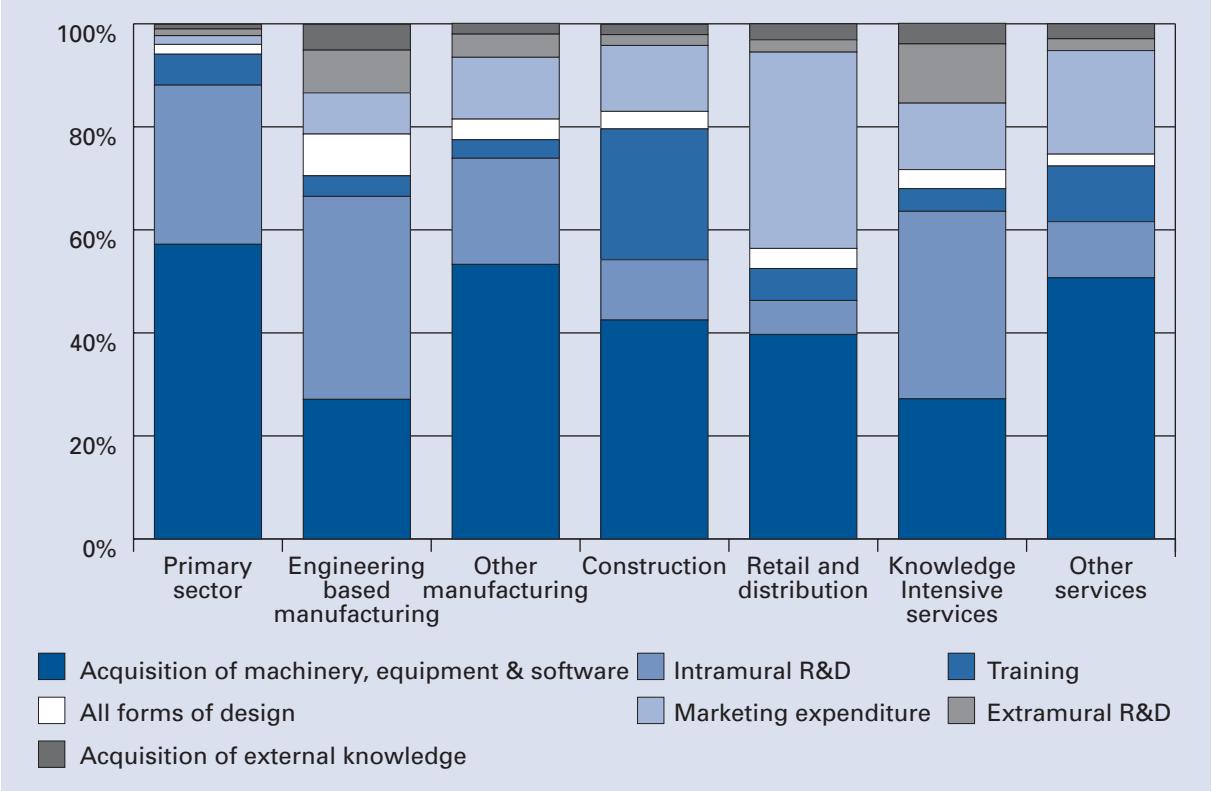
Source: Community Innovation Survey (CIS4). KIS are knowledge-intensive services.

Increasingly, firms do not consider themselves to be 'services' or 'manufacturing' but providing solutions for customers that involve a combination of products and services. Manufacturing firms often provide both a physical product and accompanying or complementary service – the so-called servicisation of manufacturing.[12] Similarly, service industries and functions are becoming more industrialised due to technological developments (e.g. ICT).

Investments in innovation inputs also show a variety of patterns across broadly defined production and services sectors (see Figure 1.2 below). For example, knowledge-intensive services businesses show a similar proportion of R&D activities within their total spending on innovation as the manufacturing industry. 'Retail and distribution' and 'other services' show a relatively higher proportion of expenditure in technology embodied in equipment and software. Services innovation is not unambiguously different on these indicators, although obviously the 'level' of expenditure can be quite different.

12 Bessant and Davies (Chapter 3) discuss the servicisation phenomenon in detail and the implications for both service and manufacturing firms.

Figure 1.2: Shares of innovation expenditure by sector



Source: Innovation in the UK: Indicators and Insights, DTI Occasional Paper No.6. July 2006.

As services innovation can happen across sectors it is preferable to look at service activities as opposed to service sectors. For this reason, the project did not limit analysis to a particular definition of service sectors or functions.[13] Tether and Massini base their empirical analysis on the service sector as defined by statistical classifications. Voss and Zomerdijk focus on experiential services (e.g. hotels, entertainment). Bessant and Davies look at services activities across the economy including those services provided by manufacturing firms. Finally, Tether and Howells consider four specific service industries, namely road transport, call centres and information processing, care for the elderly and design activities.

DEVELOPING UNDERSTANDING OF SERVICE INNOVATION

Innovation is the successful exploitation of new ideas – this definition applies to all firms in the economy and is equally relevant to services innovation. While innovations in tangible products may be more easily recognised, possibly due to their physical and 'codifiable' nature, there are a wealth of excellent examples of services innovation:

13 Empirical analysis is, however, constrained by the fact that most of the relevant statistics (e.g. the UK innovation survey) are based on service sectors as defined by the standard industrial classification. The project also focused on market services.

- **Airport runway space** – landing planes is a classic service that is intangible and jointly produced by air traffic control and the service users (airline carriers). Despite runways having been 'full' for many years, year after year major airports continue to increase capacity. This has been achieved by ongoing innovations including improved efficiency in ground operations, greater co-ordination between relevant actors and developments in technology that have facilitated safer spacing of landing times. Much of this has been achieved without additional runways being built.[14]
- **Financial Services** – many banks now offer a whole range of services online, facilitated by ICT, and recently there have been developments such as Open Plan – which is a process/business model innovation introduced by the Woolwich that enables customers to access and link all their financial holdings (savings and current accounts, mortgage, etc.) through one portal. Open Plan customers can use both traditional methods of communication such as branches and automated teller machines, and more recent channels such as telephone call centres, internet and digital television.
- **Air flights** – while the core offer of airlines remains transport between destinations there has been considerable innovation in this area, for example:
    - Low-fare carriers (e.g. Ryanair, EasyJet) have transformed the airline industry and the travel industry in general. This business model innovation emerged in Europe from the deregulation of European airspace in the 1990s[15]; similar models such as that operated by South West were already operating in the US.
    - Voss and Zomerdijk (Chapter 4) illustrate how Virgin Atlantic recognised the complete customer journey involved in business class flights to the US and innovated at every step, from pre-flight pick up to post-flight refreshment (e.g. beauty salons at the lounge) – focusing on the experience of the active user.
- **Retail** – there have been many innovations in retail services, but perhaps one of the most pervasive has been through use of bar codes. The introduction of bar code scanners linked to information and communication technology has transformed retail. It required retailers to undertake several non-technological changes (e.g. changes to distribution networks, delivery procedures, etc) to take full advantage of the new technology (e.g. more efficient inventory management, measuring the effect of promotions, etc).

These examples help illustrate several themes in the services innovation literature:

- Common in many examples of services innovation is an emphasis on non-technological innovation and/or new organisation or new products centred on technological change (e.g. stock control through bar codes, online banking

14 See CRIC Briefing Paper 'Innovation in Services' (http://www.cric.ac.uk/cric/papers.htm#BriefingPapers).

15 See *The squeeze on Europe's air fares*, The Economist, May 24th 2001 for a discussion.

through ICT). Recognising the importance of both technological and non-technological (and especially organisational) forms of innovation, and the interactions and complementarities between these two forms, is central to current innovation research (see Tether and Howells (Chapter 2)).

- The role of demand and end users/customers is highlighted. Bessant and Davies (Chapter 3) note that in the context of service innovation the search for and use of demand side knowledge is critical with end-user understanding and empathy essential to success. This is not to say that new technology is unimportant but the balance of importance in service innovation may be more in the direction of demand side knowledge.[16] Voss and Zomerdijk (Chapter 4) also note that in the case of many experiential services fellow customers can either destroy or enhance the enjoyment of the services – something that providers have little control over!
- Co-ordination and networking of different 'actors' within the innovation process can be very important. CRIC (2006)[17] stress that continued innovation around runway space required 'negotiated procedural change' where partners needed to find mutually acceptable changes to facilitate innovation.

While this highlights some areas of *emphasis* in services innovation, the drivers and fundamental process of innovation are arguably not essentially different to innovation anywhere else in the economy. Bessant and Davies (Chapter 3) propose that a generic model of innovation – involving search, strategic selection and implementation phases – applies equally to services and that, with appropriate modifications, a number of management models derived from manufacturing have relevance for service innovation.[18]

In terms of considering what 'drives' innovation, particularly considering competition, Bessant and Davies argue that *'although 'services' represents a wide and heterogeneous sector ... the underlying innovation drivers – especially the continuing emphasis on non-price factors – are similar to manufacturing'*. A number of the examples above, particularly linked to airlines, reflect the importance of non-price characteristics. Non-price attributes, such as quality and waiting times, can be more important determinants of overall demand than price.[19]

16 Technology is often used to gather the necessary data to understand demand (e.g. loyalty cards).

17 Op cit.

18 For example, in Chapter 3, Bessant and Davies argue that the key principles for the successful management of 'disruptive innovations' primarily developed to help manufacturing firms are equally applicable to low-cost airlines. Another example discussed in Chapter 3 is the use of the Product-Process Matrix framework (originally developed for manufacturing) in the restaurant industry.

19 Research shows that convenience and quality can better explain passengers' choice behaviour amongst alternative airlines than price, see Gayle, P.G. (2004) 'Does price matter? Price and Non-price Competition in the Airline Industry', *Econometric Society 2004* North American Summer Meetings no.163. Similarly, there is evidence that even in the online book industry – where information is readily available and the books being sold are identical – price differentials across firms persist, see Clay, K., Krishnan, R., Wolff, E. and Fernandes, D. (2002) 'Retail Strategies on the Web: Price and Non-price Competition in the Online Book Industry', *The Journal of Industrial Economics*, vol. 50, 3, pp. 351-367.

In trying to understand the various patterns and origins of innovation in different sectors, academics have developed several typologies or classifications. While a 'dominant' typology has yet to emerge, proposed typologies and classifications share similarities. Most of those typologies tend to consider:

- Reliance on external innovation ('supplier dominated' innovation)
- Degree of interaction with consumer ('client-led' innovation)
- Intensity of in-house innovation (innovation *in* services)
- Extent to which service firms support other firms to innovate (innovation *through* services)

Few firms or sectors fit any one classification completely. Table 1.1 illustrates this in three service sectors, retailing, transport and financial services. Paradigmatic innovations are considered to be substantive innovations marking an innovation step change in the industry.

Table 1.1: Innovation patterns

	Supplier dominated	Innovation in services	Client-led innovation	Innovation through services	Paradigmatic innovation
Retailing	Scanning registers/stock replenishment systems	New shop formulae/new franchise schemes	Green or "organic" product/home delivery	Retail consultants introducing new formulae or marketing strategies	E-commerce
Transport and logistic services	On board computers	New logistic concepts mostly streamlining value chains and adding information to it	Outsourcing of transport and "light" production/ assembly	Shippers offering clients tracking and tracing facilities and so contribute to reductions in stocks	Containarisation, e-commerce
Financial services	New distribution channels based on technical platforms (SMS alerts, new mobile devices), back office automation	New (customised) financial service concepts, multi channel management	Green banking, products covering various stages in life e.g. starters mortgage or estate planning	Financial constructions e.g. sale and lease back	Multi-functional smart cards (including non-financial functions)

Source: From van Ark, B,. Broersma, L. and den Hertog, P. (2003) 'Service Innovation, Performance and Policy: A Review'.

Recognising the multiple dimensions of innovation is a considerable leap from the time when services were usually described as 'supplier dominated' in terms of innovation.[20] This acknowledges that the full utilisation of technology, whether within service or in manufacturing firms, often depends upon how firms combine it with skills and organisational practices. Bessant and Davies (Chapter 3) note that as manufacturers look to broaden the services they provide around products, the skills needed for services innovation (such as working with active users) are increasingly needed in manufacturing firms too.

Adequately measuring innovation, incorporating both technological and non-technological dimensions is challenging. Tether and Howells (Chapter 2) suggest that 'invention' is well captured (through R&D, patents) and 'commercialisation' of inventions is measured through surveys like the Community Innovation Survey.[21] They argue the gap is in areas like diffusion and integration of technologies and practices, which require combinations of, and mutual adjustments to, skills, technologies, and organisational forms. Their research presents one such approach to measuring such activities in firms. At the same time, it is neither desirable nor practical to include all routine business learning or improvement, important though these can be for improving productivity (see Box 1.1 below). More significant learning by doing is, however, a key part of innovation.

Measurement is not just important at the aggregate level but for firm decision making too. Wölfl (2005)[22] notes a problem in financing innovation projects particularly in services as they tend to be around processes and systems which do not typically afford enough advanced information to make financial decisions. Voss and Zomerdijk (Chapter 4) suggest that the difficulty in predicting financial returns can not only cause an unwillingness to invest in a particular service innovation, but also make it easy to over-invest.

A further challenge for measurement is the *language* used around services innovation. The term 'R&D' used in a manufacturing context conjures images associated with organised research and development. Service businesses may not have a formal R&D department but they do undertake this kind of activity in order to deliver a stream of innovations. Recent indicators do, however, suggest that UK service sector firms are showing greater investment in traditional measures of innovation. In 2006 several non-technology companies declared R&D spending for the first time, following a change in accounting standards. For example, the Royal Bank of Scotland, HSBC and Tesco, together declared nearly £700m of R&D.[23]

20 Largely attributed to Pavitt's 1984 taxonomy of innovation.

21 The Community Innovation Survey in 1996 was the first large-scale systematic survey of innovation in the UK.

22 Wölfl, A. (2005) 'The Service Economy in OECD Countries', OECD Science, Technology and Industry Working Papers 2005/3, OECD.

23 See http://www.innovation.gov.uk/rd_scoreboard/

BOX 1.1: DEFINING INNOVATION

With developing interest in services innovation there is the possibility that 'what counts' as innovation becomes everything and anything that businesses do simply to survive.

For example, Tesco's recent submission to the Competition Commission illustrates the broad meaning of innovation in the retail sector: '*focus on the consumer enables us also to develop the hundreds of innovations, both small and large, that keep us ahead of our rivals – be they in product specification, distribution, design and refit of stores, staff training, or operating processes in store*'. *

Van Ark et al (2003)** believe that innovation policies should recognise non-technological innovation, however they also note that the key problem is *'to distinguish between true non-technological innovations and activities that are more than acts of good housekeeping or regular business changes'*. This all becomes relevant for measuring innovation for policy purposes, particularly in considering spillovers from innovation or when assessing the ability of firms to appropriate returns to their innovations.

*** Tesco Main Submission to the Competition Commission Inquiry into the UK Grocery Market, 2006.**

**** van Ark, B,. Broersma, L., and den Hertog, P. (2003), 'Service Innovation, Performance and Policy: A Review'.**

1.3 Services and the innovation infrastructure

The links between the Science, Engineering and Technology base and services are widely thought to be weaker than for manufacturing firms. The Institute of Innovation Research (IOIR, 2003)[24] considered the links between the knowledge intensive services sector and the science base and concluded that '*most services remained poorly linked into technological innovation systems*'. Salter and Tether (2006)[25] question whether services receive sufficient support from the public science base and other institutions in the National System of Innovation.

Research undertaken for this project by Tether and Massini (Chapter 5) considers links between the science base and services and finds:

- In the great majority of both manufacturing and service industries only a minority of firms used universities as a source of information for innovation, but in general service industries were less likely to use universities than were manufacturing industries. In a typical service industry about one in five firms used universities compared with around one in three firms in manufacturing industries.

24 Institute of Innovation Research (2003) 'Knowing How, Knowing Whom: A Study of the Links between the Knowledge Intensive Service Sector and The Science Base', University of Manchester/UMIST.

25 Salter, A. and Tether, B. (2006) 'Innovation in Services: Through the Looking Glass of Innovation Studies', Background paper for the Advanced Institute of Management (AIM) Research's Grand Challenge on Service Science.

- Public research institutes are also more widely used by manufacturing industries than by service industries, although the difference is smaller than for universities.

The research begs the question whether we would expect all firms and industries to forge links to the science base to the same extent? A number of points need to be considered:

- The evidence currently considers *direct* links to the science base only. Services may gain access through other routes (use of university graduates, through technology, input or spillovers from other firms). For example, within the knowledge-intensive services, science graduates may play an important role in knowledge transfer.
- Services may simply utilise different types of research. For example, experiential services use of 'empathic research', trend watching etc. may be best gathered through private sector companies.

Part of the challenge may come in the supply of available research. In the US, the National Academy of Engineering (2003)[26] argue: *'service industries represent a significant source of opportunity for university-industry interaction.... Nevertheless, the academic research enterprise has not focused on or been organised to meet the needs of service businesses'*.

Finland has recently taken concrete steps to improve academic research in service areas. Tekes, the Finnish agency for technology and innovation, has recently launched the Innovative Services Technology Program running from 2006 until 2010. One of the objectives of the program is to promote academic research in service related areas.[27]

This is an area that needs further consideration. In part, the 'demand' from firms such as IBM among others for a 'services science'[28] may already be shifting the orientation of some university research. The UK Government funds organisations such as the Economic and Social Research Council (ESRC), the Design Council and the Advanced Institute of Management, all of which undertake relevant services research. Nonetheless, the links between the science base and services cannot be fully understood by an examination of the available survey data, and a wider consultation with service industries may be beneficial.

26 National Academy of Engineering (2003) 'The Impact of Academic Research on Industrial Performance', National Academics Press, Washington D. C.

27 http://akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/Serve/en/etusivu.html

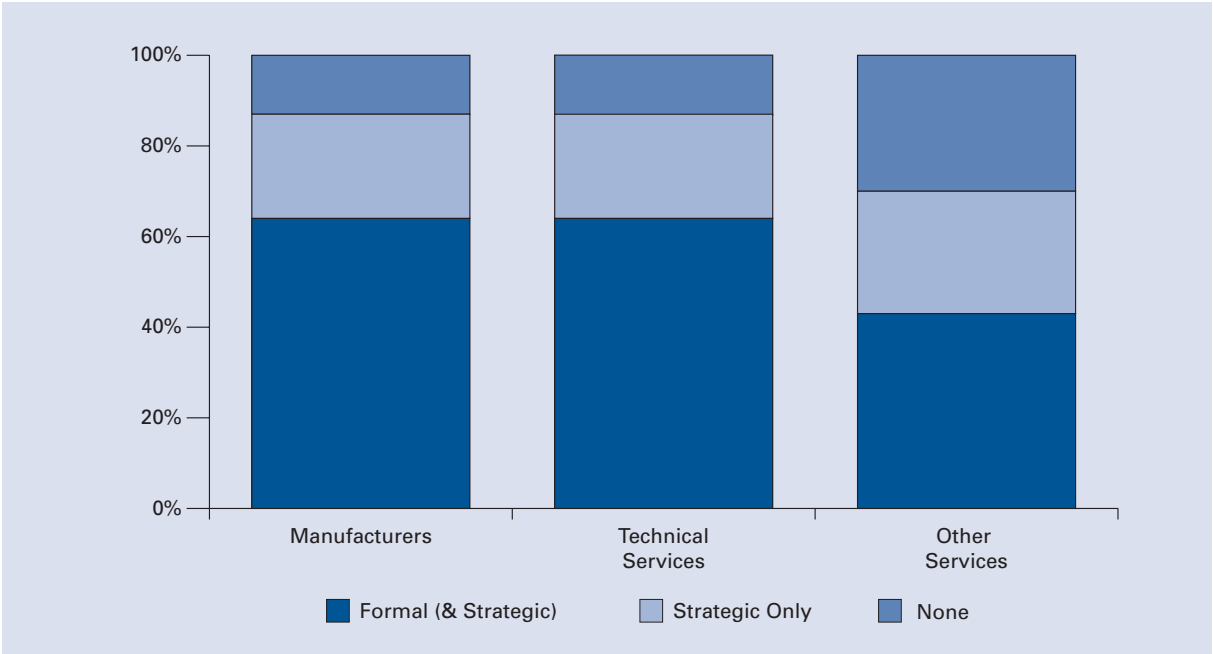
28 See IBM on services science http://www.research.ibm.com/ssme/

Another important part of the innovation infrastructure is the protection for innovations – the question being how do service firms protect their innovations, and what use do they make of formal forms of intellectual property protection, such as patents and copyrights? Tether and Massini (Chapter 5) find:

- Firms in manufacturing industries are much more likely to use patents to protect their innovations than firms in service industries – it is common for around half the innovating firms in a manufacturing industry to use patents, but rare for more than a quarter of innovating service firms in an industry to use patents. This reflects the nature of these activities, and the extent to which any inventions are patentable.
- Service industries are also less likely to use registered designs, copyrights and trademarks than manufacturing firms to protect their innovations (although service firms are more likely to use these than patents).
- Firm level analyses suggests that service innovations tend to be protected in a similar way to process innovations, rather than in a similar way to tangible product innovations.

Evidence from the Community Innovation Survey shows that manufacturers and technical services tend to protect their innovations in a similar way using both formal (patents, copyrights, trademarks, registered design) and strategic forms of protection (secrecy, lead time advantages, confidentiality agreements and complexity of design etc.) – around 65 per cent in both. Other services have a slightly higher use of 'strategic only' methods of protection and 30 per cent use none (see Figure 1.3).

Figure 1.3: Protecting innovations



Source: Community Innovation Survey (CIS4).

Note: Technical services – telecommunications, computer services, R&D services, architecture and engineering services.

The somewhat less intensive use of formal methods of protection by services begs the questions of how well the system is designed to meet their needs. Wölfl (2005) argues that some of the familiar barriers to innovation are more of a problem in service industries:

> *'...external effects may be of particular relevance for service firms as knowledge that is created in the innovation process of services firms is typically not protected by patent law; it may also diffuse more slowly than knowledge created in innovation of goods since the IPR regimes used by services are not based on registration of information pertaining to the innovation.'* [29]

Debate in recent years has considered whether firms ought to be able to patent 'business methods'. A business method may be simply defined as a method of doing business (e.g. Amazon's one click shopping). In Europe, business methods are not patentable as such, while in the USA business models are patentable. The Gowers Review[30] considered the case for patenting business methods but expressed concern that they failed to meet the criteria for patentability; namely that inventions are non-obvious and novel. The review also raised issues about business method patents potentially increasing the regulatory burden on SMEs.

Another topic of current debate is the role of the intellectual property rights (IPR) framework in encouraging/facilitating Open Innovation systems. Open Innovation systems refer to the fact that increasingly firms make use of both external and internal knowledge for the development and commercialisation of their ideas. Open Innovation systems are particularly relevant for knowledge intensive services (e.g. consultancies). Salter and Tether (2006)[31] note that professional service firms often act as brokers, spanning different structural roles in order to bring knowledge and ideas from one place to another. Open Innovation models need a flexible and transparent framework for licensing, as well as buying and selling IPRs.

1.4 UK innovation policy and services

The UK's approach to innovation policy is set out in the 2003 Innovation Report,[32] which identifies seven success factors for the UK's overall innovation performance:

- Sources of new technological knowledge;
- The capacity to absorb and exploit knowledge;
- Access to finance;
- Competition;

29 Op cit.

30 Gowers (2006) 'Gowers Review of Intellectual Property'.

31 Op cit.

32 DTI (2003) 'Competing in the Global Economy – The Innovation Challenge', DTI Innovation Report.

- Customers and suppliers;
- The regulatory environment; and
- Networks and collaboration.

From these success factors, the report derives a model of how Government policies influence business innovation, highlighting four key roles for Government, at various levels (see Figure 1.4):

i Acting as an enabler;

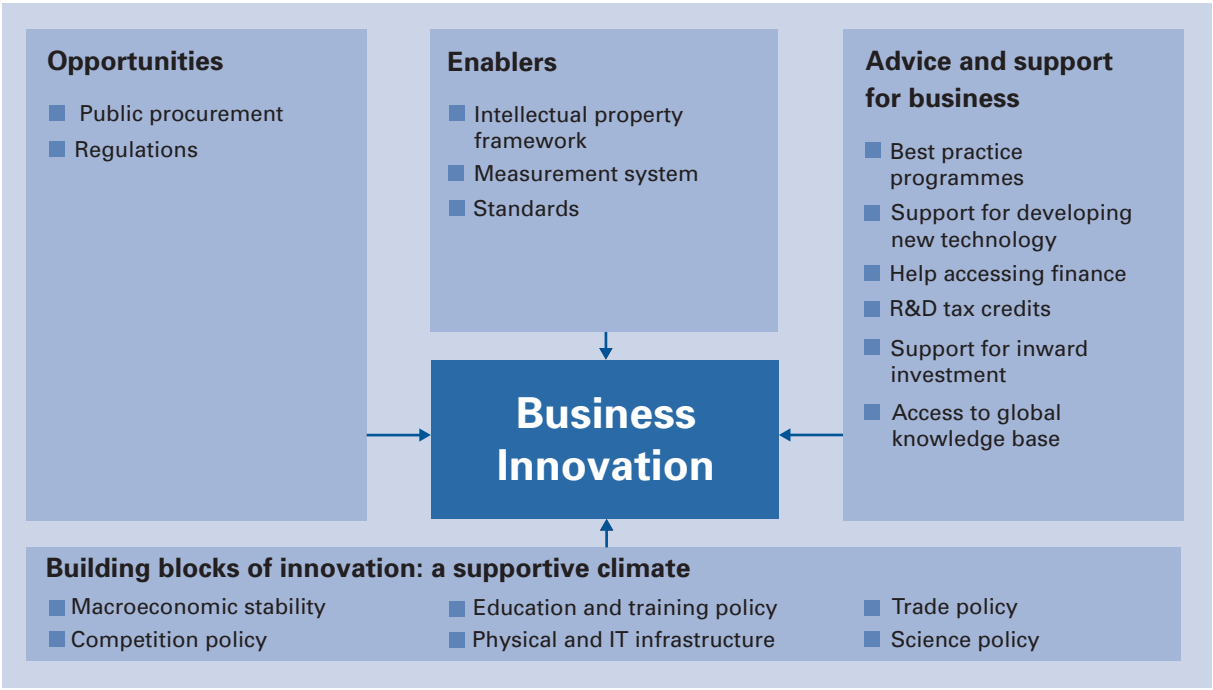
ii Providing advice and support for businesses;

iii Providing a supportive climate; and

iv Encouraging innovation through public procurement and regulation.

The model is designed to create an environment conducive to innovation across the economy.[33] Policies are based on the existence of market and system failures (or barriers) in relation to innovation and on the ability of the Government to successfully correct such failures.[34]

Figure 1.4: How Government policies influence innovation



Source: Competing in the Global Economy – The Innovation Challenge, DTI Innovation Report, 2003.

33 The OECD find innovation policy measures in most OECD countries are sector-neutral, see OECD (2005), 'Promoting Innovation in Services', *Working Party on Innovation and Technology Policy*.

34 Those market failures relate to public goods, externalities (or spillovers), uncertainty and system failures – see DTI (2003) 'Competing in the Global Economy – The Innovation Challenge', Economics Paper No. 7.

Policy designed to meet innovation needs across the economy is arguably the best approach, particularly in light of the increased blurring between different activities in the economy. Van Ark et al (2003)[35] argue

> *'...given the increased intertwining of service and manufacturing innovations the distinction between separate innovation systems for these two sectors also seems inappropriate. Instead of focusing policies specifically on sectors or individual functions, the appropriate approach is to recognise perceived innovation problems where the supply of and demand for innovations do not match...'*

Similarly, Tether (2005)[36] notes that while services tend to have an orientation to innovation that differs from manufacturers, this difference shouldn't be overstated – noting that there are a variety of modes of innovation found in both services and manufacturing. He concludes by noting that we still know much less about innovation in services, and that what is important in thinking about innovation is not which sector they belong to but which approach to innovation they use.

The Council for Science and Technology also warn against adopting a separate model:[37]

> *'...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 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 division between manufacturing and services. [..] Maintaining the divide may simply stall discussion.'*

In line with the 'emerging' nature of academic study of services innovation, international policy evidence on services is also being developed. Forfás (2006) from Ireland are one of the few Government agencies pursuing a distinctive service and innovation policy. Forfás argue:[38]

> *'...merely re-branding or repackaging of policy and supports will not be enough. Although it must be understood that many of the national supports do in fact have the "potential" to be re-oriented and expanded to be more effective but through a new and distinctive national innovation policy'*

35 van Ark, B,. Broersma, L. and den Hertog, P (2003) 'Service Innovation, Performance and Policy: A Review'.

36 Tether, B. (2005) 'Do Services Innovate (Differently)? Insights from the European Innobarometer Survey', *Industry and Innovation*, Vol 12, No 2, pp 153-184.

37 Council for Science and Technology (2003) 'Links between knowledge intensive services and the science base'.

38 Forfás (2006) 'Services Innovation in Ireland – Options for Innovation Policy'.

The OECD (2005)[39] looks at the policies implemented by some countries to encourage innovation in services (see Box 1.2). Most of these policies are not specifically targeted at services firms or activities, but they are seen as particularly relevant for services. In terms of the broader framework the OECD highlight the role of standards and regulation and these may differ significantly across sectors.

BOX 1.2: POLICIES TO PROMOTE INNOVATION IN SERVICES

The OECD (2005) note the following policies to promote innovation in services:

- ***Developing an ICT-related business environment***, for example through supporting e-trade to improve the framework for efficient use of ICT in businesses.
- ***Supporting software industries***, due to the important link that these industries provide to the overall competitiveness of the general economy.
- ***Developing human resources***, in particular ICT training, as a skilled professional ICT labour force is essential for more efficient use of ICT in business.
- ***Clustering and networking*** has been a key focus in some countries due to the importance in helping increasing the efficiency of knowledge acquisition for innovation.
- ***Investing in R&D***: The OECD suggest establishing R&D programmes focussed on the needs of the R&D-intensive segments of the service sector such as computing and telecommunications services.
- ***Fostering SMEs and start-ups*** This has been a focus innovation policy in many countries, with some even targeting support to the service sector.
- ***Standards***: There is empirical evidence that efficiently framed standards promote innovation. There are several programmes to develop service standards underway in the OECD, including the European Committee for Standardisation which has a work programme to develop service standards that cover: maintenance, transport logistics and services, tourism, postal services, facilities management, translation service and funeral services.
- ***Intellectual property rights:*** The OECD argues that attention is needed for policy makers to "*ensure that the patent system continues to strike the right balance between the appropriation of the fruits of innovation by patent holders and the diffusion of technology for society as a whole.*"

Source: OECD (2005) 'Promoting Innovation in Services', Working Party on Innovation and Technology Policy.

39 Op cit.

At a generic level, the studies in this paper bring into focus several well known areas of innovation policy:

- **Skills**: It is often argued that innovation management requires a broader mix of skills than is provided by traditional, disciplinary based approaches (see Tether and Howells (Chapter 2), Bessant and Davies (Chapter 3) and Cox (2005)[40]). Responses may be market driven, for example, IBM is supporting a new curriculum initiative in services to prepare students for careers in services sciences, engineering, and management.
- **Focus on demand**: This is stressed in much of the literature on innovation, but particularly for services. Bessant and Davies (Chapter 3) stress that search for and use of demand side knowledge is critical, particularly as many services are simultaneously created and consumed at the same time so the skills of working with users become important. The role of public procurement in stimulating innovation is also noted.
- **Diffusion**: The importance and economic gains from diffusion are stressed in much of the literature (eg. Howells and Tether (Chapter 2)). Similarly, Wölfl (2005)[41] notes that service innovation does not necessarily result from internal R&D, but from the use of knowledge and technologies that have been created in other firms or industries.
- **Measurement issues** – the importance of adequately measuring innovation is a key element of the literature on services innovation. Better capturing non-technological innovation would allow testing of arguments such as those offered by Bessant and Davies (Chapter 3) to extend support for R&D to include '*the kind of 'research' activity which takes place in service innovation.*'

Economy-wide innovation policies need to have an impact on service activities. The Government as a whole, including central and local government and regional agencies operate a range of programmes to support and stimulate innovation. These programmes are generally sector neutral but some are focused on innovation activities such as Research and Development that are relatively concentrated in production sectors, although by no means confined to them. There may be means of ensuring that economy-wide innovation policies have greater influence on service activities. This needs further careful consideration from a policy perspective, taking into account:

- Industry needs and modes of engagement: More research and analysis is needed to consider (for example) the patterns of service sector engagement with the knowledge base, especially their direct links with the research base or the role of knowledge transfer intermediaries in some services industries.
- Interdependencies between firms and sectors in the economy. Even if certain sectors have closer links to the knowledge infrastructure (e.g. some sectors are more likely to use universities) firms throughout the economy can benefit through spillovers from knowledge creation.

40 Cox, G. (2005) 'Cox Review of Creativity in Business: Building on the UK's Strengths'.

41 Op cit.

From a policy perspective another important area that deserves further investigation is the understanding of non-technological innovation. Technological change by itself rarely secures competitive advantage for the innovating firm in any sector. The different elements of innovation, technological and non-technological, are complementary and successful innovation requires an appropriate mix. This mix differs from one manufacturing sector to another and from one service sector to another but the list of ingredients remains the same across both service and manufacturing firms

The remainder of this paper is formed of the four specially commissioned research papers. In addition, there is considerable work being undertaken across Whitehall and in research institutions throughout the UK – Box 1.3 contains a non-exhaustive list of activities. Together, these research projects should provide a solid foundation on which to better understand innovation, and the appropriate policy response, throughout the economy.

BOX 1.3: DEVELOPING WORK RELEVANT TO INNOVATION IN SERVICES

A number of workstreams complement this project:

- The **Technology Strategy Board** (TSB) is running a series of workshops in particular service sectors considering services innovation. Those events will cover Financial Services, Retail and Logistics, Design Services, The Service "wrap around" manufacturing and Environmental Services.
- The TSB will establish a business-led **Knowledge Transfer Network** (KTN) for the Creative Industries. It will be established along the lines of existing KTNs, but how it engages, the services it offers, and the models of attending, accessing and networking will be geared to the specific needs of creative businesses and practitioners.
- The **Work Foundation** Knowledge Economy project – The project aims to identify what the knowledge economy is, and how advanced nations can use knowledge and information to spearhead economic growth and competitiveness in the 21st century. (http://www.theworkfoundation.com/futureofwork/research/knowledgeeconomy.aspx)
- **The National Endowment for Science, Technology and the Arts (NESTA)** is preparing a research report on the nature of 'hidden innovation' in sectors outside of high-tech manufacturing. The research covers six case study sectors: oil and gas production; construction; financial services; legal aid services; education; and prisons.
- The **Design Council** is disseminating the service design expertise of UK companies through the Designing Demand programme (www.designcouncil.org.uk/designingdemand) and is building the knowledge-base in this area (www.designcouncil.org.uk/servicedesign).
- **The Economic and Social Research Council (ESRC)** have recently awarded a number of grants under a Targeted Initiative on Innovation, and several of these deal with service sector innovation issues.
- **The Advanced Institute of Management Research (AIM)** has recently made a number of Fellowship awards, enabling UK academics to take their research forward on service-related innovation themes.

2 Changing Understanding of Innovation in Services

From Technological Adoption to Complex Complementary Changes to Technologies, Skills and Organisation

Bruce Tether[1] and Jeremy Howells[2]

Executive Summary

Despite the dominance of services in economic activity in the UK and other advanced economies, little attention has been paid to innovation in services. This paper provides a review of how understanding of innovation in services has changed over time and, by exploring a large data-set of European service firms, provides empirical evidence on innovation in services. The paper concludes by outlining the research and policy implications of the review and analysis.

Between the 1980s and the present day, four perspectives on innovation in services can be identified. The first paradigm is 'Neglect', where very little attention, or even acknowledgment, is paid to innovation in services. Here the dominant view is that innovation is about technical advances in machinery, equipment and other goods, and the processes involved with their development and commercialisation. As such, services and other 'low technology' sectors, which are predominantly users rather than producers of new technologies, are seen as uninteresting, adopters of technology, rather than as 'real innovators'.

By the early 1980s, the continued growth of services in advanced economies meant that services were increasingly hard to ignore, and a number of innovation researchers set out to explore this part of the economy. This 'Assimilation' phase of research was characterised by the attempt to study innovation in services using the conceptual tools developed to understand technological innovation in manufacturing – for example the role of R&D was seen as central. As such, this phase can be seen as an attempt to (at best) assimilate or (at worst) subordinate services into the wider fold of innovation research.

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A third 'Distinction' phase emerged in the 1990s, which was more radical in its approach and sought to reject the centrality of 'technological innovation' that had been the focus of most innovation studies. Instead it focused on organisational innovation, and innovation in knowledge-based services, where the role of formal R&D and 'hard' technologies is less prominent than in the technology-producing manufacturing sectors. The approach therefore drew on and highlighted the 'peculiarities of services' and how services, and their innovation activities, differ from archetypal manufacturing.

The last 'Synthesis' approach began with agreement that the study of innovation should combine analysis of both technological and non-technological forms of change, but also that this broader vision of innovation has as much relevance for manufacturing and other sectors as it has for services. In essence, researchers adopting this approach recognise the importance of both technological and non-technological (and especially organisational) forms of innovation, and indeed the interactions and complementarities between these two forms. As such, they seek to develop insights that are relevant to the whole economy, not just services.

These changing understandings have been associated with changing approaches to the measurement of innovation. The 'Neglect' and 'Assimilation' perspectives are largely interested in patterns of R&D activities and patenting. As most services do little of these they were considered marginal players in innovation. The development of the European Community Innovation Surveys (CIS) since the early 1990s has however revealed more innovation in services than was hitherto appreciated. The 'Distinction' and 'Synthesis' approaches both call for the development of a wider understanding of innovation, in which the measurement of organisational change is given equal status to the measurement of technological change, but as yet these perspectives are poorly served by appropriate measurement tools.

We use one survey designed in the synthesis tradition to give insight into innovation in services in the empirical section of this paper. The survey included over 900 European service firms active in four contrasting sectors: road transport, call centres and information processing, care for the elderly and design activities. Exceptionally, the survey was designed to explore the extent of changes to skills and organisation on the same basis as technological forms of innovation.

The survey found that the most widespread change was to the technologies used to produce or deliver services. But firms also claimed widespread change in other dimensions: over a third claimed their products or services had changed completely or significantly, and a similar pattern was found for changes to the means of producing services, to the skills deployed, and to the firms' organisational structures. Overall, the important finding here is the similarity between the level of change to technologies, skills and organisational arrangements, as well as to the services provided and the means of providing them. These similarities hint at connections or complementarities between these various dimensions of change.

Further evidence that innovation in services involves more than the passive adoption of technologies is found in evidence on the importance attached by firms to investing in skills and new technologies. Most firms considered both of these important, and indeed equally important.

The view that innovation in services often involves complementary changes to technologies and non-technological factors (such as skills and organisational structure) implies that innovation in services is typically considerably more complex than earlier 'technology adoption' perspectives would suggest. This also implies that the diffusion of technologies and productivity gains will only be realised through greater attention being paid to 'soft' issues like skills and organisational structure, and their interaction with technologies.

The balance between investing in technologies and people varied markedly between service sectors. Notably, elderly care businesses placed considerably greater emphasis on changes to skills and investing in training, whereas information processing companies highlighted changes to technologies and investing in technologies. This implies the role of skills and technologies in service provision, and changing service provision, differs markedly between service sectors, and points to considerable variety in patterns of innovation within the service sector. This is of course a reflection of the considerable heterogeneity of activities classified as 'services'.

What inhibits firms from innovating? The received understanding in a large part of the academic and policy community is that the supply of technologies is high on the list of factors impeding innovation. Ranked by the proportion of firms identifying it as a crucial or very important inhibiting factor, the supply of technologies was in fact the least widely identified factor impeding innovation. Other surveys also suggest the supply of technologies is not a primary barrier to innovation in most services. Interestingly, the survey analysed here finds customers' unwillingness or inability to pay for innovations is a more important barrier.

A number of options are proposed for developing innovation policy for services. Firstly, the empirical evidence has emphasised the importance of diffusion and the joint adoption of technological and non-technological, organisational innovations. Given technological diffusion is rather more complex than is often appreciated, government might help by promoting and possibly establishing knowledge sharing practices within industries and/or supply chains or networks. One vehicle for this is the DTI's 'knowledge transfer networks' which currently appear oriented to manufacturing sectors and the development of 'hard' science and engineering.

Secondly, the role of skills has received remarkably little attention from scholars of innovation in recent years, yet it is clear that skills have a fundamental bearing on innovation and firms' wider performance. Two broad areas of skills need greater attention: management skills and workforce skills. With management

skills it is notable that very few people receive any formal training in innovation management, yet it is often argued that innovation management requires a broader mix of skills than is provided by traditional, disciplinary based approaches. With workforce skills we note that the tradition within Western education and training systems has been to encourage high degrees of specialisation. Whilst such specialisation is necessary it is arguably increasingly insufficient, particularly where people need to interact and inter-relate in the course of their work. In other words, workers, especially in services and innovation-related service work, increasingly need to combine a depth of knowledge in a particular area with a breadth of knowledge and communications and team-working skills which allow them to effectively inter-relate with others from other specialisations.

Thirdly, innovation research and policy has been dominated by the supply side, and especially the supply of technologies. Evidence shows that in services the supply of technologies is not the most significant barrier to innovation; by contrast the survey suggests demand is a more important determining factor. Here, government and the public sector may have a significant role to play, through the public procurement of goods and services.

2.1 Introduction[3]

Despite the dominance of services in economic activity in the UK and other advanced economies, prior to the 1990s relatively little attention was paid to innovation in services. This paper has three main objectives. Firstly, to review how the understanding of innovation in services has changed over time, from an understanding focused on technological adoption to an understanding based on complementary changes to technologies, skills and organisation (Section 2.2). In association with this changing conceptualisation, we also discuss the development of approaches to measuring innovation, particularly in services (Section 2.3). Secondly, we explore empirical evidence of these innovation complementarities in services through a unique data-set of European service firms active in four contrasting service sectors (Section 2.4). Lastly, we provide some reflections on this review and analysis in relation to its implications for research and policymaking with regard to innovation in services (Section 2.5).

3 We are grateful to the comments of Dr Ray Lambert, Catherine Connolly and participants at the DTI's Conference on Innovation in Services (15th November, 2006) that have improved this paper. The view expressed are those of the authors, and do not necessarily reflect the views of the DTI or its officials.

2.2 The Changing Understanding of Innovation in Services

The first part of this paper is organised around a broadly temporal framework that outlines the evolution of thinking about innovation in services, from the 1980s to the present day. Not all contributions to the literature can be neatly allocated to one of the four phases we will outline, and moreover many innovation researchers and policymakers have not kept pace: many if not most are still at Stage 1, 'Neglect'.

NEGLECT

Until the 1980s very little research was undertaken on innovation in services, or indeed on services in general, despite the observation by Fuchs (1968) and Bell (1973) that advanced economies had become 'post-industrial', service economies. Much of this neglect can be attributed to the idea which dates back to Adam Smith that it is material wealth that matters, and that it is manufacturing that 'fixes' technological advance in the form of new equipment and other goods. Thus, Smith (1776) noted "*The labour of the menial servant..... does not fix or realize itself in any particular subject or vendible commodity. His services generally perish in the very instant of their performance, and seldom leave any trace or value behind them.....*"[4] Smith's implication that manufacturing matters has gone on to dominate two centuries of economic thought (see Hill, 1999 for a discussion).

To this day, much innovation study concerns the source of new technologies. In essence, there is a focus on the generation of new technologies, rather than their diffusion and use. Hence, technology producing sectors like biotechnology receive far more than their 'fair share' of attention, whilst technology-using sectors such as services and 'low technology' manufacturing (see von Tunzelmann and Acha, 2005), suffer neglect. Thus, innovation here tends to be perceived rather narrowly, focusing on technical advances, largely embodied in machinery, equipment and other goods (such as new drugs), and the processes involved with the development and commercial introduction of new, technologically advanced goods.[5]

Outside the field of innovation studies, diffusion has been widely studied by sociologists, economic historians and more 'mainstream' economists (Rogers 1995; Stoneman, 2002). Despite these diffusion studies, technological adoption is often considered to be unproblematic and therefore of secondary importance – the main difficulty and area of interest is the production not the use of new technologies. Yet, as Edgerton points out, most economic progress in society comes from 'technology-in-use' and not the creation of new technology itself (Edgerton, 1999; see also Scranton, 2006).

4 p. 330, Volume I, Book II, Chapter III 'Of the Accumulation of Capital, or of Productive and Unproductive Labour' in Smith, A (1776) An Inquiry into the Nature and Causes of the Wealth of Nations 1976 Edition edited by Campbell, R. H. and Skinner, A. S. with Todd, W. B. Oxford University Press, Oxford.

5 Although this relatively narrow conceptualisation has been paralleled by other work at a high level of abstraction on 'techno-economic paradigms' and 'long-waves' (e.g., Freeman and Louçã, 2002).

The main empirical evidence used to support the focus on new technologies is R&D statistics and patents as measures of innovative activity. Since – with the notable exceptions of telecommunications and computer software firms – service firms have traditionally done very little R&D (due in part to their less formalised approaches to innovation (Sundbo, 1997; Evangelista, 2000; Sundbo and Gallouj, 2001; Gallouj, 2002; Tether, 2005)) and obtain few patents (European Commission, 2004), they are generally considered marginal with respect to innovation. It is notable here that in recent years banks and other financial services have begun to record considerably greater expenditures on R&D.[6] The extent to which this reflects a 'real change' in their commitment to and organisation of innovation, and the extent to which it reflects a 're-labelling' of existing activities has yet to be made clear.

The development of 'object-based' approaches[7] to identifying and measuring innovations only served to reinforce the understanding that services were uninteresting with respect to the production of new technologies (Pavitt, 1984; Pavitt, 1987; Pavitt et al., 1989). The object based approach is centred on identifying innovative 'things' – such as new drugs, or new computer systems. As services tend not to produce objects directly (although they may assist in their development), the vast majority of the identified innovations were attributed to manufacturers.

The late Keith Pavitt built his seminal taxonomy of innovative activities on one such dataset of innovations, through which he identified four types of technological activity, the first two of which – **science based** (e.g., pharmaceuticals, electronics) and **specialist suppliers** (e.g., instrumentation, specialist machinery) – are producers of new technologies, whilst the third – **scale intensive producers** (e.g., car manufacturing, bulk chemicals) – is both a producer and a demanding user of new technologies, and the fourth – **supplier dominant** – is seen as being passively dependent on the others for the supply of new technologies. Pavitt's original classification (Pavitt, 1984) identified services as being 'supplier dominated' and therefore as uninteresting if the primary concern is the production rather than the use of technologies.

Arguably, this 'neglect' perspective remains dominant to this day, and within innovation studies research on innovation in services (and 'low technology' manufacturing) remains a relatively marginal (if growing) line of work, which receives much less attention than 'hot' areas such as biotechnology or nanotechnology despite accounting for a vastly greater share of the economy than these 'hot' sectors.

6 See http://www.innovation.gov.uk/rd_scoreboard

7 See Archibugi and Pianta (1996, 455-456) for a more detailed discussion about 'object' versus 'subject' based approaches to innovation.

ASSIMILATION (OR 'SUBORDINATION STUDIES')

By the early 1980s the continued growth of services in advanced economies meant that services were increasingly hard to ignore, and a small number of innovation researchers set out to explore this very large part of the economy. This phase of research was essentially characterised by the attempt to study innovation in services using the conceptual tools developed to understand (technological) innovation in manufacturing. As such, this phase can be seen as an attempt to (at best) assimilate or (at worst) subordinate services into the wider fold of innovation research.

Perhaps the most notable attempt to assimilate services into innovation research using the conceptual tools derived from studies of manufacturing was Miozzo and Soete's (2001) adaptation of Pavitt's taxonomy to embrace services. Like Pavitt, Miozzo and Soete identified different classes of technological activities:

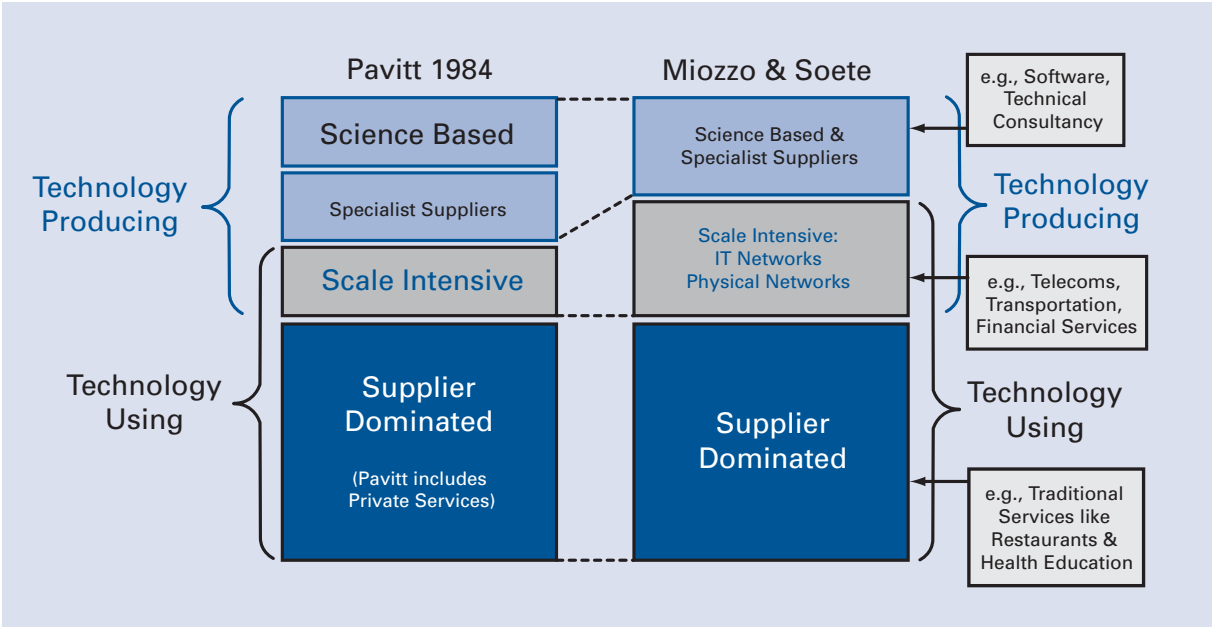
- **Supplier dominated sectors** – e.g., public or collective goods (education, health care, administration) and personal services (food and drink, repair businesses, hairdressers, etc).
- **Production-intensive sectors**, amongst which there are two sub-types:
    a. **Scale-intensive sectors**: Services involving large scale back-office administrative tasks that are well suited to the application of information technologies (IT), initially at least, with the aim of reducing costs.
    b. **Network sectors**: Services dependent on physical networks (e.g., transport and travel services, and wholesale trades and distribution) or on elaborate information networks (e.g., banks, insurance, telecommunications, and broadcasting services). Public utilities such as electricity, water and gas supply may also be included in this group, although they are often not considered services. These services often play a major role in defining and specifying innovations and new technologies, such that the suppliers of the new technologies are to an extent 'service dependent'.
- **Specialised technology suppliers and science-based sectors**. This group includes software and specialist business services, including technical and design services. The main source of technology is the innovative activities of the businesses themselves, although innovations can often be developed in close co-operation with particular clients.

The close mapping between Pavitt's taxonomy and that of Miozzo-Soete is shown in Figure 2.1 below. Both taxonomies highlight the role of embodied technologies, rather than capabilities based in skills, for example. Also notable is that the role of customers and demand is absent (with the exception of user-producer interactions being important to specialist suppliers' innovations) in these taxonomies.

In the meantime, European countries had begun to measure innovation directly, through what have become known as the European Community Innovation Surveys (CIS). The CIS, and the OECD's Oslo Manual (1992) on which it is based, were originally motivated by the understanding that much innovation was being missed by measuring only R&D and patents (Smith, 2005). The CIS uses a 'subject based' approach (Archibugi and Pianta, 1996) – that is rather than focus on innovative things (as in the object based approach), firms were asked about various aspects of their innovative activities, including whether they have introduced new or significantly changed products or processes. The CIS, however, was originally developed to survey the innovative activities of manufacturers, and was designed around the traditional dichotomy of (technological) product and process innovation, with organisational innovation omitted. In almost all countries, the first CIS, which was carried out in 1992, was confined to manufacturing.

Subsequently, the Oslo Manual and CIS were adapted to extend the surveying to services. This adaptation involved little effort to address the peculiarities of services, and instead merely accommodated services by replacing the word 'product' with the word 'service'. The second CIS, which was carried out in 1997, included many private services, although not public services (Tether et al., 2001).

Figure 2.1: Pavitt, Miozzo and Soete's Taxonomies of Innovation and Technology Trajectories



Source: Adapted from Pavitt (1984) and Miozzo & Soete (2001)

Evangelista (2000) exploited Italian innovation survey data and classified service firms into four groups, which resonate with the Pavitt and Miozzo-Soete taxonomies discussed above:

- **Technology Users** – are the least innovative group, and come closest to the archetype of services as being 'supplier dominated'. These firms rely on technologies bought in from external sources, usually the manufacturing and/or information technology (IT) sectors. The types of activity within this group include (amongst other things) waste processing, land and sea transportation, security, cleaning, legal services, travel services and retail.
- **Interactive Services**. In these sectors, innovation is achieved through close interaction with clients, rather than through internal R&D or technological acquisition. A heavy reliance is placed on developing and/or implementing software and/or acquiring know-how. The activities in this classification include: advertising, banks, insurance, hotels and restaurants.
- **Science and Technology Based Services**. These firms are major generators of new technological knowledge, which they then diffuse to manufacturers and other service providers. Their innovation activities are typically located 'up-stream' at the 'front-end' of the innovation and knowledge generation chain, often involving close interactions with public and private research institutions (Tether and Tajar, 2006a). The activities included here are R&D services, engineering, computer and software services.
- **Technology Consultancy Services** – these combine characteristics of the science and technology-based services and the interactive services. They carry out internal innovation activities but draw heavily on clients' knowledge. While all services may be said to have some problem-solving activities of one sort or another, the technical consultants' main function is the provision of solutions to meet the specific needs of their clients.

Miozzo and Soete's classification, and Evangelista's empirical study, are useful in highlighting the diversity that exists in services, and showed that dismissing all services as supplier dominated was an important error. However, Evangelista's study found that whilst this was an error, it was not a bad first approximation. Despite accounting for less than 5% of employment in services, the technologically intense 'Science and Technology Based Services' were found to account for 30% of all service firms' expenditures on innovation, whilst the 'Technology Users' accounted for only a small share of innovation expenditures but 80% of all service firms and more than half of employment in the service sectors included in the analysis.[8]

Evangelista's work broadly supports the conceptual work of Miozzo and Soete, and argues that innovation in services broadly mirrors Pavitt's conceptualisation of innovation in manufacturing. It also reflected Evangelista's finding, elicited

8 Meanwhile, the 'Interactive Services' category accounted for around a quarter of employment in services, and technology consultancy services less than a fifth.

from CIS survey data, that capital spending accounts for the largest single component of innovation expenditure across all sectors (see Evangelista et al. 1998). Overall, Evangelista concludes that innovation in services shows more similarities than differences to innovation in manufacturing, and in general this line of research suggests that innovation in services and manufacturing are not so very different – there may be differences in emphasis, but there are differences of degree rather than of kind.

However, critics (e.g., Sundbo, 1997; Gallouj 2002), particularly those following the distinction approach (see below) argue that these findings are based on an approach that uses the conceptual and empirical tools derived from studies of manufacturing. It is a bit like using tools developed to understand the behaviour of mammals to explore the behaviour of reptiles or birds – similarities and differences in behaviours that lie within the frame of reference can be highlighted, and many similarities will be found, but those behaviours that lie beyond the frame of reference will be neglected (e.g., using only ideas from the study of mammals to study birds is likely to neglect the fundamental characteristic of birds – that they can fly!). In particular, critics argue that the received understanding of innovation takes a rather narrow, technological view – there is, for example, little attention to interaction (for example through delivery innovation, which is often important in services), surprisingly little attention to skills (Tether et al., 2005), and the focus is still on the production rather than the use of new technologies.

DISTINCTION (OR 'AUTONOMOUS STUDIES')

A third line of research has argued that innovation in services follows different patterns from archetypal innovation in manufacturing. An early yet bold effort to develop a theory of innovation in services was proposed by Richard Barras (1986). Through research on financial services Barras observed that, contrary to the conventional pattern of innovation through the life cycle of an industry as observed by Abernathy and Utterback (1978), in which innovation initially focuses on developing new products until a dominant design emerges before the focus of innovation switches to processes, in (financial) services innovation appeared to first focus on processes (eg. the application of information and communication technologies (ICT) to improve the efficiency of back-office functions), before shifting to products. This was partially through learning but also through the increasing ability to customise offerings, again due to the flexibility afforded by ICT.

Barras not only claimed services may follow a fundamentally different pattern of innovation, through a 'reverse product cycle', but that the application of ICT had brought services into the industrial era: they begin to use an industrial technology appropriate to their information intensive activities, and reorganise important parts of their work around this (see also Levitt, 1972). Eventually, service firms become important independent innovators in their own right.

Barras' model was highly influential, and marked a first step towards theorising innovation in services. However, his 'one-size-fits-all' model of innovation in services has been subject to considerable criticism (e.g., Uchupalanan, 2000; Miles, 2005), especially as Pavitt's recently introduced taxonomy had argued there were multiple patterns of innovation in manufacturing. If multiple patterns exist in manufacturing, why should a single pattern exist in services?

Barras' model can be seen as lying between the assimilation approaches discussed above and the more radical 'distinction' studies that were undertaken in the 1990s, for although Barras argued the model of innovation in services differs from that in manufacturing, he still placed technologies at the heart of his analysis. The distinction scholars that followed rallied against this obsession with technologies, as Gallouj points out:

> *"Those studies that equate innovation in services with technological innovation (adopted by services) are by far the oldest and most numerous, which has contributed to some extent to the overestimation of the technological dimension or, more precisely, the underestimation of other aspects of innovation" (Gallouj, 2002, p. 2)*

The mid-to-late 1990s saw considerable growth in studies on innovation in services, and significantly many of these were undertaken by researchers (from France, Denmark, the Netherlands and Norway) who came from outside of 'mainstream' innovation studies. As is often the case (Kuhn, 1963), it was outsiders who challenged the orthodoxy in conceptualising and measuring innovation, and those scholars sought to undertake 'autonomous studies' of innovation in services that were not hidebound to the existing conceptualisation that privileges technological over other forms of innovation.

Initially at least, this set of scholars emphasised the 'peculiarities of services', and how services differ from archetypal manufacturing. For example, services are often intangible, and are often (but not always) produced and consumed at the same time, often with the direct involvement of the consumer (i.e., some services, such as air traffic control, are co-produced by the provider and user working together – Tether and Metcalfe, 2003). This means it is much more difficult to define a service product and observe a moment at which the service

product changed significantly (i.e., distinct service innovations are harder to identify than distinct goods innovations, and service innovation is likely to involve more continuous or wave like change than the stepwise improvement model associated with innovation in goods). Service processes are not all internal to the firm – for example, a delivery process is a 'service product', which creates difficulties with the widely accepted dichotomy of product and process innovation. Beyond this there is also confusion as to how to differentiate between process and organisational innovation in services.

By studying innovation in a variety of services from cleaning to knowledge-based services such as management consulting, this line of research rejected the centrality of 'technological innovation', and instead emphasised organisational innovations and innovations in work practice. Indeed, Sunbo (1997) suggests that the traditional focus on R&D based technological innovation represents something of a special case,[9] whereas innovation in most of the economy (including most services) is strategically determined (i.e., the firm's strategy is the core determinant of innovation) rather than its technological position. Whilst many strategically determined innovations are facilitated by technologies, their development does not necessarily depend on leading-edge technologies or on holding a technological advantage over competitors, and therefore the role of 'hard' technologies is less prominent than in the technology-producing manufacturing sectors that have been the primary focus of most innovation research.

The distinction researchers argued the need to move away from narrow technological definitions of innovation, and that merely adapting conceptual and empirical tools developed with technology-based manufacturing in mind, as had been done by those working in the assimilation tradition, was inappropriate. Instead, they called for the development of conceptual and empirical tools that are more sensitive to the peculiarities of services – and in particular their intangibility, their high dependence on people, and high levels of interaction (Tether 2005). Some ad hoc large scale survey work has been undertaken in this tradition, notably in France by Djellal and Gallouj (1997).

9 He also identifies innovation through entrepreneurship (and intrapreneurship) as another special case.

Table 2.1: Various Modes or Patterns of Innovation in Services

The Classic R&D Pattern	Where innovation is based on the linear model of technological advance, and is primarily developed through dedicated R&D departments. This is the classic industrial pattern of innovation, which is becoming less common in manufacturing. It is and always has been rare in services. A few exceptional services follow this pattern – e.g., telecommunications companies and large packaged software producers.
The Services Professional Pattern	This mode is based on service professionals who do not sell products but their competencies and (often ad hoc) 'solutions'. Generally, the innovation process is not formalised, but depends heavily on the professional skills of employees. Management and engineering consultancies are examples of this. This mode can however be highly resistant to more radical forms of innovation, especially that which undermines the status of professionals (e.g., doctors can be reluctant to give up responsibilities to nurses). We should not confuse the idiosyncratic, client-specific nature of the services provided by professionals with more fundamental innovation.
The Neo-Industrial Pattern	This is a hybrid between the classic R&D pattern and the service professional pattern, in which the firm does have an R&D or innovation department, but in which innovation is also more distributed to also involve professionals. It is found in health services, and in larger engineering consultancies.
The Organised Strategic Innovation Pattern	In this mode there is rarely an R&D or innovation department, and instead innovation is more distributed, with particular projects been driven through by ad hoc, cross-functional teams (with marketing often the most prominent function). The innovation process is often organised through distinct, managed steps. This mode is commonplace in large, professionally managed service firms, such as airlines and retailers.
The Entrepreneurial Pattern	This mode is based on start-up firms offering radical innovations, often based on alternative technologies and/or business models to established businesses. Many 'dot.com' companies followed this mode, as did firms such as Direct Line Insurance and SouthWest Airlines (the originator of the 'low-cost' model followed by EasyJet and RyanAir).
The Artisanal Pattern	This mode is found in operational services, such as clearing and catering. Innovations tend to be small scale, and often not repeated (i.e., variants rather than true innovations). More fundamental innovations often come from outside, through regulation or new technologies.
The Network Pattern	This pattern is based on a network of firms acting together, rather than a single firm acting alone. Franchises would be one, more formalised example.

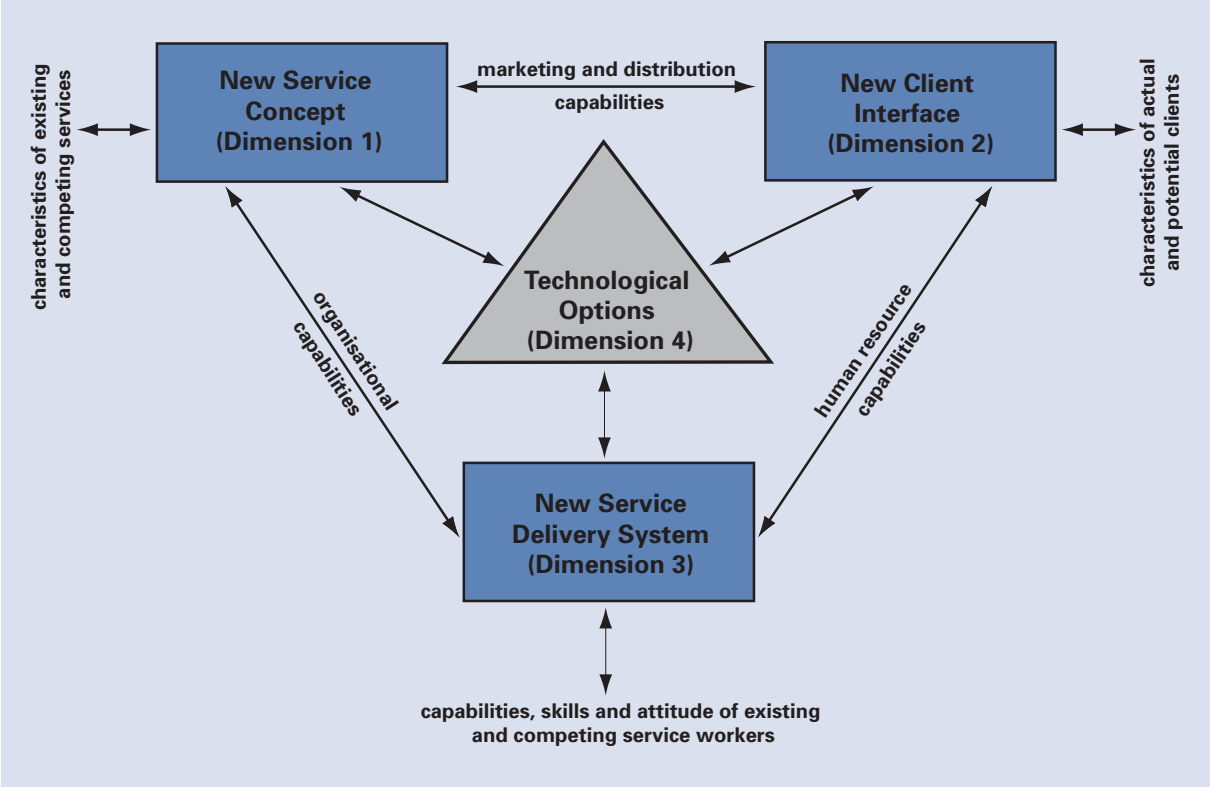
Authors' summary for patterns outlined in Sundbo and Gallouj (2001)

Drawing on survey and case study work, Sundbo and Gallouj (2001) outline a number of service innovation patterns derived from work in this tradition (Table 2.1). The list of patterns is not intended to be exhaustive, but illustrative of the variety of modes of innovation, in which 'physical' technologies are prominent in only a few. In short, the distinction line of research tended to privilege organisational and people issues, and interactivity, rather than technologies, as the key elements to innovation in services.

SYNTHESIS (OR INTEGRATIVE APPROACHES): TOWARDS A CONSENSUS

The 'distinction' line of research stirred up debate amongst researchers studying innovation in services. In essence, there is considerable agreement that the concept of innovation should be extended to include non-technological forms of change, but concern that the concept is being stretched too far, to include many ad hoc, non-reproducible and easily reversible changes that may even have been accidental. Some researchers argue that the concept of innovation should involve at least an element of technological change and should not be extended to all organisational change (Drejer, 2004), as in the long-run it is primarily technological change that drives increases in productivity.

Figure 2.2: Dialogic's Four Dimensional Model of Innovation in Services



Source: Den Hertog (2000, 495)

A variety of viewpoints persist, but suffice to say that researchers studying innovation in services increasingly recognise the importance of both technological and organisational forms of innovation, and indeed the interactions and complementarities between these. One such model is that offered by the Dialogic consultancy, which highlights four dimensions of innovation, where only one of these dimensions is technological (Figure 2.2). The interactions between technological and non-technological change are also highlighted. We will explore these issues further in the empirical section of this paper (Section 2.4).

The growing consensus that is captured by the synthesis approach highlights the increasing complex and multidimensional character of innovation, not only in services but also in manufacturing. This includes the increasing bundling of services and manufactured goods into 'solutions' (Howells, 2004). This also recognises the major changes that have occurred in management practice, and the shift away from 'manufacturing' versus 'service' companies, towards organizations focused on the realisation of value. This has moved the focus of research away from technologies to knowledge, and away from individual firms towards understanding value chains or networks, locating service and manufacturing in a set of interrelated activities (Womack et al. 1990; Davies, 2003). It is for example widely acknowledged that certain Knowledge-Intensive Business Services (KIBS) play key roles as knowledge or technology-intermediaries in systems of innovation, producing innovations for their clients, or helping their clients to innovate (see, for example, Miles et al., 1995; Hargadon and Sutton, 1997; Hargadon, 1998; Howells, 2006).

The motivation in this line of research is less to understand the peculiarities of innovation in services, but rather to use the broader conceptualisation of innovation as a set of processes that does not privilege technological change and that has been developed through investigating services to understand innovation across the economy. Thus aside from technological change this research is interested in organisational change, social networks, the development of 'integrated solutions', and a range of other mechanisms to support in innovation in services and manufacturing. This shift in emphasis requires incorporation of many tools and theories from outside traditional innovation studies, including organisational behaviour, social networks, marketing, strategy and communications studies. Much remains to be done to fully realise this fuller understanding of innovation, not just in services, but across the economy.

2.3 Measuring Innovation in Services

In this section we briefly outline the development of approaches to measuring innovation, particularly with reference to services. Generally, the measurement of innovation has lagged someway behind theoretical ideas, whilst theoretical ideas often lag someway behind changes in the 'real world'. Thus the measurement of innovation lags considerably behind changes in the real world (NESTA, 2006).

A key metric for measuring innovation is commitments to **research and development (R&D)**. This is reflected, for example, in the prominence given to R&D in the Lisbon Strategy aimed at enhancing Europe's competitiveness. The prominence of R&D reflects the development of standardised approaches to defining R&D, through the OECD's Frascati Manual, the first version of which was published in the early 1960s. The current version is the 6th edition of the manual, which was published in 2002. R&D statistics therefore have the advantage of a long time series and comparability between countries, although critics argue that differences in incentives to undertake R&D (through for

example the presence or absence of R&D tax credits) and differences in methods of data collection mean R&D statistics are rather less comparable than their widespread use would suggest. Arguably, it is also becoming increasingly difficult to measure R&D, as innovation practices have become more diffused and less dependent on the centralised R&D laboratories of major companies (which was the organisational model of innovation in the late 1950s to early 1960s when the Frascati Manual was first developed (see Roussel et al., 1991). Beyond this, the fundamental criticism of R&D as a measure of innovation is that it is an input, not an output, and firms and countries may differ markedly in their ability to convert that input into innovative outputs.

The other traditional indicator of (technological) innovation is **patents**. Patents are widely used because of the availability of large scale patent databases (especially from the US patent office and more recently from the European Patent Office). To patent, firms have to develop things that are patentable, and this varies between countries (particularly with respect to software patents and business process patents). It is also known that firms and industries differ widely in their propensities to patent, and that patents are only really an effective defence mechanism in the chemicals industry, and especially pharmaceuticals. Ultimately, patents are not a measure of innovation, but invention – as many patented devices are not commercialised. They are also only a partial measure of invention, as many inventions are not patented.

Dissatisfaction with R&D and patents as measures of innovation (as opposed to inventive effort and invention) led to the development of new measurement approaches in the 1980s and 1990s. One was the so called '**object-based approach**', which was based around identifying innovations directly, either by asking experts in various industries to identify major innovations, or by using trade journals to identify and classify new product announcements. Although these approaches showed a great deal of innovation does not flow directly from investments in R&D, these methods tend to favour industries which produce tangible things – as it is rather easier for experts to remember new devices (which may be stored in museums) than new practices or procedures. Similarly, trade journals are more likely to record the introduction of a new tangible product than a practice, such as 'just in time'.

The other main approach to measuring innovation is the '**subject-based approach**' which is based on asking firm (the subjects) whether they have introduced innovations. Although used by the European Innobarometer amongst other ad hoc surveys, the main instrument that uses the 'subject-based approach' is the European Community Innovation Surveys (CIS), which were first undertaken in 1992.

In principle, subject-based approaches are equally applicable to manufacturing and services, but in practice – and particularly as operationalised through the European Community Innovation Surveys – these have (arguably) tended to favour manufacturing. Especially in the first edition of the Oslo Manual (OECD 1992) – the OECD's guide to gathering innovation data through surveys – the

focus was on technological product and process innovation (or 'TPP innovation'), in which innovation is conceived as a step change in product or process performance. Scholars of innovation in services argue that this is less appropriate to services, as innovation in services is thought to be more continuous, or wave-like, rather than based on occasional, step-changes. In recent years the definition of innovation in the Oslo Manual has been extended, to lessen the emphasis on technology and to include other forms, such as organisational and marketing innovation, but tensions remain within the community between those who prefer narrower, more technology oriented definitions, and those who prefer broader, more holistic approaches.

The CIS has provided a number of valuable insights into innovation since its inception around 15 years ago, but it is still focused on the act of commercialising new products and new processes, and is limited in aiding our understanding of the diffusion of technologies and practice (and how technologies are integrated into organisations alongside other changes to skills, relationships and organisational structure). The connection between innovation and firm strategy is also poorly developed. Yet strategy and these processes of diffusion and integration are fundamental to economic performance. For this reason, as part of a European Commission funded study on innovation in services, we decided to develop an experimental approach which would explore the multiple dimensions of change in businesses rather than privilege invention or the commercialisation of (technological) innovations. Some of the results of that survey are discussed in the next section. Table 2.2 summarises the different approaches to measuring innovation, where these are especially relevant, and how they are measured.

Table 2.2: Stages of Innovation, their Focus Activities and Measurement

'Stage' of Innovation	Focal Activities	Especially Relevant to	Measured by	Gaps & Weaknesses
Invention	R&D & other 'discovery' oriented activities	The 'high technology' sectors of the economy	R&D surveys, patent databases	Informal R&D & entrepreneurial invention by new and small firms
Commercialisation (of new products and processes)	Introduction to new (technology-based) products and processes	Sectors in which competition is based on discrete products and processes	European Community Innovation Surveys	Links between innovation activity and firm strategy. Links between technological and organisational change
Diffusion & Integration (of technologies and practices)	Combinations of, & mutual adjustments to, skills, technologies, and organisational forms	All sectors of the economy, but especially those that apply rather than develop technologies	Measured by ad hoc surveys, e.g., the survey analysed in Section 2.4*	Lacks status as conducted through ad hoc surveys. Methodologically underdeveloped in terms of detailed content of surveys.

* Some surveys of workplaces and changes to workplaces through the introduction of computers and/or new work practices are also relevant here. To our knowledge there no dedicated survey that seeks to explore this 'stage' of innovation.

2.4 Survey Evidence on Innovation in Services

In this section, we provide direct insight into innovation in services, by exploring empirical evidence from a survey of over 900 European service firms. The survey, which was designed in 'synthesis tradition' outlined above, was carried out in 2003 and focused on innovation, or 'change', amongst firms active in four contrasting service sectors: road transport, call centres and information processing, care for the elderly and design activities. We selected these four activities to reflect some of the diversity that lies within the broad 'services sector'. The four activities can be conceptualised as being engaged in different types of transformations: road transport involves physical transformations, handling and moving goods from place to place; call centres and information processing involve transforming information; elderly care services focus on people; whilst design and related activities involve transforming knowledge.

In contrast to the European Community Innovation Surveys (CIS), the survey examined here was designed to explore the extent of changes to skills and organisation on the same footing as technological forms of innovation. The analysis that follows therefore has four basic aims, namely to: 1) explore innovation in services through a broad conceptual framework, which includes both technological and non-technological forms of innovation; 2) to highlight that innovation in services often involves changes to both the technological aspects of a business and its non-technological dimensions, such as its organisational structure and inter-relations with other businesses. As such, it will be shown that innovation in services is often a much more complex, interactive and complementary process than has hitherto been widely appreciated; 3) explore the relative balance between investments in skills (through training) and technologies; and 4) explore the barriers to change in services.

METHODOLOGY AND SURVEY

In keeping with the synthesis perspective outlined above, we consider that all sectors have innovative activities, which include not only technological, but also organisational and relational forms of change. The aim of the survey analysed below was to explore some of the basic characteristics concerning the pattern of innovation within a variety of service activities. Details and further particulars (such as questionnaire design and sampling methodology) can be found in the report of the study (Howells and Tether, 2004).

A number of issues are however worth highlighting before the findings are reported. Firstly, innovation is, by its very nature, highly diversified, and a large scale survey of innovative behaviour is necessarily reductive. In total, 1,007 firms responded to the survey. However, in the analysis that follows we excluded firms that reported no change to any of the eight dimensions discussed below, as well

as those that reported the same level of change to all of the eight dimensions.[10] This leaves a sample of 932 for the analysis. Of these firms, 238 are in road transport; 226 in call centres and information processing; 281 in design and related activities and 187 in elderly care services. Firms were surveyed in all the EU-15 member states of the European Union. Of the analysed sample, 196 firms were based in Germany, 186 in the UK, 186 in France, 131 in Italy, 120 in Spain, and 113 in the other, smaller, European countries.[11]

Unlike the CIS, the aim of the survey was not to benchmark innovative activities across countries and sectors. Nor did the survey aim to be strictly scientific. Instead, it was intended to be more exploratory in nature. On this basis, it was decided to over-sample (relative to the population) amongst the larger businesses in each sector (the vast majority of service firms, including firms in these sectors, are micro businesses)[12], although in the analysis that follows 30 per cent of the responding firms have less than 10 employees, and only 16 per cent had more than 250 employees. Three quarters are independent companies or partnerships, with the remainder being subsidiaries or divisions of larger company groups.

It is also important to note that there were several novel (or innovative) aspects to the survey. Firstly, the language and phrasing of the survey was kept simple, partly to reduce problems inherent in translating the concepts from one language to another, but in particular the term 'innovation' was avoided in the early part of the questionnaire. Instead the respondents were asked about the extent to which various aspects of their business had 'changed' in the last three years. The term 'innovation' was avoided in the early part of the survey because it was thought to have become a very loaded concept, which would have required a definition (which creates as many problems as it solves) and also because innovations tend to be associated with discrete events, which may be harder to identify in services where change is arguably more continuous or wave-like. Although the relationship between 'change' and 'innovation' is contentious (not least because services or processes may change for reasons other than innovation), it was felt that the advantages of avoiding the term innovation outweighed the disadvantages.

10 'No change' firms were excluded not because this position is implausible, but because the methodology was probably biased towards more dynamic firms – it made sense to remove 'static firms' from the analysis. Firms reporting the same level of change in all dimensions were excluded not because this is impossible, but because of the danger of 'lazy answering'. As these measures excluded relatively few firms it is unlikely that they have had a major impact on the analytical results.

11 The original survey also included responses from the United States for firms in three of the four sectors (road transport, information processing and design and related activities). To simplify matters we have confined our analysis in this paper to European firms. The surveying of European firms was undertaken by ourselves and our partners in the project. The project partners included: Faiz Gallouj, Faridah Djellal and Camal Gallouj from IFRESI, University of Lille, France; Knut Blind and Jacob Edler from the Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe and Christiane Hipp from the University of Hamburg-Harburg, Germany; Fabio Montobbio and Nicoletta Corrocher from CESPRI, Bocconi University, Milan, Italy. We thank Elvira Uyarra at CRIC for her contribution to the surveying of the firms.

12 A 'strictly scientific' approach might seek to focus on a 'representative sample' of businesses in each sector, but in sectors like road transport we feared that this would probably give rise to uninteresting samples, as small independent trucking firms are arguably the representative firms in that sector. In any case, it is very difficult to achieve a 'representative sample' with a voluntary survey. Businesses have to be persuaded to participate, and participation is very likely to be biased towards more dynamic businesses, as these are more likely to want to discuss their innovation efforts.

Secondly, the survey sought to extend the investigation of innovation beyond the narrow confines of 'product', 'process' and 'delivery' innovations, by exploring changes to the technologies and skills of the organisation, as well as changes in its organisational structure and its inter-relations with customers and other businesses. These aspects were included because we were interested in trying to understand innovation (or 'change') in its wider context, rather than counting innovations and comparing innovation rates.

INNOVATION AS INVOLVING MULTIPLE, COMPLEMENTARY, CONCURRENT CHANGES

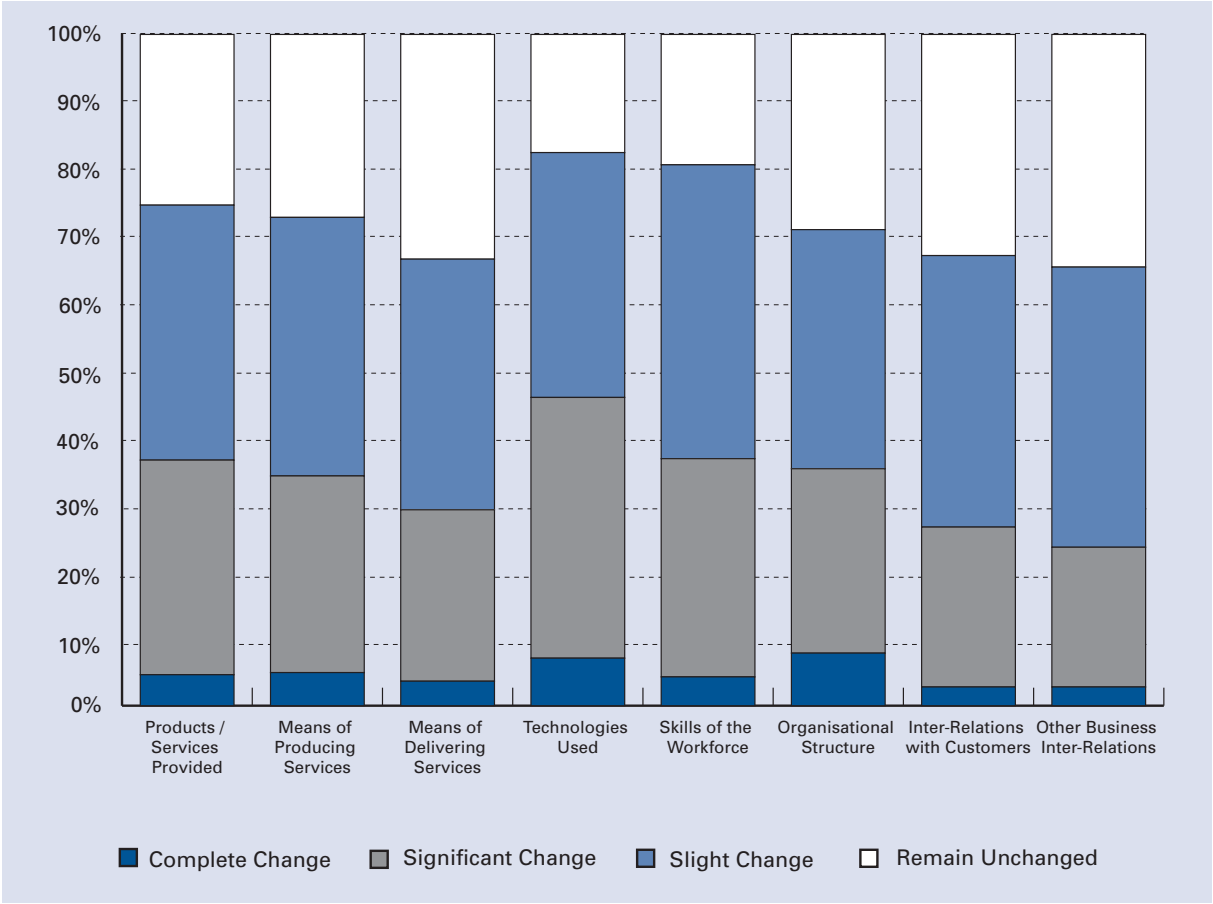
This section explores the pattern of 'change' in the firms that responded to the survey across the four service sectors. As indicated above, it seeks to highlight the fact that by concentrating our attention on product, process and technological indicators of innovation we restrict and narrow our view of innovation, which means we not only neglect the soft/organisational side of innovation, but also the inter-relationships between these technological and soft/organisational forms of innovation.

Figure 2.3 includes all the dimensions of 'change' that the businesses were asked about. In each case the firms were asked to indicate the extent to which these had changed, over the last three years, from 'changed completely', through 'changed to a significant extent', and 'changed but only slightly', to 'remain unchanged'.

The first four dimensions of change cover what might be considered the traditional, technological aspects of innovation:

- changes to the products or services provided;
- changes to the means of producing services;
- changes to the means of delivering services; and,
- changes to the technologies used to produce or deliver services.

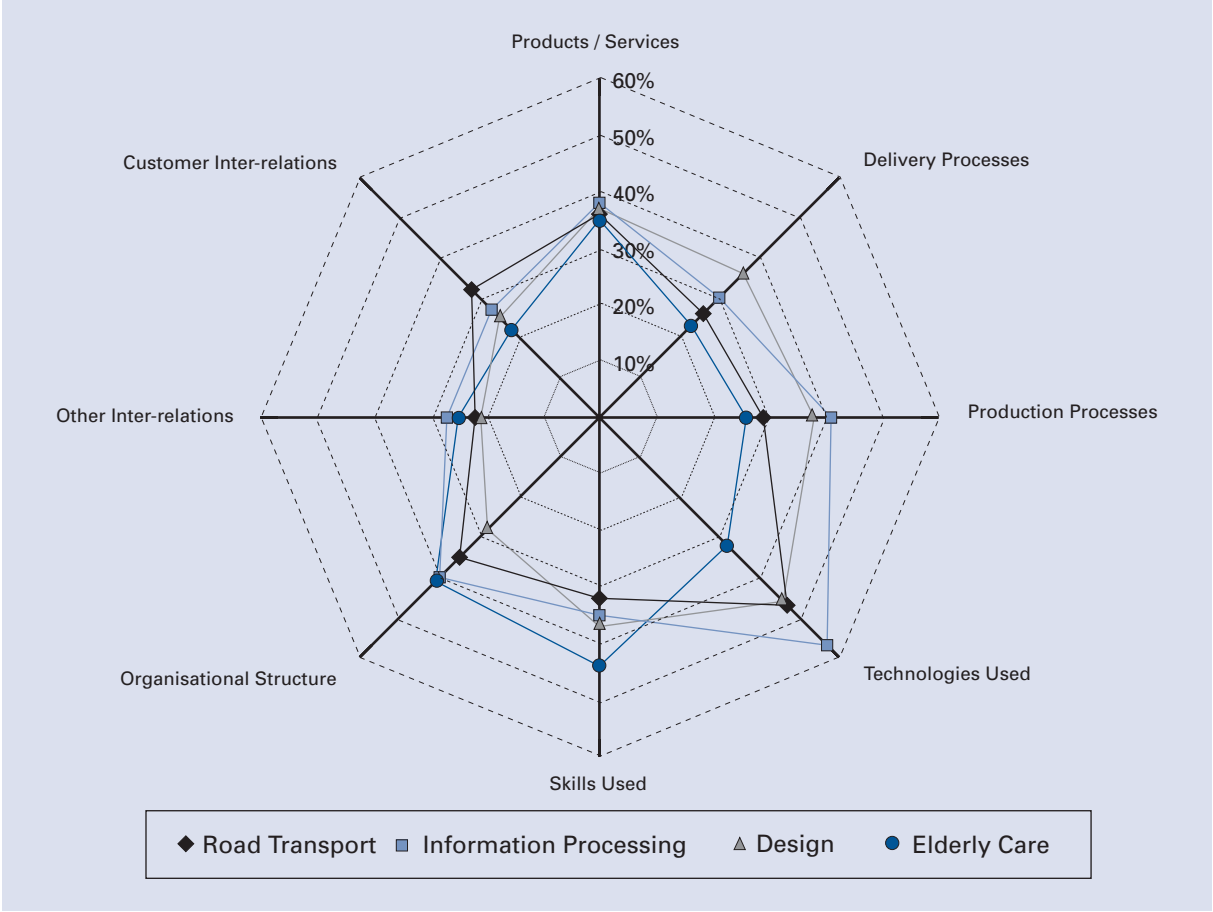
Figure 2.3: The Extent of Change in Each Dimension amongst All Firms



Of these, the most widespread change was found in the technologies used to produce or deliver services, with almost half the firms reporting significant or complete changes, and only 17% claiming their technologies had remained unchanged. Over a third of the businesses claimed their products or services had changed completely or significantly, with a quarter claiming they remained unchanged. A very similar pattern was found for changes to the means of producing services, whilst slightly fewer firms reported extensive change to their means of delivering services.

The extent of significant or complete change by sector is shown in Figure 2.4. It is notable, though perhaps unsurprising, that the extent of change to technologies was much greater amongst information processing companies than amongst those providing elderly care, whilst the extent of change to services was similar. This implies the role of technologies in service provision, and changing service provision, differs markedly between (these two) service sectors.

Figure 2.4: The Extent of Significant or Complete Change by Sector



Turning to other types of change, which we consider soft/organisational aspects of innovation, the following were considered:

- changes to the skills of the workforce used to produce or deliver services;
- changes to the organisational structure of the business;
- changes to customer inter-relations; and,
- changes to other business inter-relations.

The extent of 'change' reported to the skills used to produce and deliver services was remarkably similar to the extent of change to the firms' services and their means of producing and delivering services, with a third of the businesses claiming the skills they used had changed completely or significantly in the last three years (see Figure 2.3). This is unlikely to be representative of firms in these sectors, as due to the methodology used there is probably a bias in our results towards more dynamic or innovative firms. What is important from our perspective is that the similarity between the level of change to skills, change to the services provided and to the means of providing these services hints at a connection between these dimensions of change. The extent of change to firms' organisational structures, and to their inter-relations with other businesses (including customers) tended to be less, but still substantial with at least a fifth claiming complete or significant changes to these in the last three years.

To explore further the extent of connections between the various dimensions of change, we calculated the conditional probabilities that a firm would have changed (significantly or completely) in one dimension given that it had also changed (significantly or completely) in another dimension. Although this analysis does not tell us anything about the direction of causation, it can be used as a test of complementarities (Swann, 2006). If a firm is more likely than not to change in a second dimension given that it has changed in a first dimension, the two dimensions can be considered complementary. Note, however, that complementarity scores are not necessarily symmetrical – the probability of doing B given that A has been done is not necessarily the same as the probability of doing A given that B has been done.

The results are shown in Table 2.3, which shows the conditional probability that the firm changed significantly or completely the dimension identified in the column given that it had changed significantly or completely in the dimension identified in the row. For example, of the firms that changed their services, 57% also changed their production processes. Cells in which the probabilities equal or exceed 50% are shaded, to indicate complementarities (i.e., firms that changed in the row dimension are more likely than not to also change in the column dimension).

Table 2.3: Complementarities between the Dimensions of Change

	Se	P	D	T	Sk	O	IC	OI
Services (S)	100%	57%	47%	59%	53%	52%	38%	33%
Production Processes (P)	61%	100%	56%	69%	55%	46%	41%	31%
Distribution Processes (D)	58%	66%	100%	69%	52%	42%	40%	32%
Technologies (T)	47%	51%	44%	100%	50%	39%	34%	26%
Skills (S)	53%	51%	41%	63%	100%	49%	39%	30%
Organisational Structure (O)	53%	44%	34%	51%	51%	100%	37%	34%
Customers Inter-Relations (IC)	52%	52%	44%	58%	54%	50%	100%	52%
Other Inter-Relations (OI)	51%	45%	40%	51%	47%	50%	59%	100%

What is striking is that the scores in a large number (30) of cells equal or exceed 50%, whilst the scores in another 6 cells are between 45% and 49%, indicating firms that changed in the row dimension are almost as likely as not to also change in the column dimension. In only 11 cells are the scores below 40%, with the lowest score being 26% – i.e., only a quarter of the firms that changed their technologies also changed their inter-relations with other businesses. Interestingly, if they made any other significant or complete change the firms were more likely than not to also change their technologies (significantly or completely). The dimensions of change that showed the least connection to the others were changes to customer and other business inter-relations, and changes to the firms' organisational structures.

Also shown are the results for each of the four sectors, and these matrices show some interesting differences (Table 2.4). In particular, design firms that reported change in the technological dimesions (services, processes, technologies) were more likely than not to also report significant or complete changes in all of the

other dimensions of change, including the soft-organisational aspects, but this was not the case with firms reporting organisational change. By contrast, amongst elderly care firms, fewer complementarities were found with those that changed their processes or technologies. This perhaps indicates differences in the main locus of innovation – in design (road transport and information processing) the main locus of innovation appears to be around technologies, processes, services and skills, whereas in elderly care services the main locus of change appears to be around skills, organisational arrangments and services.

Overall, the analysis in Tables 2.3 and 2.4 suggests that firms that engaged in one form of change are more likely to also engage in other forms of change. Figure 2.5 shows the observed distribution of firms by the count of the dimensions for which they reported significant or complete change, against the expected count distribution which would arise if the various dimensions were independent of one another (i.e., if the probability of each change was independent of any of the others). This shows that firms were both much more likely to report no significant or complete changes, and to report change to several dimensions (i.e., five or more) than would be expected if the dimensions of change were statistically independent (recall that we have eliminated all firms which gave the same level of change for each of the eight dimensions). Also notable is that fewer firms reported significant or complete change to two or three dimensions than would be expected if these dimensions of change were statistically independent of one another. Similar findings arise when the data is analysed on a sector by sector basis.

Table 2.4: Complementarities between the Dimensions of Change by Sector (%)

Road Transport

	Se	P	D	T	Sk	O	IC	OI
Se		50	41	55	43	50	40	29
P	62		52	67	54	46	46	26
D	56	58		66	47	44	44	27
T	42	41	37		46	38	41	25
Sk	49	49	38	67		54	46	26
O	51	38	32	50	49		49	33
IC	44	42	35	60	45	53		49
OI	47	34	32	53	38	53	72	

Information Processing

	Se	P	D	T	Sk	O	IC	OI
Se		62	45	67	56	55	35	41
P	57		51	75	51	45	37	39
D	58	70		84	46	40	34	31
T	45	55	44		48	41	29	30
Sk	60	59	39	76		53	40	35
O	52	46	30	57	46		32	37
IC	50	57	38	62	53	48		55
OI	56	58	34	61	45	55	53	

Design

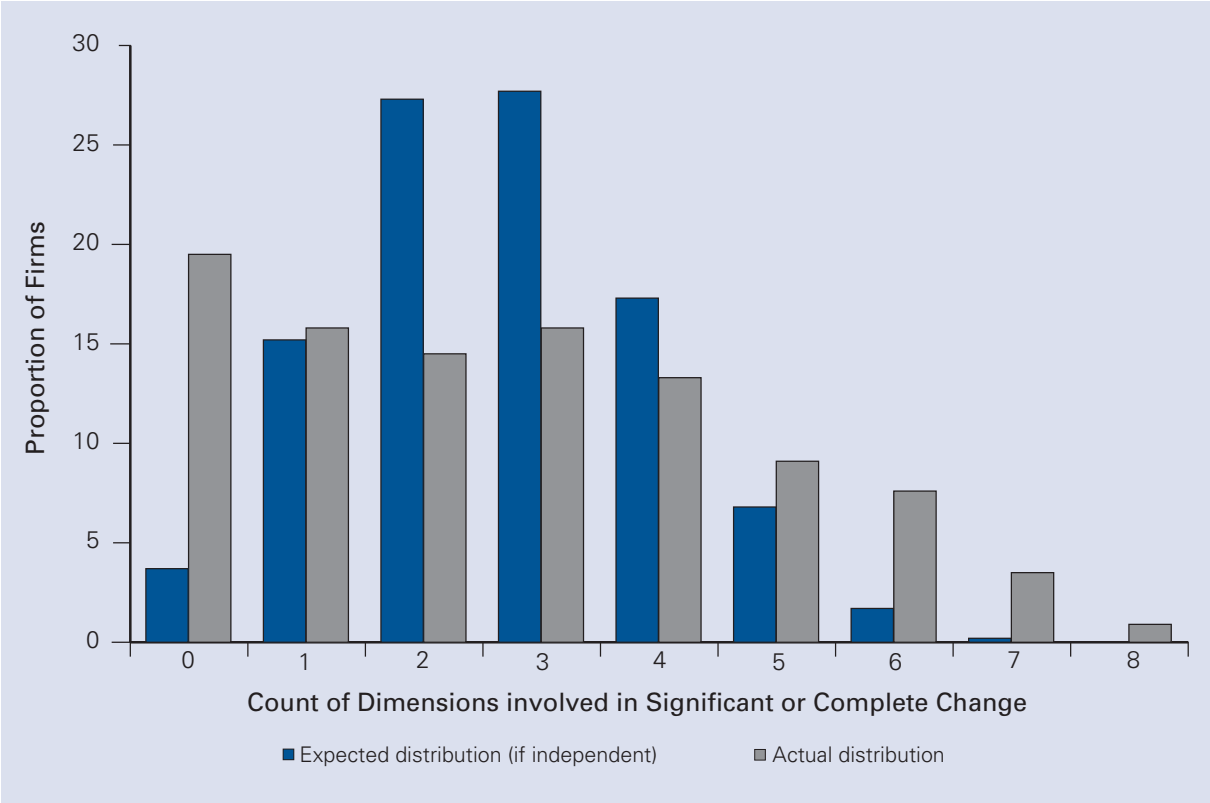
	Se	P	D	T	Sk	O	IC	OI
Se		63	52	60	55	45	42	29
P	61		63	76	54	36	40	25
D	54	68		63	53	33	39	31
T	48	64	49		51	33	31	24
Sk	54	55	50	63		38	35	30
O	60	50	42	55	51		36	33
IC	64	62	57	58	54	41		57
OI	52	47	53	53	53	45	67	

Elderly Care

	Se	P	D	T	Sk	O	IC	OI
Se		49	48	52	62	60	34	34
P	65		57	45	65	67	43	39
D	72	65		67	65	60	49	42
T	58	37	49		63	54	36	27
Sk	49	39	34	45		55	35	30
O	51	43	34	42	59		33	30
IC	52	50	50	50	69	60		45
OI	47	40	38	34	53	49	40	

Note: Uses same definitions as Table 2.3.

Figure 2.5: 'Expected' and Actual Distributions of Firms by Extent of Change



Ideally, we would like to simplify these findings to identify different areas of change – such as a set of changes related to technological change, and another set related to organisational change. Principal components analysis (Table 2.5) suggests that (at least for three of the four sectors) there are two meta dimensions of change – one centred on changes to the processes of service provision and delivery (including changes to the technologies used in these processes), and another associated with organisational changes, both to the structure of the business and how it inter-relates with its clients and other businesses. Changes to the services provided and to the skills of the workforce are more closely associated with changes to processes than organisation. However, further analysis shows that firms are significantly more likely to claim to have changed either both or neither their processes and organisation than one or other of these, suggesting that they are not truly independent.

Table 2.5: Principal Components Analysis on the Eight Dimensions of Change

	All Firms		Road Transport		Info. Processing		Design	
	PC-1	PC-2	PC-1	PC-2	PC-1	PC-2	PC-1	PC-2
Se	0.58	0.34	0.63	0.18	0.49	0.47	0.57	0.36
P	0.79	0.17	0.80	0.13	0.76	0.30	0.80	0.13
D	0.76	0.12	0.71	0.11	0.80	-0.02	0.75	0.20
T	0.75	0.05	0.71	0.15	0.76	0.01	0.78	0.01
Sk	0.53	0.32	0.60	0.25	0.47	0.49	0.53	0.31
O	0.19	0.63	0.17	0.66	-0.04	0.67	0.24	0.64
IC	0.19	0.77	0.20	0.83	0.11	0.77	0.20	0.80
OI	0.09	0.81	0.15	0.80	0.15	0.73	0.05	0.85

Note: Principal components analysis is a statistical technique used to simplify a dataset into patterns by reducing the variables to a lower number for analysis. For definitions see Table 2.3.

Principal components analysis found only one component for the Elderly Care firms, hence the results for that sector are not reported here. For all firms and the other three sectors, at around 55% of the total variance was 'explained' by these components.

Ultimately, we cannot prove that the changes the firms claim to have made were inter-related, rather than just coincidental or concurrent, but anecdotal evidence from the descriptions of their most important innovations (and the fact that most of the firms in our sample are relatively small) does make it highly likely that innovation in services often involves multiple changes along inter-related technological and non-technological dimensions. This also reflects the conceptualisation of innovation in services that other studies have derived, such as that shown in Figure 2.2 earlier in this report (Den Hertog, 2000). This paints a very different picture from innovation in services as the passive adoption of technology as indicated by the nomenclatures 'supplier dominated' or 'technology-users'.

The Importance of Investing in Skills and Technologies

Further evidence that innovation in services involves more than the passive adoption of technologies is found in evidence on the importance attached by firms to investing in new technologies and in skills. Table 2.6 shows the importance that firms attached to investing in training for existing staff compared with the importance they attached to investing in new technologies. The first three columns show, subject to the condition than one or both of these were considered to be of at least medium importance, whether training or new technologies were considered more important, or whether they were considered equally important. The fourth column shows the proportion of firms in which neither training of existing staff nor acquiring new technologies were considered of at least medium importance to the business (i.e., these were considered, at most, of low importance). What is striking about these distributions is that the majority of firms claimed investing in new technologies and training of existing staff were of equal importance, whilst in a quarter the training of staff is more important and in a fifth new technologies are more important.

Table 2.6: The Importance of Investing in Training and New Technologies

	Training is more Important	Both are equally Important	New Technologies are more Important	Neither is Important	
All Firms	25%	51%	20%	3%	100%
Info Processing	15%	62%	21%	2%	100%
Design	18%	56%	24%	2%	100%
Road Transport	19%	49%	25%	7%	100%
Elderly Care	57%	36%	5%	2%	100%

The balance between investing in technologies and people varies markedly between sectors. Perhaps unsurprisingly, in the elderly care sector investing in people is much more significant, whereas in road transport, design and information processing there is a slight bias in favour of investing in new technologies. This again suggests that the locus of innovation tends to vary between services sectors – such that, in people based sectors such as elderly care, skills and human factors take primacy over technologies and technical change.

BARRIERS TO INNOVATION

What inhibits firms from innovating? The assumption that is implicit in much of innovation and technology policy is that the supply of technologies is high on the list of factors impeding innovation. Essentially, 'supplier dominated' firms are conceived as waiting for new technologies to come along, which are then incorporated into their businesses to allow the provision of new products or to enable more efficient production of existing products. Whilst the importance in the long run of a supply of new technologies is undeniable, in the short run the situation is rather different. Indeed, it can be argued that in the short run the problem is not the supply of technologies, but how these are integrated and absorbed into the firm, given skill endowments (and scope for enhancing these through training), organisational structures, and market and business relationships.

Figure 2.6: Barriers to innovation

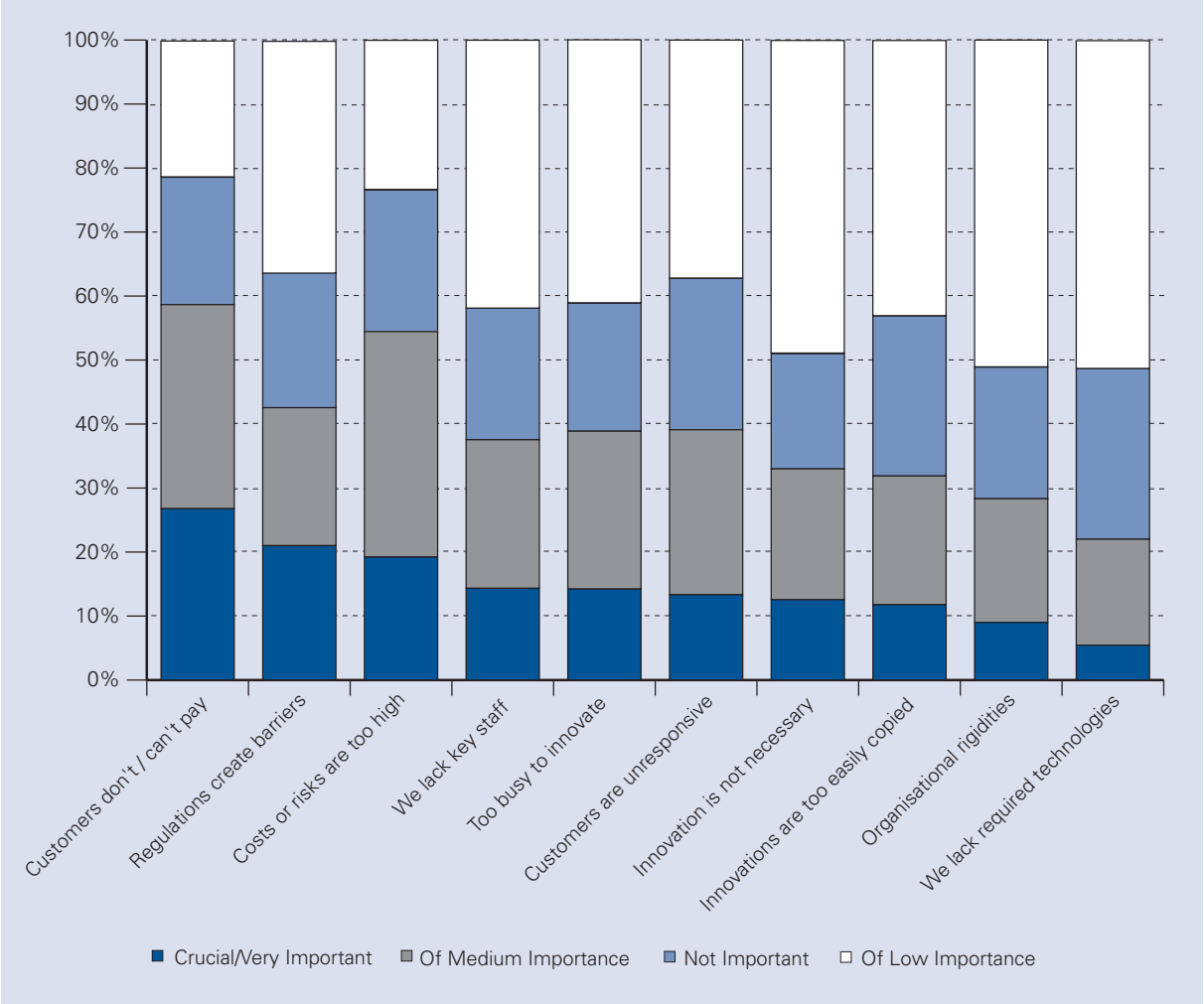


Figure 2.6 shows that a wide number of factors are cited as impeding firms' commitments to innovation, with none of these standing out as markedly more important than the others. However, ranked by the proportion identifying it as a crucial or very important factor, it is notable that the top factor was customers' unwillingness or inability to pay for innovations, whilst the factor least likely to be identified as an important impediment to innovation was a lack of required technologies. The low significance of technologies chimes with the results of the UK Innovation Survey of 2005 which found that a 'lack of information on technology' was the least important barrier to innovation, being identified as a barrier of high importance by just 3% of firms (Robson and Ortmans, 2006). Further analysis shows that this proportion did not very significantly between manufacturing and service firms. Instead, factors associated with the cost and risk of innovation, as well as regulations tended to be the most widely identified barriers to innovation of high importance (ibid). According to the UK Innovation Survey, uncertain demand is (alongside a lack of qualified personnel) a mid-level factor hampering innovation, being more significant than a lack of information on technologies or markets, but less important than the direct costs and risks of

innovation. This factor appears to be more important amongst manufacturing and technical service firms, amongst which about 10% of firms identified it as a factor of high importance, than amongst other services (6%).[13]

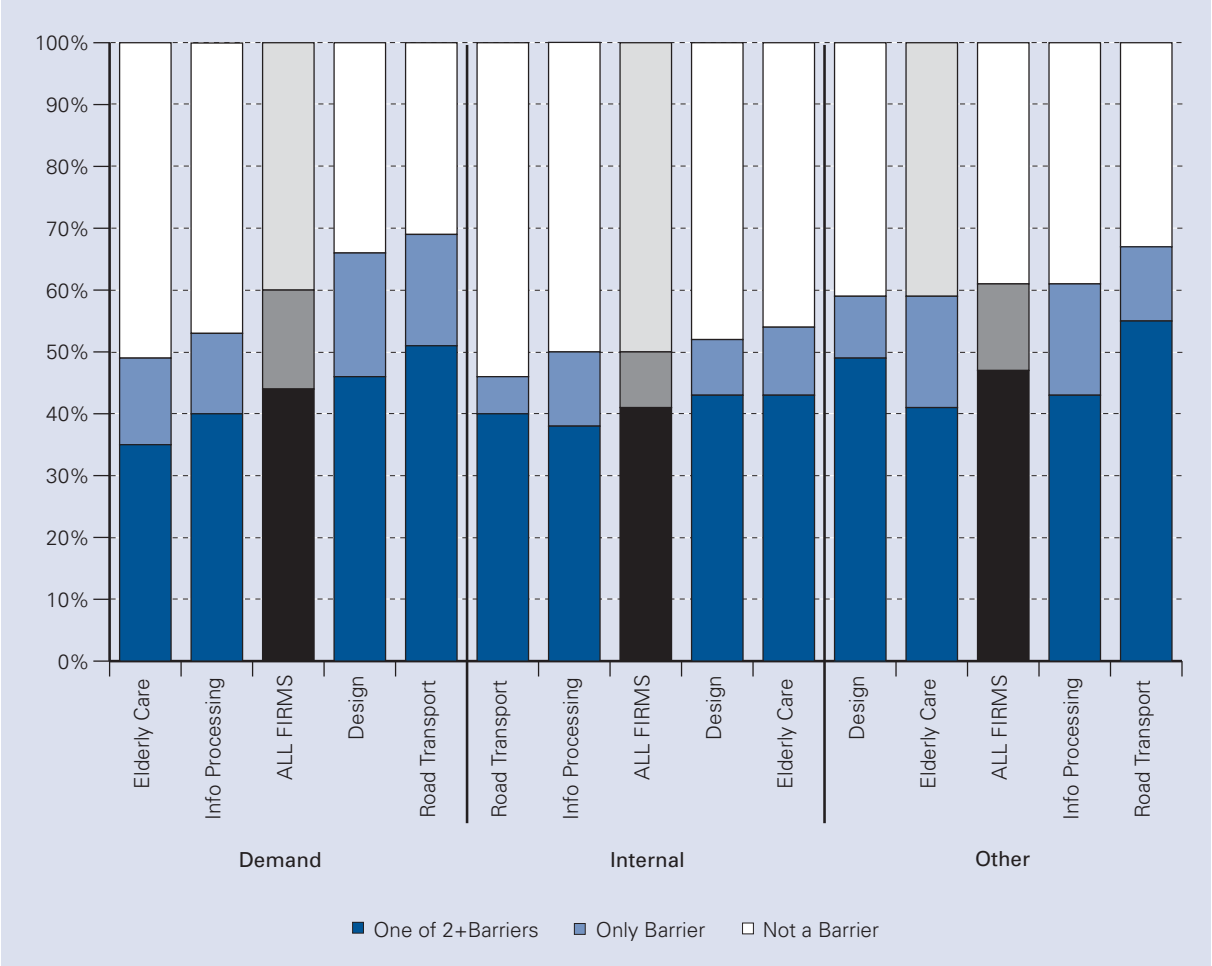
To examine this further we classified our survey data on barriers to innovation into three groups. The first relates to demand – customers do not want and/or cannot pay for innovations; customers are unresponsive to innovations; and previous innovations make further innovations unnecessary. The implication here is that firms do not innovate because they perceive no need to, and/or no reward for innovation. The second set of barriers relate to the firm's own abilities and internal impediments to innovation – the firm lacks the required technologies; the firm lacks the key staff necessary to innovate; organisational rigidities make innovation difficult; and the firm is too busy to innovate. The implication here is that firms would innovate more if they had more resources (including time) to do so.

The third set of 'other factors' includes firms feeling regulations inhibit innovation; innovations are too easily copied; and the costs and risks of innovation are too high. The last of these especially might have been included in the set of demand barriers, but we include it here for two reasons – firstly not all innovation is about products, and these costs/risks might relate to internal rather than product innovations; and secondly all three of the these 'other' factors are things that government policies, including innovation policies, have sought to address, and which have an immediate bearing on innovation, whereas, government can only normally have an indirect influence on demand and a firm's internal capabilities. The role of government in regulations is obvious, and governments have sought to protect innovators from imitators through providing protection for intellectual property through institutions such as patents, copyrights and trademarks. Meanwhile, the existence of tax credits for R&D can be viewed as an attempt to reduce the costs and risk of innovation.

Figure 2.7 shows that firms do not divide easily into groups facing different difficulties. Instead, the great majority of those facing one difficulty also report facing other difficulties. For example, about half the firms did not claim any internal difficulties with innovation, but amongst those that did the vast majority also claimed at least one of the 'demand' or 'other' factors were also of at least medium importance in restricting their innovation activities. Similar patterns can be found for those facing difficulties with demand and 'other' factors. This implies that breaking down the impediments to innovation is not likely to be easy, and there is no single or obvious 'magic bullet' policy solution. Of course, there will always be impediments to innovation (as innovation implies risk and uncertainty), and government cannot be expected to break all of these down, especially when the impediments are not simple but intertwined.

13 Overall, however, over 60% of manufacturers and technical service firms, and over 40% of other service firms recognised uncertain demand as being a barrier to innovation of some importance.

Figure 2.7: Overlapping Barriers to Innovation in Services



2.5 Reflections on the Findings for Policy Research on Innovation in Services

The study of innovation in services has come a long way from the early 1980s when services were dismissed as being 'supplier dominated' and thus uninteresting from the perspective of innovation research. Several advances can be highlighted:

1. It is recognised that some service firms are very prominent actors in technological 'systems of innovation'. Notable amongst these are the 'science based and specialist suppliers' identified by Miozzo and Soete (2001) and the 'science and technology based' services identified by Evangelista (2000). These firms, which include R&D, design and engineering consultancies, frequently spend far more on innovation than typical manufacturers and often have very close links with the science base, in part acting as conduits through which technological knowledge is disseminated throughout the economy (Tether and Tajar, 2006a).

2. The importance of organisational and other forms of non-technological innovation has been highlighted by studies of innovation in services. It is clear that these forms of innovation are particularly important in services.

3. The interconnections between technological and non-technological have been highlighted, such that, rather than passively adopting new technologies, innovation in services often involves processes of mutual adjustment between the technological and organisational aspects of the business. The view that innovation in services often involves complementary changes to technologies and non-technological factors (such as skills and organisational structure) implies that innovation in services is typically much more complex than earlier, 'technology adoption' perspectives would suggest. This also implies that the diffusion of technologies and productivity gains will only be optimised through greater attention being paid to 'soft' issues like skills and organisational structure, and their interaction with technologies, than has hitherto been the case.

4. This brings to the fore another issue, which is that innovation research has tended to focus on narrow, one-dimensional, 'single issue' aspects that have tended to highlight certain types of innovation, such as product innovation or process innovation in isolation, such that these different types of innovation are typically viewed as being independent of one another (Damanpour and Evan, 1984; Reichstein and Salter, 2006). Even when innovations are treated together this tends to be confined to the firm or organisation, rarely in relation to inter-organisational types of innovation. By contrast, we consider that (perhaps especially in services) different types of innovation often interact with each other in complex, interdependent and complementary ways. It follows that an objective for research is to move towards a more holistic, interdependent view of innovation than has hitherto prevailed.

5. The role of demand has been highlighted. Services often work closely with their customers, which gives them close insight into the needs and practices of their clients. Our evidence suggests demand is more likely to be a limiting factor than the supply of technologies in determining service firms' innovation activities. This may indicate that markets are working optimally with regard to the level of innovation, and more innovation is not necessarily better (it may be wasted effort). Having said that, there may be some more subtle problems, such as customers desiring innovation but not wanting to bear the costs or risks of being the first users of a new service. In a sense these are not so much matters of demand but of management and customer relations.

6. Innovation in services provides a challenge for the measurement of innovation. Often service innovations are tacit and intangible in nature, and often associated with personal knowledge (rather than knowledge largely embedded in equipment or systems). They are therefore typically disembodied and non-technological. Other issues, such as service automation and the significance of self-service, are important aspects of the innovation process within service activities, but remain largely uncharted for the purposes of mapping and measuring of the new service economy. This is largely because, despite considerable development, innovation surveys, such as the European CIS, still concentrate on more traditional forms of technological innovation. In part, this stems from conceptual gaps in our understanding of innovation processes within services, but there have also been problems with measuring innovation in services. Service innovations are difficult to capture with existing measurement tools because of their often tacit and disembodied nature, as noted above. Underlying this there are intrinsic, dynamic qualities of services, such as their emphasis on customisation, variation and continuous change (rather than punctuated change), which make them difficult to study (Tether 2005).

In our view, innovation in services is typically much more complex than received understandings would lead us to expect. There is however also a great deal of variety, and there is certainly no single pattern of innovation in services (Tether and Tajar, 2006b). Given that the service sector is comprised of some giant organisations (such as the large scale retailers, airlines, banks, etc.) as well as a vast array of very small and micro businesses employing one or two people, this is hardly surprising.

Further policy research in this area might usefully consider the benefits of a:

- **Focus on Diffusion** encouraging the rapid diffusion of 'best' or 'appropriate practices' within businesses. If innovation in services (and indeed manufacturing) involves sets of mutual adjustments between technologies, skills and organisation, then finding the 'right combination' of changes is not easy. We recommend that consideration be given to the question as to whether government currently has the right balance between policies aimed at stimulating the production of technologies, and policies aimed at encouraging the diffusion of technologies and associated practices. What may be needed is more help with sharing knowledge about the diffusion of technologies within industries and/or supply chains or networks.

- **Focus on Skills**. The role of skills has received remarkably little attention from scholars of innovation in recent years (Tether et al., 2005), yet it is clear that skills have a fundamental bearing on innovation and firms' wider performance.

An intriguing challenge for both governments and industry is the development of more 'polymaths',[14] or people with T-shaped skills (Iansiti, 1993; Madhavan and Grover, 1998; Lee and Choi, 2003). The idea of T-shaped skills is that an individual combines a high degree of specialisation (the I of the T) in a particular discipline with a breadth of knowledge which is sufficient to allow him/her to have a non-trivial appreciation of other disciplines (the '–' of the T). This enables the possessor of T-shaped skills to understand how developments in his/her own specialisation interact, systematically, with developments in other domains. Thus instead of 'talking past' one another, teams of people with T-shaped skills are (or should be) able to integrate knowledge from quite different domains.[15] Along with IBM and others, Hewlett Packard is arguing that the increasing tendency to specialise in Western education as a reaction to greater complexity (combined in some countries with a decline in many 'hard' technical skills) means that the supply of people with T-shaped skills is not expanding, but possibly contracting, whilst demand is growing. They argue that T-shaped skills are especially important to IT-based systemic services.

Clearly the development of new skills for innovation is a matter for both government and industry, and here we note that tax credits are now available to support investments in R&D; the same arguments (for and against) might be applied to the desirability of tax credits for innovation related training. Consideration might be given to the introduction of such a scheme, particularly where this involves the development of more generic, rather than company specific, skills.

- **Focus on Demand**. Innovation research and policy has been dominated by the supply side, and especially the supply of technologies. We have shown evidence that suggests that in services the supply of technologies is not a primary barrier to innovation (at least in the short run) – demand appears to be a much more significant limiting factor. Of course people and organisations should not be encouraged to buy things on the basis of novelty alone, and it is sometimes said that there is no problem here, that there is simply a lack of demand for innovation. Whilst this may often be the case, we are not so sure that it is always the case. For example, it is often said in project management that the client wants innovation, but not in his/her project. In other words, whilst the client wants new ideas and approaches, he or she does not want to bear the risk inherent in being the experimental guinea pig. Similarly, in business there was the adage that you never got sacked for buying from IBM – indicating a risk-averse approach to purchasing. In other words there may be some problems associated with market- or systems-failure, although we accept that the case for either is not proven.

14 According to Hewlett Packard (Monahan et al., 2006) these are people 'who combine cultural sensitivity with an ability to abstract and analyse and then manage' – this itself is built on a combinations of mathematically based analytical or technical skills with good social and communication skills.

15 Alongside T-shaped skills, another idea is A-shaped skills, which are held by individuals with deep knowledge of two (or more) subjects, and able to integrate these different knowledge domains (Madhaven and Grover, 1998).

In this area the role, or potential role, of government and the public sector in general is often highlighted (e.g., Franhofer ISI et al, 2006). The public sector is a massive buyer of goods and services, and it is sometimes argued that procurement can be used to encourage innovation and best value for taxpayers' money over the long term, not the immediate lowest cost solution. Yet there is always the danger that the public sector will make 'wrong bets' and end up an 'angry orphan' (David, 1987), having adopted innovations the market rejects (e.g., Betamax videos as opposed to VHS). We certainly do not claim to have the answers here, but raise this as an issue for attention and creative thought.

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3 Managing service innovation

John Bessant and Andrew Davies[1]

Executive summary

This report explores issues around organising and managing the innovation process in services. Specifically it addresses the following questions:

(i) What are the patterns of innovation in services and do they differ from those in manufacturing?

Although 'services' represents a wide and heterogeneous sector we argue that the underlying innovation drivers – especially the continuing emphasis on non-price factors – are similar to manufacturing. In addition we highlight three core trends which have particular relevance for service innovation – 'servicisation' of manufacturing, mass customisation and outsourcing. The first is important because it suggests that skills traditionally associated with service sector innovation (such as understanding customer needs and working with active users) become increasingly relevant for manufacturing firms, whilst service businesses need to develop more systematic approaches to organising and managing innovation. Customisation requires increasing emphasis on user involvement in co-creation as a route to sustaining defensible competitive advantage through innovation.

In outsourcing there has been a growing split in the sector between those firms specialising in 'transactional' outsourcing – where the offer is essentially to carry out relatively standard operations for less than would be the case in-house – and 'strategic' outsourcing, where the complexities and uncertainties of managing the activities on behalf of a client firm mean that the outsourcer has to develop considerable innovation skills.

(ii) Does the pattern of innovation management differ across service activities?

There are significant differences across different parts of the service sector which have an impact on the dominant drivers and management of innovation. For example, banking and insurance deal in high volume markets and are often cost driven whereas professional legal services or knowledge-intensive business services have more of a one-off project orientation where service quality and competence may be more significant drivers. We argue that a version of the 'product/process' matrix used to map manufacturing activities across different parts of the sector by separating on the basis of volume and variety can also be used to segment/differentiate service innovation activities.

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(iii) Does the generic innovation process model for manufacturing translate to a service context and where are there similarities and differences?

We suggest that the generic model of innovation – involving search, strategic selection and implementation phases – applies equally to services and that, with appropriate modifications, a number of management models derived from manufacturing have relevance for service innovation. In particular product life cycle, taxonomies of innovation, product/process matrix, disruptive innovation and open innovation models are explored.

(iv) What are the policy implications for supporting the development of improved innovation management capability in services?

In policy terms the size and economic importance of the service sector to the UK economy makes it important to get policy right. Policy makers should consider undertaking more analysis in the following areas:

- Are there demonstrable weaknesses in the ability of services firms in particular segments to manage knowledge for effective innovation, particularly considering integrative management of technology and non-technological innovation?
- Should the Government be involved in the diffusion of models of 'good practice' in innovation management?
- Should support for R&D via tax credits etc. be extended to include the kind of 'research' activity (prototyping, piloting, etc.) which takes place in service innovation?

In terms of policy actors there is clearly a role for a much wider group of players than central government. For example, devolution of policy and support delivery to Regional Development Agencies, Business Links and other bodies suggests a distributed approach on a geographical basis. Equally many of these issues relate to sector-based concerns and innovation patterns which argue for policy activity by trade and business associations.

3.1 Introduction

This chapter is primarily addressed at *management of innovation* at the firm level. We have tried to explore the issues around organising and managing the innovation process in services and the extent to which this represents a similar or different model to that which operates in manufacturing. Specifically we explore the following questions:

- What are the patterns of innovation in services and do they differ from those in manufacturing?
- Does the pattern of innovation management differ across service activities?

- Does the generic innovation process model for manufacturing translate to a service context and where are there similarities and differences?
- What are the policy implications for supporting the development of improved innovation management capability in services?

SERVICES DO INNOVATE BUT THE LANGUAGE IS DIFFERENT

In 2001 an influential report was presented to the annual conference of a key economic sector laying down the innovation challenge in clear terms: '*we are at the brink of change of an unprecedented and exponential kind and magnitude... We must be willing and able to discard old paradigms and engender and embrace manifest change.....These required changes include implementing new customer-centric processes and products, cutting costs and improving service through the application of IT and business process re-engineering and putting in place systems and a culture for sustainable innovation'*. Another study, in 2006, reviewed the capability of firms within this sector to deal with innovation and highlighted problems such as:

- No culture of innovation
- No strategy for where to focus innovation efforts
- Innovation is seen to conflict with fee paying work and is thus not always valued
- A formal innovation process does not exist
- Project management skills are very limited

At first sight these seem typical of statements made regularly about innovation in a manufacturing economy and the difficulties individual firms – particularly the smaller and less experienced – face in trying to manage the process. But these are in fact *service* sector examples – the first report was to the US Bar Association, the second the result of a survey of 40 professional law firms in the UK trying to prepare for the big changes likely to arise as a result of the Clementi review (2004).[2]

Competitive advantage undoubtedly can come from innovation in services. Citibank was the first bank to offer automated telling machinery (ATM) service and developed a strong market position as a technology leader on the back of this process innovation, whilst Bank of America is literally a textbook case of service innovation via experimentation with new technologies and organisational arrangements across its branch network. Benetton is one of the world's most successful retailers, largely due to its sophisticated IT-led production network, which it innovated over a 10-year period and the same model has been used to great effect by the Spanish firm Zara. Southwest

2 Clementi (2004) can be found at: http://www.gnn.gov.uk/Content/Detail.asp?ReleaseID=110721&NewsAreaID=2

Airlines achieved an enviable position as the most effective airline in the USA despite being much smaller than its rivals; its success was due to process innovation in areas like reducing airport turnaround times. This model has subsequently become the template for a whole new generation of low-cost airlines whose efforts have revolutionised the once-cosy world of air travel.

Importantly we need to remember that the advantages which flow from these innovative steps gradually get competed away as others imitate. Unless an organisation is able to move into further innovation, it risks being left behind as others take the lead in changing their offerings, their operational processes or the underlying models which drive their business. For example, leadership in banking has passed to others, particularly those who were able to capitalise early on the boom in information and communications technologies; in particular many lucrative financial services like securities and share dealing have been dominated by players with radical new models like Charles Schwab. As retailers all adopt advanced IT so the lead shifts to those who are able – like Zara and Benneton – to streamline their production operations to respond rapidly to the signals flagged by the IT systems.

With the rise of the Internet the scope for service innovation has grown enormously – not for nothing is it sometimes called 'a solution looking for problems'. As Evans and Wurster (2000) point out, the traditional picture of services being either offered as a standard to a large market (high 'reach' in their terms) or else highly specialised and customised to a particular individual able to pay a high price (high 'richness') is 'blown to bits' by the opportunities of web-based technology. Now it becomes possible to offer both richness and reach at the same time and thus to create totally new markets and disrupt radically those which exist in any information-related businesses.

The point is clear. Innovation matters significantly to service sector players across the economy. If they don't change their offerings and the ways they create and deliver those (traditionally what we would term 'product' and 'process' innovations) then their survival and growth is in question. Indeed the pressure to innovate may be stronger than in manufacturing because new ideas in services are often easy to imitate quickly and hard to protect.

It is important in the context of service innovation to remind ourselves of the definition of innovation – as expressed, for example, by the DTI: '*the successful exploitation of new ideas*'. Whilst this involves invention, the creation of some new or different combination of needs and means, there is much more to getting that invention successfully developed and widely adopted. Central to this is the idea of different kinds of knowledge streams being woven together, about possibilities (for example, opened up by new technology) and needs (whether articulated or latent). Countless studies of innovation highlight its nature as an interactive, coupling process, yet much thinking in policy and management practice defaults to linear views of the process and especially to a knowledge-push model.

In the context of service innovation the search for and use of demand side knowledge is critical. Many services are simultaneously created and consumed and end-user understanding and empathy are essential to success. This is not to say that new knowledge – for example, of technological possibilities – is unimportant but the balance of importance in service innovation may be more in the direction of demand side knowledge.

One consequence of this different orientation is that much of the language which surrounds discussion of innovation may differ between manufacturing and service contexts. The underlying principles and issues may be the same but the labels may differ. For example, the term '*R&D*' used in a manufacturing context conjures images associated with organised research and development. Search involves reviewing established scientific knowledge (in papers, via patent searches, etc.) and identifying interesting lines of enquiry which are followed through via experiments in laboratories. Small-scale successes may be further explored in pilot plants or via construction of prototypes and there is a gradual convergence around the final product or process involving an increasing commitment of resources and an increasing involvement of wider skills and knowledge sets. Eventually the new product is launched into the marketplace or the new process adopted and diffused across an internal context.

The Frascati definition captures much of this, defining R&D as '*creative work undertaken on a systematic basis in order to increase the stock of knowledge .... and the use of this stock of knowledge to devise new applications*'. If we look at the challenge of service innovation we can see a similar process taking place – search (albeit with a much stronger demand side emphasis), experiment and prototyping (which may extend the 'laboratory' concept to pilots and trials with potential end-users) and a gradual scaling up of commitment and activity leading to launch. Service businesses may not have a formal R&D department but they do undertake this kind of activity in order to deliver a stream of innovations. Importantly the knowledge sets with which they work involve a much higher level of user insight and experience.

They are also similar to manufacturing in that much of their innovation-related work is about 'doing what we do but better', essentially building competitive advantage through a stream of incremental innovations and extensions to original concepts. The distinction made in Frascati between 'routine' – incremental – improvements and R&D also applies in service innovation.

Table 3.1 gives some examples of this language gap, suggesting that extensive innovative activity does take place within services but may not be recognised – importantly by policymakers – because the terminology used is less familiar.

Table 3.1: Language differences between manufacturing and service innovation

Core innovation concept	Manufacturing	Services
Search for new possibilities	R&D, laboratories, prototyping, test-beds, pilot plants, simulation, etc.	User-needs analysis, empathic design, concept testing, pilot studies, ethnography
Strategic selection and resource allocation to projects	Portfolio tools, bubble charts, risk/reward matrices	Business case development
Implementation of innovation projects	Stage gate models, NPD systems, heavyweight project management, concurrent engineering, design for manufacture and assembly, CAD/CAM, etc	New service development systems, test marketing, beta testing, market development teams
Process innovation tools	Lean production and supply, kaizen, total quality management, Six Sigma, etc.	Business development, process excellence.

3.2 Innovation space for services

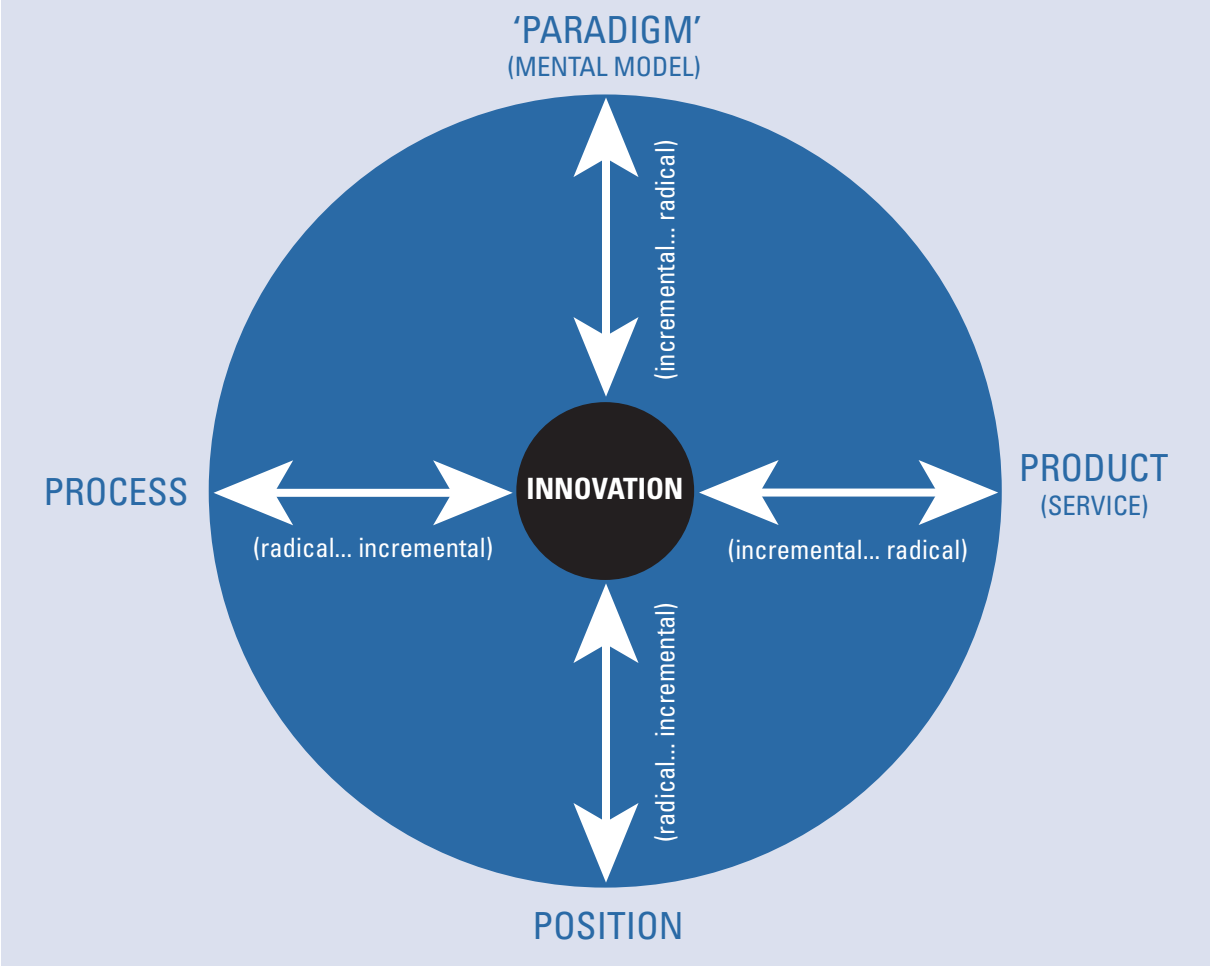
Innovation can take several forms (see Figure 3.1):

- 'product innovation' – changes in the things (products/services) which an organisation offers,
- 'process innovation' – changes in the ways in which they are created and delivered
- 'position innovation' – changes in the context in which the products/services are introduced
- 'paradigm innovation' – changes in the underlying mental models which frame what the organisation does

For example, a new design of car, a new insurance package for accident-prone babies and a new home entertainment system would all be examples of product innovation. And change in the manufacturing methods and equipment used to produce the car or the home entertainment system, or in the office procedures and sequencing in the insurance case, would be examples of process innovation.

Sometimes the dividing line is somewhat blurred – for example, a new jet-powered sea ferry is both a product and a process innovation. Services often represent a particular case of this where the product and process aspects merge – for example, is a new holiday package a product or process change?

Figure 3.1: The Innovation Space



Innovation can also take place by repositioning the perception of an established product or process in a particular user context. For example, an old-established product in the UK is Lucozade, originally developed as a glucose-based drink to help children and invalids in convalescence. These associations with sickness were abandoned by the brand owners, GSK, when they re-launched the product as a health drink aimed at the growing fitness market where it is now presented as a performance-enhancing aid to healthy exercise. This shift is a good example of 'position' innovation.

Examples of position innovation in services include the creation of a new market segment around low-cost flying (essentially the low cost carriers did not begin by challenging established airlines but instead addressed a new market prepared to trade comfort and extra servcies for low cost) or the development of a wide range of new media applications across both the internet and mobile delivery platforms, segmenting and opening up radically new market space.

Sometimes opportunities for innovation emerge when we reframe the way we look at something. Henry Ford fundamentally change the face of transportation not because he invented the motor car (he was a comparative latecomer to the new industry) nor because he developed the manufacturing process to put one together (as a craft-based specialist industry car-making has been established

for around 20 years). His contribution was to change the underlying model from one which offered a hand-made specialist product to a few wealthy customers to one which offered a car for Everyman at a price he/she could afford. The ensuing shift from craft to mass production was nothing short of a revolution in the way cars (and later countless other products and services) were created and delivered.

Recent examples of 'paradigm' innovation – changes in mental models – include the shift of mainstream customers to low-cost airlines, the provision of online insurance and other financial services, and the repositioning of drinks like coffee and fruit juice as premium 'designer' products.

Each of our 4Ps of innovation can take place along an axis running from incremental through to radical change; the area indicated by the circle in Figure 3.1 is the potential innovation space within which an organisation can operate (Tidd et al., 2005). As far as managing the innovation process is concerned, these differences are important. The ways in which we approach incremental, day-to-day change will differ from those used occasionally to handle a radical step change. Table 3.2 lists some examples of incremental and radical innovations across services to underline the point that there is extensive scope for innovative activity.

Table 3.2: Examples of incremental and radical innovations in services

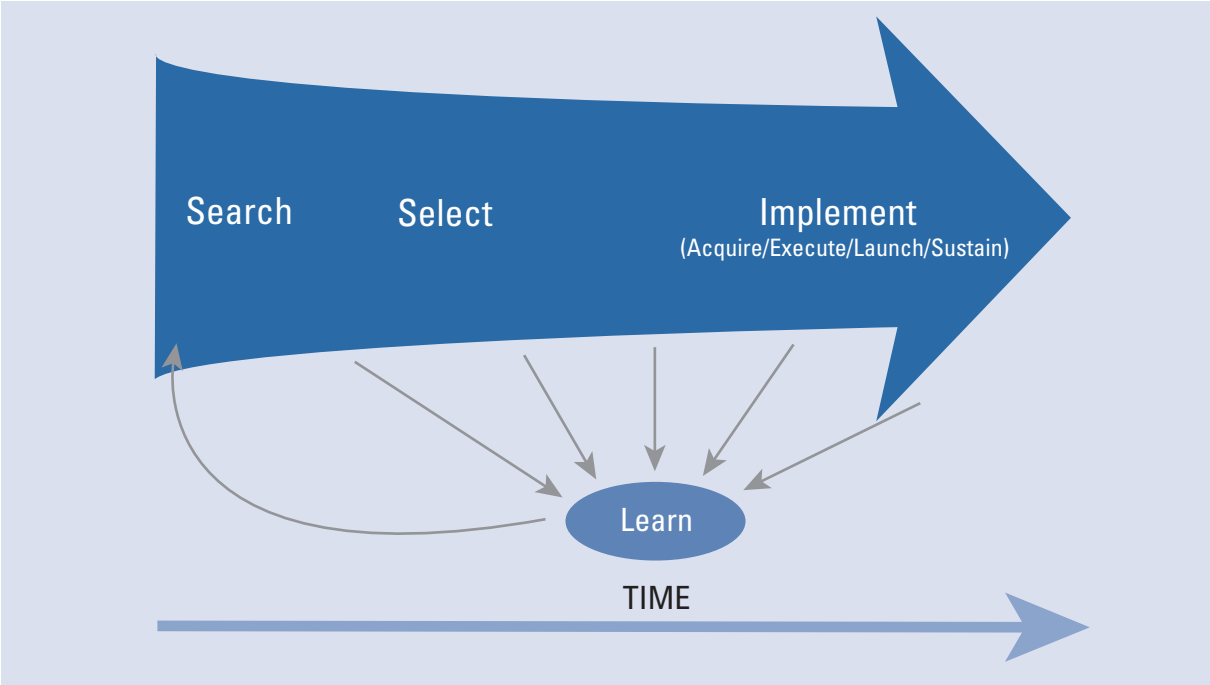
Type of innovation	'Do better' – incremental	'Do different' – radical
'Product' – service offering to end-users	Modified / improved version of an established service offering – for example, more customised mortgage or savings 'products', add-on features to basic travel experience (e.g. in entertainment system), increased range of features in telecomms service	Radical departure – for example online retailing
'Process' – ways of creating and delivering the offering	Lower cost delivery through 'back office' process optimisation, waste reduction through lean, six sigma, etc. approaches	Radical shift in process route – for example moving online from face to face contact, supermarkets and self-service shopping rather than traditional retailing, hub and spoke delivery systems, etc.
'Position' – target market and the 'story' told to those segments	Opening up new market segments – for example, offering specialist insurance products for students	Radical shift in approach – for example, opening up new travel markets via low-cost travel innovation, shifting health care provision to communities
'Paradigm' – underlying business model	Rethinking the underlying model – for example, migrating from insurance agents and brokers to direct and on-line systems	Radical shift in mindset – for example, moving from product-based to service-based manufacturing

3.3 Innovation management in services

The scope for innovation across services raises the question of how well the process is organised and managed. We suggest that innovation is a core process concerned with renewing what the organisation offers and the ways in which it generates and delivers these. Whether the organisation is concerned with bricks, bread, banking or baby care, the underlying challenge is still the same. How to obtain a competitive edge through innovation – and through this survive and grow? This is as much a challenge for non-profit organisations – in police work, in health care, in education – where the role of innovation is still one of getting a better edge to dealing with problems of crime, illness or illiteracy.

At this generic level we suggest that organisations have to manage four phases making up the innovation process (see Figure 3.2)

Figure 3.2: Phases of Innovation Processes



Organisations have to:

- Scan and search their environments (internal and external) to pick up and process signals about potential innovation. These could be needs of various kinds, or opportunities arising from research activities somewhere, or pressures to conform to legislation, or the behaviour of competitors, but they represent the bundle of stimuli to which the organisation must respond.
- Strategically select from this set of potential triggers for innovation those things which the organisation will commit resources to doing. Even the best resourced organisation cannot do everything, so the challenge lies in selecting those things which offer the best chance of developing a competitive edge.

- Implement the innovation, growing it from an idea through various stages of development to final launch as a new product or service in the external marketplace or a new process or method within the organisation.

A final – optional – phase is to reflect upon the previous phases and review experience of success and failure – in order to learn about how to manage the process better, and to capture relevant knowledge from the experience.

Of course there are countless variations on this basic theme in how organisations actually carry the innovation process out. And much depends on where they start from and on their particular contingencies. For example, large firms may structure the process much more extensively than smaller firms who work on an informal basis. And firms in knowledge-intensive sectors like pharmaceuticals will concentrate more on formal R&D – often committing sizeable amounts of their income to this activity – whereas others like clothing will emphasise closer links with their customers as a source of innovation. Non-profit organisations may be more concerned with reducing costs and improving quality, whereas private-sector firms may worry about market share. Networks of firms may have to operate complex co-ordination arrangements to ensure successful completion of joint projects and to devise careful legal frameworks to ensure that intellectual property rights are respected.

But at heart the process is the same basic sequence of activity. Innovation management is about learning to find the most appropriate solution to the problem of consistently managing this process, and doing so in the ways best suited to the particular circumstances in which the organisation finds itself. Services may emphasise some elements more than manufacturing, for example, the relatively high importance of demand side signals in triggering the process. And innovation in services may involve some particular challenges, for example, the intensity of competition/lack of entry barriers means that continuous innovation is required, whilst co-creation options open up the possibility for some for of relationship 'lock-in' to end users.

On the basis that service innovation happens widely across the innovation space identified earlier, and that it raises the same generic management challenges, it will be worthwhile looking at the transferability of models to aid understanding and action in managing the process which have emerged in the world of manufacturing.

TRANSFERABILITY AND VALUE OF INNOVATION MANAGEMENT MODELS

It is well known that models, frameworks and taxonomies of innovation have been largely derived from studies of manufacturing rather than services (Miles, 2000). Much of the existing literature is concerned with the development and commercialisation of new technologies and physical products rather intangible services. But many of these models may be relevant in service innovation.

In this section we will look at the potential transferability of these and their relevance in helping managers dealing with the challenge of managing service innovation. We also need to recognise that there is a strong tradition of research into improved service operations management which has created robust approaches to innovation management, many of which draw on generic theories (Brown et al. 2004; Slack, 2000).

In particular we will focus on the following examples of models:

- Product life cycle
- Taxonomies of innovation
- Product-process matrix
- Disruptive innovation
- Open innovation

PRODUCT LIFE CYCLE

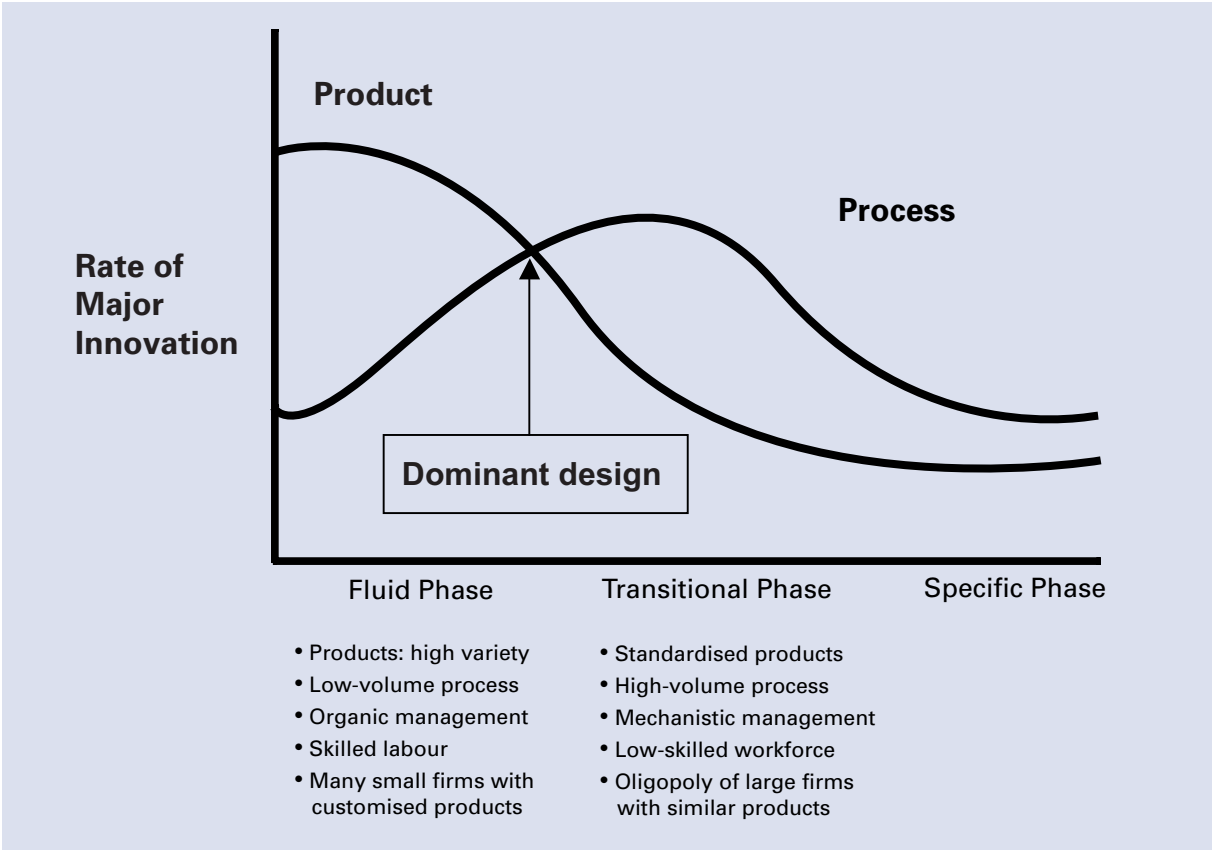
The 'product life cycle' (PLC) model of innovation developed by William Abernathy and James Utterback (Abernathy and Utterback, 1975); (Utterback, 1994); (Abernathy and Utterback, 1978) is perhaps the most influential conceptual framework for understanding how firms manage the innovation process. The PLC model in Figure 3.3 shows the dynamics of innovation in an industry by focusing on the rate of innovation in physical products and processes. It describes three main phases of innovation in the life cycle of a product from birth to maturity:

1. ***Fluid phase***: dominated by product innovation and characterised by competition between many small firms offering competing product designs.
2. ***Transitional phase***: initiated by the emergence of a 'dominant design' which signals a shakeout as an industry becomes dominated by a few large firms and characterised by an emphasis on process innovation and the production of standardised products in high-volumes.
3. ***Specific phase***: when the rate of product and process innovation declines.

The model shows how products tend to follow a life cycle from birth to maturity. The focus of innovation shifts over time from innovation in products, with a great variety of alternative designs supplied by many different smaller entrepreneurial firms. In the transitional phase, a standardised or 'dominant design' replaces product variety and the rate of innovation in processes speeds up. The emergence of a dominant design signals a shakeout in the industry as a few large corporations with vertically-integrated structures begin to dominate the industry. After the design of the product is settled, these large firms gain increasing market shares by producing a limited range of products at much lower cost. This typical pattern of evolution is intermittently disrupted by waves

of radical innovation, which force firms tied to the existing technologies to adopt the new innovations or risk being relegated to a minor role in the industry.

Figure 3.3: Product Life Cycle



Source: Adapted from Utterback (1994).

As shown in Table 3.3 the model is used to show how the focus of innovation, types of management structures and competencies of the firm must change as an industry moves from low-volume production and high-variety in products to high-volume production and standardised products:

- skilled labour and general purpose machinery to low-skilled labour and specialised equipment.
- organic management structures used by small, entrepreneurial firms to mechanistic structures used by large, hierarchical corporations (with few rewards for radical innovation) (Burns and Stalker, 1961).

Table 3.3: Stages in the innovation life cycle

Innovation characteristic	Fluid pattern	Transitional phase	Specific phase
Competitive emphasis placed on	Functional product performance	Product variation	Cost reduction
Innovation stimulated by	Information on user needs, technical inputs	Opportunities created by expanding internal technical capability	Pressure to reduce cost, improve quality, etc.
Predominant type of innovation	Frequent major changes in products	Major process innovations required by rising volume	Incremental product and process innovation
Product line	Diverse, often including custom designs	Includes at least one stable or dominant design	Mostly undifferentiated standard products
Production processes	Flexible and inefficient – to experiment and make frequent changes	Becoming more rigid and defined	Efficient, often capital intensive and relatively rigid.

The PLC model can be used by firms to make informed predictions about the changes that are likely to occur within a particular industry and to develop a richer set of strategies for responding to such changes.

Although originally developed for manufactured products the model also works for services – for example the early days of Internet banking were characterised by a typically fluid phase with many options and models being offered. This gradually moved to a transitional phase building a dominant design consensus on the package of services offered, the levels and nature of security and privacy support, the interactivity of website, etc. The field has now become mature with much of the competition shifting to issues like relative interest rates.

The pattern can be seen in many studies and its implications for innovation management are important. In particular it helps us understand why established organisations often find it hard to deal with discontinuous change. Organisations build capabilities around a particular trajectory and those who may be strong in the later (specific) phase of an established trajectory often find it hard to move into the new one. The example of the firms which successfully exploited the transistor in the early 1950s is a good case in point – many were new ventures, sometimes started by enthusiasts in their garage, yet they rose to challenge major players in the electronics industry like Raytheon (Braun and Macdonald, 1980). This is partly a consequence of sunk costs and commitments to existing technologies and markets and partly because of psychological and institutional barriers (Christensen and Raynor, 2003). They may respond but in slow fashion – and they may make the mistake of giving responsibility for the new development to those whose current activities would be threatened by a shift (Foster, 1986).

Although the PLC is presented as a generic model of innovation which should apply universally across industries, its application is restricted to industries that evolve into high-volume production, particularly mass produced commodity goods such as cars, mobile handsets, cameras and PCs. The PLC pattern of evolution does not apply in a range of manufacturing industries (Porter, 1985):

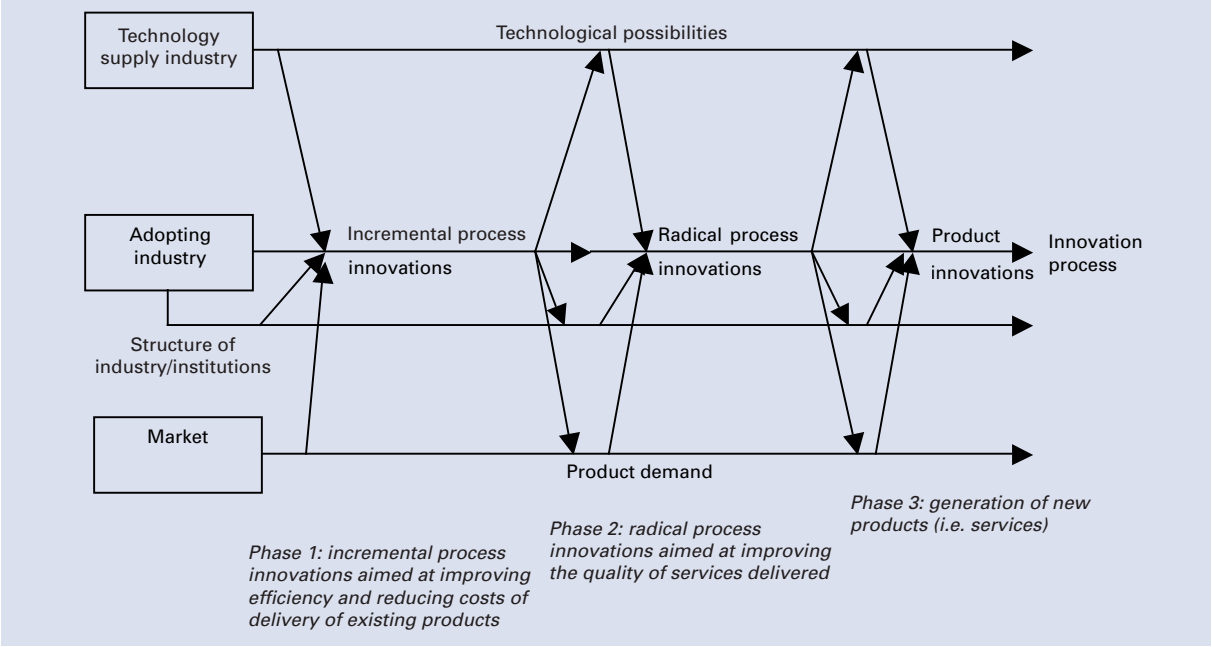
- with undifferentiated products, e.g. minerals and chemicals
- where a dominant design does not emerge or takes place very quickly
- where the move from low-volume to mass production is never achieved and innovation remains product-oriented, e.g. complex capital goods such as weapons systems, commercial aircraft and flight simulators (Davies and Hobday, 2005).

The PLC model has been adapted by Richard Barras to explain the dynamics of innovation in services. Barras (1986) claims that in the early phase of product innovation 'technology push' is the main driving force, whereas in later stages of incremental process innovation, the 'demand pull' pressures of users of technology and products become increasingly important. The majority of users of innovations supplied by capital goods industries consist of service firms and industries (see Pavitt's 'supplier-dominated' industries). Focusing on user industries that adopt technology, the 'reverse product life cycle' model developed by Barras suggests that innovation in services takes place in three phases:

1. ***Improved efficiency phase***: improvements in processes to increase the efficiency with which existing services are delivered.
2. ***Improved quality phase***: process innovations which improve the quality of services.
3. ***New services phase***: product innovations to generate new variety in services.

Drawing upon a study of the adoption of IT in three service sectors (insurance, accountancy and local government), Barras (1986) shows how the organisations and the impact of new technology on labour change during the life cycle. In the first phase, process innovations are pre-dominantly labour-saving and organisations are restructured to achieve cost savings and increased efficiency. In the second phase, the impact of innovation on labour utilisation is neutral, while the third phase of product innovation tends towards capital-saving technical change, competition shifts to service variety to capture and open new markets. Existing firms transform their organisations to promote diversification and new firms and industries emerge to supply the growing range of services. As shown in Figure 3.4 Barras (1990) develops the reverse product life model further by emphasising the interactive nature of the innovation process which is a response to technological opportunities, market conditions and industry characteristics.

Figure 3.4: Interactive innovation in the reverse product life cycle



Source: Adapted from Barras (1990).

Like the PLC model, the reverse product life cycle has been criticised because it fails to apply to all types of service industries. It works best for those high volume sectors like banking, insurance or hotels where the 'back office' activities are susceptible to extensive process innovation – and have been significantly affected by IT-based process innovations in recent years.

TAXONOMIES OF INNOVATION

The dynamics of PLC in both manufacturing and services industries has been criticised for failing to recognising how patterns of technological innovation vary across industries. Porter (1985) argues that innovation is driven by incentives created by varying industry structures and is a shaper of those structures. Pavitt's (1984) taxonomy of innovation shows how the characteristics of innovation varying according to the sources of technology, needs of users and possibilities for appropriation. Although Pavitt's (1984) data does not show how innovation in the different industries evolve over time, it does show that industries vary in the relative importance of product and process innovations at any particular point in time. The taxonomy classifies firms into three industrial groups:

1. ***Supplier dominated***: firms found in traditional manufacturing industries, e.g. agriculture, construction and professional, financial and commercial services.
2. ***Production intensive***: two sub-categories (a) large-scale producers (e.g. mass production and continuous process industries) and (b) specialised equipment suppliers.
3. ***Science based***: R&D is the main source of innovation in chemical, electrical and electronic sectors.

Services are classified as supplier-dominated firms, which depend on external sources for the supply of technology from production-intensive and science-based firms. These adopter and users of technology 'make only a minor contribution to their process and product technology' (Pavitt, 1984a). However, the innovative activities that does occur in supplier-dominated sectors is directed at process innovation.

Several authors have used Pavitt's taxonomy as a starting point for examining patterns of innovation in services. Evangelista (2000) develops a taxonomy of innovation in service industries by classifying firms into four groups:

1. ***Technology users***: resemble Pavitt's 'supplier-dominated' firms: they are low innovation intensity sectors and rely on external sources of technology.
2. ***Science and Technology based***: resemble Pavitt's 'science-based' firms: they are R&D, engineering and computing firms that supply technological innovations to other service and manufacturing industries.
3. ***Interactive and IT based***: highly customised innovations are developed interactively with users or customers.
4. ***Technical consultancy***: large resources are channelled to innovation activities with customers and private research institutes.

The differences can be explained by the innovative performance of firms, nature of innovative activities performed, the variety of knowledge bases underpinning the innovation process, and different patterns of interaction through which service firms innovate.

Mizzo and Soete (2001) develop a taxonomy of services based on the close technological linkages between manufacturing and services. The taxonomy identifies three groups of service industries:

1. ***Supplier-dominated***: two sub-sectors – (a) small firms involved personal services (e.g. restaurants, hotels, and beauty services) and (b) large firms in public services (e.g. education, healthcare and publication administration). The emphasis is on process innovation and technology is sourced from suppliers of equipment and instruments.
2. ***Scale-intensive physical networks and information networks***: two sub-sectors – (a) firms in physical networks are found in transport, travel, trade and distribution and (b) firms in information networks are found in finance, insurance and communications. The needs of these users of technology determines the technology supplied by manufacturing firms.
3. ***Science-based and specialised suppliers***: firms involved in R&D, software and the ICT. The main sources of technology are the research activities of the firms in the sector.

While these taxonomies begin to help to explain the variety of patterns of innovation in manufacturing and services, they provide little or no guidance on how firms can improve the management of the innovation process.

PRODUCT-PROCESS MATRIX

This section shows how services can also be categorised using a matrix designed to understand different types of manufacturing activities.

Early studies of manufacturing classified production processes into varying stages of production from low to high-volume including three broad process categories: unit and small batch, large batch and mass production, and process production (Woodward, 1965). Following a similar approach, Hayes and Wheelwright (1984) identified five generic categories of production processes:

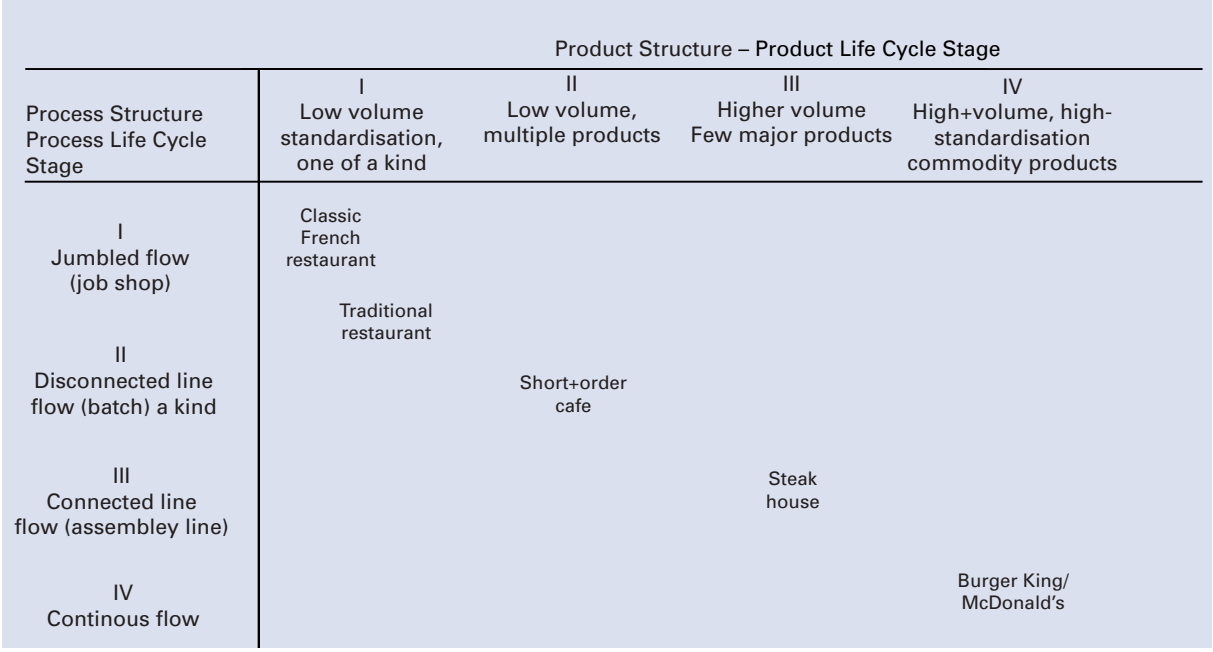
- ***Project*** – the production a variety of customised products to order (e.g. buildings or prototype products)
- ***Job Shop*** – small batch production of a variety of customised products (e.g. commercial printing and machine tool plants)
- ***Batch or Decoupled Line Flow Processes*** – less customised products produced to customer order or for inventory (e.g. heavy equipment, electronic devices and metal castings)
- ***Assembly Line Processes*** – mass production of standardised products (e.g. cars, digital watches and children's toys)
- ***Continuous Flow Processes*** – continuous process to produce highly standardised products (e.g. chemicals, food processing and cereal plants)

A firm's position along this process spectrum from one-off to high-volume processes requires different types of manufacturing capabilities, management systems and process technology.

Hayes and Wheelwright (1984) develop a framework for classifying manufacturing firms that encompasses product change as well as process change. They show how the 'Product Life Cycle' approach is complemented by the concept of the 'Process Life Cycle'. The Product-Process Matrix (PPM) in Figure 3.5 shows how product and process capabilities interact over time. The PPM is useful to managers because it shows the key challenges and capabilities required at different stages in the life cycle. It also demonstrates how firms can alter their positions in the matrix by making a variety of product and process choices. For example, as firms move towards more standardised and higher volume processes, the focus of competitive advantage shifts from capabilities based on production flexibility and customisation to production stability, standardisation and cost.

Shifts in the PPM can be triggered by innovations in products and processes, which we described in the Abernathy and Utterback's PLC model discussed above. A key management task is how to achieve a balance between process and product innovation. Some firms prefer to remain within specific sections of the PPM rather than evolve over time from product to process innovation as suggested by the PLC model.

Figure 3.5: Restaurant examples of product and process matching



Source: Hayes and Wheelwright (1984).

Although the PPM was primarily developed to help manufacturing firms understand where to position themselves in the PPM, Hayes and Wheelwright (1984) apply the framework to an example taken from services. Looking at the restaurant industry in the matrix in Figure 3.5, first-class restaurants, located in the top left corner of the PPM, offer high-quality meals at high prices. The traditional short-order café uses a job shop process to make low volumes of a variety of standard food items. Fast-food restaurants such as McDonald's and Burger King are positioned in the bottom right-hand corner of the matrix. However, these high-volume producers had followed slightly different positioning strategies. McDonald's 'produces to inventory' by offering standardised products in high volumes using automated assembly processes. Burger King 'produces to order' by offering customers a little more flexibility and customisation by cooking hamburgers in response to individual orders, allowing customers to select their own pickles, onions and various condiments. The customer's perception of the service offering is the main difference between these strategies. Burger King has sought to change the customers' perceptions of the product and service by offering options that have little impact on the production process.

The use of the PPM to describe the restaurant industry suggests that it can be usefully applied to help firms in service industries position themselves in terms

of product and process life cycle stages. Figure 3.6 shows our modified version of the matrix which can be applied to understand innovation strategies in service industries. We have included the additional stage of project/unique at the extreme low-volume end of the spectrum, which was identified by Hayes and Wheelwright (1984), but not included in the original PPM. Our matrix therefore addresses the full spectrum of services, ranging from high-value, ad hoc, project-based services tailored to an individual customer's needs to high-volume network-based services. We call this the Product-Service-Process (PSP) matrix to include combinations of products and/or services.

Figure 3.6: Product-Service-Process Matrix

	Product Structure – Product Life Cycle Stage				
Process Structure Process Life Cycle Stage	I Unique product one-of-a-kind	II Low volume low standardisation	III Low volume, multiple product/ services	IV Higher volume Few major products/ services	V High-volume, high-standardisation commodity
I Project	Consultancy, engineering, legal services architecture				
II Jumbled flow (job shop)		Restaurants, specialist healthcare			
III Disconnected line flow (batch)			Specialist retailing, hotels, entertainment		
IV Connected line flow (assembley line)			Airport terminals, shopping malls	Railway, logistics systems, commercial airlines	
V Continuous flow				Telecoms, financial services	Water, energy

Many different types of services can be positioned on the diagonal in the PSP matrix. At the extreme low-volume end of the spectrum, we find project-based processes that provide unique or one-of-a-kind services, such as consultancy, engineering, legal services and architectural practices. High-volume and high-throughput, network-based services, such as water and energy provision, delivered to large numbers of consumers, are positioned at the other end of the spectrum. While telecoms and financial services also use high-volume processes, they are positioned slightly to the left of the bottom right-hand quadrant because software-based intelligence in the networks is used to provide multiple services at low cost.

As Figure 3.6 illustrates, the PSP matrix can also be used to examine the emergence of product-service bundles because many products are provided in combination with services as integrated solutions to customer needs (Galbraith, 2002; Slywotzky, 1996; Slywotzky, 1997). As shown in Figure 3.7 these solutions

range from one-of-a-kind, bespoke services tailored to specific needs to fully standardised offerings.

In low-volume business-to-business markets located in the upper left-hand quadrant, product-service bundles are designed and produced in projects to solve the specific needs of individual business or government customers (Davies, 2004, 2006; Gann and Salter, 2000; Wise and Baumgartner, 1999). For example, Rolls-Royce competes by providing airlines with "power-by-the-hour": leasing the jet engines along with the services to maintain, repair, and upgrade them over many years. Alstom Transport, the railway equipment manufacturer, offers 'train availability' solutions. For example, Alstom's contract for the London Underground's Northern Line does not simply specify the size of the fleet: it requires that 96 trains be available for service each day. Providers of services such as IT, telecom network management, and technical consultancy now compete by offering solutions that incorporate products from a few favoured manufacturers. EDS, the global IT service provider, has built the capabilities to manage and integrate different suppliers' technologies and products as part of its business outsourcing solutions.

Figure 3.7: Product-service bundles positioned on the matrix

	Product Structure – Product Life Cycle Stage				
Process Structure Process Life Cycle Stage	I Unique product one-of-a-kind	II Low volume low standardisation	III Low volume, multiple product/ services	IV Higher volume Few major products/ services	V High-volume, high-standardisation commodity
I Project	Rolls-Royce 'power by the hour', Alstom 'train availability'				
II Jumbled flow (job shop)					
III Disconnected line flow (batch)			Novo Nordisk offering intergrated diabetes care services wrapped around core drug and delivery system		
IV Connected line flow (assembley line)				iPod and iTunes	
V Continuous flow					

In low-volume markets there is a growing application of the above principle – for example, in the field of diabetes care firms like the Danish Novo Nordisk are increasingly providing a 'wrapper' of services around core drug and delivery systems, and engaging end-users as part of that service provision. The element of 'make to order' is increasingly around the service configuration rather than the core product.

In high-volume consumer markets located nearer the bottom right-hand quadrant, a set of standardised services are traditionally provided after the product is delivered. Increasingly, however, customer experiences are fed back often via the internet to front-end designers to co-create customised mass products (Lampel and Mintzberg, 1996) or personal experiences for consumers (Voss, 2003). Mass customised solutions provide customers with products and options for services that can be configured to address their individual needs. For example, the iPod is an integrated bundle which includes access to iTunes, an internet-based service for downloading music.

The PSP matrix could be developed to show how firms based in services can identify the capabilities and management structures required to occupy a particular position in the matrix and how their capabilities, competitive priorities and management tasks are profoundly affected when they alter their positions in the matrix. For example, large international firms, such as IBM, Nokia and Ericsson that have moved into the provision of integrated solutions have made far-reaching changes in their strategic focus, capabilities and organisational structures. IBM's shift from hardware manufacturing into integrated solutions provision involved the creation of an entire new division called IBM Global Services and the acquisition of PriceWaterhouseCoopers, a major professional services company.

As these firms move away from their traditional base in manufacturing towards services (Oliva, 2003; Quinn, 1992), they have outsourced a growing proportion of standardised manufacturing processes to low-cost producers in Eastern Europe, China and India. They have developed new sets of service capabilities including systems integration, operational services, business consulting and finance (Davies et al, 2006). They have also adopted customer-facing organisations that are based on the front-office/back-office structures originally developed by service industries (see Box 3.1: Ericsson's journey into integrated solutions). These 'front-back' organisations consist of front-end, customer-facing units, back-end providers of product and services, and a strategic centre to provide overall coordination (Davies, 2006; Galbraith, 2002). They are responsible for developing products and service components that can easily be configured in projects to solve specific customer problems.

BOX 3.1: ERICSSON'S JOURNEY INTO INTEGRATED SOLUTIONS

Beginning in the mid-1990s, Sweden's telecommunications giant Ericsson successfully developed new capabilities and organisational structures to make the strategic shift in focus from manufacturing to systems integration and service provision. In 1999, Ericsson Services was established as a standalone division to consolidate the product units' disparate service activities. In 2000, the service activities were brought together to form Ericsson Global Services. The following year, Global Services became one of Ericsson's five business units, responsible for developing a global service portfolio and supplying staff and resources to help the front-end units design and sell solutions. Another year on, and Ericsson merged its two product units to create the Systems business unit. This back-end product unit develops a standardised platform of products for various mobile system generations and standards. It also works with the front-end units to develop new customised products that meet the needs of lead customers such as Vodafone.

Ericsson has recently refocused its entire organisation on providing customer-focused integrated solutions; it continues to move away from its traditional base in manufacturing. A growing proportion of Ericsson's components and products is manufactured under contract by Flextronics Corp., a leading electronics manufacturing services company. In 2003, Ericsson took its integrated solutions strategy a step further by reorganising its 120 local companies in 140 countries to form 28 market units. It also created Customer Facing Units (CFUs) to deal with its largest global customer accounts – for example, the Ericsson Vodafone division. Under the new streamlined organisation, all business activities with mobile operators – from strategic engagement to solutions delivery – are undertaken by the front-end units. The company's back-end product and service capabilities can be delivered through an efficient global network of front-end units, providing a single channel to each customer.

DISRUPTIVE INNOVATION

The pattern of evolution described by the PLC model is intermittently disrupted by discontinuous waves of radical innovation. Such discontinuous innovations force firms with capabilities tied to the existing technologies and markets to adopt the new innovations or risk being relegated to a minor role in the industry (Tushman and Anderson, 1986).

However, Christensen (1997) has found that such breakthrough or 'disruptive innovations' are often initially rejected by customers because they cannot currently adopt them in their business processes. He shows that an excessive focus on current customer needs, can encourage large incumbent firms to invest heavily in existing technologies that provide customers with the products they require to achieve their existing business objectives. But it can also lead firms to

abandon disruptive technologies that will become vital to their future growth and profitability. This creates opportunities for a new wave of entrepreneurial firms to respond by using the new innovations to open up new markets and find new customers for the new products. The 'innovator's dilemma' as Christensen calls it is the trade-off between knowing when to listen closely to customers to achieve short-term competitive advantage and when to not to listen to customers to pursue breakthrough technologies in initially small markets to achieve long-term and more profitable growth.

Christensen (1997) shows that the successful management of disruptive innovation depends on four principles:

1. embedded projects to develop and commercialise disruptive technologies within a customer's organisation.
2. place projects to develop disruptive technologies in organisations small enough to pursue small opportunities.
3. plan to fail early and inexpensively in the search for markets for disruptive innovations.
4. commercialise disruptive innovations by finding or developing new markets that value the disruptive innovation, rather than search for a technological breakthrough to compete with existing products and markets.

While Christensen's research is based mainly on manufacturing firms supplying physical products (e.g. hard disc drives and mechanical excavators), the approach has considerable relevance for services. The case of low-cost airlines can be construed as a 'classic' example of his theory. Initially airlines in this field were targeting a very different set of user needs with radically different price/performance expectations, for example, students who would accept 'no frills' flying for a much lower price as long as basic safety standards were 'good enough'. Working with such fringe users involved rapid learning about how to make the model work, for example, how to reduce turnaround times, how to manage internet pricing models and cut the cost of sales, how to increase load factors, etc. Gradually a new business model emerged – an example of 'paradigm innovation' – which offered considerable attractions not just to the original fringe group of users but to an increasingly mainstream market interested in a lower cost solution to short-haul travel. Thus the marketplace was disrupted and established incumbents could only imitate, often with considerable difficulty because of the implicit challenges to their 'traditional' approaches to innovation.

Similar patterns can be seen in other services – for example, voice over internet protocol (VOIP) telephony or digital entertainment.

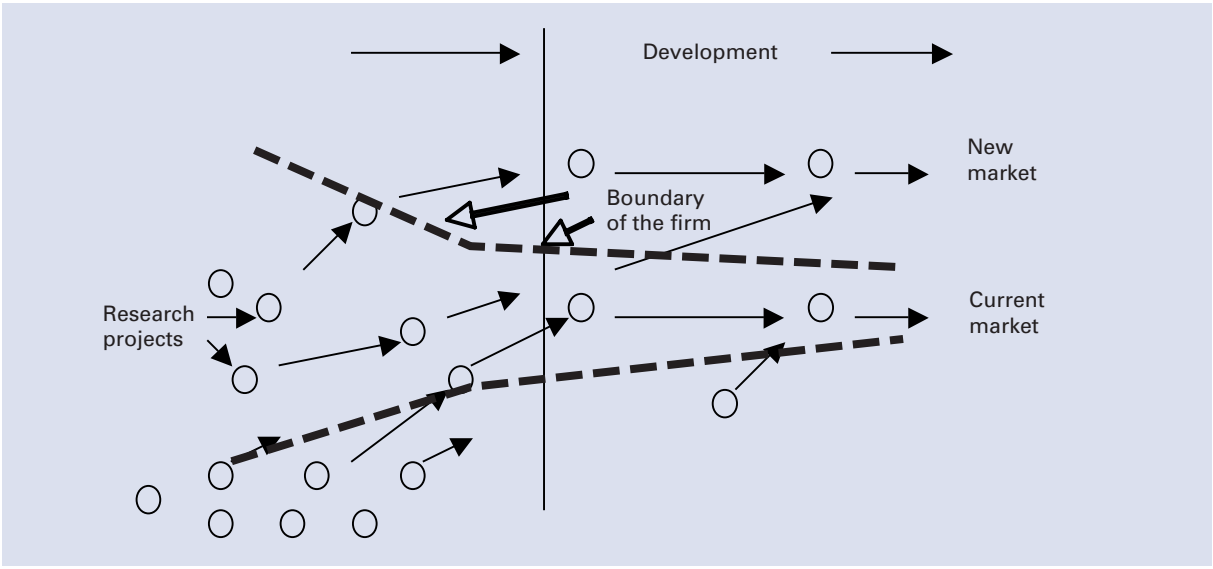
OPEN INNOVATION

Chesbrough (2003) distinguishes between two contrasting models of innovation. The traditional 'closed innovation model' describes a process under the control of a single firm. Firms focus on internal R&D projects to make breakthrough ideas, develop the ideas into products and services, market them, distribute them and service them as well. In recent years, several factors have begun to undermine the traditional approach including:

- the growing mobility of skilled people that are able to take new ideas with them to a new employer
- the increasingly rapid time to market for products and services
- scientists, engineers and managers that pursue breakthroughs on their own by establishing start-up firms

The traditional approach is being replaced by a new 'open innovation model' where firms use internal and external sources of knowledge to turn new ideas into products and services that can have internal and external routes to market. Figure 3.8 shows how firms can initiate internal projects, while tapping into new sources of ideas from outside the firm. It also shows how firms can use internal or external distribution channels to market. A good example of a manufacturing firm that has adopted this is Cisco, the telecommunications equipment supplier. Rather than allocating large resources to internal R&D projects, Cisco invested in, partnered with or acquired many new start-up companies. In this way, Cisco kept pace with the innovation output of some of the largest R&D organisation like Lucent Technologies, without carrying out much internal R&D.

Figure 3.8: The Open Innovation Paradigm for Managing Industrial R&D



Source: Chesbrough (2003).

While Chesbrough (2003) is primarily concerned with manufacturing firms that use open innovation to develop and commercialise new products, this approach can be usefully applied to services. For example, the challenge of new digital media makes it difficult for established providers like the BBC to 'second guess' a fragmenting market and relying on traditional R&D capacity may be insufficient. One alternative is to try to engage a rich variety of players in those emerging spaces via a series of 'open innovation' experiments. BBC Backstage is an example, trying to do with new media development what the open source community did with software development. The model is deceptively simple: developers are invited to make free use of various elements of the BBC's site (such as live news feeds, weather, TV listings, etc) to integrate and shape innovative applications. The strap line is "*use our stuff to build your stuff*" – and since the site was launched in May 2005 it has already attracted interest of hundreds of software developers. Ben Metcalf, one of the program's founders, summed up the approach: "*Top line, we are looking to be seen promoting innovation and creativity on the Internet ..... if someone is doing something really innovative, we would like to ..... see if some of that value can be incorporated into the BBC's core propositions.*"

New business models are often the result of emergence from within a group of different stakeholders, essentially the architects and the players of the new game. So another strategy is to get involved in exploring radically different approaches in order to be in early enough to pick up weak signals and in deeply enough to shape what emerges. For example, the Danish pharmaceutical firm Novo Nordisk is exploring a number of avenues in parallel with its 'steady state' pharmaceutical product development model. It is looking, for example, at future models which might involve a much higher level of care services wrapped around a core set of products for treating chronic diseases like diabetes. Its activities include working with health education programmes in Tanzania, carrying out extensive psycho-social research on diabetes sufferers to establish actual needs and problems in diagnosis and treatment. It also contributes to multi-stakeholder groups like the Oxford Health Alliance set up in 2003 with members drawn from an international set of academics, health professionals, government agencies and private sector firms sharing a common goal – '*... to raise awareness among influencers and educate critical decision-makers so that the pressing case for preventative measures can advance, and we can begin to combat chronic disease.'*

CEO Lars Rebien Sørensen doesn't underestimate the mindset change this represents: '*in moving from intervention to prevention – that's challenging the business model where the pharmaceuticals industry is deriving its revenues! ....We believe that we can contribute to solving some major global health challenges – mainly diabetes – and at the same time create business opportunities for our company.*' [3]

3 Source Oxford Health Alliance introductory video

The trend towards open innovation also encourages the emergence of specialised service suppliers. Innovation activities such as R&D, engineering, marketing, sales and distribution may be performed as functions within an integrated firm or supplied as 'services' by a separate firm (see Quinn, 1992). Many of the research, development and commercialisation activities previously performed in-house by vertically-integrated manufacturing firms are now outsourced and provided by a growing number of specialised service providers. Design of major electronic devices like mobile telephones, computers, handheld devices, etc is increasingly carried out by specialist design contractors like WIPRO in India whilst firms like IDEO and Design Works are active as outsourcing partners for a range of products and services. Even major service providers are looking to make greater use of such agents. For example, Arvato (part of the Bertelsmann group) is a major German provider of mobile content: games, services, video, etc. Arvato recognises that in a volatile environment it is impossible to track all the developments in software, pricing models, market segments, etc and so employs a range of service organisations acting as eyes and ears on its behalf.

Table 3.4 summarises the concepts discussed in this section which derived from manufacturing which potentially can be applied to services.

Table 3.4: Models of innovation: summary of managerial implications

Innovation models, taxonomies and concepts	Implications for management	
	Manufacturing	'Do different' – radical
Product Life Cycle (PLC) – (Abernathy and Utterback 1975a)	PLC model to help managers understand dynamics of product and process innovation by understanding: • How dominant design changes basis of competition • How technologies are displaced by disruptive innovations • Renewing or abandoning capabilities to embrace innovation • Why most innovating firms come from outside an industry • How established firms respond to radical innovation • How many firms fail to bridge successive generations of technology	Reverse PLC in services shows how many service firms are key users, adopters and developers of innovations. (Barras 1986) Reverse PLC identifies: • Process innovations which improve service delivery • Process innovations which improve service quality • Product innovations which generate new services Reverse PLC shows interactive nature of innovation between services and suppliers of technology.
Sectoral Taxonomy – (Pavitt 1984b)	Helps managers understand that most innovation is specific to firms and varied across industries. Taxonomy identifies: • Supplier-dominated firms: including services • Production-intensive firms • Specialist equipment suppliers • Science-based firms While extremely useful for classifying specific innovation processes, the sector taxonomy provides no guidance on how managers can improve the innovation process.	Taxonomies of innovation in services show how innovation differs across firms and industries.Taxonomies identify different types of firms such as: • Technology users/supplier dominated • Science & Technology based • Interactive and IT based • Technical consultancy • Scale-intensive physical networks and information networks • Specialised suppliers
Product-Process Matrix (PPM) - (Hayes and Wheelwright 1984)	PPM is a positioning framework to help managers understand where their firm is located along a spectrum showing life cycle changes in products and processes. It shows how managers can understand: • what capabilities are required to maintain a strong competitive position • what capabilities and choices are required to move position	The framework is applied to services, using the case of the restaurant industry. This suggests that the PPM can be usefully adapted to explain: • the variety of positions service firms on the matrix • the shift from products to services
Disruptive Innovation - (Christensen 1997)	This concept shows how industries (and their PLC) are disrupted by waves of radical innovations on both demand and supply side: • It shows that focusing on current investments, technologies and customers can weaken a firm's ability to respond to disruptive innovations. • It offers a step-by-step approach for managing disruptive innovation	The concept can be applied directly to understand disruptive innovation in services. It explains well, for example, the low-cost airline service disruption which has reshaped the competitive dynamics of the industry. However, the impact on services may vary as many service firms develop strong relationships with customers based on brand, excellence service and reputational assets.
Open Innovation - (Chesbrough 2003)	This concept shows how the nature of innovation is changing from: • A closed model of internally developed R&D, production, and commercialisation of new ideas • To an open model based on multiple internal and external sources of ideas and channels to market. Open innovation emphasises knowledge flows rather than knowledge creation as a driver of innovation	The concept can be applied directly to service innovation. The emphasis on knowledge flows and the need to combine from multiple sources underlines the strong user dimension in knowledge management around services. It also shows how many services are now provided by many specialised external suppliers, rather than internal functions performed by large corporations.

3.4 Drivers of innovation in services

'Services' covers a very wide and heterogeneous field, ranging from low volume local retailing or the supply of professional legal or medical services through to high volume, technologically enabled activities like telecommunications, utilities, banking and insurance. For this reason it is important to recognise that 'one size does not fit all', but rather that there will be a need for extensive configuration in managing innovation in this field. However, as with manufacturing we can identify some generic drivers which are shaping the patterns of innovation across the sector and these pose significant management challenges. In this section we briefly consider three of these: 'Servicisation', 'Customisation' and 'Outsourcing'.

SERVICISATION OF MANUFACTURING AND SYSTEMATISING SERVICES

As we have already noted there is a growing trend across manufacturing for value to be added via a wrapper of services linked to a core physical product. For example, a manufacturer of pumps is less likely to compete on the basis of product excellence alone – instead it will seek to add value by offering a range of support services (maintenance, financing, spares and servicing, etc.) to provide end users with a total solution. This has two advantages – it increases the range of revenue earning options available to the firm (with services often commanding higher margins than physical product elements) and it also builds a relationship with end-users. The value of such customer 'lock on' lies not only in their long-term loyalty but also in their potential role as a source of innovation in the future. Such patterns of manufacturing blurring into service businesses – 'servicisation' – are increasingly found and pose significant challenges to the underlying skills base in general and to innovation skills in particular. If manufacturers are becoming more like services then innovation will increasingly require skills in understanding customer insights rather than traditional R&D and technology development.

The reverse is equally true, as services recognise their innovation processes have much in common with manufacturing so there will be an implication for the skills base in terms of building and operating systems for innovation. But as we saw in section 3.1 service businesses are often weak in managing innovation on a systematic basis. For example, the UK report (mentioned in section 3.1) on legal firms highlighted the need to become much more 'professional' in their approach to innovation.

Similarly research carried out by the consultancy PWC in Germany of 141 firms employing over 500 people found that 78% considered innovation to be critical for their business survival. But here too there were concerns about the ability of firms to manage the process:

- *57% of the respondents don't have a well-defined innovation strategy*
- *80% have no innovation management system*
- *66% have no systematic performance measurement of their innovation activities*
- *47% do not have clear-cut competencies for innovation management.*
- *12% believe that their corporate culture is not conducive to innovations*

Arguably as the two sectors converge so there will be a need for development of complementary skills and operating systems to deploy their knowledge effectively.

TOWARDS MASS CUSTOMISATION

A second core trend running across both manufacturing and services has been that of increasing customisation. There has always been a market for personalised custom made goods – and similarly custom configured services – for example, personal shoppers, personal travel agents, personal physicians, etc. But until recently there was an acceptance that this customisation carried a high price tag and that mass markets could only be served with relatively standard product and service offerings. But a combination of enabling technologies and rising expectations has begun to shift this balance and resolve the trade-off between price and customisation. 'Mass Customisation' (MC) is a widely used term which captures some elements of this. MC is the ability to offer highly configured bundles of non-price factors configured to suit different market segments (with the ideal target of total customisation, i.e. a market size of 1) but to do this without incurring cost penalties and the setting up of a trade-off of agility vs. prices.

Of course there are different levels of customising – from simply putting a label 'specially made for ..... (insert your name here)' on a standard product right through to sitting down with a designer and co-creating something truly unique. Table 3.5, gives some examples, highlighting that this is as powerful an innovation driver in services as in manufacturing

Table 3.5: Options in customisation (after Mintzberg and Lampel)

Type of customisation	Characteristics	Examples
Distribution customisation	Customers may customise product/service packaging, delivery schedule and delivery location but the actual product/service is standardised.	Sending a book to a friend from Amazon.com. They will receive an individually wrapped gift with a personalised message from you – but it's actually all been done online and in their distribution warehouses. iTunes appears to offer personalisation of a music experience but in fact it does so right at the end of the production and distribution chain.
Assembly customisation	Customers are offered a number of pre-defined options. Products/services are made to order using standardised components.	Buying a computer from Dell or another on-line retailer. Customers choose and configure to suit your exact requirements from a rich menu of options – but Dell only start to assemble this (from standard modules and components) when your order is finalised. Banks offering tailor-made insurance and financial products are actually configuring these from a relatively standard set of options.
Fabrication customisation	Customers are offered a number of pre-defined designs. Products/services are manufactured to order.	Buying a luxury car like a BMW, where the customer are involved in choosing ('designing') the configuration which best meets your needs and wishes – for engine size, trim levels, colour, fixtures and extras, etc. Only when they are satisfied with the virtual model they have chosen does the manufacturing process begin – and they can even visit the factory to watch their car being built. Services allow a much higher level of such customisation since there is less of an asset base needed to set up for 'manufacturing' the service – examples here would include made to measure tailoring, personal planning for holidays, pensions, etc.
Design customisation	Customer input stretches to the start of the production process. Products do not exist until initiated by a customer order.	Co-creation, where end users may not even be sure what it is they want but where – sitting down with a designer – they co-create the concept and elaborate it. It's a little like having some clothes made but rather than choosing from a pattern book they actually have a designer with them and create the concept together. Only when it exists as a firm design idea does it then get made. Co-creation of services can be found in fields like entertainment (where user-led models like YouTube are posing significant challenges to mainstream providers) and in healthcare where experiments towards radical alternatives for healthcare delivery are being explored – see for example, the Design Council RED project.

This trend has important implications for services, in part because of the difficulty of sustaining an entry barrier for long. Service innovations are often much easier to imitate and the competitive advantages which they offer can quickly be competed away because there are fewer barriers – for example, of IP protection. The pattern of airline innovation on the transatlantic route provides a good example of this – there is a fast pace of innovation but as soon as one airline introduces something like a flat bed, others will quickly emulate it.

Arguably the drive to personalisation of the service experience will be strong because it is only through such customised experiences that a degree of customer 'lock-in' takes place. Certainly the experience of internet banking and insurance suggests that, despite attempts to customise the experience via sophisticated web technologies there is little customer loyalty and a high rate of churn. However, the lower capital cost of creating and delivering services and their relative simplicity makes co-creation more of an option. Where manufacturing may require sophisticated tools like computer-aided design and rapid prototyping, services lend themselves to shared experimentation at relatively lower cost. There is growing interest in such models involving active users in design of services – for example in the open source movement around software or in the digital entertainment and communication fields where community and social networking sites like MySpace, Flickr and YouTube have had a major impact.

OUTSOURCING

The third major driver of innovation is the trend towards outsourcing of business activities. For some time businesses have sought to reduce their costs by outsourcing non-core activities (such as IT services, payroll management and customer billing) to specialist firms. The growth in this service sector has been significant and increasingly global in reach, taking advantage of labour cost differences in the provision of people-intensive services like call centres.

One consequence has been a growing split in the sector between those firms specialising in 'transactional' outsourcing – where the offer is essentially to carry out relatively standard operations for less than would be the case in-house – and 'strategic' outsourcing, where the complexities and uncertainties of managing the activities on behalf of a client firm mean that the outsourcer has to develop considerable innovation skills. The former are likely to move inexorably to low labour and transaction cost locations, probably offshore – but the latter represent a powerful source of service innovation. For example, managing a 25 year contract with service level agreements and improvement targets requires an ability to develop and keep on developing novel solutions, and many of these will need to be 'co-created' with end users. Once again this places innovation capability high on the agenda. If such firms are to grow and continue to create employment in the UK then they will need to manage their innovation activities to deliver a continuing stream of product and process improvements and radical breakthroughs.

3.5 Policy implications

In this report we have focussed on the management implications of service innovation and we have identified a number of issues which may have policy relevance. But in exploring these we should be aware of two core questions:

- Is there a case for intervention at some level – a 'market failure' of some kind, and if so, where?
- Who could take the responsibility for design and implementation of such interventions – who 'owns' the emergent policy agenda?

In policy terms the size and economic importance of the service sector to the UK economy makes it important to get policy right. Policy makers should consider undertaking more analysis in the following areas:

- Are there demonstrable weaknesses in the ability of services firms in particular segments to manage knowledge for effective innovation, particularly considering integrative management of technology and non-technological innovation?
- Should the Government be involved in the diffusion of models of 'good practice' in innovation management?
- Should support for R&D via tax credits etc. be extended to include the kind of 'research' activity (prototyping, piloting, etc.) which takes place in service innovation?

In terms of policy actors there is clearly a role for a much wider group of players than central government. For example, devolution of policy and support delivery to Regional Development Agencies, Business Links and other bodies suggests a distributed approach on a geographical basis. Equally many of these issues relate to sector-based concerns and innovation patterns and argue for policy activity by trade and business associations.

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4 Innovation in Experiential Services – An Empirical View

Chris Voss and Leonieke Zomerdijk[1]

Executive Summary

This chapter examines innovation in experiential services. These are services where the focus is on the experience of the customer when interacting with the organisation, rather than just the functional benefits following from the products and services delivered. The report is based on a continuing research programme on experiential services at London Business School. It draws on a recent case-based study of eight design agencies and consultancies and nine successful experiential service providers. The report addresses the question of how do experiential service providers innovate, in particular the content and the process of innovation including organisation for innovation. Studying innovation in experiential services facilitates wider reflection on the subject of service innovation.

The research found that experiential services are often designed from the perspective of the customer journey rather than as a single product or transaction; the service is seen as a journey that spans a longer period of time and consists of multiple components and multiple touchpoints. The journey perspective implies that a customer experience is built over an extended period of time, starting before and ending after the actual sales experience or transaction. During a customer journey, numerous touchpoints occur between the customer and the organisation or the brand. These touchpoints need to be carefully designed and managed. The research shows that innovation takes place at each of these touchpoints as well as of the overall journey itself.

The customer journey perspective differs from the current models and frameworks describing service innovation, as it clearly shows the central role of the customer in innovation and design, as opposed to for example a central role of technology. In addition, the scope of the journey perspective is much broader than traditional models, for example it includes aspects such as building anticipation and facilitating transport to the core experience. Finally, the journey perspective integrates the common distinction between service product innovation and service process innovation, as a journey has elements of both.

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Another finding from the research is that innovation takes place in five distinct design areas that directly or indirectly influence the customer experience: the physical environment, the service employees, the service delivery process, fellow customers and back office support. Although these areas are relevant to any service, they generally do not receive the same amount of attention as experiential service designers pay to them. Examples include sensory design for the physical environment, stimulating employees to engage with customers, using fellow customers to make an experience more enjoyable and connecting back office employees to the front stage experience. There is a large theoretical base from the service management literature concerning innovation in these areas, yet linkages with the service innovation literature are sparse.

With regard to the process of innovation in experiential services, the research revealed that many innovations were driven by detailed insights into customers. Both design and consultancy firms and experiential service providers invested a large amount of time and effort in conducting research leading to insights in customers' behaviour, needs and preferences. Common techniques were traditional market research, empathic research to understand customers at an emotional level, trend watching and learning from companies in different industries. This indicates that experiential innovations are typically customer rather than technology driven.

Another process-related finding from the research is the occurrence of both 'tight' and 'loose' methodologies in the design and innovation process of experiential services. Tight methodologies entail a relatively fixed set of steps, activities and tools and techniques required in the design process that can be used across projects, whereas in loose methodologies the required steps, activities and tools and techniques are determined individually for each project. Whilst some organisations had well-developed and tight methodologies, many successful innovators did not and preferred a more flexible approach. They feared that tight methodologies would inhibit the creativity required for experiential service design and would increase time to market unnecessarily. This suggests that the relatively tight and rigorous methodologies typically found in product innovations may not always be applicable to service innovation.

One of the difficulties in innovation in experiential services is predicting the outcome in financial terms. It can be difficult to measure the impact of a particular improvement of a customer experience on company performance. Many companies devoted much effort and used multiple methods to capture the outcomes of innovation. Common measures included footfall, dwell time, revenue growth, customer satisfaction and customer loyalty. The difficulty in predicting financial returns can not only cause an unwillingness to invest in service innovation, but also make it easy to over-invest and have a great and innovative service that is actually losing money.

Finally, the research found that although both product and process innovation were observed, significant innovation came from incremental process innovation. In addition service innovation was often associated with innovation

in business models. This leads to a typology of service innovation consisting of three areas: product innovation, process innovation and business model innovation. Considering part of service innovation as process innovation provides insights into the problems of studying and measuring service innovation. Process innovations are embedded in a wider operational process and are frequently incremental rather than radical. They take place in operational areas, not separate R&D departments, and activity and expenditure is thus hard to measure. Rather than product leading process or vice versa, the research indicated that service innovation in general, not just in experiential services, is an iterative process where product, process and business model innovation go hand in hand.

4.1 Introduction

Service innovation has proved an elusive area for many reasons, including the intangibility of services, the heterogeneity of services, much innovation being of processes rather than products and the lack of an identifiable R&D function. Much research has focused on services where products can clearly be defined (for example financial services), and where technology is being used to change the nature of the service or the business. However, as Salter and Tether (2006) have pointed out, there is an emerging research stream which addresses the particular nature of services such as intangibility, dependence on people and high levels of interaction rather than technologies. A significant proportion of services, and hence their innovation activities, reflect this. The research by Hipp et al. (2000) reveals a pattern of diversity in the innovation behaviour of service firms, which reflects the diversity amongst service firms. Consequently, they call for more subtle and differentiated analyses of services and service innovations.

This report investigates innovation in the area of experiential services: services that focus on the experience customers are having. Innovation is particularly important for this type of services, as one of the key features of successful experiences is considered to be continuous renewal or refreshment of the experience to keep exceeding customer expectations (Pine and Gilmore, 1998).

This report addresses the question: how do experiential service providers innovate? It mainly focuses on the content and process of innovation. Content includes the ‘what’ of innovation, addressing the substance of innovations, whereas process refers to the ‘how’: main steps, tool and techniques and people involved.

The report is based on extensive and ongoing case-based research of companies that either provide or help design experiential services, both in the UK and the US. The research is informed by the discipline of service management. An empirical view of current innovation practice in experiential services is put forward. From this, conclusions are derived that are relevant for both companies and policy makers.

The remainder of this Chapter is structured as follows:

4.1 **Introduction** provides an introduction to the report, experiential services and the research underlying this report.

4.2 **The Content of Innovation** presents observations on service as a journey and five distinct innovation areas.

4.3 **The Process of Innovation** presents observations on the consumer research underlying service innovations, the methodologies, tools and techniques for service innovation and the organisation of the innovation process.

4.4 **Additional Observations** links service innovation to business model innovation and investigates the role of competition as a driver of innovation, as well as how companies protect their innovations from copying.

4.5 **Reflections on Service Innovation** uses the research on innovation in experiential services to propose a typology of service innovation that includes service product innovation, process/system innovation and business model innovation and links them together in an iterative model.

EXPERIENTIAL SERVICES

Experiential services are services where the focus is on the experience of the customer when interacting with the organisation, rather than just the functional benefits following from the products and services delivered. Companies in the leisure and entertainment industries have traditionally focused on the experience of their customers, as an experience is their main offer, for example skiing, theme parks and cinemas. However, it can also be argued that every touchpoint that the customer has with the organisations is an experience, no matter how mundane the product or service that is being delivered. These experiences can be positive or negative, and to a greater or lesser extent memorable (Carbone and Haeckel, 1994).

Recently companies have begun to see systematically designing and managing customer experiences as a powerful way of improving service levels and differentiating from competitors (Pine and Gilmore, 1998). Providing compelling customer experiences is also seen as an important factor influencing customer loyalty, for customers are more likely to make repeat purchases and give positive word of mouth when they had a good experience. Pullman and Gross (2004, p.551) define experience design as an approach to create emotional connection with guests or customers through careful planning of tangible and intangible events. European examples of companies which stress the importance of the customer experience include: YO! Sushi, first direct, Land Rover with the Land Rover Experience Centres, the Eden project, the Guinness Storehouse in Dublin and Die Gläserne Manufaktur (the Transparent Factory) of Volkswagen in

Dresden. Well-known examples and successful pioneers in the US are the American Girl Stores, the Apple Retail Stores, Build-A-Bear Workshops, Joie de Vivre Hotels and the Disney theme parks. All of these companies have designed services with the customer experience in mind.

These examples indicate that experiential services can occur in any industry or sector, both goods-based and service-based. They can be found in banking, hospitals, retail, hotels, restaurants, transportation and traditional manufacturing. Indeed they relate to the service element of all companies.

THE RESEARCH

This report is based on a continuing research programme in the field of experiential services at London Business School. Starting in 2003, it has involved case-based field studies of experiential services in nearly 100 companies, primarily in the UK and US. Details are given in Appendix 4.1.

The most recent phase of this research serves as the main data source for this report. This study involves eight case studies with design agencies and consultancies that specialise in helping companies design good customer experiences and nine case studies of experiential service providers. They are listed in Appendix 4.1. These were all examples of successful organisations. This provided the opportunity to study widespread or good innovation practice. Several companies also had innovation as one of their brand values or are known in their industry as innovators. A case-based research methodology (Yin, 1994) was used; interviews were conducted with founders, executives and experienced designers to investigate process and content issues of experience design and innovation. As well as interviews, in the design agencies and consultancies examples of actual projects were studied, and in the experiential service providers site visits were conducted to observe and experience the customer experience on offer.

As service innovation is an emergent area, case study research is an appropriate method in this context (Yin, 1994). The case method lends itself to early, exploratory investigations where the variables are still unknown and the phenomenon not well understood (Meredith, 1998). The phenomenon can then be studied in its natural setting, and meaningful, relevant theory can be generated from the understanding gained through the observation of actual practice. When building theory from case studies, researchers ordinarily select cases using replication rather than sampling logic (Eisenhardt, 1989; Voss et al., 2002; Yin, 1994). This means selecting cases that offer the best opportunities to learn and build or extend theory. There are therefore limits to the generalisability of the results from case-based research. The observations presented in this report cannot be used for statistical inference, but point out several key issues and characteristics of innovation in experiential services.

4.2 The Content of Innovation

This section explores the content of innovation in experiential services. It first examines how experiential services are often seen as a journey, rather than a product. This influences the types of innovation taking place. It then presents a framework that captures the different areas in which service innovation occurs and provides examples of innovations in each area, and finally discusses the implications for service innovation.

SERVICE AS A JOURNEY

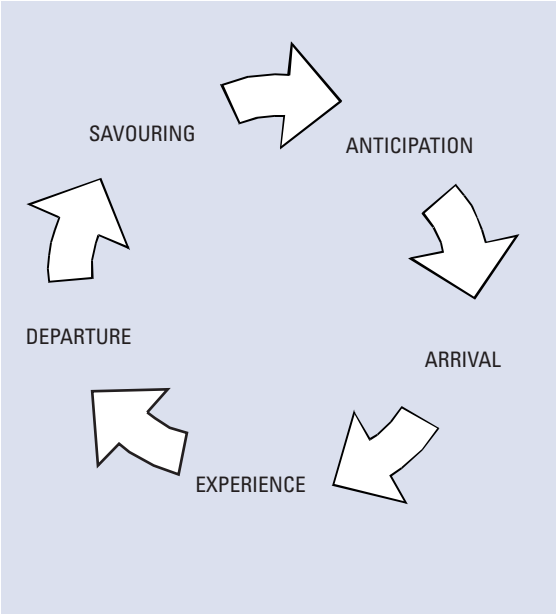
Innovation in services has traditionally been seen in terms of product innovation. It became clear in the field research that this mindset usually did not match how the organisations studied saw or managed innovation. The cases indicated that both design and consultancy firms and experiential service providers shared a common perspective or metaphor: that of the customer journey. As opposed to a single transaction or purchase experience that involves a service product and a service process, the service is seen as a journey that spans a longer period of time and consists of multiple components and multiple touchpoints. The total customer experience is the result of every element in this journey. Another way of describing the customer journey is as a film that consists of multiple scenes.

Typically, a customer journey is considered to start long before the actual transaction and ends long after the transaction is completed, preferably with recommendations to other people. Journeys are often cyclical, with the end of one cycle leading into another. See for example the Walt Disney World Guest Experience Cycle in Figure 4.1. Some of the characteristics of taking a journey perspective on service delivery include:

- A customer experience is built over an extended period of time, starting before the actual sales experience or transaction to include pre and post purchase experiences;
- The journey consists of numerous touchpoints between the customer and the organisation or the brand; these touchpoints need to be carefully designed and managed; and
- Each touchpoint has the potential for innovation.

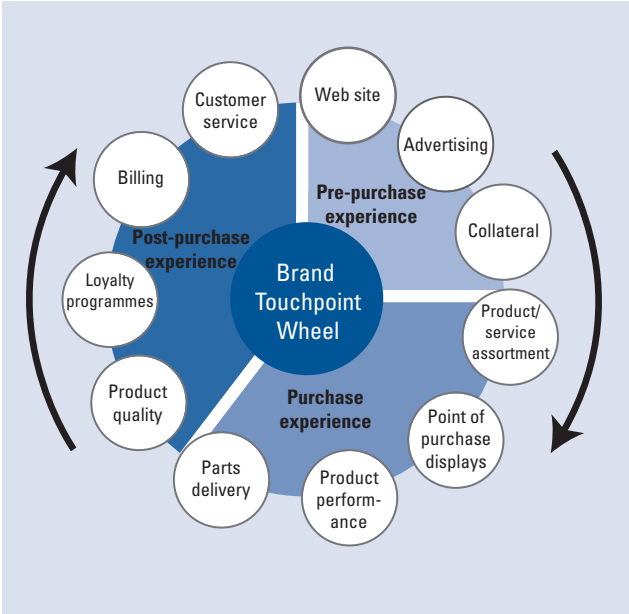
Several of the design agencies and consultancies that specialise in designing customer experiences used the journey perspective to analyse current experiences and design new ones. This often involved mapping customer journeys in detail. The journey model has its origins in the work on service blueprinting and service mapping by Shostack (1984), Kingman-Brundage (1992) and Bitner (1993). Several firms had developed a technique for mapping customer journeys such as ‘Moment Mapping ®’ (Shaw and Ivens, 2002) and ‘the Brand Touchpoint Wheel’ (Davis and Dunn, 2002). An example is shown in Figure 4.2.

Figure 4.1: Service journey, Guest Experience Cycle



Source: Walt Disney World

Figure 4.2: Service journey, Brand Touchpoint Wheel



Source: Dunn and Davis (2003)

Companies that provided experiential services also frequently used the perspective of the customer journey. They included both physical aspects, such as travelling to a service, and non-physical aspects such as building anticipation. For example, the customer journey was one of the leading design principles for the Xscape destinations of X-Leisure. The journey starts with finding out about a destination, and includes getting there, moving through the various stages of the experience, finding reasons to come back, telling other people and paying repeat visits.

The innovations observed in the study covered a spectrum from creating entirely new journeys, through changing or adding elements in a journey, to making existing journeys more comfortable or efficient. In general, the experiential service providers produced a continuous stream of innovations to improve elements of existing journeys. A common issue in a customer journey is waiting or queuing. Another common issue is physically getting to the service location: using transportation and finding the right place. Several organisations paid a great deal of attention to signage, parking and public transportation. In a few cases the companies even added elements that were traditionally considered outside their boundaries to the customer journey, such as transport to and from the service location. An example of an extended service journey is the one designed by Virgin Atlantic for its Upper Class passengers. It is designed to be seamless and includes a wide range of services at each part of the journey, see Box 4.1.

BOX 4.1: SERVICE JOURNEY – VIRGIN ATLANTIC UPPER CLASS

Flying Virgin Atlantic includes more than transatlantic flights. It is designed as a seamless and experiential journey that starts with booking and ends with transportation home. Having booked, Upper Class passengers are picked up by a chauffeur-driven car or LimoBike motorcycle, driven to the airport, go through a unique Drive-Thru Check In process and are dropped off at customs, close to the entrance to the Virgin Atlantic Clubhouse. The clubhouse has an incredible range of services from restaurants and a bar through to a massage and hairdressing salon. At weekends there are activities there, for example a Gibson guitar clinic, to engage passengers. Onboard the plane in addition to flat-bed seats there is a bar where passengers can congregate and an in-flight massage service. At the airport of arrival, passengers can go to an arrival lounge to relax, have breakfast, shower and have a foot massage, before being escorted to their final destination. Although the core offer is the transatlantic flight, Virgin Atlantic recognised the complete journey involved and has innovated at every step.

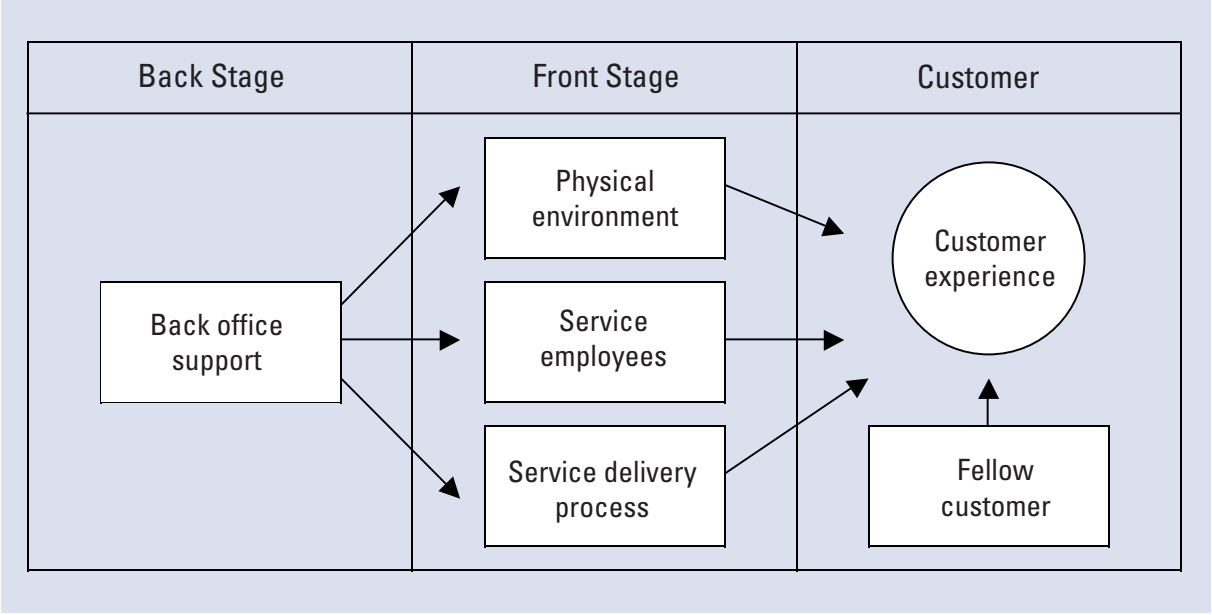
EXPERIENTIAL INNOVATION AREAS

In addition to applying the service as a journey perspective, experiential service providers and design agencies and consultancies in the field of experiential services innovated in five distinct design areas:

1. Physical environment ('stage')
2. Service employees ('actors')
3. Service delivery process ('script')
4. Fellow customers ('audience')
5. Back office support ('back stage')

These five design areas directly or indirectly contribute to a customer's experience. In a restaurant for example, the dining experience consists not just of the quality of the food and drinks but is heavily influenced by the atmosphere and comfort of the venue, the behaviour of the staff, the presence of other guests, and the flow of the meal, for example waiting to be served. The areas are often referred to in theatrical terms, emphasising that a service can be seen as a performance that involves a stage, actors, a script, an audience and a back stage area (e.g. Grove et al., 1992). The research reported here shows that companies innovated in each of these areas to improve existing or develop new customer experiences. The relationships between these five areas are shown in Figure 4.3. The next sections examine each of these areas in turn.

Figure 4.3: Experiential design areas



Physical environment

The physical environment is the setting in which a service is delivered or experience is created. The physical environment is considered a key variable influencing customer perceptions and behaviour and has been studied from the perspectives of environmental psychology (e.g. Mehrabian and Russell, 1974), retail atmospherics (e.g. Kotler, 1973; Turley and Milliman, 2000) and 'servicescapes' (Bitner, 1992). The environment performs different roles: accommodating customers and employees, guiding behavioural actions, such as where to queue, and providing cues about the type of service to be expected. The companies in this study paid careful attention to the design of physical environments, such as a cruise ship, aircraft interior or shopping centre. Innovations regarding the physical environment include designing for the journey and sensory design.

Innovation: Design for the journey

Physical environments were often designed with the customer journey in mind, including the ease of getting in and out, how people move around inside to avoid crowding or congestion and making strong first impressions. An example can be found at the Xscape destinations in Braehead and Castleford. These destinations have double-height foyers that are designed to make entry a 'wow' experience. Likewise, the new Arsenal Emirates Stadium designed by HOK Sport Architecture is designed to generate a strong visual impact when spectators turn the corner and first see the stadium in full.

Innovation: Sensory design

Another area for innovation in physical environments is sensory design. This is design that stimulates all five senses: sight, sound, touch, smell and taste. Deliberately addressing the senses is a powerful way of influencing customers'

emotions and the experience they have. The design agencies and consultancies in this study agreed on the large opportunities associated with sensory design, but also on the lack of use in practice. Some of the companies in this study engaged in sensory design. Excellent examples can be found in the sport stadiums designed by HOK Sport Architecture and the airport lounges and aircraft interiors designed by Virgin Atlantic. An example that combines sensory with journey design is when Virgin Atlantic changed the positions of the galley and the bar on their aircraft, so that passengers were no longer hit by the smell of food from the galleys when they boarded the plane, but instead were greeted by the smell of fresh orange juice. Another example is the entry ticket for the Guinness Storehouse in Dublin as designed by Imagination. It is a pebble with a drop of Guinness in it, which doubles as a sensory touchpoint right at the beginning of the journey and a souvenir.

Service employees

It has long been known that the interaction between customers and the people delivering the service is a major factor influencing customer experiences. For example, three of the five dimensions in the SERVQUAL instrument to measure service quality, described in more detail in section 4.3, are explicitly related to employee behaviour: responsiveness, or the willingness to help customers and provide prompt service, assurance, or the knowledge and courtesy of employees and their ability to inspire trust and confidence, and empathy, or the caring and individualised attention the firm provides its customers (Parasuraman et al., 1988). Most of the experiential service providers in this study saw the role of the employees in delivering service as the key factor influencing customer experiences. As a consequence, organisations paid a lot of attention to their front line employees and the service they are providing. Walt Disney World is a renowned example of great customer service provided by their cast members, as are Virgin Atlantic and Royal Caribbean. Two areas for innovation are engaging with customers and managing the employee experience.

Innovation: Engaging with customers

For several companies in the study it was important for staff to engage with customers, or build emotional connections with them. This makes the customer experience more personal, more positive and more memorable. Furthermore, by connecting with the employees, the customers are connecting with the brand or the organisation which increases customer loyalty. To that end, several experiential service providers hired employees based on empathic skills (or Emotional Intelligence). Empathic skills refer to the ability to perceive and assess one's own emotions and those of others and the ability to manage them. For example, Luminar Leisure recognised the importance of the 'people element' for a pleasant night out and has started to train the front line employees of their Liquid and Lava & Ignite nightclubs in empathic skills. As part of this training, doormen are taught to recognise different customer segments and respond to them with a response tailored to that particular person. In addition, employees

are encouraged to have fun themselves, so that their positive emotions can rub off on customers via a process called emotional contagion (Pugh, 2001).

Innovation: Managing the employee experience

A second innovation area related to service employees was the employee experience. The experiential service providers in this study explicitly saw that one key to excellent service was satisfied and motivated employees. As a result, they not only managed the customer experience, but also the employee experience. For example, management at Walt Disney World has specified four guest expectations and four cast (employee) expectations. The cast expectations, what cast members expect from Walt Disney World management, are: (1) Make me feel special, (2) Treat me as an individual, (3) Respect me and (4) Make me knowledgeable. Walt Disney World puts a great deal of effort into creating an environment where employees feel valued and supported so that, in turn, they will do their job well and take better care of guests. Leadership plays a large role in establishing this environment. Another example can be found at Royal Caribbean. Here, the importance of the employee experience is reflected in the quality of crew food, the design of crew areas on the ships and the availability of communication tools such as internet access in crew cabins and the entire fleet being cell phone capable, no matter where a ship is. As a result, these companies typically get lower employee turnover whilst they pay the same wages as competitors. This reasoning is consistent with the Service-Profit Chain model, developed by Heskett et al. (1994). This model links employee satisfaction to customer satisfaction, proposing that satisfied employees will be more productive and more loyal and will provide better service value, which will lead to greater customer satisfaction (see also section 4.3).

Service delivery process

The service delivery process is another area where companies innovate to improve the customer experience. A service delivery process is a series of actions or events that take place to deliver the service. In theatrical terms, the service delivery process is the script for the service performance, defining the acts, scenes, intervals and actors involved. The service delivery process for a large part determines the customer journey or the flow of the customer through the organisation. The companies in this study innovated in the design of service delivery processes by managing the start, end and peaks.

Innovation: Managing start, end and peaks

One of the key innovations for experiential services regarded designing the flow of a service delivery process in terms of its start, end and peaks. This is based on principles from behavioural and cognitive science regarding how people experience the passage of time and interpret events after they are over. For example, customers generally do not remember every single moment of an experience. Instead, they remember the trend in the sequence of pain and pleasure, the high and low points and the ending (Chase and Dasu, 2001).

Research shows that positive performance trends lead to more favourable evaluations and the end of an experience has a greater impact on customer's perception than the beginning (Hansen and Danaher, 1999). Furthermore, Verhoef et al. (2004) found that in addition to average performance, positive peaks contribute to customer satisfaction. Such principles can be used to influence people's perception of a particular experience or service, making it as positive as possible. Several of the design agencies, consultancies and experiential service providers studied employed this reasoning to the design of service delivery processes. Yet, managing first and last impressions were more common than managing peaks or trends.

For example, office furniture manufacturer Herman Miller explicitly uses these principles in its B2B context. When potential customers visit their offices the company pays much attention to the start of the visit to set the right tone: bringing people in the right mood, establishing rapport and explaining customers are in control. They use specifically designed 'decompression' rooms for that. An example of a strong ending to a service delivery process can be found at the Guinness Storehouse developed by Imagination. Here the final activity is a complimentary pint of Guinness in the sky bar, the highest point in Dublin, with 360 degrees panoramic views across the city. This ending to the process is specifically designed to connect with the brand and create a very positive memory. How cruise line Royal Caribbean manages start, end and peaks is described in Box 4.2.

BOX 4.2: MANAGING THE START, END AND PEAKS OF A CRUISE EXPERIENCE

A cruise's itinerary and schedule for entertainment and activities are developed to optimise onboard revenue, passenger experience and positive memories. Ideally, the first and last day of a cruise are spent at sea. The first day at sea enables passengers to unwind and get acquainted with the ship. The last day at sea not only gives passengers the chance to relax and make the most of what the ship has to offer, but also means the passengers are in the control of the cruise line, so the company can influence how passengers spend the last day of their cruise. The entertainment and activities schedule is not so much designed around peaks. Instead, the schedule is aimed at providing a constant flow of things to do to keep passengers active and entertained. In the beginning of the cruise there is more emphasis on providing information and building anticipation. The entertainment programme builds towards a crescendo on the second to last night. The last night is all about the 'warm and fuzzies' to reinforce the emotional connection between the passengers and the crew and the brand. The main tool in this is the Farewell Show where key events from the past cruise are recapitulated and several hundred crew members appear on stage to wave goodbye.

Fellow customers

Experiences are not only influenced by interaction with the service providers, but also by the other customers present. In theatrical terms other customers form the audience, and crowding, unruly or unanticipated behaviour can destroy a service performance (Grove et al., 1992). On the other hand, socialising or bonding with other customers can make an experience more enjoyable (Martin and Pranter, 1989). Many services are created while other customers are present. This particularly applies to situations where customers share the setting simultaneously, as in the case of restaurants and airline travel. This is enhanced when they are in close proximity to each other, have to share space or resources and waiting is involved (Martin and Pranter, 1989). Yet, the role of fellow customers has received little attention in practice and in the literature, except for issues of crowding and social density. This study did not show much evidence of design agencies and consultancies considering the role of other customers in an experience. On the other hand, a number of experiential service providers included fellow customers in their designs and found innovative ways of utilising the value they could add.

Innovation: Making experience more enjoyable and driving revenue

An example of using fellow customers to improve the experience and drive revenue can be found at bakery / coffee shop Le Pain Quotidien. Central to the concept of Le Pain Quotidien is the large communal table in the middle of each coffee shop. The table fits the theme of eating at a farmhouse and uses space efficiently. The main feature of the communal table is that it attracts customers who are by themselves and would like to come in and have a coffee, but do not want to sit alone. Joining the communal table avoids customers feeling alone. It also gives the opportunity to chat with other customers, but often the mere fact that customers do not feel or look alone is enough. As a result, the Le Pain Quotidien shops are very successful at attracting off-peak business from customers that shop by themselves.

Another illustration is the creation of a community around a product or service. A good example is Harley-Davidson, with their Harley Owners Group (H.O.G.). H.O.G. was established in 1983 as a company-sponsored enthusiast organisation in the motorcycle industry, designed to enhance the Harley-Davidson lifestyle experience and bring the company close to its customers. H.O.G. currently has over a million members. Benefits include a magazine, road-side assistance, a touring handbook, events and much more. In addition to this, one of the key benefits of H.O.G. is the opportunity to meet fellow enthusiasts through the local chapters or events that are organised nationally. This camaraderie between riders enhances the experience of owning and riding a motorcycle. From a company perspective, the bonds between fellow customers are a good way of making people ride more, because they know people to ride with and have events to go to. Thus, H.O.G. is also about giving people reasons to ride and put miles on their motorcycle. This will keep people in the sport and make them spend more on service, accessories and clothing. In this way, Harley-Davidson

deliberately uses fellow customers to improve the riding experience and drive expenditure.

Back office support

The physical setting, service employees, service delivery process and fellow customers directly influence a customer's experience and take place front stage. However, there are many things that go on back stage and influence the front stage performance. Most service organisations have a considerable number of back office employees that are vital to the customer experience, yet generally do not interact with customers. As a result, the main innovation related to back stage areas of service delivery involved connecting back office employees to the front stage experience.

Innovation: Connecting back office employees to the front stage experience

Several companies argued that in order to deliver great customer experiences the whole service supply chain should be focused on the customer experience, not just the front stage parts. Yet, this can be difficult for back office employees that rarely meet customers and are quite far from the actual experience creation. To that end, Walt Disney World has developed a system called Role and Purpose. Role and Purpose emphasises that everybody has a different role in the organisation, from checking tickets and sweeping the floor to managing maintenance for example, but all employees have the same purpose: making sure that every guest has the most fabulous vacation of his or her life. This system aims to achieve that everyone knows how their work matters in the final outcome. For example, sweepers know that they are the reason that Walt Disney World is famous for cleanliness, and they are trained in giving guests directions and interacting with children, emphasising how their role contributes to the bigger purpose of a great customer experience.

Another example of creating back office understanding of the front stage experience can be found at Cirque du Soleil. The Studio, Cirque du Soleil's international headquarters in Montreal, is designed around visual contact between administrative staff and artists. From the offices, the administrative staff can see into the training studios where artists work out and develop new routines and vice versa. In this way, the back office employees see what they are contributing towards and the artists keep in touch with the people supporting them.

SUMMARY AND SOME IMPLICATIONS FOR SERVICE INNOVATION

Although service innovation includes both product and process innovation, the design and consultancy firms and experiential service providers in this study often saw a service as a journey. Innovation can take place at any of the touchpoints in the customer journey, including pre and post purchase experiences. The experiential service providers in this study were constantly looking for incremental innovations aimed at improving the customer journey. From a designer's and innovator's perspective, the customer journey is a powerful focus for analysing and designing memorable customer experiences.

Innovation in experiential services covers a broad spectrum, taking place in five distinct areas. The first is the physical environment in which the service is delivered. In experiential services, physical environments are designed for the customer journey and deliberately stimulate the five senses. The second is the service employees that interact with customers. In experiential services, front line service employees are key to engaging with customers and building emotional connections with them. To improve the quality of their work, several companies manage the employee experience, in addition to the customer experience. Thirdly, innovations take place in the design of service delivery processes. For example service delivery processes can be designed to have strong starts and endings and carefully placed peaks. The fourth area for innovation regards the fellow customers that are present. They can be a valuable resource in making an experience more enjoyable through meeting like-minded people. Several companies have found ways of realising this potential and managed to create additional revenue following from the linkages between fellow customers. The final area for innovation is back office support. Some companies developed systems for connecting back office employees to the front stage experience to ensure the entire service supply chain is focused on the customer experience.

The customer journey perspective is very different from the current models and frameworks used for discussing and measuring service innovation. Similarly the innovation content areas such as using fellow customers or sensory design are often neglected in current views of service innovation. This is despite there being a strong theoretical background behind these areas in the field of services management. As yet, there are few linkages between this literature and the literature on service innovation.

4.3 The Process of Innovation

This section discusses the innovation process in experiential services: the process from the initial need or desire to innovate to an implementable solution. It examines the data from the cases on (1) how customer insights drive innovation, (2) what type of design methodologies are being used, (3) the tools and techniques that are employed in the design process, (4) how experiential service providers have organised the innovation and design functions internally and how design agencies and consultancies collaborate with clients and finally (5) the issues with and ways of measuring the success of a service innovation. The chapter ends with a discussion of implications for service innovation.

CUSTOMER INSIGHTS AS A DRIVER OF SERVICE INNOVATION

One of the most important aspects of the innovation and design process in both design and consultancy firms and experiential service providers was research. Consumer research, leading to customer insights, was seen as the basis of experience design and acted as one of the main drivers for innovation. Consequently, the organisations in this study invested a large amount of time and effort in conducting research. Four types of research were commonly carried out: traditional market research, empathic research, trend watching and learning from others.

Traditional market research

Traditional market research focuses on finding out what the market is and what customers want and expect from a company, brand or experience. Both design and consultancy firms and experiential service providers often employed a combination of different techniques, such as focus groups and surveys (web-based or off-line). Market research was used for segmentation, based on customers' demographic and psychographic characteristics. Psychographic characteristics involve, for example, people's motivations to engage in a particular activity such as shopping, cruising or going out. As one consultancy noted, doing market research does not necessarily mean a company should do everything the customer wants. For example it might not be able to afford it, but it should at least find out. Moreover, several companies mentioned that customers might not even know what they want, so they did not expect their customers to design their next service.

Empathic research

Empathic research can be seen as a special kind of consumer research that is particularly important for designing good customer experiences. It was used by a number of organisations in this study. Empathic research is not about finding out what customers want, but about finding out how they 'work'. It aims to lead to an understanding of customers at an emotional level, knowing not just what they say and do but also what they think and feel. In this way, customers' latent needs can be uncovered and, more importantly, it helps to identify what makes

them tick. This is important for developing compelling experiences that say 'for me'. Several techniques are available, including asking customers to draw a particular experience, shadowing them and investigating extreme users. For a project for a financial start-up, IDEO used a set of empathic research techniques to segment users of financial services based on their feelings towards their finances. They then identified a segment of customers with low daily engagement with their money and a lack of clear long-term goals. This segment was currently not being addressed in the marketplace, so financial solutions particularly attractive to this segment were developed.

An example of how Harley-Davidson, a highly customer-focused organisation, gathers customer insights that drive innovation is discussed in Box 4.3.

BOX 4.3: CUSTOMER RESEARCH AT HARLEY-DAVIDSON

In addition to focus groups, surveys and more empathic research methods, Harley-Davidson gathers customer insights through riding with its customers. Employees attend events and rallies and talk to customers, both Harley-Davidson riders and non-Harley-Davidson riders, to find out what they like about the brand and what they are currently missing. People in leadership roles are required to attend at least two events a year and other employees from all departments (marketing, finance, legal, logistics, production etc.), whether they ride themselves or not, volunteer to help out at different events throughout the year, varying from an afternoon to several days. It is not uncommon for Harley-Davidson employees to go on organised multiple-day trips covering thousands of miles. From observing and talking to customers at events and during rides, Harley-Davidson gathers in-depth insights in what motivates them and what their needs are, even if they do not yet express them. These insights are fed back into the organisation and form the basis for innovations in the Harley-Davidson portfolio of products and services. For Harley-Davidson, riding with customers and sharing the experience is the ultimate way of getting close to them.

Trend watching

In addition to the primary research they do with customers, companies often engaged in trend watching, or making long-range forecasts about customer behaviour, needs and preferences. They followed socio-economic or demographic changes, such as changes in lifestyles or what is happing with the baby boomer generation. On a more detailed level, they tried to predict how customers will be spending their time and money, what they would like to be doing, with whom etc. Royal Caribbean, for example, identified that because they are spending less time as a family in their daily lives, a lot of people nowadays want to spend more time together as a family when they are on holiday. As a result they added more family-oriented activities on their ships. They also looked at trends in land-based gyms to help decide what new features

to put in the gyms on their ships, such as a boxing ring. For Royal Caribbean trend watching is vital, because of the lead time of new ships and their lifetime. The ships they are working on today are designed for the voyages they will make fifteen years later. For other companies, looking into the future was a way of staying ahead of the competition and ensuring the products and services on offer continue to match customer's needs. Techniques for trend watching include talking to experts in particular areas (culinary, entertainment, lifestyle etc.), reading magazines and newspapers, and using third-party research focusing on trends.

Learning from others

Although most of the experiential service providers monitored their own industry and observed competitors from a distance, they did not intend to copy what others were doing. Many of the cases in this study were leaders in their industry with regard to the customer experience or were doing something that is unique. Therefore, they looked outside their own industry for inspiration. For example Virgin Atlantic and Herman Miller studied luxury hotels to learn about customer service. X-Leisure saw Selfridges as an inspirational brand and looked to align the same values of matching the customer experience with marketing and brand. X-Leisure also got inspiration from the world of theatre. Walt Disney World followed developments in retail and manufacturing to see how innovations in those industries can be applied in their world. Cross-industry insights are obtained through publications in newspapers and magazines and through site visits.

TIGHT OR LOOSE METHODOLOGIES

There has been much debate as to whether tight and rigorous methodologies typically found in product innovation are also essential for service innovation. On the one hand, these are seen as contributing to effective and controlled innovation processes. On the other hand, it has been argued that services require a more creative and less structured approach. This study revealed strong contrasts within the design agencies and consultancies studied.

In some firms, the design process was seen as requiring a great deal of flexibility in execution. In other firms, the design process was accompanied by a detailed step-by-step approach for coming up with a new design for a service or service delivery process. The first group employ what could be called a 'loose' methodology, when the main steps, activities and tools and techniques involved in the design process are determined for each project individually and on the way. The second group employ a more 'tight' methodology: the main steps, activities and tools and techniques are known beforehand and do not differ much between projects. Both design agencies and consultancies with 'tight' or 'loose' methodologies were passionate about their approach. The firms that advocated a loose design methodology did so from the perspective that every project is different and unique and therefore requires a tailored solution. This

implies that the required activities, techniques for gathering insights and conceptual frameworks need to be chosen specifically for that particular project. Firms with a tight methodology used a particular protocol or road map that they had found to be very effective.

The design agencies and consultancies that were interviewed for this study differed in size. As organisational size is often associated with increasing degrees of formalisation and standardisation of procedures, size might explain this preference for either a tight or loose methodology. However, this was not the case, for both small and large firms employed tight or loose methodologies. An alternative explanation might be that for a relatively homogenous customer base, i.e. all in one industry, tight methodologies would make more sense whereas for highly diverse customer bases spanning different industries loose methodologies would be more effective. However, this was not supported by the data, as both focused and broad firms employed both types of methodologies. Instead, the different methodologies seem to represent different business models: one aimed at selling a particular process or approach, the other at developing customised solutions.

As with some of the design and consultancy firms, several experiential service providers stressed the importance of having flexibility in the design process. They stated that sticking to a fixed routine or fixed group of people inhibits their creativity, can increase time to market unnecessarily and might not lead to the best set-up for the job. In one organisation, the design process was considerably shortened when a good idea could be mocked up into a full-size working prototype in a number of weeks, skipping some of the interim steps. This way of working is obviously enabled by an ongoing design thinking process and customer research efforts to gather insights. In another company, the design processes and design people involved in service innovation projects were also flexible, because the company believed that forcing every project in the same mould would become too stifling from a creative standpoint and it would not get the best thing. The company emphasised there was not one way to design experiences, it depends on what it is. Whilst the contrast between tight and loose methodologies was not as evident as in the sample of design agencies and consultancies, there was clear evidence that the experiential service providers saw flexibility in the use of methodologies as important.

TOOLS AND TECHNIQUES

The companies in this study employed a wide range of tools and techniques in the service innovation and design process. Design agency IDEO for example, has developed a set of 51 Method Cards to inspire design and keep people at the centre of the design process. The methods are grouped in four categories: Learn, Look, Ask and Try. Some of the tools and techniques used by the organisations in this study include the following:

- **Simulation** – Several tools are available for simulating aspects of an experience, including the sensory experience. Such tools were extensively used by HOK Sport Architecture for the design of sport stadiums. For example, they employ software that calculates sight lines, sound reflection and crowd movement in a stadium.
- **Prototyping** – A common step of any product innovation process is prototyping, or making a representation of a design before the final artefacts exist. Prototyping is often done to test various aspects of a design, communicate ideas or features and collect early user feedback. Given the intangible nature of services, prototyping is more difficult (Vermeulen and Van der Aa, 2003). This is even more true for prototyping experiences, as they are not only intangible but also inherently unique and personal. Still, prototyping was an integral part of IDEO's design process. Prototypes are developed from quite early stages in the design process. Early-on they are used to try things out ('build to think'), in the same way as in a theatre play actors might try something out on stage to see whether and how it works. At later stages they are used to communicate ideas to an audience. Particularly for designing experiences, it is important prototypes have physical aspects, to get as close as possible to experiencing the actual experience. Looking at digital 3D demonstrations or witnessing somebody else's experience will not give the full sensory experience end-users will have (Buchenau and Fulton Suri, 2000). A useful technique in experience prototyping is IDEO's method 'bodystorming': setting up a scenario and acting out roles, with or without props, focusing on the intuitive responses prompted by the physical environment.
- **Experimentation** – Experimentation involves trying something on a small scale before launching it in full. This is perhaps easier to achieve for services than for products, as the relatively large intangible component means services can be tested without the need for large capital investments. Several respondents reported that their company had a culture of trying things out: new ideas are put into practice for a limited period of time and carefully monitored. Based on the test results, the innovation is continued, terminated or adapted. At Walt Disney World, for example, small experiments are set up in the parks, accompanied by a sign 'work in progress', and guests are asked for feedback. The Head of Development explained that guests and consumers in general are tolerant of tests, and actually enjoy it, because it shows that companies are innovating and care about customer feedback.

- **Knowledge transfer** – Operating at multiple sites or conducting similar projects brings about the opportunity to learn from across the organisation. For example, HOK Sport Architecture could rely on an impressive range of stadiums to observe what works and what does not and lessons are carried on from one project to the next. Royal Caribbean currently operates a fleet of 21 ships and often innovations on one ship or the introduction of a new ship is informed by the experience at the other ships. For example, entertainment schedules are developed from existing ones and then adjusted for the ship under consideration. With other resorts in California, Paris, Tokyo and Hong Kong, Walt Disney World in Florida can build on the creativity and operational expertise of a worldwide network.

ORGANISING FOR INNOVATION AND DESIGN

In most product-based organisations, the majority of innovation and design activities are allocated to specific organisational roles, such as R&D or product development departments. For the experiential service providers in this study, this generally was not the case. Whilst there was considerable variation in the ways in which the experiential service providers allocated tasks and responsibilities related to innovation, a number of underlying patterns can be identified. They include a different structure for designing tangible and intangible elements, the widespread use of cross-functional teams and a broad base for creativity. Similar reasoning was found in the way in which design agencies and consultancies collaborate with their clients in service design projects.

Tangible versus intangible design

In general, services and experiences are made up of tangible and intangible elements. The experiential service providers in this study often had dedicated design and product development departments for the tangible elements in the service or customer experience, but not for the intangible elements. The tangible elements include the products that are required for or support the service being delivered, such as the motorcycles of Harley-Davidson, the food at Le Pain Quotidien and the cruise ships of Royal Caribbean. Most companies had dedicated design departments, who worked with external consultants, designers and architects who specialise in a particular area. For the intangible elements, however, the companies generally did not have dedicated design departments. Intangible aspects include the service provided by employees, the interaction with other customers and the service delivery process. Design and innovation of intangible aspects principally resided in the operational departments, resembling what Gorb and Dumas (1987) call ‘silent design’: design that is carried out by individuals who are not called designers and would not consider themselves to be designers. Several companies made a point of avoiding distinct design departments for the intangible parts of a customer experience. They argued that such departments might lose touch with reality and do not have the same understanding of customers’ needs and wishes as the people

who are actually involved with delivering the service. Therefore, design and innovation were part of each functional area.

The design agencies and consultancies in this study also emphasised the importance of including operational people in design teams. They often collaborated closely with their clients in order to develop appropriate solutions. They argued that the client knows the business better than the agency does. Furthermore, a high degree of client involvement increases buy-in and makes successful implementation more likely. Several firms mentioned that they often include front line employees in their projects, because of their detailed insight in the current customer experience and the opportunities for improvement. They form a great source of information and the firms emphasised the creativity that can be found inside an organisation, particularly with the people involved in daily operations. At the same time, working with front line employees helps the agencies and consultancies create more essential buy-in.

Cross-functional teams

Experiential design projects are often cross-functional, requiring contributions from people in operations, marketing, branding, business and technology. In most experiential service providers the design and innovation process was executed by multi-disciplinary project teams. The occurrence of multidisciplinary project teams that work on innovation part-time is consistent with Vermeulen and Van der Aa (2003). As in the experiential service firms, the design and consultancy firms emphasised the importance of cross-functional involvement. Yet, as people from the different functions frequently have never worked together before, they faced the challenge of overcoming different interests, specialities and backgrounds.

Broad base for creativity

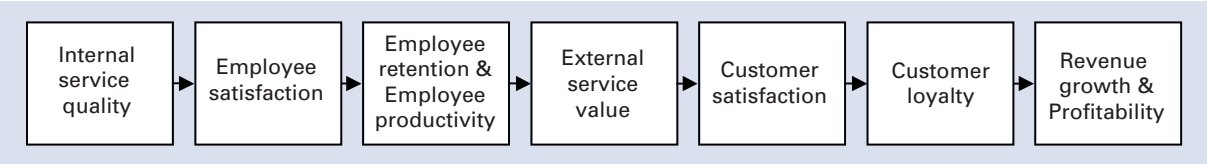
Having dedicated design departments for tangible elements and cross-functional teams of operational people for intangible elements did not mean, however, that creative thinking was limited to these roles. Instead, the experiential service providers emphasised that creative ideas can come from anywhere and anyone in the organisation. It is by no means restricted to management levels or product development roles. Some respondents argued that having such a broad base for creativity was required to remain innovative.

MEASURING THE SUCCESS OF INNOVATIONS

Because of their intangibility and heterogeneity, the quality of services is often more difficult to establish than the quality of physical goods. This is even more true for experiential services, as customer experiences are inherently unique and personal. There are a number of established models for performance measurement in services. A widely used one is ‘the Service-Profit Chain’ developed by Heskett et al. (1994) that looks at the key drivers of performance in service organisations and their inter-relationships (see Figure 4.4). The model

links internal and external service quality to employee satisfaction, customer satisfaction, customer loyalty and eventually profitability. Each of these links can be measured and the results suggest actions that can lead to better financial results.

Figure 4.4: The Service-Profit Chain



Within the Service-Profit Chain an important area is external service value: the relationship between price and service quality. Service quality is defined as the discrepancy between consumers' perceptions of service offered by a particular firm and their expectations about firms offering such services. The SERVQUAL framework (Parasuraman et al., 1988) is a widely accepted model of service quality. It embraces five dimensions:

1. **Tangibles** – appearance of physical facilities, equipment, personnel, and communication materials;
2. **Reliability** – ability to perform the promised service dependably and accurately;
3. **Responsiveness** – willingness to help customers and provide prompt service;
4. **Assurance** – knowledge and courtesy of employees and their ability to convey trust and confidence; and
5. **Empathy** – the caring, individualised attention the firm provides its customers.

The way quality is measured in services is clearly very different from traditional manufacturing-based measures of quality.

The experiential service providers studied devoted considerable efforts to measuring the performance of existing and new services. Current performance was one of the drivers for service innovation. At Walt Disney World, for example, things end up on the agenda for two reasons: one is when something is extremely successful and needs to be advanced and taken to the next level; the other is addressing a gap between customers' expectations and the actual experience at Walt Disney World. Therefore, analysing performance data becomes a crucial activity. Most companies in this study had an ongoing process for data collection and analysis, involving large numbers of customers and continuous measurements. For example, Bluewater measures virtually everything that goes on in the shopping centre: from weekly sales and footfall (165 clusters of 4 cameras) to how many people walk past a particular promotion and the ratio between regular and diet soft drinks sold from the vending machines. They also do regular exit surveys. In this and other companies such data were part of a feedback loop where information on current performance

was fed back to service providers and service designers for continuous improvement of existing services and the development of new services.

To justify investments in service innovation, the experiential service providers in this study often developed business cases, estimating the costs and benefits of the proposed innovation. One of the difficulties with making business cases for innovations in experiential services was predicting the outcome in financial terms. The companies advocated the use of multiple measures, as maximising return on investment may not necessarily mean maximising what is being delivered to the customer. The innovation could be seen as part of a holistic customer experience, having effects across different areas not easily captured by financial measures Therefore, companies often used additional performance indicators such as footfall, dwell time, revenue growth, customer satisfaction, customer loyalty and specific measures of the quality and outcome of the service. These performance indicators are not unique for experiential services, but selecting the right set of indicators for an innovation was considered an art.

This difficulty in predicting the financial returns could have two negative effects. On the one hand it is easy to over-invest and have a great and innovative service that loses money. On the other hand, the difficulty in predicting returns can lead to unwillingness to invest in service innovation.

SUMMARY AND SOME IMPLICATIONS FOR SERVICE INNOVATION

This chapter addressed the innovation process in designing and delivering experiential services. A significant commonality between the organisations in this study was the fact that many innovations were driven by customer knowledge: detailed insights into what customers want, need and what makes them tick. This implies that service innovation in experiential services is primarily customer rather than technology-driven (Hipp et al., 2003).

In several design agencies and consultancies the service innovation process was characterised by a relatively tight methodology, whilst other firms promoted flexibility in activities, frameworks and tools and techniques. This suggests that the relatively tight and rigorous methodologies typically found in product innovation are not always applicable to service innovation.

The innovation process was supported by a range of tools and techniques for service innovation. The intangible nature of services does not preclude the use of sophisticated techniques for reducing risks and improving efficiency of the innovation process.

With regard to the organisation for innovation, the research indicates that although the design of tangible elements typically resides in separate design departments, the design of intangible elements is typically addressed by cross-functional teams of operational people. Thus a great deal of innovation is

undertaken by people whose affiliation or job title does not refer to innovation or design.

Measuring the success of service innovations can be difficult, leading to over- or underinvestment in innovations. The experiential service providers in this study often made business cases to justify a particular innovation and devoted a lot of efforts to measuring performance on a daily or weekly basis. They advocated the use of multiple measures to capture the breadth of a customer experience and link the innovation to financial performance. Yet, choosing the right set of performance indicators was still considered a challenge.

4.4 Additional Observations

In addition to the process and content of service innovation, the research on experiential services identified a number of other areas relevant to service innovation: business model innovation; the role of competition as a driver of innovation and how experiential service innovations were protected from copying by competitors.

BUSINESS MODEL INNOVATION

Business models have for a number of years been at the centre of attention in innovation in IT and e-business innovation. For example in the online music arena there has been a continuous stream of innovations each trying to find new ways of capturing value from consumers. Afuah and Tucci (2003, p.4) define business models as 'the method by which a firm builds and uses its resources to offer its customers better value than its competitors and to make money doing so', being made up of components, linkages and their dynamics. They subsequently develop a taxonomy of business models in e-business. Chesbrough and Rosenbloom (2002) see the function of a business model as embracing the value proposition, the targeted market segments, the structure of the value chain, the cost structure, the position of the firm in the value network and competitive strategy for exploiting the business model. They also extend the application of the business model concept beyond IT to embrace a wider range of innovations. Business model innovation can be defined as the discovery of a fundamentally different business model in an existing business (Markides, 2006).

The research on experiential services revealed that in a number of cases significant business model innovation was involved. In the UK a good example of business model innovation was the development of the Travelex £10 Season at the National Theatre, see Box 4.4.

BOX 4.4: BUSINESS MODEL INNOVATION AT THE NATIONAL THEATRE

The objective of the Travelex £10 Season at the National Theatre was to extend and grow audiences by attracting many who would otherwise not come to the theatre, by selling the majority of seats at a significantly lower cost than before. However, in order to do this on a financially sound basis, it also required considerable innovation in the production of plays. Ways had to be found of producing plays that would work in a large theatre, but at significantly lower cost. Both new behaviour and buy-in was required from directors and producers. The innovative approach worked, all the key people bought into the new business model and the Travelex £10 Seasons have been both artistic, financial and audience successes with near full houses for the season.

Another UK example comes from the Xscape destinations run by X-Leisure. They are experiential service destinations combining a wide variety of activities including indoor skiing, rock climbing, cinemas and bowling; with retail, restaurants and bars. This concept, though innovative in its own right, required substantial business model innovation to become successful. The first Xscape destination was operated within a retail property business model of build and rent. The Chief Executive, PY Gerbeau, brought to this a new business model that included managing it as a destination, building synergy between the brands and activities, proactively developing a culture of experiential service in all the tenants, and aggressive marketing and branding. The impact of this included a sharp upturn in footfall (visitors), increased profitability for the tenants and the knock-on effect for the owners of higher rents. In addition this business model was seen by the city as a low risk strategy, even though the city normally considered leisure as high risk, and thus it reduced the cost of capital for future expansion.

A final example is from the US. When Amazon.com's online business model led to their immense growth, many predicted the demise of regular bookshops. However, the leading chains in the US (Barnes and Noble and Borders) reacted by rethinking their business model along experiential lines. Today, these stores have added a wide range of services such as coffee shops, comfortable chairs for sitting and welcome extended browsing and reading of books in the store. They have now become what is often known as a 'third place' where people can go, relax and possible meet people. Customers have found this very attractive and as well as spending more time there, they spend more on books and sales and profits have risen sharply.

There is much evidence of business model innovation in the whole service sector, not just in experiential services. For example, whilst most financial service innovations do not change the business model, some do. The Open Plan banking model, combining multi-channel delivery with the ability to offset interest across accounts, developed initially by Woolwich embraced a radical change of business model. It was so effective that it was one of the main reasons

for Barclays acquiring them and subsequently adopting the Open Plan model. The low-cost airline model of Southwest Airlines, subsequently adopted by Ryanair, Easyjet and others is as much a business model innovation as a service product innovation. Markides (2006) lists business model innovations in banking, insurance, airlines, brokerage, bookstores and car rental. This indicates that much of the real impact of innovation in services comes not just from the service itself, but from exploiting new ideas to create innovation in the business model.

COMPETITION AS A DRIVER OF SERVICE INNOVATION

Competition between firms is a common driver for innovation as firms try to stay ahead of or keep up with their competitors. For most experiential service providers in this study providing experiential services was a way to distinguish themselves from competitors and increase market share.

Most companies monitored their direct competitors' actions and performance, often using benchmark studies. The companies commented that they welcomed competition, because it keeps them on their toes. In many industries competition leads to a continuous stream of service innovations. This is clearly illustrated by the airline industry (see Box 4.5).

BOX 4.5: INNOVATION IN LONG-DISTANCE AIR TRAVEL

Business travel on transatlantic flights is one of the most competitive of markets. This has led to a continuous stream of innovation in all parts of the service journey and in business models, the main protagonists being BA and Virgin Atlantic. The stream of major innovations started with BA's introduction of flat-bed seats in 1996, but then led on to innovations including a new intermediate class (Premium Economy and World Traveller Plus), meals served before take-off to allow passengers to sleep the whole way, better departure lounges, arrival lounges and services, limousine or bike pick up and delivery, and in-flight services such as massage. More recently, innovation has come from new entrants, Eos Airlines and MAXjet, who offer luxury-only transatlantic travel with more room and further innovations such as suites for on-board business meetings.

In addition to direct competition, the companies typically took a broader perspective on what is competition. For example, for leisure and entertainment services, companies saw themselves competing for customers' time and thus competing with a wide range of service providers.

PROTECTING INNOVATIONS FROM COPYING

In order to capture the benefits of an innovation, companies can try to protect it from copying by competitors using, for example, patents or secrecy. Service innovations are generally thought to be easy to imitate (Vermeulen and Van der Aa, 2003). However, the research did not find much evidence of organisations seeking to protect the Intellectual Property associated with their innovations. Some companies claimed that whilst individual elements of the service experience can be copied, the whole service experience is not easy to replicate. Gupta and Vajic (2000) argue that copying individual elements of an experience will not recreate the same experience, because creating an experience depends on how well the different elements of an experience fit together and on how well they are adapted in continuing interactions with customers. This is not easily copied.

Several experiential service providers in this study felt their innovations were partly protected by their design and innovation culture. Most companies had a culture that was characterised by a thorough understanding of the importance of good customer experiences, a strong dedication to innovation and much support in terms of the resources that were devoted to research, design and development. This enabled them to continuously develop and renew coherent experiences that fit their particular context.

Another major element of protection is provided by the tacit knowledge of managing the service experience. For example X-Leisure incorporates indoor ski-slopes into their Xscape destinations. To do this profitably has required the development of extensive tacit knowledge of the design and running of these slopes and gives the company a competitive advantage and the potential to export this knowledge. When Woolwich developed the successful Open Plan banking model, Barclays did not try to copy this innovation. Instead, it took over Woolwich, partly to acquire the tacit knowledge that made the Open Plan banking model work.

4.5 Reflections on Service Innovation

Studying innovation in experiential services enables us to reflect more widely on the process of innovation in services. This leads to development of a typology and an iterative model of services innovation. In addition, the research illustrates the importance of the use of service language and addressing the heterogeneity of services.

A TYPOLOGY OF SERVICES INNOVATION

As many have pointed out, the innovation literature is dominated by product innovation models. It has also been argued that there are few differences between the basic processes for developing new products and services (Vermeulen and Van der Aa, 2003). Research in service innovation has been

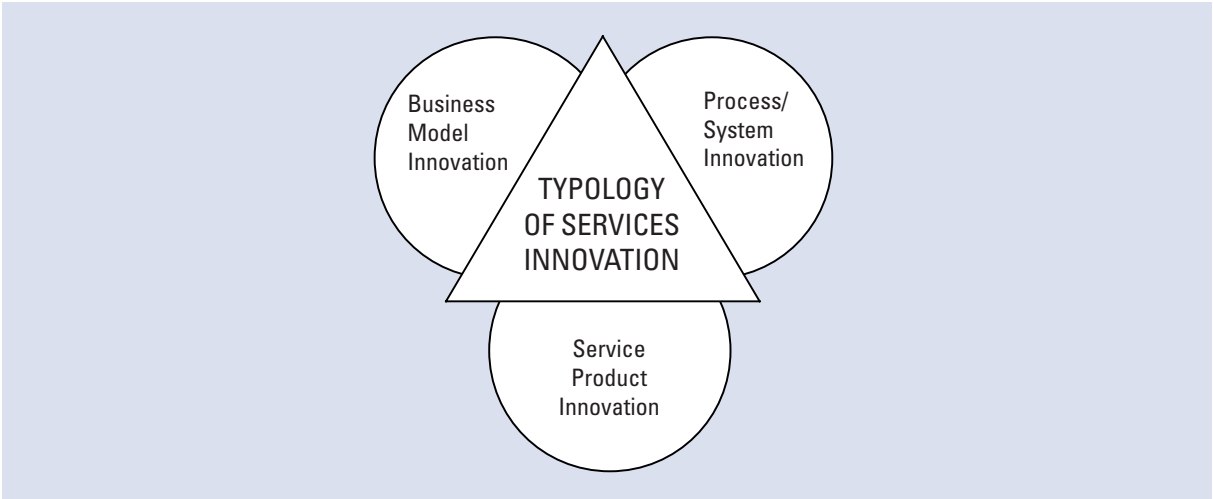
dominated by contexts where the innovation can be considered a product, such as financial services (Vermeulen and Van der Aa, 2003). This research on experiential services is consistent with Hipp et al. (2003), and questions the view of service innovation as being just product innovation. Although product innovation was observed, significant amount of innovation in the services studied came from major or incremental process innovation around customer journeys. Further, consistent with Chesbrough and Rosenbloom (2002) and Markides (2006), considerable services innovation was associated with business model innovation. In addition, in this area technology played a lesser role than might be expected. Some innovations were initiated by new technologies, others exploited them, but many were more complex or not technology dependent.

These observations are consistent with a recent study of services innovation in Ireland (Forfás, 2006). This presented a three-fold typology of services innovation:

- **New business models/concepts** involve a complete or substantial change in the way in which revenues and profits are earned. This is often accompanied by innovations in organisational arrangements in order to accommodate the changes in the business model.
- **New customer/delivery interfaces** involve changes in the way information is exchanged between a customer and a service provider.
- **New service-product offerings** is the most analogous to traditional manufacturing based innovation activity. It involves the introduction of new services.

The second area is consistent with the service process and service journey observed in this research, and with systems innovation (Bower, 2003) and infrastructure innovation (Nightingale, 2003). This leads to a proposed typology shown in Figure 4.5.

Figure 4.5: A typology of services innovation



Source: adapted from Forfás (2006).

Seeing a considerable part of service innovation as process innovation provides insights into understanding the problems of studying and measuring innovation. First, process innovation primarily takes place in operational areas not in separate R&D departments. Innovation activity and expenditure is thus very difficult to measure. Second, process innovations are difficult to measure, both because they are embedded in a wider operational process and because they are frequently incremental rather than radical. Both of these characteristics are shared with manufacturing innovation.

AN ITERATIVE PROCESS

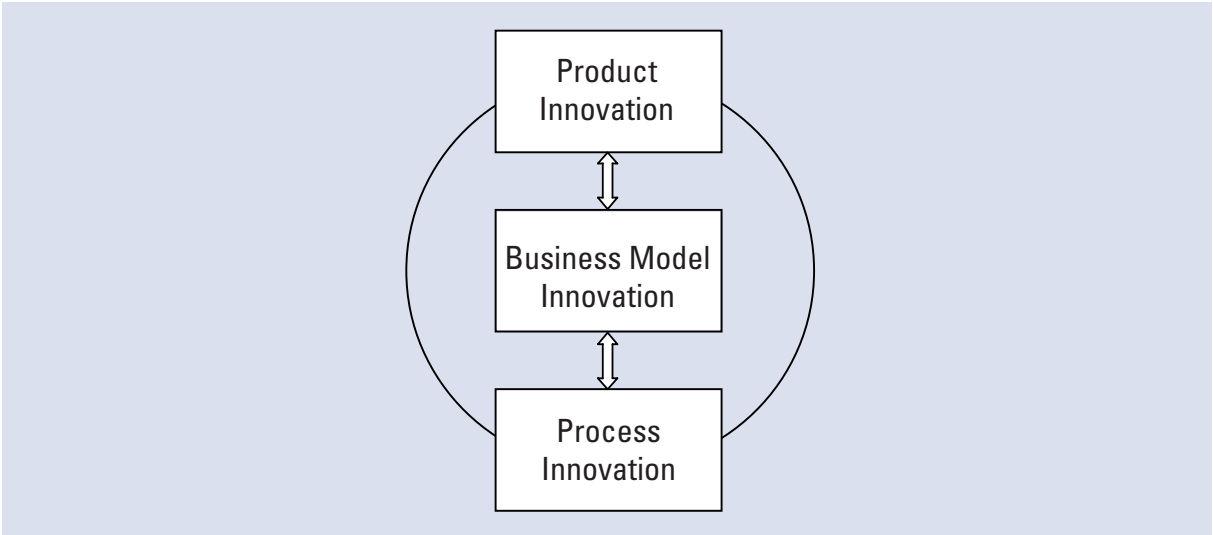
In manufacturing product innovation is seen as leading process innovation. Barras (1986; 1990) observed in service innovation product innovation was preceded by process innovation, and Nightingale (2003) argued that it was enabled by infrastructural innovation. The observations in this research support this, but also indicate that there is an iterative process. For example, a new product, such as all-luxury transatlantic flights mentioned earlier, requires process innovations to enable it to be successful. In addition, the research indicated that business model innovation was an important element of service innovation, and frequently went hand in hand with product and process innovation.

This leads to a model of innovation that links product and process innovation in an iterative cycle, and links them to business model innovation. This is illustrated in Figure 4.6.

This model is consistent with the view on the service innovation process that was put forward by one of the design agencies in this study. Companies should step away from the traditional product-based funnel model for innovation where a large number of ideas is reduced to the last one standing and instead adopt an idea nurturing process, going through cycles of innovation to continuously improve the service:

> *'I think a good innovation is about the idea nurturing process. What one needs to do, is to go around the circle maybe several times. Even after you launched a service, you should be doing this, to evolve it. One needs to go round potentially several times, rather than 'here's an idea, do we kill it or not?' Companies that innovate well get something out there that is 'quite good', and then evolve it and make it into something really good. A mistake that many companies make is that you need to have a 'killer ap' every time. You generally only get to know about wonderful service innovations after it has been evolved and sorted out.' (Source: Practice lead, Service Design and Innovation, IDEO)*

Figure 4.6: An iterative model of service innovation



LANGUAGE

Conducting research into innovation in experiential service innovation leads to further implications for innovation. The language of managing services is in many ways very different from the language of managing manufacturing, for example manufacturing processes are rarely described as customer journeys. Furthermore, the companies in this study often used metaphors from theatre, music or film. At Walt Disney World, for example, customers are called guests and employees are cast members. Bluewater's visitors are also referred to as guests and it is the role of the centre to host them. Whilst the language of product innovation may be similar across services and manufacturing, the language of process and business model innovation is certainly not. In addition, as Barras (1986; 1990) has indicated, uncritical use of manufacturing process-based frameworks may not be appropriate either.

HETEROGENEITY OF SERVICES

This research, having studied innovation in a context different from much previous research, indicates that different contexts may lead to different types of innovation and innovation process. This reflects the heterogeneity of services, and indicates that there is a need for development of effective typologies of services to reflect this and to help understand what processes are required in what context.

IMPLICATIONS FOR POLICY

Despite the heterogeneity of services, there are some generic lessons that can be learnt from innovation in experiential services. The findings of this research are consistent with many of the general models proposed by Bessant and Davies (2007), in particular the reverse product life cycle and customisation. In addition, as pointed out by Markides (2006), business model innovation is at the heart of

disruptive innovation in organisations. Other service sectors, including the public service sector, can learn from the techniques used by the organisations in this study, such as the service journey and touchpoint models and empathic customer research.

The three modes of innovation described above (product innovation, process innovation and business model innovation) are not sector specific, but may occur in any context. Whilst much innovation in services is about product, service innovation can best be understood through a process innovation and business model innovation lens. Doing this helps to understand the problems in measurement of innovation, both of inputs and outputs, and will recognise and advance the innovations in services currently taking place.

Although the successful organisations in this study did not indicate that they required government support, for others it could be important. The implications from this research are that such support should recognise that service innovation includes process innovation as well as product innovation. Although existing manufacturing-based models are important, care should be taken to use the language of service in any support process. Such support should also recognise existing good practices in service process design. Finally support should also be about helping organisations exploit their service innovations through creating innovative and profitable business models.

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Appendix 4.1: Details of Research Studies

This report is based on a continuing programme for research in the field of experiential services at London Business School. It draws from the following studies:

Study I	Trends in the Experience and Service Economy	2004
Study II	Experience and the Brand	2005
Study III	New Strategies in Experience and Leisure	2005
Study IV	Designing for Experience	2006

Study I set out to examine trends in the service economy involving the creation of experiences and to identify factors associated with business success in this area. The research involved interviews with executives from a range of organisations that are delivering experiences, added upon by field data and internal and external documents. The sample contained 50 organisations in the areas of retail, entertainment and sport, theme parks, destinations and hotels, largely from the UK, Europe and US.

Study II was a field study of over 20 organisations, all of which were applying experience management to support existing businesses, build new ones and create innovative ways of connecting with customers. The focus was on the relationship between experience and brands.

Study III focused on innovators and innovations in the experience and leisure industry. Field research was conducted in a wide range of organisations, primarily in the UK and US. The data collection methods entailed interviews with managers from over 50 organisations, site visits to many of their operations and studying public documents to try to understand the strategies and outcomes of these organisations.

Study IV addressed the question how focusing on the customer experience changes the way services and service delivery processes are designed. It looked at the process and content of experience design. The study involved eight case studies of design agencies and consultancies that specialise in experience design and nine case studies of experiential service providers. They are displayed in Table A4.1. The main method of data collection was interviews with founders, executives or experienced designers. In total, 40 interviews were conducted. They were aimed at identifying the design processes, principles and practices for experiential services. In addition, at the design and consultancy firms examples of actual design projects were studied. The interviews at the experiential service providers frequently involved a site visit to observe and experience the customer experience on offer.

Table A4.1: Participants in Study IV: Designing for Experience

Design Agencies and Consultancies	Experiential Service Providers
Brand Experience Consultancy	Bluewater
Beyond Philosophy	Harley-Davidson
Gorgeous Group	Herman Miller
HOK Sport Architecture	Le Pain Quotidien
IDEO (Service Practice)	Luminar Leisure (Lava & Ignite / Liquid)
Imagination	Royal Caribbean
MindFolio	Virgin Atlantic
Prophet	Walt Disney World
	X-Leisure (Xscape destinations)

More information about these and other research projects can be found at http://www.london.edu/otm/

5 Services and the Innovation Infrastructure

Bruce Tether and Silvia Massini[1]

Executive Summary

In this paper, we ask to what extent do service firms have direct links with the science base in the course of their innovation activities? And how do service firms protect their innovations from imitation? In particular, what use do service firms make of formal forms of intellectual property (IP) protection, such as patents and copyrights? Both the science base and formal forms of IP protection can be considered parts of the 'innovation infrastructure', and therefore our wider question is: how well are services served by the innovation infrastructure?

The UK Innovation Survey of 2005 shows most firms use one of four information sourcing strategies for innovation:

1) 27 per cent use only, at most, sources internal to the company or company group;

2) beyond internal sources, 8 per cent use only near-market sources, such as suppliers, customers and/or competitors;

3) 23 per cent use intermediaries, such as conferences, journals or associations and standards, as well as near-market and internal sources; and

4) 38 per cent use internal, near-market and intermediary sources but also directly use specialist research or knowledge organisations, such consultants, private research organisations, universities or public research institutes.

In most industries two-thirds or more of firms make use of near-market sources (customers, suppliers and/or competitors) and over half use intermediaries as sources of information or knowledge for innovation, with manufacturing industries showing a greater tendency to use these sources than services. Specialist research or knowledge organisations are less widely used: in many industries around half the firms make use of these organisations. The wide spread in the distributions also indicates that in some industries it is the norm to make use of research and consultancy organisations, whereas in others such links are uncommon. In general service firms are less likely to use each of near-market sources, intermediaries and research and consultancy organisations as sources of information for innovation, although there is also considerable variety in behaviour across both of these 'grand sectors'.

In the great majority of both manufacturing and service industries only a minority of firms used universities as a source of information for innovation, but

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in general service industries were significantly less likely to use universities than were manufacturing industries. In a typical service industry about one in five firms used universities compared with around one in three firms in manufacturing industries. Public research institutes are also more widely used by manufacturing industries than by service industries, although the difference is smaller than for universities. Consultants and private research organisations are used more widely than either public research institutes or universities, but here again services firms tend to make less widespread use of these than do manufacturers.

The hierarchy of information search behaviours outlined above is associated with different commitments to innovation, such that firms that undertake several innovation related activities (from R&D to marketing) tend to have the widest search patterns, whilst those that undertake few innovation activities tend to have narrow search patterns. Financial commitment to innovation tends to be highly skewed, such that whilst many firms commit little or nothing to innovation, some firms commit substantial resources (i.e., several thousand pounds per employee). Wider search strategies are associated with higher average expenditures on innovation, such that, amongst service firms, those that used near-market sources, intermediaries and research sources spent on average over twice as much per employee (a median of £1,175 per employee) as firms that used no external source of information (a median of £500 per employee), or which confined their search to only near-market sources (median = £517).

We conclude that the UK appears to have an elite of innovating firms committing substantial resources to innovation. For example, just over 1,000 firms in the dataset spent over £5,000 per employee on innovation and engaged in four or more innovation related activities. About half of these 'elite firms' are in manufacturing, the other half are in services, but as a share of the sample of firms elite firms are more common in manufacturing (10 per cent of the sample) and technical services (16 per cent) such as telecommunications, computer software, R&D services and engineering services than other services (3 per cent). These elite firms are characterised by having particularly wide ranging information search strategies that go beyond near-market sources and intermediaries to include research organisations.

Overall, our analysis shows that direct links between universities and the wider public science base are weaker for services than for manufacturing industries. This does not necessarily mean there is a problem to be fixed, as we should not expect that all industries will be equally likely to forge links with the science base. This said, we cannot afford to be complacent either, if links between universities and service industries could be strengthened to the benefit of the UK economy. A recent study by the US National Academy of Engineering (2003) has highlighted the potential of developing the 'underdeveloped interface' between research universities and service industries for the benefit of the US economy. The 2006 CBI-Qinetiq survey of UK businesses also suggests there may be a

greater role for universities, and social and behavioral sciences in particular, to aid the development of the UK's service industries.

The second part of this study concerns how firms – and service firms in particular – protect their innovations. Innovation is about taking calculated risks and dealing with uncertainty, and one way that governments have sought to stimulate innovation is by providing legal instruments by which firms can protect the results of their creative endeavours, most notably through the granting of patents and other forms of intellectual property protection, such as registered designs, copyrights and trademarks

Firms in manufacturing industries are much more likely to use patents to protect their innovations than firms in service industries – it is common for around half the innovating firms in a manufacturing industry to use patents, but rare for more than a quarter of innovating service firms in an industry to use patents. This reflects the nature of these activities, and the extent to which any inventions are patentable. Service industries are also less likely to use registered designs than manufacturing firms to protect their innovations (although service firms are also more likely to use these than patents). The use of copyrights and trademarks to protect innovations also show similar patterns to the use of registered designs, with firms in service industries generally less likely to use these methods of protection than firms in manufacturing industries.

Aside from these formal methods, firms can also use informal or strategic methods to protect their innovations. These include secrecy, confidentiality agreements, complexity of designs, and lead time advantages. It is evident that firms in both manufacturing and service industries made greater use of these strategic forms of protection than formal forms of protection. In general, innovating firms in service industries were less likely to use each of the strategic forms of protection than were innovating manufacturing firms. Taken together, manufacturing and service industries differ markedly by the average number of protection methods used, with services tending to use two or three of the eight methods asked about in the survey, compared with the use of five or six amongst most firms in manufacturing industries.

Firm level analyses suggests that service innovations tend to be protected in a similar way to process innovations, rather than in a similar way to tangible product innovations. However, firms that introduced more than one type of innovation (i.e., new goods, new services and/or new processes) tend to use complex innovation protection strategies involving several of the formal and strategic protection methods. This may be due to their greater awareness of each of the methods, but may also be due to their having more sophisticated intellectual property protection strategies by which they build 'systems of protection' involving several protection methods working together rather than rely on any single line of defence (e.g., patents alone).

If IP protection is indeed based on systems as well as individual components (i.e., patents, copyrights, secrets, etc.) then the strength of protection depends on how well the various components fit together, and it would appear that some of the stronger components (such as patents and registered designs) are more applicable to manufacturing activities (and especially the production of goods) than to services. Overall, these stronger systems may be encouraging greater commitments to innovation by manufacturers than by most service firms. Introducing stronger or more 'service-oriented' forms of IP protection (such as business method patents) might be thought likely to encourage some service firms to commit greater resources to innovation. But such a change to the 'rules of the game' is also likely to influence how the game is played, and the welfare implications of such changes in behaviour are hard to predict. For this reason, we urge caution in this difficult area of policy making.

5.1 Introduction

In this paper we ask two broad questions. First, to what extent do service firms forge direct links with the science base which they use in the course of their innovation activities?[2] Second, how do service firms protect their innovations, and, in particular, what use do they make of formal forms of intellectual property protection, such as patents and copyrights? Both the science base and formal forms of intellectual property protection can be considered parts of the 'innovation infrastructure', and therefore our wider question is: how well are services directly served by the UK's innovation infrastructure?

5.2 Services and their links to the science base

The aim of this section is to provide an up-to-date analysis of the UK situation regarding the direct links between service firms and the science base. To do this, we undertake an analysis of the 2005 UK Innovation Survey data, and examine the extent to which service firms (and their manufacturing counterparts) interact with the science base (i.e., universities and government or public research institutes), as sources of information for innovation or as longer-term innovation cooperation partners. As previous research has shown that service firms tend to be more likely to use private sources of specialist knowledge whilst manufacturers are relatively more likely to use the public science base (Tether and Tajar, 2006), we will also compare the direct use of the science base against the extent to which manufacturing and service firms draw on private consultants, research enterprises or institutes. The large number of respondents to the 2005 UK Innovation Survey makes it is possible to undertake this analysis for a large number of industries within the broader manufacturing and services sectors.

2 It is of course possible for firms to have indirect links to the science base, for example if a firm works with a supplier which itself has direct links with the science base, or if it uses ideas developed by the science base and published in the academic, technical or popular press. Because tracing the indirect use of the science base is difficult with the information available to us, we concentrate on the direct links between firms and the science base.

Aside from descriptive analysis at the industry level, we also use econometric methods to model the extent to which manufacturing and service firms interact directly with the science base (and for comparative purposes their interaction with private sources of knowledge, such as consultants and private research enterprises/institutes).

DATA SOURCE

The dataset used in this paper is the United Kingdom Innovation Survey of 2005, that is the UK's version of the fourth European Community Innovation Survey (CIS) (Robson and Ortmans, 2006), which itself was based on the OECD's "Oslo Manual" guidelines for collecting and interpreting technological innovation data (OECD, 2005). CIS surveys of innovation are 'subject-based' as they ask individual firms about their innovation activities – the firm is the unit of analysis.[3] The firm is asked about whether it has introduced product and/or process innovations, and also other questions about the sources of knowledge for innovation, engagement in R&D, the effects of innovation, intellectual property protection strategies, and expenditures on R&D and other innovative activities. The 2005 survey relates to firms' innovation activities undertaken in the three year period between 2002 and 2004.[4]

The UK innovation survey of 2005 was administered by the UK's Office for National Statistics (ONS) on behalf of the UK Government's Department of Trade and Industry (DTI). The survey was confined to firms with 10 or more employees and the sample of targeted firms, stratified across sections C to K of the Standard Industrial Classification (SIC), was created by the ONS. The survey includes all sectors of the UK economy except agriculture and fishing, the public sector, charitable organisations and personal services.

The survey was sent to 28,000 'enterprises' in the UK in 2005.[5] The responses were voluntary, with the respondents promised confidentiality and that the survey would be used to shape government policy. Overall, 16,446 responses were received – a response rate of 58 per cent (Robson and Ortmans, 2006). Response rates for different sectors, regions, and firm-sizes were broadly consistent.

3. Aside from using indirect measures like patents or R&D activities, the main alternative to the subject-based approach is identifying innovations directly, i.e., the 'object-based' approach, which takes the innovation as the unit of analysis.

4. Overall, CIS data offers a direct measure of participation in commercializing innovations for a broad range of industries that more traditional measures such as patents, or R&D expenditures do not capture (Laursen and Salter, 2006). The interpretability, reliability, and validity of the UK and other CIS surveys were established by extensive piloting and pre-testing before implementation within different European countries and amongst firms from a variety of industrial sectors, including services, construction and manufacturing. Laursen and Salter (2006) observe that CIS data have been used in over 60 recent academic articles, mainly in economics.

5. On the survey: "An enterprise is defined as the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a certain autonomy in decision making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations. An enterprise may be a sole legal unit." It was sent by post to the firm's official representative for providing information on the firm's activities (other surveys are used to calculate the UK Gross Domestic Product, R&D expenditures, etc.). The survey was normally completed by the Chief Executive, Managing Director, Chief Financial Officer, or by the R&D manager of the firm. The implementation of the survey was administered by the ONS and to guide respondents a help service was provided (Robson and Ortmans, 2006).

INFORMATION NETWORKS AND THE SCIENCE BASE

The survey asks about eleven sources of information and whether or not firms used these in the course of their innovation activities.[6] These sources are: sources internal to the firm; other firms in the group of enterprises to which the firm belongs* (if relevant); suppliers of equipment, materials, services, or software*; clients or customers*; competitors or other enterprises in the same industry*; consultants or private research organisations*; universities*; government or public research organisations*; conferences, trade fairs or exhibitions; scientific or trade/technical publications; professional or industry associations; and technical, industry or service standards. For the seven partner types identified above with an asterisk (*), the questionnaire also asks whether the firm had any cooperative arrangements for innovation with these partners.[7]

Swann (2006) found that the sources of information fall into three groups: Companies (internal sources, and sources within the enterprise group, suppliers, customers and competitors); the Science/Research base (universities, government research institutes and consultancies and private research institutes); and Intermediaries (conferences, trade fairs and exhibitions, scientific and trade journals, professional and industrial associations, and technical and industrial standards). A principal components analysis on the sources of information question (Table 5.1), confirms Swann's classification of sources of information into these three groups.

6. The exact question used was: "How important to your enterprise's innovation activities during the three-year period 2002-2004 were each of the following information sources?"

7. This question asked: "Did your enterprise co-operate on any of your innovation activities with other enterprises or institutes during the three-year period 2002-2004? Innovation co-operation is active participation with other enterprises or non-commercial institutions on innovation activities. Both partners do not need to commercially benefit. Exclude pure contracting out of work with no active co-operation."

Table 5.1: Principal components analysis on sources of information used

	PC-1	PC-2	PC-3
Internal to the Enterprise or Enterprise Group	0.065	0.661	0.217
Suppliers of Equipment, Materials, Services & Software	0.173	0.633	0.109
Clients or Customers	0.165	0.790	0.029
Competitors or Other Enterprises in Same Industry	0.255	0.705	0.107
Consultants, Commercial Labs & R&D Institutes	0.175	0.298	0.665
Universities or other Higher Education Institutes	0.196	0.073	0.840
Government or Public Research Institutes	0.287	0.092	0.793
Conferences, Trade Fairs or Exhibitions	0.608	0.237	0.166
Scientific Journals and Trade/Technical Publications	0.798	0.097	0.206
Professional and Industrial Associations	0.810	0.150	0.180
Technical, Industry or Service Standards	0.714	0.257	0.212

Note: Authors' analysis. This principal components analysis (with varimax rotation)[8] was confined to firms that used at least one source of information for innovation. These three components account for 61.5 per cent of the variance in the data.

Although firms might in principle use any source, or combination of them, Swann finds the vast majority of firms follow one of four information sourcing strategies:

1. They rely on none of these sources of information (31 per cent of all firms).
2. They use only companies as direct sources of information for innovation (8 per cent of all firms).
3. They use both companies and intermediaries as direct source of information (22 per cent of all firms).
4. They use all of companies, intermediaries and the research/science base as direct sources of information for innovation (36 per cent of all firms).

It is very unusual for firms to rely only on intermediaries, or on only the research/science base, or a combination of companies and the research/science base (but not intermediaries), or intermediaries and the research/science base (but not companies). Only 4 per cent of all firms engage in these 'other strategies' for sourcing information for innovation.

Swann does not show how this sourcing of information for innovation varies by sector of activity. We can reveal that manufacturers (which here includes a small number of mining and quarrying firms, and a small number of water and energy utility firms) are more likely than services (which here includes construction firms) to use any of these sources of information in their innovation activities. In our analysis we will use a slightly different grouping of sources of information

8. Principal components analysis (PCA) is a statistical technique for simplifying a dataset, by reducing a set of variables to a lower number of dimensions for analysis. In effect, PCA reduces the information in the original variables into a smaller set of weighted linear combinations of those variables. Principal components are then rotated (here with varimax rotation) to enhance the interpretability of the components. Varimax rotation aims to maximize the variance of each of the components so the total amount of variance accounted for is redistributed over the extracted components.

or knowledge for innovation from that of Swann (2006). Firstly, we combine the information provided on cooperative arrangements for innovation with that on sourcing information.[9] Secondly, we are interested in the external sourcing of information or knowledge for innovation and we therefore omit internal (and internal to the company group) sources, and combine the external sources into three groups:

1) Near-Market Sources: Customers, Suppliers and/or Competitors.
2) Intermediaries – as identified by Swann (i.e., conferences, fairs and exhibitions, scientific, technical and trade press, associations, and standards).
3) Consultancy & Research Organisations – as identified by Swann, i.e., universities, government research institutes and consultancies and private research institutes.

Table 5.2: Sources of information or knowledge used for innovation

	Manufacturers	Services	All Firms
Any Involving Near Market	79%	68%	71%
Any Involving Intermediaries	71%	60%	63%
Any Involving Research Organisations	47%	39%	41%
No External Source	19%	30%	27%
Near Market Only	7%	8%	8%
Near Market & Intermediaries	25%	22%	23%
Near Market, Intermediaries & Research Organisations	44%	36%	38%
Other Strategies	4%	4%	4%
All Firms	100%	100%	100%

Note: Analysis based on weighted data, including all firms providing answers.

Table 5.2 shows the overall pattern of response; manufacturing firms are more likely to use all of the sources than are service firms. More detailed analysis, however, reveals that these broad characterisations conceal significant variation within the broad manufacturing and services sectors. Figures 5.1 – 5.3 show the share of companies by industry that recognised they directly used – as sources of information or knowledge for innovation – respectively, near-market sources, intermediaries and research organisations. Figures 5.4 – 5.6 show, respectively, the use of universities, government and public research organisations, and consultants and private research organisations as sources of information for innovation (i.e., the three components of the research organisations identified above). In all of these figures, the unit of analysis is the industry. Industries are defined by both 3-digit and 4-digit Standard Industrial Classification (SIC) or NACE codes (see Box 5.1).

9. Such that all firms with cooperative arrangements for innovation are coded as using that partner type as a source of information or knowledge for innovation.

BOX 5.1: THE STANDARD CLASSIFICATION OF INDUSTRIES AT 3 AND 4 DIGITS

The standard industrial classification (SIC) is hierarchical, such that the more digits in the code the more specific the industry, whilst fewer digits implies a broader collection of activities. For example, 24.41 is the 'class' or 4 digit SIC code for the 'Manufacture of Basic Pharmaceuticals'. This, when combined with the 'Manufacture of Pharmaceutical Preparations' (24.42) forms the 'group' or 3-digit SIC code industry 'Manufacture of Pharmaceuticals, Medicinal Chemicals and Botanical Products'. This 'group' or 3-digit industry itself belongs to the wider "sub-division" or 2-digit SIC code industry "24 – Manufacture of Chemicals and Chemical Products", which is also sub-section DG of the wider "Section D – Manufacturing" in the SIC.

For a full list of the SIC Codes see
http://www.statistics.gov.uk/methods_quality/sic/

Table 5.3 reports the number of industries included in the analysis at the 3 and 4 digit levels of the SIC. To be included an industry had to be represented by at least 10 firms active in it responding to the survey and providing details on their sourcing of information for innovation. In the analysis that follows, we include a small number of mining and water and power utility industries under the label 'manufacturing industries' (however, the analysis is dominated by manufacturing industries as defined by Section D of the standard industrial classification – see Table 5.3) and a small number of construction industries (from Section F in the SIC) under the label of 'service industries' (although the analysis is dominated by service industries as defined by Sections G to K of the SIC).

Table 5.3: Number of manufacturing and service industries in the analysis

	3-digit Industries or SIC 'groups'	4-digit Industries or SIC 'classes'
Manufacturing Industries (+ Mining & Utilities)	84	121
Mining and Water and Power Utilities	6	7
Manufacturing (excluding Mining & Utilities)	78	114
Service Industries (including Construction)	67	129
Construction	5	15
Service Industries (excluding Construction)	62	114
Share of firms providing valid responses to the UK Innovation Survey and included in the analysis	99%	96%

In the figures below, the solid lines show the distribution of 'manufacturing industries' by the proportion of firms in each industry that directly used the various sources of information or knowledge for innovation, whilst the dashed lines show the distribution of 'service industries' (including a few construction industries) by the proportion of firms that directly used these sources. Industries defined by both 3-digit and 4-digit SIC codes are shown. The advantage of using 3-digit industries is that a larger proportion of the total sample is included in the analysis, whereas the advantage of using 4-digit industries is that they are more specific than 3 digits industries. The patterns are in fact very similar for both levels of analysis.

The figures can be viewed like mountain ranges, as the areas under the lines reveal the distributions of industries within the 'manufacturing' and 'services' classifications we have outlined above. Essentially, there are two things to look for. Firstly, the height of the peaks: if the peaks are high, this shows that industries are clustered and that there is relatively little difference in behaviour between the various industries. If, however, there are two or more distinctly separate peaks, this would indicate there are two or more subgroups within the analysed set of industries. Alternatively, if the distribution is much flatter, with few if any distinct peaks, this shows that there is a high degree of variance in behaviour amongst the analysed industries.

Figure 5.1: Share of companies by industry that directly use near-market sources as sources of information for innovation

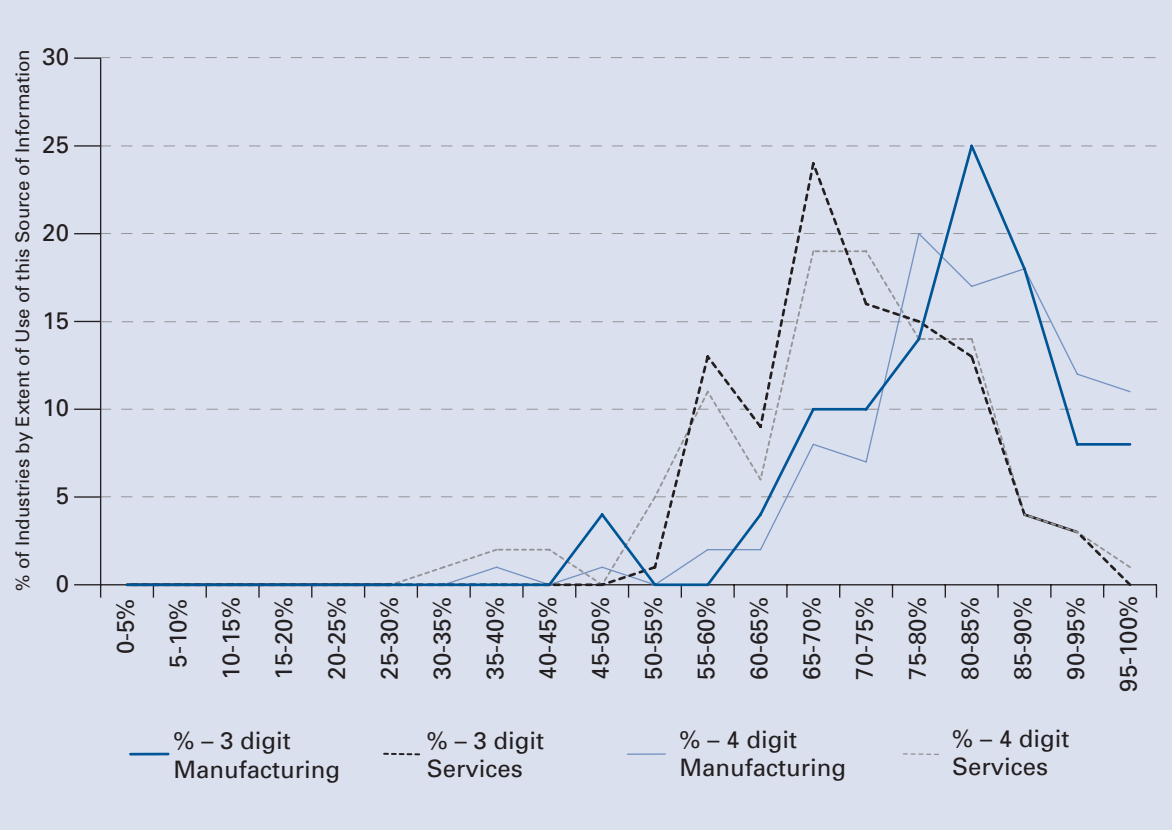


Figure 5.2: Share of companies by industry that directly use intermediaries as sources of information for innovation

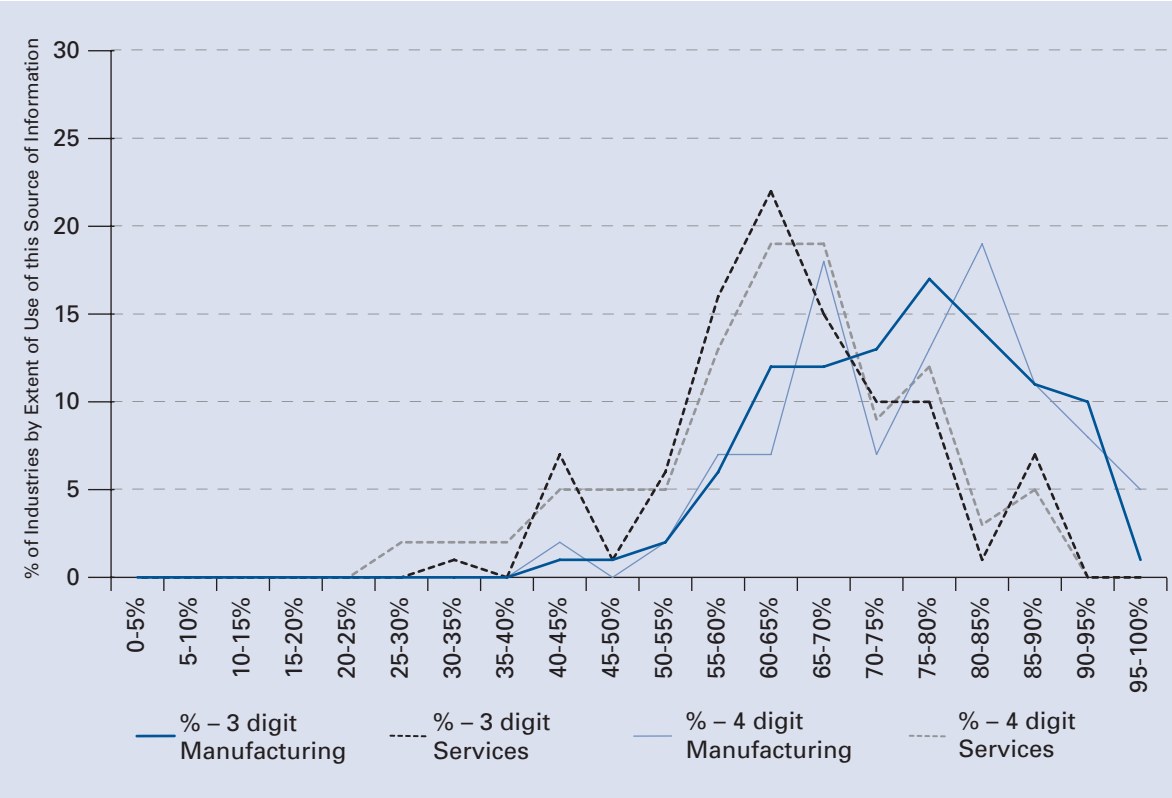
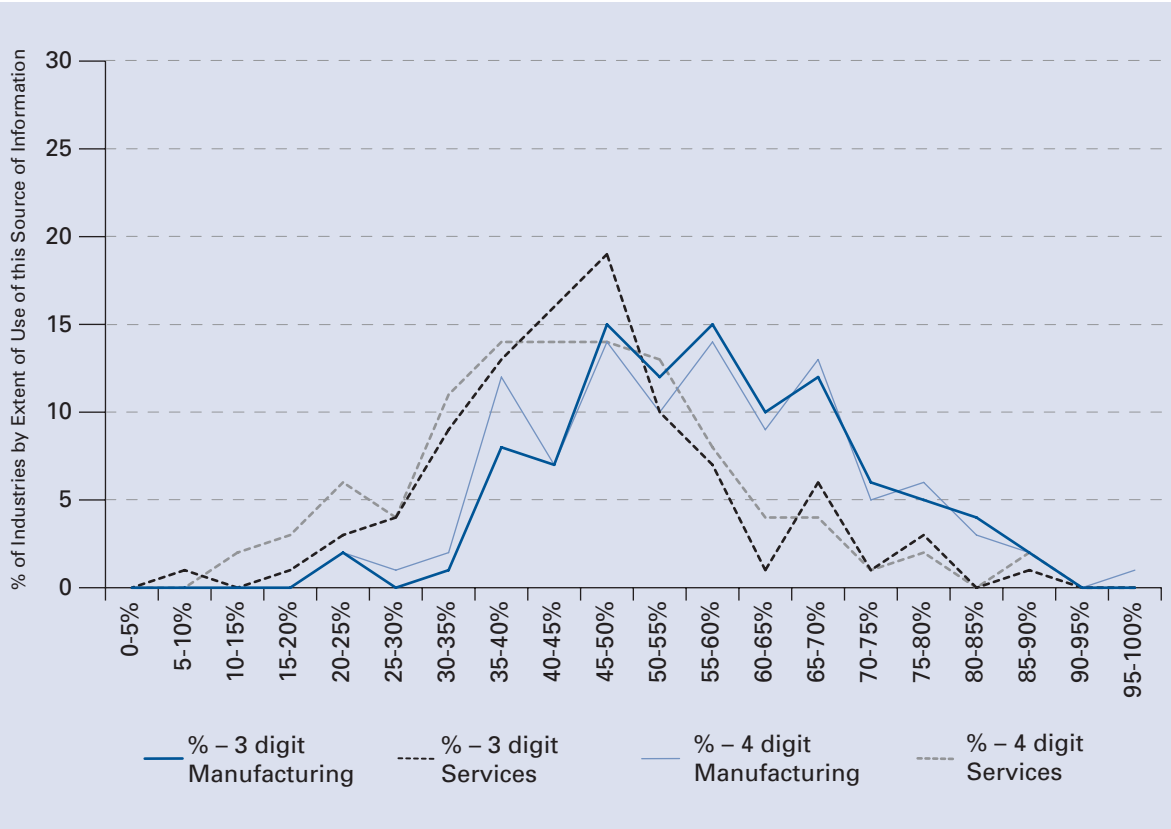


Figure 5.3: Share of companies by industry that directly use consultancy and research organisations as sources of information for innovation



The second thing to look for in the figures is the horizontal positioning of any peaks. If the peaks are to the left of the figure this shows that in many if not most industries firms are unlikely to use the source of information in question, whereas if the peaks are to the right this shows that in many if not most industries firms are much more likely than not to make use of the information source in question. At the extreme left, no firm in the industry uses the source, whilst at the extreme right all firms in the industry use the source. If the peaks are in the middle of the figure then in most industries around half the firms make use of the source of information in question, whilst the other half does not.

The profiles for using near-market sources (Figure 5.1) of information or knowledge for innovation show relatively high peaks to the right of the graph, indicating that in most industries the majority of firms make use of customers, suppliers and/or competitors as sources of information or knowledge for innovation. The widespread use of near-market sources is unsurprising, but what is also notable is that the peak of the distribution for manufacturing industries is to the right of the peak for services, showing that in manufacturing industries there is a greater tendency to use these sources than is the case amongst services. This is perhaps surprising, as it is often argued that innovation in services involves close interaction between the service provider and its customers (i.e., the innovation is 'co-produced') (e.g., Gadrey and Gallouj, 1998), so we might expect the distribution for services to be to the right of that for manufacturers, rather than the other way round. Both manufacturing and services display variation however, and the distributions are overlapping.

The profiles for using intermediaries (Figure 5.2) also show relatively high peaks (and more so for services than for manufacturing industries) that are to the right of the graph, indicating that in most industries the majority of firms make use of one or more intermediary sources. These distributions are however nearer the centre than was the case with near-market sources, which indicates firms are less likely to use intermediaries than near-market sources. It is again notable that the distribution for manufacturing industries is, in general, to the right of the distribution for services (which peaks around 60 per cent of firms using intermediaries, compared with around 80 per cent amongst manufacturers). This shows that in manufacturing industries there is a greater tendency to use intermediaries than in services. As before, both manufacturing and services display variation, and again the distributions are partially overlapping.

The profiles for using consultancy and research organisations (Figure 5.3) for innovation show lower peaks than the distributions for the use of near-market sources or intermediaries. This shows there is greater variation in behaviour amongst the various manufacturing and service industries. The centre of the distributions are also nearer the middle of the graph, indicating in many industries around half the firms make use of one or more of these organisations, whilst the other half do not. As before, the centre of the distribution for manufacturing industries is to the right of the centre of the distribution for

services, showing that, overall, firms in manufacturing industries are more likely to use these sources than are firms in service industries.

The extent of use of these sources are all positively correlated at the industry level, as Table 5.4 shows, with the weakest correlations (at 0.59) being amongst manufacturing industries between the use of near-market sources and of research organisations. This means that those industries in which the use of near-market sources is widespread also tend to be the industries in which the use of intermediaries and/or research organisations is most widespread. Industries in which firms rarely make use of one of these sources also tend to be the industries that make little use of the others.

Table 5.4: Correlations between extent of use of the three information sources

	All Industries			Manufacturing			Service Industries		
	NM	IN	RO	NM	IN	RO	NM	IN	RO
Near Market (NM)	1.00	0.90	0.70	1.00	0.88	0.59	1.00	0.91	0.75
Intermediaries (IN)	0.90	1.00	0.79	0.86	1.00	0.72	0.89	1.00	0.80
Research Org (RO)	0.70	0.76	1.00	0.59	0.67	1.00	0.70	0.75	1.00

Note: The figures above the diagonal give the correlations for the 3-digit SIC industries, those below the diagonal give the correlations for the 4-digit SIC industries. To be included an industry needed to be represented by at least 10 firms providing information.

The graphs above only show the extent to which firms in different industries used these sources. What they do not show is the average importance attached to them. It might be, for example, that one source is used less frequently (e.g., research organisations) but considered more important by those firms that use it than the average importance attached to another, more widely used source of information (e.g., intermediaries). Using a similar approach to that outlined above, we found that amongst firms that used the three sources of information there was little difference between manufacturing and service industries in terms of the importance they attached to them. Overall, however, the average score for importance (where 1 would signify that all firms using the source considered it to be of low importance, whilst 3 would indicate that all firms using the source considered it of high importance) shows that near-market sources tended to be considered the most important (with an average score of 2.40), followed by intermediaries (1.93), with research organisations generally considered the least important (1.59). Table 5.5 shows the average scores and standard deviations are very similar for firms in manufacturing and service industries.

Table 5.5: Importance of the sources of information amongst users

	All Industries Mean Score (S.D.)	Manufacturing Mean Score (S.D.)	Services Mean Score (S.D.)
Near Market	2.40 (0.14)	2.42 (0.13)	2.38 (0.15)
Intermediaries	1.93 (0.17)	1.92 (0.18)	1.94 (0.16)
Consultancy & Research Organisations	1.59 (0.19)	1.61 (0.19)	1.57 (0.19)
Universities	1.36 (0.18)	1.40 (0.19)	1.33 (0.15)
Public Research	1.34 (0.14)	1.30 (0.13)	1.37 (0.14)
Public Science Base	1.44 (0.18)	1.45 (0.20)	1.43 (0.17)
Consultancies & Private Research Institutes	1.49 (0.14)	1.49 (0.15)	1.48 (0.14)

Note: These means are based on the means for each industry, in which each firm using the source scored this 1 (of low importance), 2 (of medium importance) or 3 (of high importance). A score of 1 therefore implies all firms using the source regarded it as of low importance, whilst a score of 3 indicates all firms using the source regarded it as being of high importance.

To summarise, whilst the graphs show that the shares of companies using these sources differ between manufacturing and services, amongst those that do use them manufacturing and services firms tend to value them in a similar way.

The correlations between the importance ascribed to each of these sources are given in the Table 5.6. Although considerably lower than the correlations for the extent of their use, these correlations are all positive – so industries that give high (or low) scores to one source also tend to give high (or low) scores to the other sources.

Table 5.6: Correlations between the importance of the sources of information

	All Industries			Manufacturing			Service Industries		
	NM	IN	RO	NM	IN	RO	NM	IN	RO
Near Market (NM)	1.00	0.41	0.29	1.00	0.40	0.26	1.00	0.46	0.32
Intermediaries (IN)	0.33	1.00	0.50	0.34	1.00	0.45	0.38	1.00	0.59
Research Org (RO)	0.35	0.48	1.00	0.34	0.53	1.00	0.36	0.45	1.00

Note: The figures above the diagonal give the correlations for the 3-digit SIC industries, those below the diagonal give the correlations for the 4-digit SIC industries. To be included an industry needed at to be represented by at least 10 firms providing information.

As a particular interest of this paper is in the extent to which firms directly use the science base in their innovation activities we now repeat the analysis disaggregating the 'consultancy and research organisations' into its three constituent parts: universities; government and public research organisations and, for comparative purposes, consultants and private research organisations (including R&D enterprises).

Figure 5.4 shows the proportion of manufacturing and service firms using universities as a source of information or knowledge for innovation. The distributions show high peaks (especially for services, less so for manufacturing) to the left of the graph. This shows that in most industries only a minority of firms used universities in this way, and in general, firms in service industries were less likely to use universities than were manufacturers. However, there are some outlying service and manufacturing industries in which firms are more

likely than not to directly use universities as a source of information in the course of their innovation activities.

Figure 5.5 shows the use of government and public research institutes as a source of information for innovation. Again, the distributions show high peaks to the left of the graph, which shows that in most industries the norm was for firms not to use this source of information. It is notable that the distribution for manufacturing industries appears slightly to the left of the corresponding distribution for using universities (indicating slightly lower use overall), whilst for services the distribution for public research institutes was slightly to the right of the corresponding distribution for universities (indicating still low but slightly greater use). In contrast to universities, there appears to be little difference between the extent of use of public research organisations by firms in manufacturing and service industries (i.e., the distributions overlap to a greater extent than those concerning the use of universities).

Figure 5.6 is for the use of consultants and private research organisations. The distributions are less peaked than for universities or public research organisations, indicating greater variation in behaviour between industries within the broad manufacturing and service classifications. Notable also is that the distributions of both manufacturing and service industries are closer to the centre of the graph, indicating more widespread use than was the case with either universities or public research organisations. The peak of the distribution for service industries remains to the left of that for manufacturers, indicating less widespread use of this source than amongst manufacturing industries.

Figure 5.4: Proportion of manufacturing and service firms using universities as a source of information

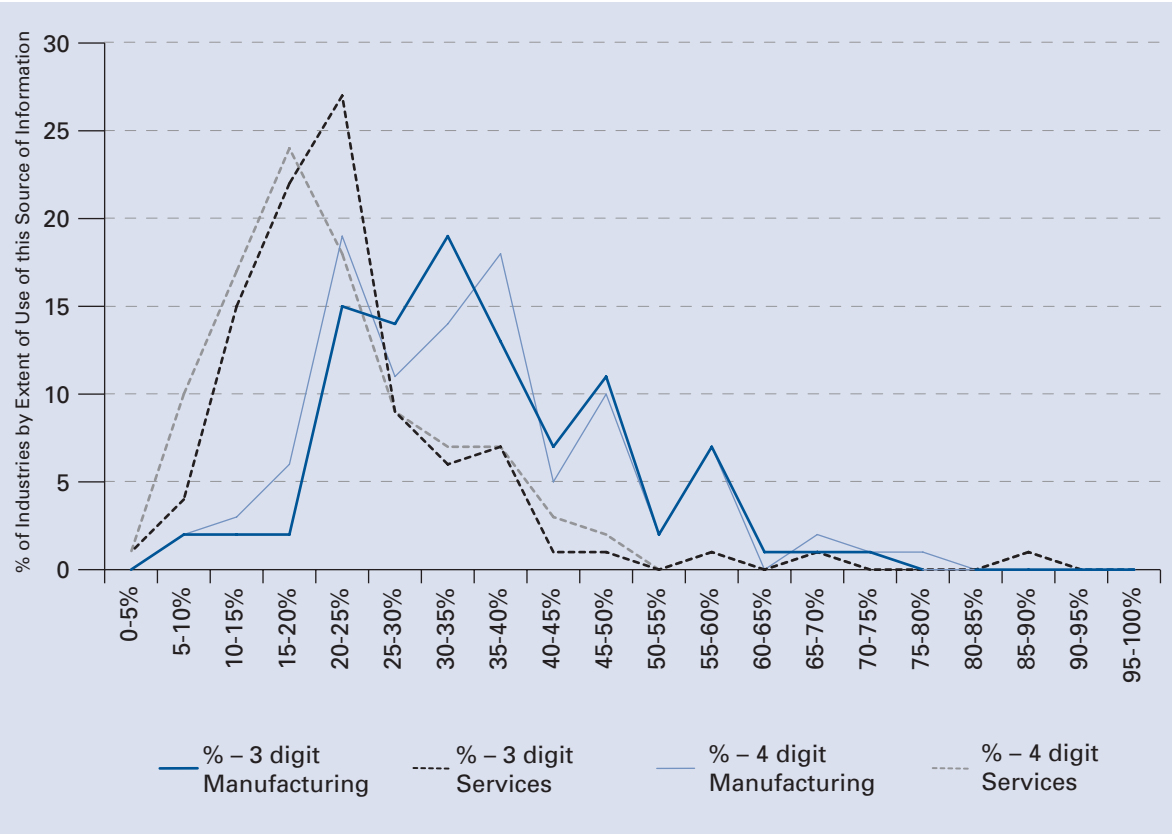


Figure 5.5: Proportion of manufacturing and service firms using public research institutes as a source of information

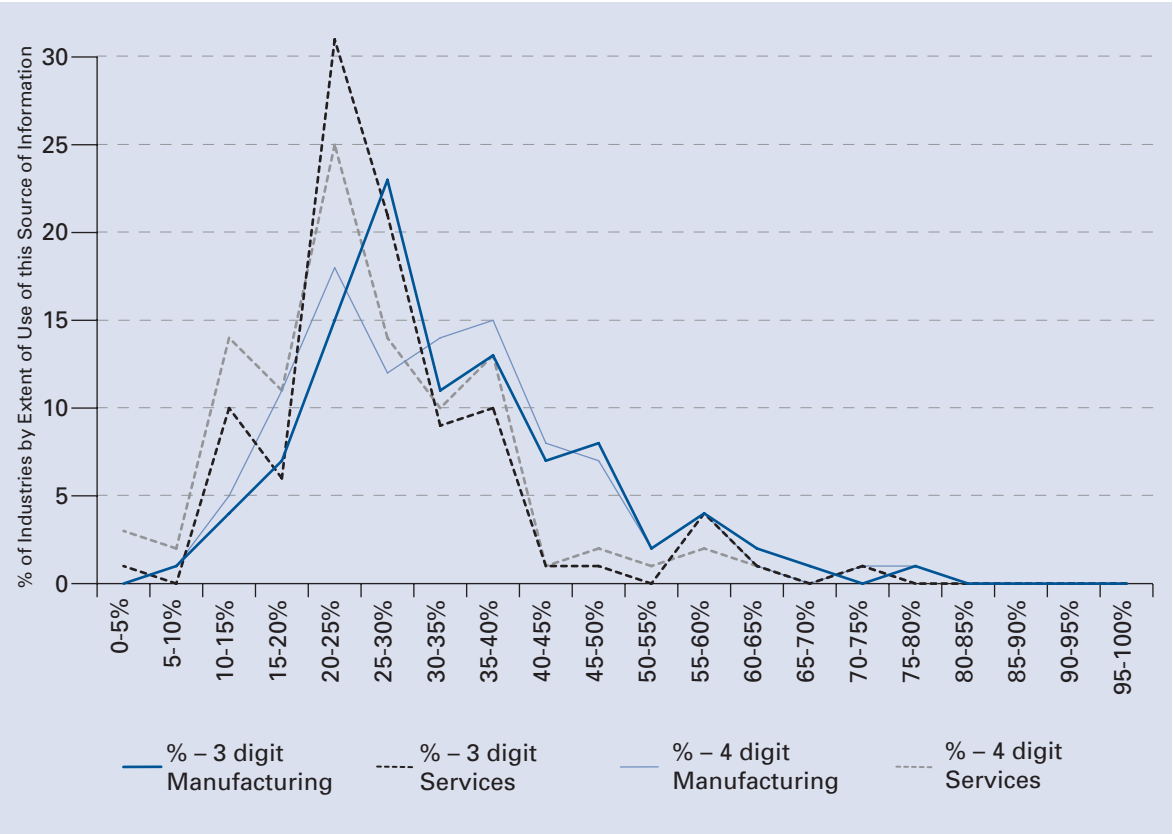
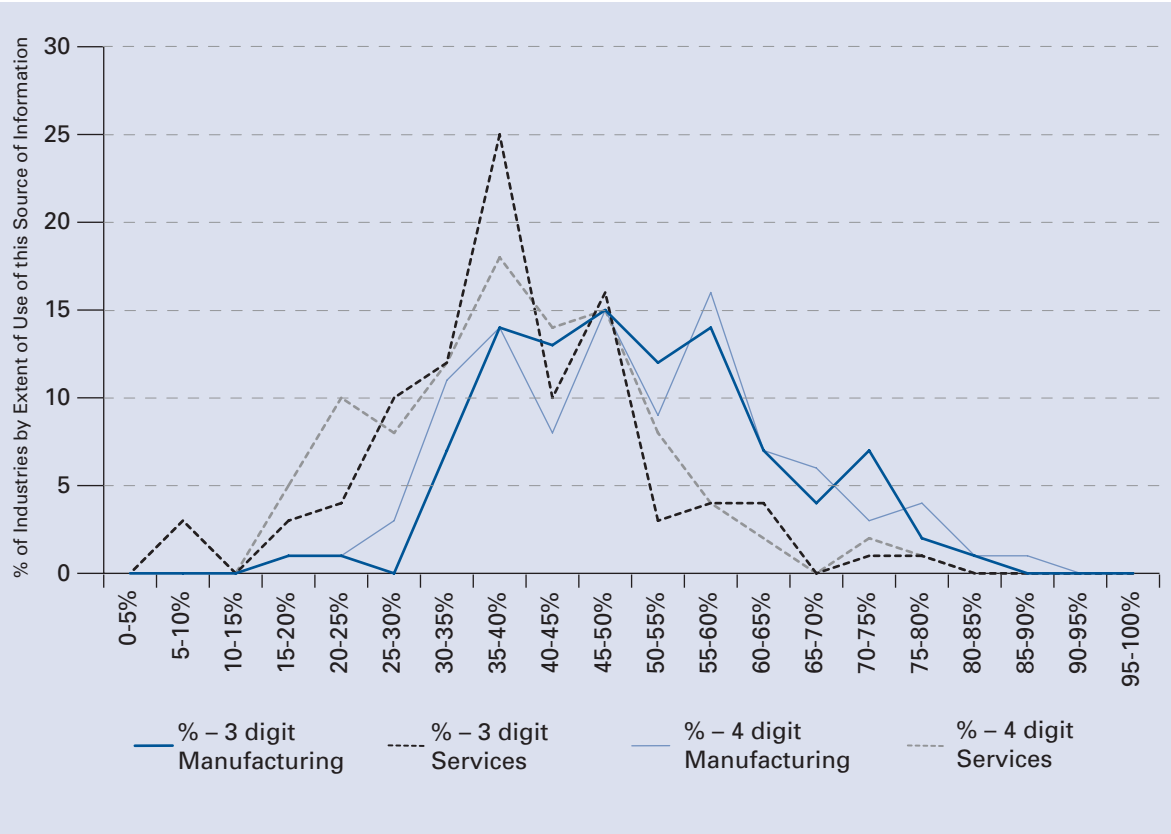


Figure 5.6: Proportion of manufacturing and service firms using consultancies and private research as a source of information



Correlations between the extents to which industries use these research sources are all high and positive, within both manufacturing and service industries (Table 5.7). This shows that industries in which one of these sources is widely used also tend to be the industries in which the others are more widely used, whilst there are other industries in which most firms make little use of any of these sources.

Table 5.7: Correlations in the extent of use of the research sources

	All Industries			Manufacturing			Service Industries		
	Uni	Pub	Pri	Uni	Pub	Pri	Uni	Pub	Pri
Universities (Uni)	1.00	0.87	0.83	1.00	0.87	0.80	1.00	0.87	0.79
Public Research (Pub)	0.82	1.00	0.80	0.82	1.00	0.78	0.82	1.00	0.82
Consultancies & Private Research (Pri)	0.80	0.77	1.00	0.80	0.77	1.00	0.80	0.77	1.00

Note: The figures above the diagonal give the correlations for the 3-digit SIC industries, those below the diagonal give the correlations for the 4-digit SIC industries. To be included an industry needed to be represented by at least 10 firms providing information.

Table 5.5 showed that, on average, consultancies and private research institutes tend to be regarded as the most important of research organisations, followed by universities and public research organisations. When combined into the public science base, the importance of universities and public research organisations is similar to that of consultancies and private research institutes. Also notable is that amongst firms using these sources there was little difference in the importance attached to them between firms in manufacturing and those in service industries.

Correlations concerning the importance attached to these sources of information amongst firms that used them are also all positive, indicating that those industries that score one source highly also tend to score the other sources highly, although these correlations are substantially lower than those for the extent of their use (Table 5.8).

Table 5.8: Correlations between the importance of research sources

	All Industries			Manufacturing			Service Industries		
	Uni	Pub	Pri	Uni	Pub	Pri	Uni	Pub	Pri
Universities (Uni)	1.00	0.51	0.48	1.00	0.55	0.48	1.00	0.60	0.46
Public Research (Pub)	0.53	1.00	0.61	0.58	1.00	0.66	0.58	1.00	0.59
Consultancies & Private Research (Pri)	0.39	0.47	1.00	0.37	0.48	1.00	0.41	0.47	1.00

Note: The figures above the diagonal give the correlations for the 3-digit SIC industries, those below the diagonal give the correlations for the 4-digit SIC industries. To be included an industry needed to be represented by at least 10 firms providing information.

SUMMARY

We have shown that firms tend to display a hierarchy in their direct sourcing of information or knowledge for innovation. The first set of firms uses no external sources of information or knowledge in their innovation activities. This group appear to rely entirely on internal sources. The second set confines its external sourcing of information or knowledge to near-market sources, such as customers, suppliers and/or competitors. The third group of firms also use near-market sources but extends beyond these to also include intermediaries, such as conferences, trade fairs and exhibitions, scientific and trade publications, professional and industrial associations, and technical and industrial standards. The fourth set of firms also uses near-market and intermediary sources, but goes beyond these to also include direct connections with consultancy and/or research organisations in their information search activities. Only a small set of firms do not follow any of these four information search strategies.

Secondly, we have shown that service firms are less likely to use all of these sources of information for innovation than are manufacturing firms. There is, however, substantial variation within each of these 'grand sectors', such that in some service industries a larger number of sources are used than in the average manufacturing sector.

Thirdly, we have shown that amongst consultancy and research organisations, firms are more likely to make direct use of private consultancies and research organisation than they are of universities or public research organisations in their innovation-related information seeking activities. Amongst these three sources the greatest difference in direct use between manufacturing and service firms is found with universities, whilst the least difference arises with public research organisations.

We should stress again that this analysis examines firms' direct links with various sources of information for innovation. The importance of universities and other research organisations is likely to be substantially greater if indirect

links are taken into account (e.g., with information passing through other companies like suppliers or intermediaries like scientific and trade publications), but such an analysis is not possible with the available data. It is probably the case, however, that those industries in which firms make greatest direct use of universities and research organisations also tend to be the industries which make greatest indirect use of these organisations, as our analysis has shown strong positive correlations between the use of near-market sources, intermediaries and research organisations.

FURTHER QUESTIONS

We would like to know whether the hierarchy of information search behaviours outlined above is associated with differential commitments to innovation, such that, as we would expect, firms that commit most to innovation also tend to have the widest search patterns, whilst those that commit least tend to have narrow search patterns.

Secondly, why are services less likely to use the various sources of information, and the science base in particular, than are manufacturing firms? This also relates to the question: what types of firms use the public science base and which use private consultants? This second question especially is complex, and we do not pretend to provide a full answer here, but some insight into the issue.

INFORMATION SOURCING STRATEGIES AND COMMITMENTS TO INNOVATION

The evidence suggests that there is indeed a relationship between the extent of firms' information search behaviours and their own commitments to innovation. We can see this in two ways. First through the various innovation-related activities that firms engaged in, and second through their recorded expenditures on innovation, with both of these being related to firms' information search strategies.

Concerning the innovation activities that the firms may have engaged in, the survey asked: During the three-year period 2002-2004, did your enterprise engage in the following innovation activities?: Intramural (in-house) R&D; Acquisition of R&D (extramural R&D); Acquisition of machinery, equipment and software; Acquisition of external knowledge; Training; All forms of Design; Market introduction of innovations.[10] The questionnaire also asks for the firms' expenditures on these activities in the year 2004. When examining the innovation-related activities that firms engaged in, it is apparent that firms with the widest innovation search activities were the most likely to do each of these activities, whilst firms which did not undertake these activities tended to have narrow (if any) information search activities (see Table 5.9).[11]

10. For definitions of these, see the survey questionnaire, at: http://www.dti.gov.uk/files/file9688.pdf

11. Notable also here is that the patterns of expenditure of manufacturing and service firms are similar with respect to training, acquired external knowledge and marketing of innovations, whereas services are less likely to record expenditures on R&D (especially in-house R&D), design and acquired machinery and equipment than are manufacturing firms.

In relation to using research organisations, firms that engaged with any research organisations were considerably more likely to engage in any or all of the innovation related activities outlined above than were firms that did not engage with the research organisations (see Table 5.10). Firms that engaged with only the public science base were less likely than those that engaged only with private consultancy and research organisations to undertake these activities. The firms that engaged both public and private research organisations were the most likely to undertake any and all of the various innovation activities.

In relation to expenditures on innovation, Figures 5.7 to 5.10 show that firms with wider search strategies tended to spend more (per employee) on innovation than firms with narrow search strategies, although there is also wide variation in expenditures as is shown by the large gap between the firms at the 25th and 75th percentiles of each distribution.[12] Amongst service firms, those that used all three of near-market, intermediary and research sources spent, on average (i.e., median expenditure per employee), over twice as much on innovation as firms that used no external source of information, or which confined their search to near-market sources only. The differences in expenditure are even more marked when expenditures on acquired technologies (acquired R&D, machinery and equipment, or other external knowledge) are excluded to leave (internal) expenditures on R&D, design, training and marketing.

Amongst those firms that engaged research organisations as sources of information or knowledge for innovation, those that used both public and private sources of information or knowledge tended to spend more, on average, than firms that engaged with either private or public research organisations.

12. Note that the figures that follow (Figures 5.7, 5.8, 5.9, and 5.10) show only those firms that recorded expenditures on innovation in 2004 - we know that those firms with wide information search strategies were much more likely to record such expenditures than were firms that had (at most) narrow search strategies, so the differences in average expenditures including all firms would be still wider than those reported here.

Table 5.9: Engaging in innovation activities by information sourcing strategies

		None Used	Near-Market Only	Near-Market & Intermediaries	Near-Market, Intermediaries & Research	Other Strategies	All Firms
Intra-mural R&D	All Firms	2%	17%**	28%***	46%***	16%**	27%***
	Manufacturing	4%	27%	44%	61%	28%	42%
	Services	1%	14%	23%	41%	13%	22%
Acquired R&D	All Firms	0%	4%	6%	21%*	6%	10%
	Manufacturing	1%	2%	7%	25%	7%	13%
	Services	0%	4%	6%	19%	5%	9%
Acquired Machinery & Equipment	All Firms	7%*	43%**	52%**	63%**	37%***	42%**
	Manufacturing	13%	55%	63%	72%	55%	57%
	Services	6%	40%	48%	59%	33%	38%
Other Acquired Knowledge	All Firms	1%	5%	10%	24%	12%	12%
	Manufacturing	1%	6%	9%	25%	16%	15%
	Services	1%	4%	10%	24%	11%	12%
Innovation related Training	All Firms	6%	26%	41%	60%	30%	37%
	Manufacturing	7%	25%	43%	61%	37%	42%
	Services	6%	26%	40%	60%	28%	35%
All Forms of Design	All Firms	1%	9%*	14%**	27%**	9%*	15%**
	Manufacturing	3%	14%	25%	40%	14%	26%
	Services	0%	7%	11%	22%	8%	12%
Innovation related Marketing	All Firms	1%	12%	24%	39%	16%	22%
	Manufacturing	1%	7%	23%	41%	16%	26%
	Services	1%	13%	25%	39%	16%	22%
Any of these Activities	All Firms	11%*	58%**	71%**	82%**	52%***	57%***
	Manufacturing	17%	72%	84%	91%	74%	73%
	Services	10%	55%	67%	79%	47%	53%

Note: Weighted analysis including all firms (except where data is missing). Manufacturing – Services: *** 20%+ differences; ** 10 – 20% differences; * 5 – 10% differences.

The table can be read as follows (from first column): of the firms that used no sources of information 2 per cent engaged in intra-mural R&D (4 per cent of manufacturers, 1 per cent of services), whereas amongst those that used only near-market sources 17 per cent of firms engaged in intra-mural R&D and so on.

Table 5.10: Engaging in innovation activities by sourcing information from consultancy and research organisations

		Not Used	Universities or Public Institutes only	Private Consultancy or Research only	Both Public and Private Sources Used	All Firms
Intra-mural R&D	All Firms	14%**	33%**	41%**	51%***	27%***
	Manufacturing	26%	45%	53%	66%	42%
	Services	11%	29%	36%	45%	22%
Acquired R&D	All Firms	3%	10%	19%	23%*	10%
	Manufacturing	4%	9%	20%	30%	13%
	Services	3%	10%	18%	21%	9%
Acquired Machinery & Equipment	All Firms	29%**	56%**	63%**	63%**	42%**
	Manufacturing	43%	64%	70%	74%	57%
	Services	26%	53%	60%	59%	38%
Other Acquired Knowledge	All Firms	5%	18%	21%	27%	12%
	Manufacturing	5%	19%	19%	29%	15%
	Services	5%	18%	22%	26%	12%
Innovation related Training	All Firms	22%*	51%*	54%	63%*	37%*
	Manufacturing	27%	47%	52%	67%	42%
	Services	21%	52%	55%	62%	35%
All Forms of Design	All Firms	7%**	16%**	24%**	30%***	15%**
	Manufacturing	15%	29%	32%	45%	26%
	Services	5%	12%	21%	25%	12%
Innovation related Marketing	All Firms	12%	27%	33%	44%	22%
	Manufacturing	13%	27%	33%	47%	26%
	Services	11%	27%	34%	43%	22%
Any of These Activities	All Firms	41%***	75%**	81%**	83%**	57%***
	Manufacturing	57%	88%	89%	92%	73%
	Services	36%	72%	79%	80%	53%

Note: Weighted analysis including all firms (except where data is missing). Manufacturing – Services: *** 20%+ differences; ** 10 – 20% differences; * 5 – 10% differences.

The table can be read as follows (from first column): 14 per cent of firms that did not use any of the research organisations as a source of information engaged in intra-mural R&D and so on.

Figure 5.7: Manufacturing Firms – Total Innovation Expenditure per Employee

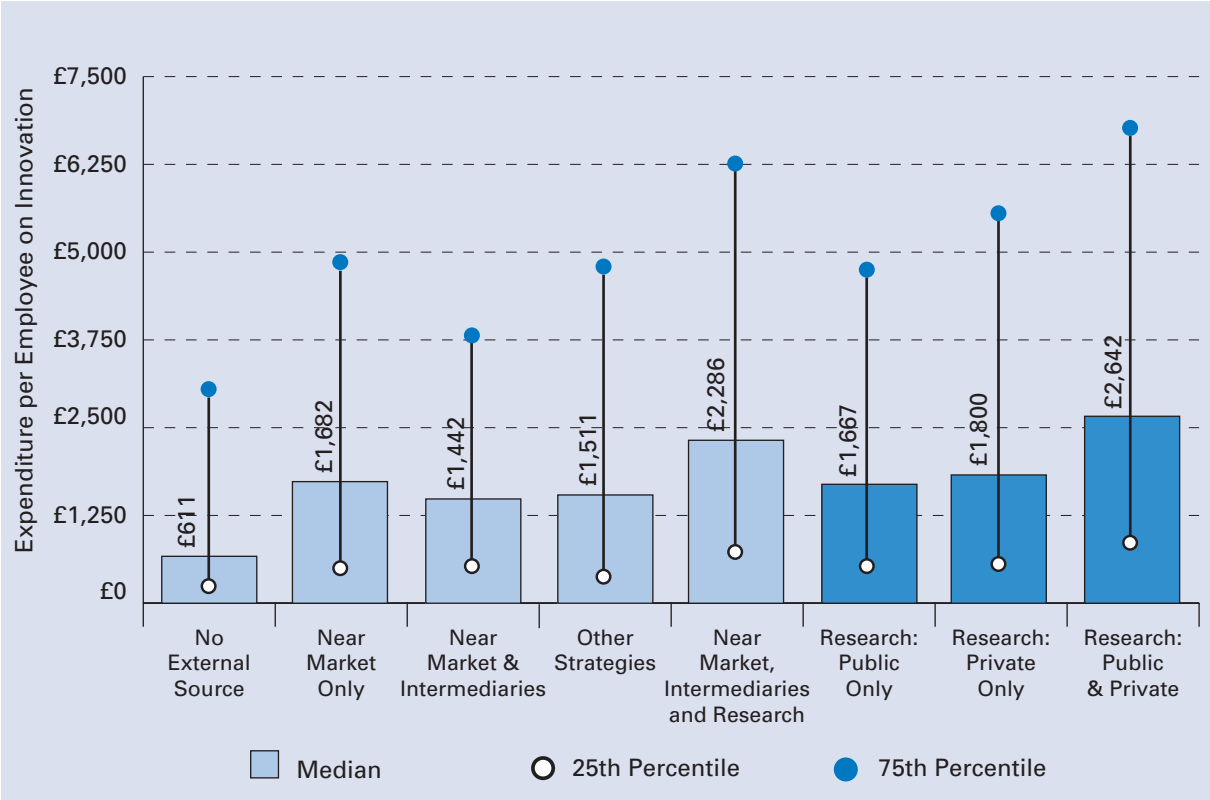


Figure 5.8: Services Firms – Total Innovation Expenditures per Employee

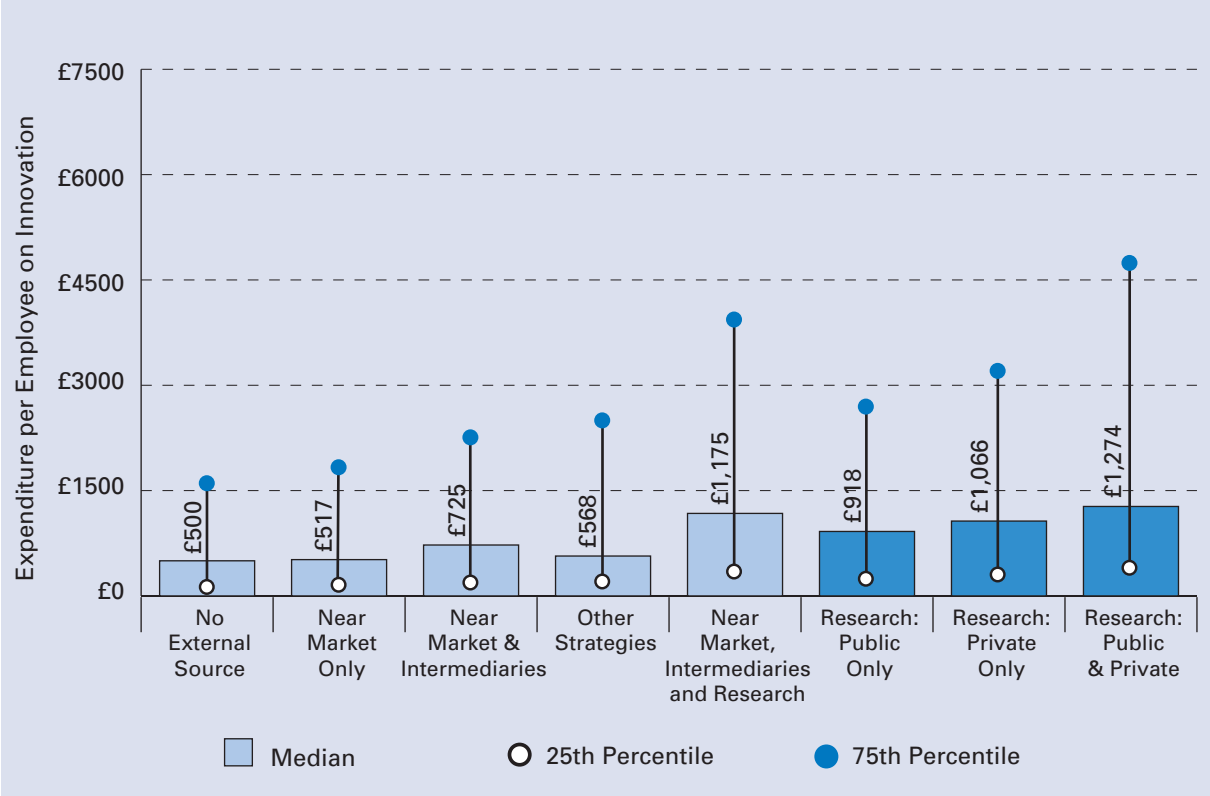


Figure 5.9: Manufacturing Firms – Internal Innovation Expenditure per Employee

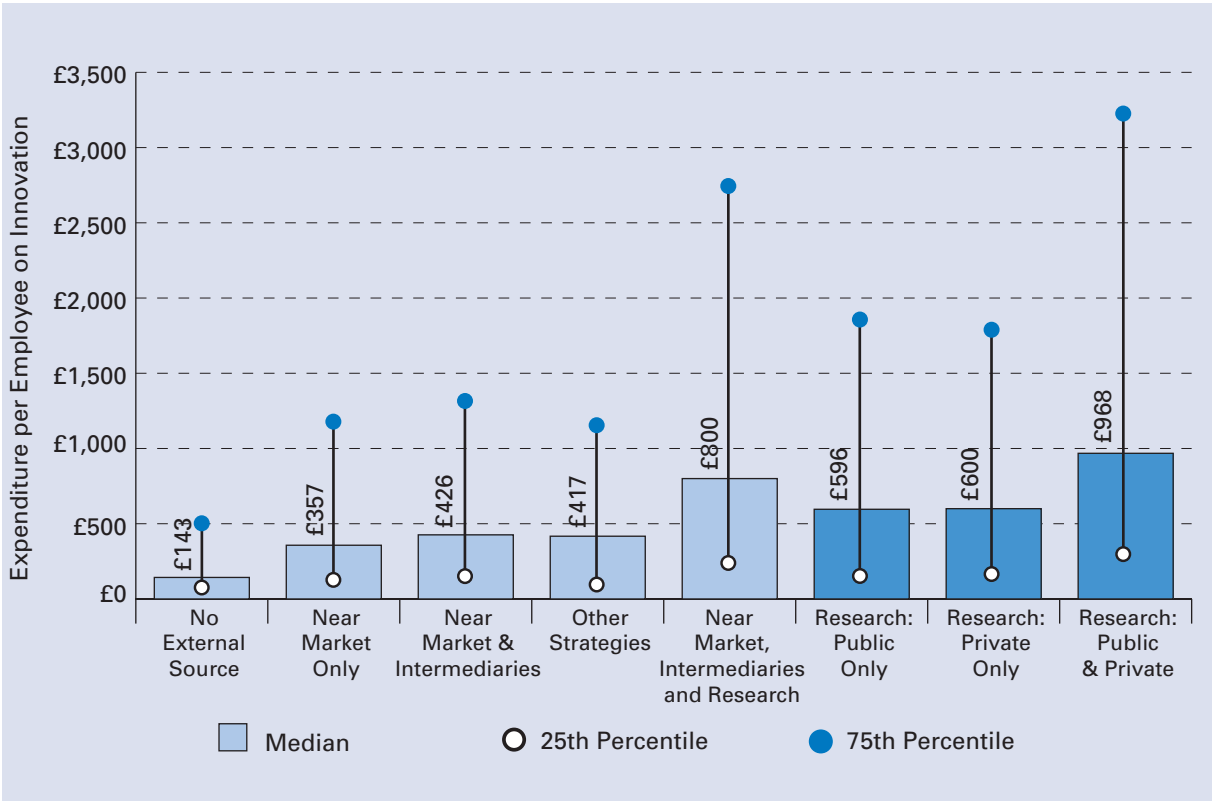
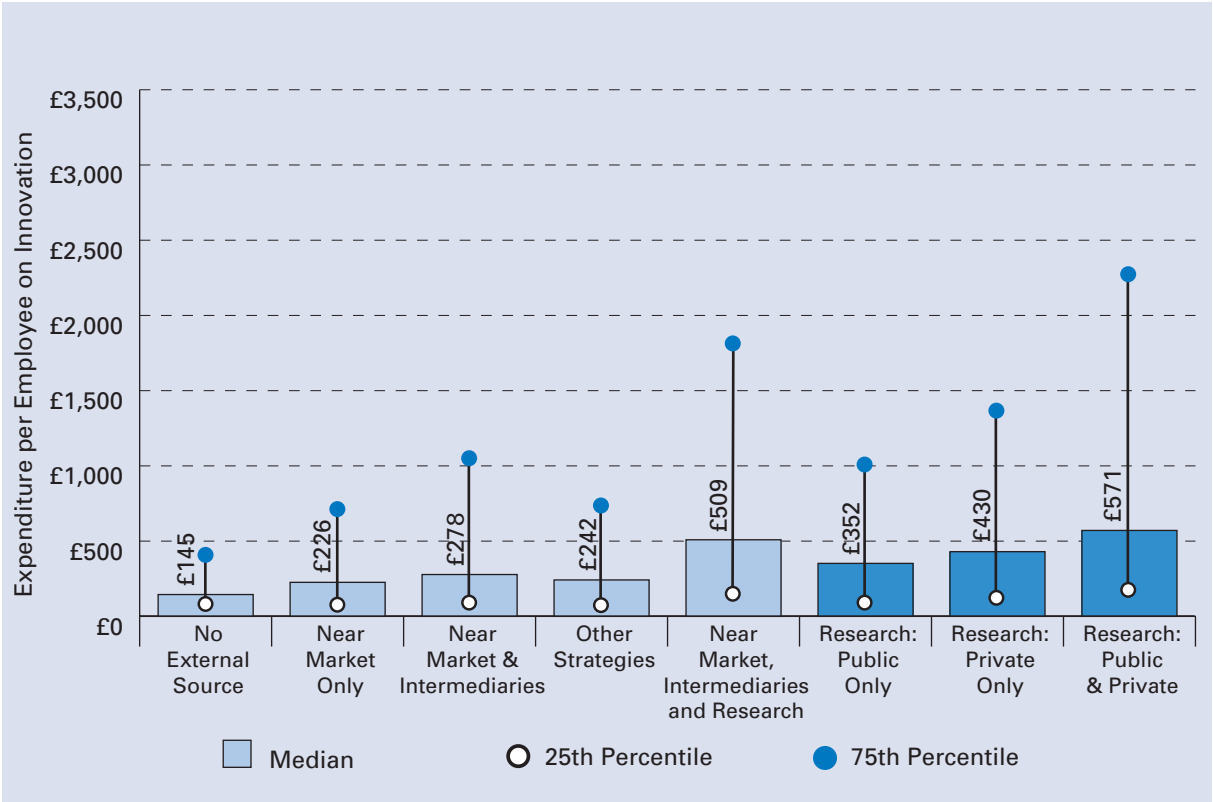


Figure 5.10: Services Firms – Internal Innovation Expenditures per Employee



These patterns do not, of course, imply any direction of causation, wide information search behaviours are not necessarily caused by, or the cause of, greater commitments to innovation. Instead, they are likely to be co-determined and reflect the fact that commitments to innovation tend to be skewed, such that whilst many firms commit little or nothing to innovation, some firms commit considerable resources.

USE OF SOURCES OF INFORMATION BY SERVICES

In this section, we report the results of statistical modelling of the use of different sources of information for innovation by firms with different characteristics. Here we are interested in what the firm level evidence can tell us about why service firms appear less likely to use the various sources of information, and the science base in particular, than are manufacturing firms. This also relates to the question; what types of firms use the public science base and which use private consultants?

Table A5.1 in Appendix 5.1 reports the results of a multinomial logistic regression model concerning the different information sourcing strategies used by the firms. There are four outcomes, with the first (using no external sources of information) being used as the reference case against which the other three strategies (using only near-market sources; using near-market and intermediary sources; and using near-market, intermediary and research sources) are compared.

Table A5.2 in Appendix 5.1 reports the results of four ordinal logistic regressions which model the use and importance (from 'not used' through to 'of high importance') of universities, public research institutes, these combined into all public-science, and private research and consultancy organisations.

The models in Tables A5.1 and A5.2 contain the same independent variables. These are described in Appendix 5.1, but include firm size, sector of activity (the reference sector being manufacture of rubber and plastic products and other non-metallic mineral products – SIC divisions 25 and 26) ownership and age, the spatial nature of the markets served by the firm (the reference case being only local or regional markets), whether the firm engaged in in-house R&D activities, the proportion of science and engineering graduates in its total workforce, the proportion of other graduates in its total workforce, and the type of innovations the firms had introduced. Three categories for types of innovations introduced were included: only product and process (P&P) innovations, only wider, managerial or organisational innovation, or both P&P innovations and wider organisational/managerial innovations. The reference group was neither P&P nor wider innovations.

The models in Table A5.1 show that firms active in international markets, those undertaking R&D, those with a high share of graduates, including both science and engineering and other graduates, and those engaged in innovation, and

especially those that engaged in both product and process and wider organisational/managerial innovations, are more likely to engage in wide ranging innovation search activities that extend beyond near-market and intermediary sources to also include research organisations. Beyond these factors though, some sectoral differences remain. After controlling for the factors summarised above, the models show that firms in the water and energy utilities (SIC 4041), as well as those in retailing (SIC 52); hotels and catering (SIC 55); financial services (SIC 6567); computer services (SIC 72); R&D services (SIC 73); and legal and accounting services (SIC 7414) were less likely than otherwise similar firms in manufacturing to use all three of near-market, intermediary and research organisations as sources of information in their innovation activities.

The models in Table A5.1 show that the use and importance of different types of research organisations is positively related to firm size, and firms that are part of a wider company group are also more likely to use these organisations, as are firms with their own R&D activities, those with high proportions of graduates in their workforces, and those that engaged in one or both product and process and/or wider organisational/managerial innovations. Beyond this, however, there are also some interesting sectoral differences.

In particular, firms in almost all the service industries except R&D services (SIC 73) and architectural and engineering consulting (SIC 7423) were less likely to use universities as a source of information for innovation than otherwise similar firms in manufacturing sectors. There were fewer differences between manufacturing and service sectors in their use of public research institutes, although several service sectors, including computer services (SIC 72) were less likely to use these. When universities and public research institutes are combined into the public science base it is again apparent that almost all services sectors are less likely to directly use the public science base as a source of information for innovation than are otherwise similar manufacturing firms. Finally it is notable that private research institutes and consultancies are less widely used by firms in several service sectors (including computer services) than similar firms in manufacturing sectors. Interestingly, this is not the case with financial services.

Whilst we should be careful about our interpretation of these models, which are rather ad hoc in construction (due to the nature of the available information) rather than derived from theory, overall the models do indicate that many service sectors are less engaged with specialist research organisations, and with universities in particular, than are otherwise similar manufacturing firms.

We should stress that there is no reason why we should expect that all industries would use each of the information sources – and the public science base in particular – to the same extent. The finding that in general services tend to have weaker direct links with the public science base does not necessarily suggest there is a 'problem to be fixed' here; it may simply be that service have less need for the type of knowledge produced by the science base, and that the 'market

failure' arguments that are often used to justify the activities in the public science base are, for one reason or another, less pertinent with respect to the knowledge used (or potentially used) in services than is the case with more traditional areas of science and engineering, which tends to be more applicable to certain areas of manufacturing.

That said, the findings also indicate that there is a difference which probably deserves fuller investigation. A study by the US National Academy of Engineering (2003a&b) assessed the impact of academic research on performance in five industries, including two service industries: transport, distribution and logistics services, and financial services. The study found that whilst academic research had made significant contributions to these industries,[13] and despite significant opportunities, overall these service industries were poorly connected to academic research, and that there is "an underdeveloped interface" between research universities and service industries. To quote the report:

Services industries represent a significant source of opportunity for university-industry interaction. ... Innovation and increased productivity in the services infrastructure (e.g., finance, transportation, communication, health care) have an enormous impact on productivity and performance in all other segments of the economy. Nevertheless, the academic research enterprise has not focused on or been organized to meet the needs of service businesses. (NAE, 2003a, p. 8).

The same study also observes that the contributions of the social and behavioral sciences to industry have been greatly undervalued,[14] a finding echoed in the recent CBI-Qinetiq survey of UK businesses (2006).

Another initiative worth mentioning here is the 'service science, management and engineering initiative' being advanced by IBM. IBM is a research giant, but it now earns most of its revenues from its Global Services business, a unit that did not exist in 1990. IBM is highly experienced at industry-academic relations, and at exploiting the 'two faces of R&D' (Cohen and Levinthal, 1989). Yet as IBM has moved into services it has become dissatisfied with the state of academic research on services, and pertinent to services, observing that: "there is no academic community of scholars that shares a common mission to understand the roots of [services as an] arena of economic activity and how to advance it" (Chesbrough and Sphorer, 2006). This they find disconcerting, not only because we live in service-based economies, but also because: "our ability to achieve a further rise in our standard of living requires a deep understanding of how to innovate in services" (op cit, p. 3).

13. "For instance, portfolio theory, linear programming, derivative pricing theory, and prospect theory, all of academic origin, have laid the foundation for whole new families of financial products and services. Academic contributions to linear and integer programming and to queue theory are the building blocks of the information-management and decision-support technologies at the heart of the integrated logistics revolution." (NAE, 2003a, p. 3).

14. Meanwhile, they argue there is a growing imbalance in US Federal R&D funding, with current investments in life sciences far outpacing investments in the complementary disciplines of physical sciences, engineering, and the social and behavioral sciences (NAE, 2003a, p. 7).

IBM is now using their influence to inspire and drive the formation of a new academic discipline: 'service science, management and engineering', drawing a parallel with IBM's role in the creation of computer science half a century ago. The proposed 'new science' would not be wholly technical, but involves the interface of social and behavioural science (including management science), applied mathematics and informatics. IBM's 'call to arms'[15] suggests there may be a significant opportunity here, that the UK would be wise to investigate.

5.3 Do service firms protect their innovations, and how?

The second part of this study concerns how firms – and service firms in particular – protect their innovations. Innovation is about taking calculated risks and dealing with uncertainty, and one way that governments have sought to stimulate innovation is by providing legal instruments by which firms can protect the results of their creative endeavours, most notably through the granting of patents and other forms of intellectual property (IP) protection, such as registered designs, copyrights and trademarks. The mission statement of the UK Intellectual Property Office (formerly the UK Patent Office), claims: "We stimulate innovation and enhance the international competitiveness of British Industry and commerce".

Other than software patents, the role of intellectual property protection in stimulating, inhibiting and shaping innovation in services has received remarkably little attention. It is generally assumed that service innovations are difficult to protect from imitation (as patents and other protection either do not apply, or are easy to circumvent). Studies on new service development, particularly in financial services, show that if one firm introduces an innovative service that appears successful, rival firms will quickly develop and launch their own versions of the service. This situation, it is argued, provides disincentives for service firms to engage in more radical forms of innovation, and instead encourages highly incremental approaches with low commitments to innovation. On the other hand, survey evidence shows that relatively few service firms consider ease of copying to be a major barrier to their innovation activities, with demand and inadequate internal resources being regarded as more significant inhibiting factors (Tether and Howells, 2006).

To shed light on these important issues, we explore and compare the methods used by service and manufacturing firms to protect their innovations.[16] In this part of the paper, we restrict the analysis to firms that introduced at least one product or process innovation in the three year period between 2001 and 2004. This provides a smaller sample than was used in the first part of this study which focused on the sources of information used by innovating and non-innovating firms. We begin by analysing the data at the industry level, with industries

15. Which has the support of other corporations like Hewlett Packard and British Telecom.

16. The survey asks about eight methods that might be used to protect innovations (patents, registration of designs, trademarks, copyrights and confidentiality agreements, secrecy, complexity of designs and lead-time advantage on competitors). We consider the first four of these to be 'formal methods', and the second four to be 'strategic methods'. For each of the eight methods, the firms were asked whether or not they were used, and if used whether they were of low, medium or high importance in protecting the firm's innovations.

defined by 3-digit and 4-digit Standard Industrial Classification (SIC) or NACE codes. To be included in this analysis, an industry needed to be represented by at least 10 firms responding to the survey. The number of 'manufacturing' and 'service' industries included in the analysis is shown in Table 5.11.

Table 5.11: Number of manufacturing and service industries

	Using 3-digit or 'group' SIC codes	Using 4-digit or 'class' SIC codes
Manufacturing Industries (+ Mining & Utilities)	62	74
Mining and Water and Power Utilities	2	2
Manufacturing (excluding Mining & Utilities)	60	72
Service Industries (including Construction)	52	78
Construction	3	7
Service Industries (excluding Construction)	49	71
Share of firms providing valid responses to the UK Innovation Survey and included in the analysis	95%	85%

We begin with patents. Figure 5.11 shows that proportion of firms in each industry that used patents to protect their innovations, with the dashed lines again representing service industries, and the solid lines representing manufacturing industries. As before, industries defined by both 3-digit and 4-digit SIC codes are shown. It is clear from the figure that, especially in manufacturing, the use of patents is the norm in some industries but is uncommon in others (i.e., the distributions for manufacturing industries show a wide spread with relatively low peaks). In most service industries the proportion of firms using patents is low, with a high peak at between 10 and 25 per cent of firms in an industry using patents to protect their innovations.[17] There are however a few service industries in which firms are more likely than not to use patents to protect their innovations.

Further analysis reveals that amongst the firms that use patents to protect their innovations, firms in manufacturing industries tend to place considerably greater importance on patents than firms in service industries – see Table 5.12. This suggests that even where patents are a viable means of defending innovations they tend to be less relevant to service firms than to their manufacturing counterparts.

17. Although even this level of use is perhaps surprisingly high, given the intangible and non-patentable nature of most service innovations.

Table 5.12: Importance of protection methods amongst users

	All Industries Mean Score (S.D.)	Manufacturing Mean Score (S.D.)	Services Mean Score (S.D.)
Confidentiality Agreements	2.16 (0.23)	2.22 (0.21)	2.10 (0.23)
Patents	2.09 (0.35)	2.21 (0.30)	1.88 (0.33)
Lead Time Advantages	2.08 (0.21)	2.14 (0.20)	2.01 (0.20)
Trademarks	2.03 (0.23)	2.08 (0.22)	1.96 (0.22)
Secrecy	2.02 (0.23)	2.08 (0.23)	1.94 (0.20)
Registered Designs	1.92 (0.27)	2.03 (0.24)	1.77 (0.24)
Copyrights	1.90 (0.26)	1.92 (0.24)	1.89 (0.29)
Complexity of Designs	1.79 (0.23)	1.87 (0.24)	1.70 (0.19)

Note: These means are based on the means for each industry, in which each firm using the protection method scored this 1 (of low importance), 2 (of medium importance) or 3 (of high importance). A score of 1 therefore implies all firms using the method regarded it as of low importance, whilst a score of 3 indicates all firms using the method regarded it as being of high importance.

Registered designs have received much less attention than patents from scholars of innovation, but our analysis shows that their pattern of use across industries is similar (Figure 5.12). This is confirmed by a correlation between their extents of use by industries of 0.88. Amongst service industries there is a distinct peak at between 20 and 25 per cent of innovating firms in the industry registering designs, whereas amongst manufacturers the peak of the distribution is between 40 and 45 per cent. Thus, overall, services are less likely to use registered designs than are manufacturers, which also probably reflects the less tangible nature of service innovation. Services are however more likely to use registered designs than patents. Amongst innovating firms registering designs, firms in service industries tend to consider these less important than firms in manufacturing industries as a means of protecting their innovations, although the difference between manufacturing and service industries is smaller than is the case with patents.

Figure 5.11: Use of Patents to Protect Innovations

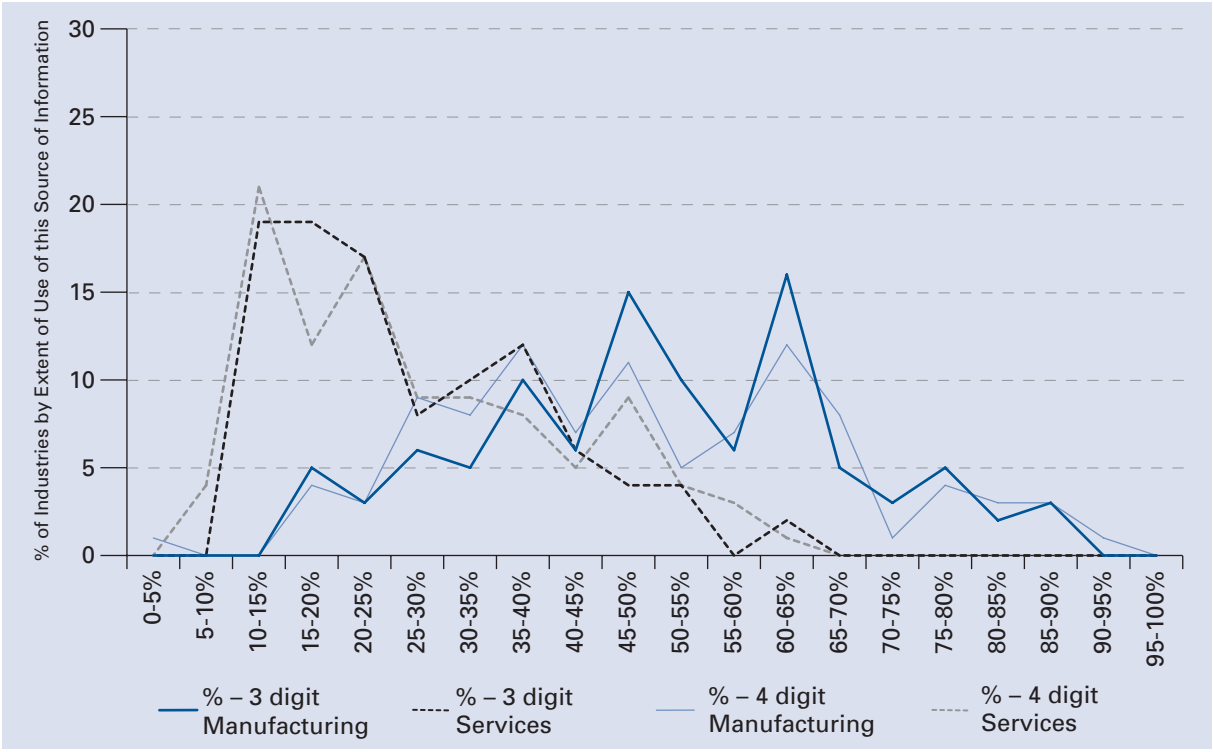
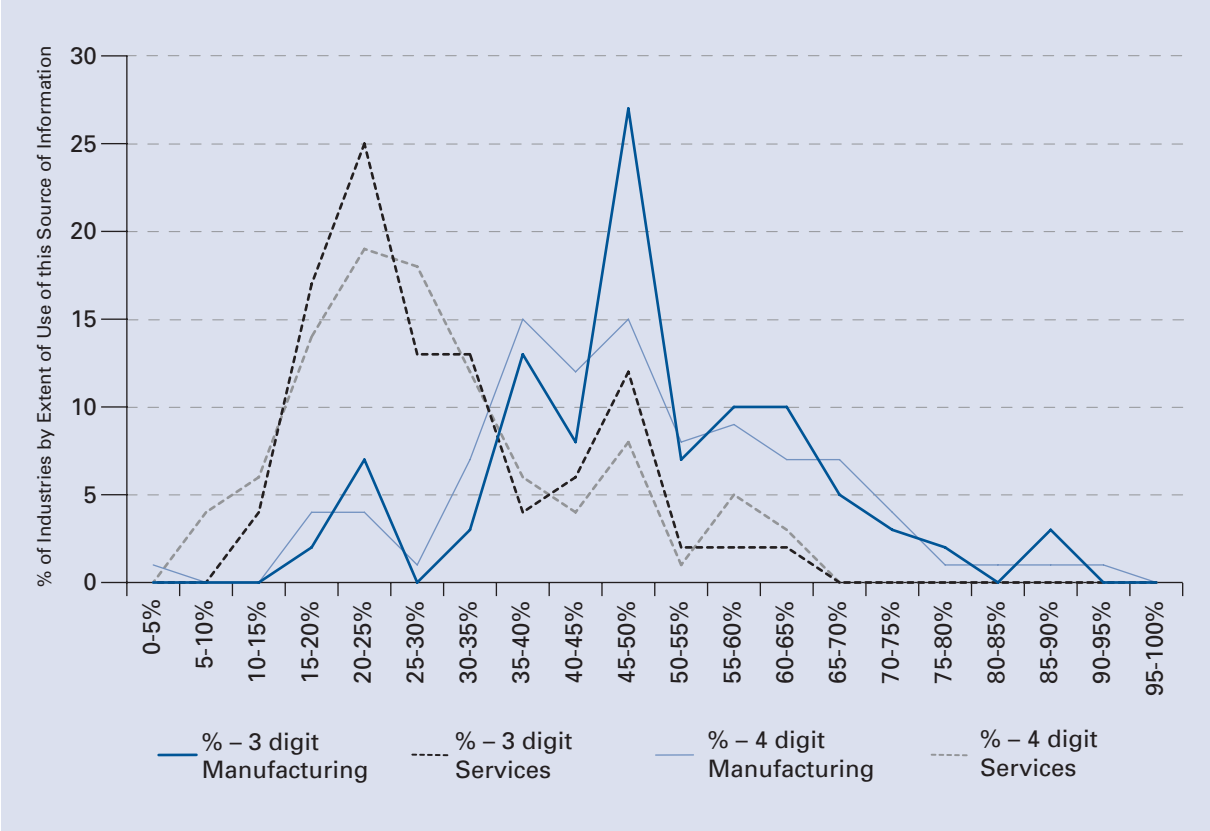


Figure 5.12: Use of Registered Designs to Protect Innovations



The use of copyrights (Figure 5.13) and trademarks (Figure 5.14) to protect innovations also show similar patterns to the use of registered designs (although both of these also show less peaked distributions), with firms in service industries generally less likely to use these instruments to protect their innovations than firms in manufacturing industries. There is however considerable overlap in the distributions, such that some service industries are more likely than some manufacturing industries to make use of these protection methods.

The survey also finds that, unlike patents, firms in manufacturing and service industries tend to attribute similar importance to trademarks and copyrights (Table 5.12). This perhaps suggests that whereas with patents and registered designs an issue is the extent to which these protection methods are applicable to less tangible forms of innovation, with copyrights and trademarks, which are applicable to both tangible and intangible innovations and innovators, any problem may primarily be one of awareness of these means of protection, rather than of the their applicability.

Figure 5.13: Use of Copyrights to Protect Innovations

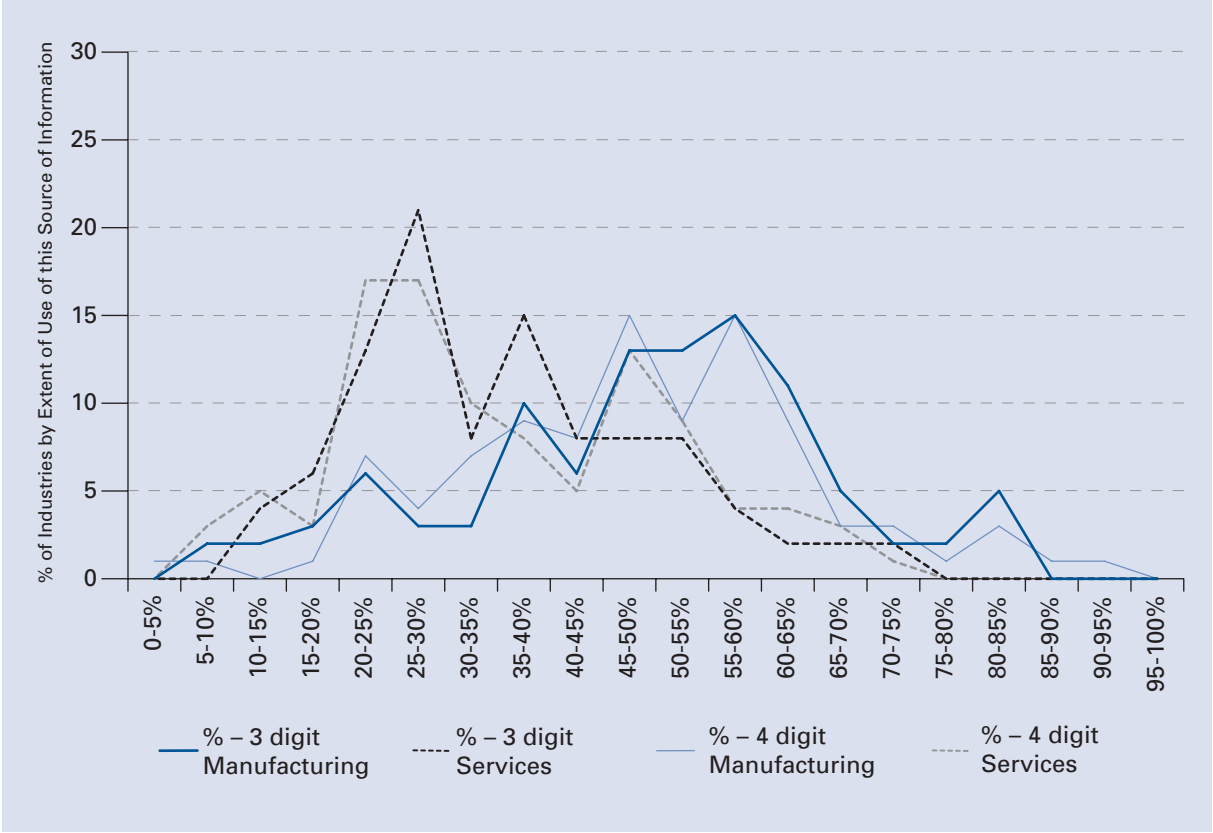
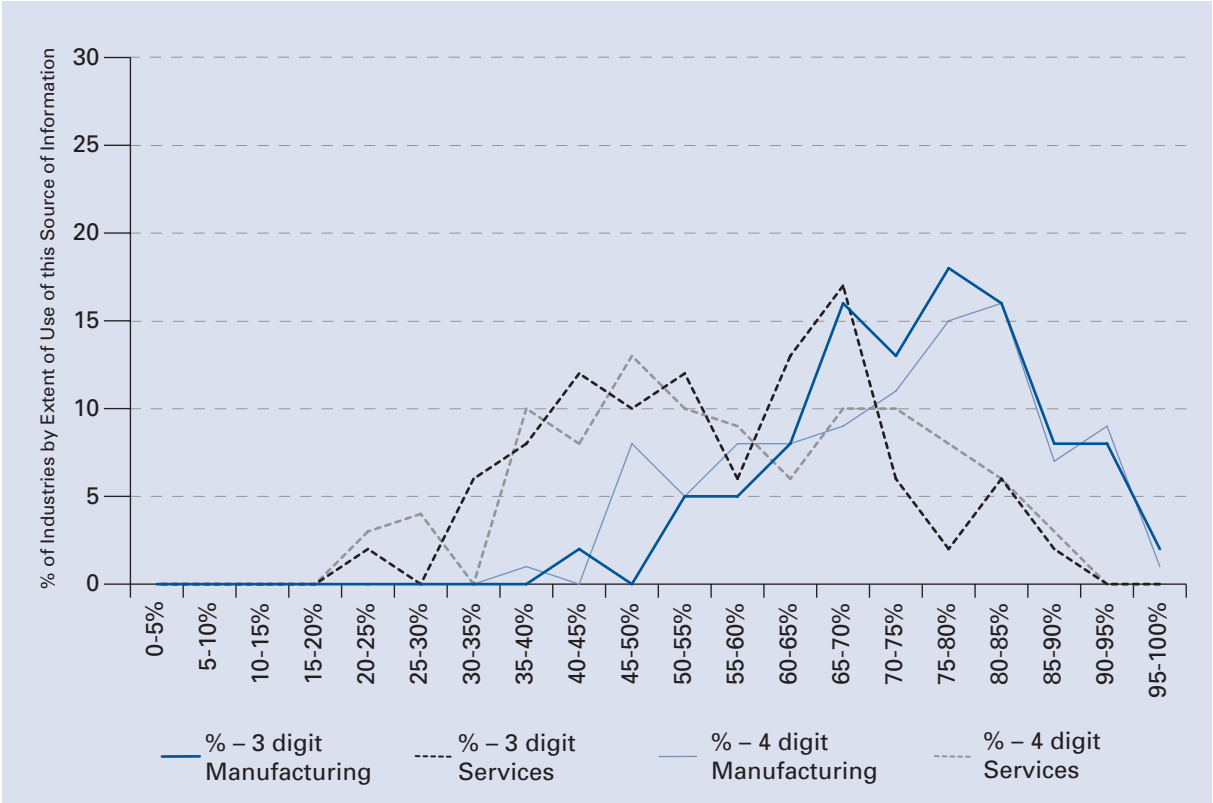


Figure 5.14: Use of Trademarks to Protect Innovations

Aside from these formal methods, firms can also use informal or strategic methods to protect their innovations. These include secrecy, confidentiality agreements, complexity of designs, and lead time advantages. Below, we explore the extent to which firms in manufacturing and service industries made use of each of these.

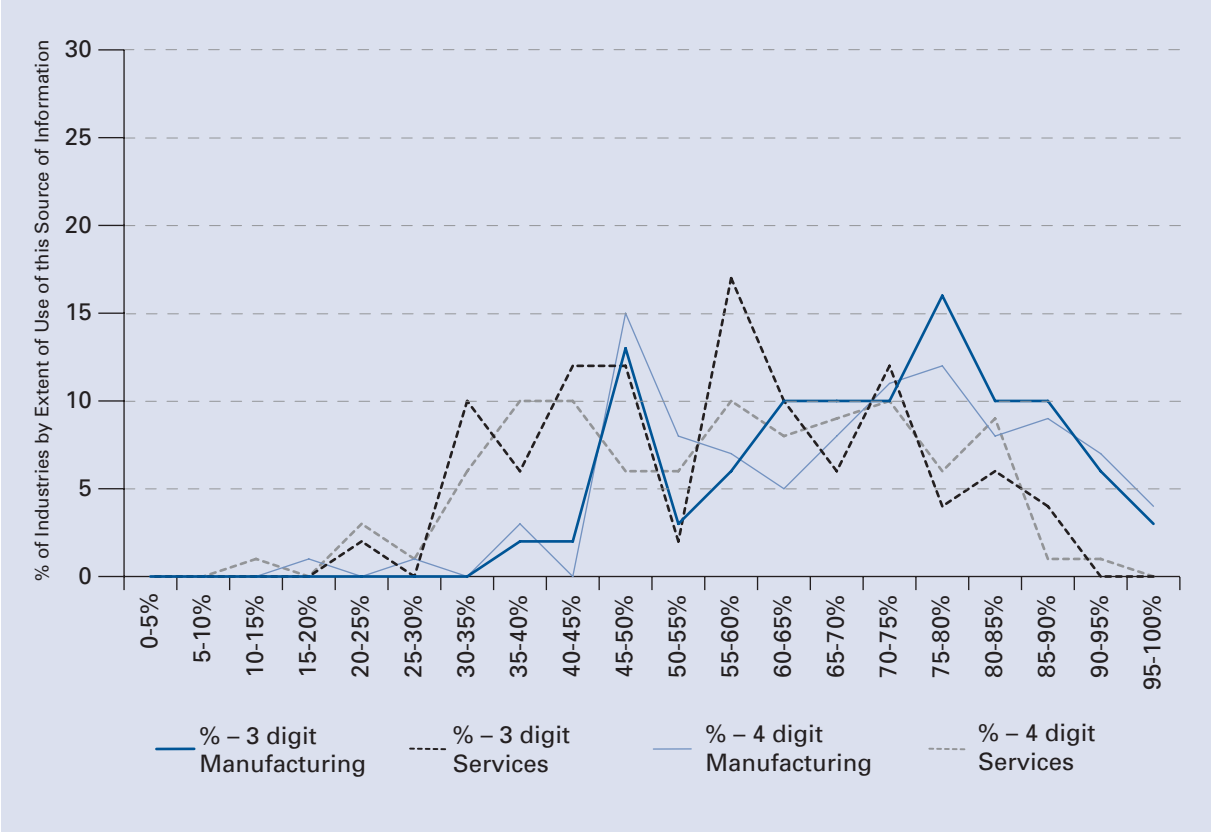
It is immediately apparent that the proportion of firms using secrecy to protect their innovations (Figure 5.15) is considerably greater in both manufacturing and service industries than their use of any of the formal protection methods, and especially patents (i.e., the distributions are all well to the right of the corresponding distributions for patenting and other formal forms of IP protection). In general firms in service industries are less likely to make use of secrecy than are firms in manufacturing industries. Amongst firms that use secrecy, the importance attributed to this method of protecting innovations is similar, but slightly lower, amongst service industry firms as compared with manufacturers.

Figure 5.15: Use of Secrecy to Protect Innovations



The use of confidentiality agreements (Figure 5.16) follows similar patterns to the use of secrecy. In general, firms are much more likely to use this form of protection than patents or other formal protection methods, and there is considerable variation in practice within both of these 'grand sectors'. In terms of the importance attached to confidentiality agreements by those firms that use them, the distributions for manufacturing and service industries are strikingly similar, with services tending to attribute only slightly less importance to this method of protection than firms in manufacturing industries.

Figure 5.16: Use of Confidentiality Agreements to Protect Innovations



The use of lead time advantages (Figure 5.17) and complexity of designs (Figure 5.18) show that firms in manufacturing industries tend to make considerable use of both of these means of protecting innovations, with the peaks of the distributions at 80-85 per cent of the firms in the industry. Service industries tend to make much less use of these methods, with the peaks of their distributions at around 40 per cent of the firms in the industry. In terms of the importance attributed to them amongst firms that use them, firms in service industries tended to ascribe slightly less importance to them than did firms in manufacturing industries, but lead time advantages especially were regarded as more important than the formal methods of protection, including patenting.

Figure 5.17: Use of Lead Time Advantages to Protect Innovations

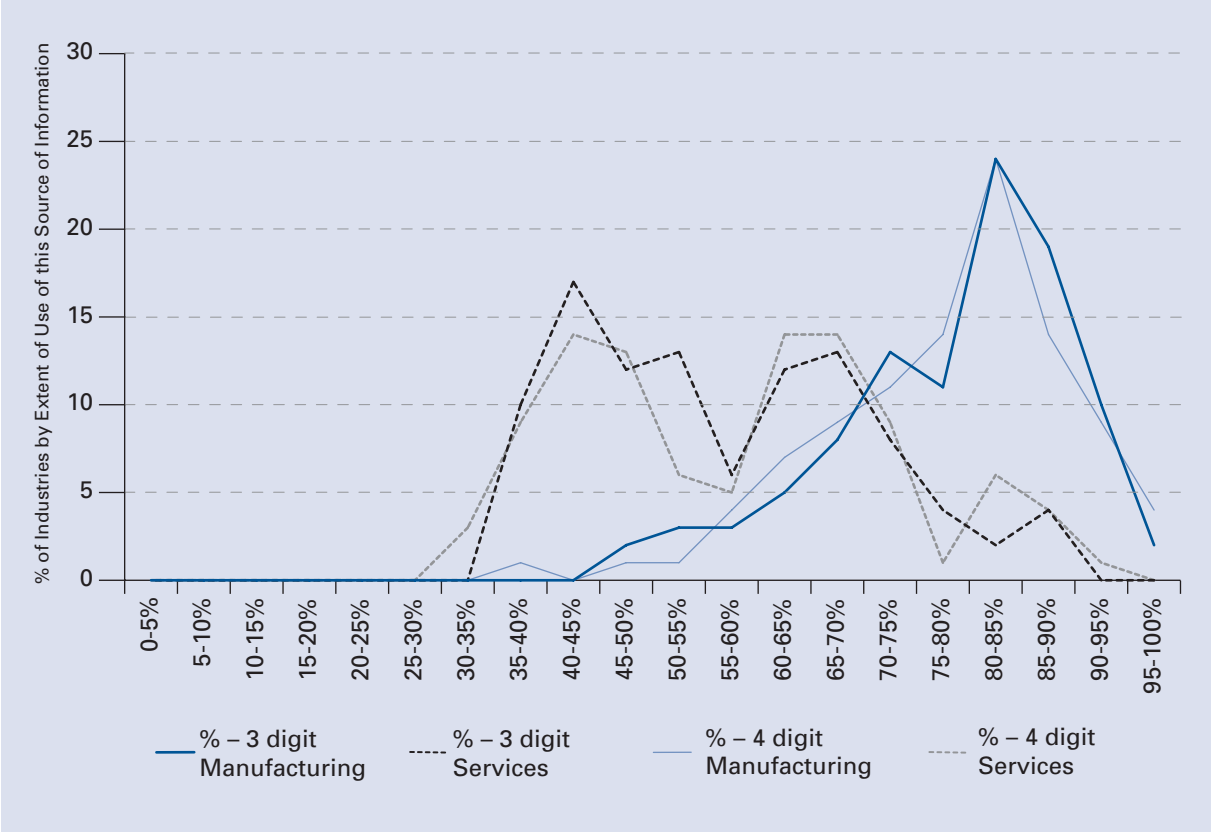


Figure 5.18: Use of Complexity of Designs to Protect Innovations

Figure 5.19 shows the average number of formal protection methods used (i.e., patents + registered designs + copyrights + trademarks, providing a scale of 0 to 4) by firms in service and manufacturing industries. Although there is variation within both 'grand sectors', there is also a clear difference in the distributions, with a third of service industries tending to use only one of these protection methods, whereas in a third of manufacturing industries firms used two or more.

Figure 5.20 shows the average number of strategic forms of protection used (i.e., secrecy + confidentiality agreements + lead time advantages + complexity of designs, providing a scale of 0 to 4) by service and manufacturing industries. This again shows manufacturing industries tend to use more strategic protection methods than services, but both manufacturing and service industries tend to use more of these than the formal forms of protection. Figure 5.21 shows the distributions for the average number of protection methods used when all eight are added together (i.e., a scale of 0 to 8). Different distributions for manufacturing and service industries are again apparent, with firms in manufacturing industries most likely to use five or six of these protection methods whereas firms in service industries are most likely to use just two or three.

Figure 5.19: Average number of formal protection methods used

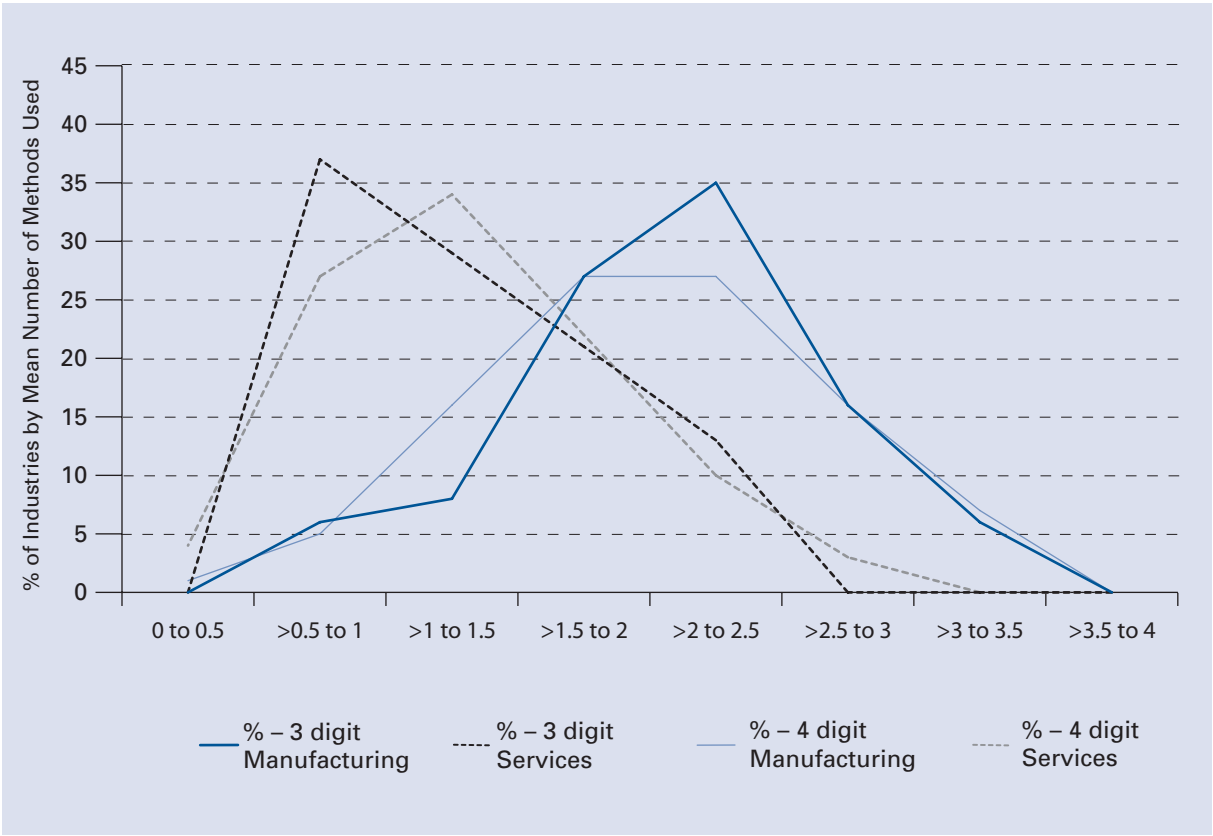


Figure 5.20: Average number of strategic protection methods used

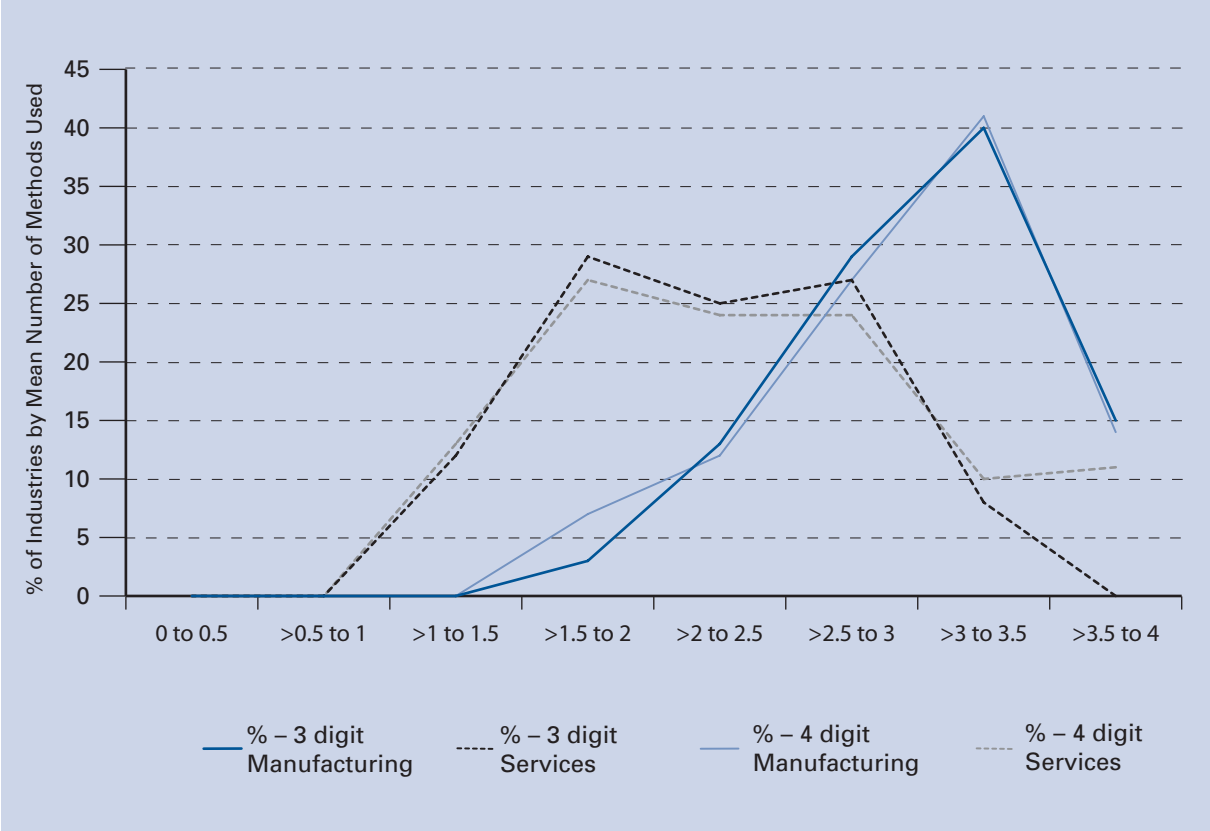
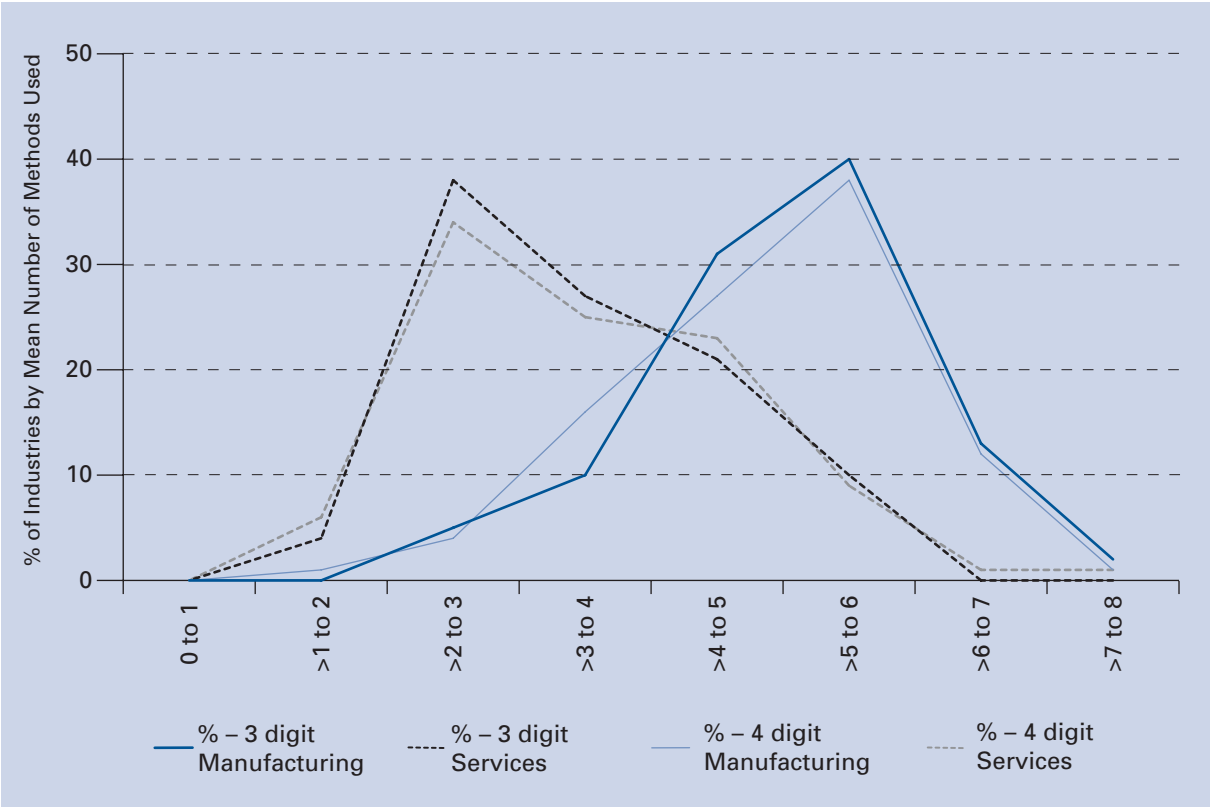


Figure 5.21: Average number of (formal and strategic) protection methods used



Correlations between the extents to which industries use these different forms of protection (Table 5.13) are all high, ranging from 0.65 to 0.92. This shows that industries which use one form of protection also tend to use other forms of protection. As these eight methods of protections concern different but overlapping aspects of a firm's intellectual property (for example, patents protect technological novelty, trademarks marketing and branding, copyrights creative aspects of innovations – including new software) it is interesting that the methods tend to be complementary rather than substitutes. Correlations between the importance attached to these protection methods amongst users (Table 5.14) are also all positive, although the values tend to be substantially lower than for the correlations concerning their use. This again indicates protection methods tend to be complementary, rather than substitutes.

Table 5.13: Correlations in the extent of use of protection methods

	PT	RD	CR	TM	CA	SE	CD	LT
Patents (PT)	1.00	0.89	0.74	0.86	0.74	0.82	0.80	0.81
Registered Designs (RD)	0.88	1.00	0.77	0.91	0.65	0.77	0.77	0.77
Copyrights (CR)	0.72	0.76	1.00	0.77	0.73	0.74	0.71	0.71
Trademarks (TM)	0.87	0.91	0.79	1.00	0.66	0.80	0.78	0.79
Confidentiality Agreements (CA)	0.72	0.69	0.73	0.70	1.00	0.87	0.75	0.73
Secrecy (SE)	0.77	0.75	0.72	0.80	0.86	1.00	0.88	0.88
Complexity of Design (CD)	0.78	0.76	0.71	0.77	0.74	0.85	1.00	0.92
Lead Time Advantage (LT)	0.77	0.76	0.70	0.76	0.75	0.84	0.90	1.00

Note: Correlation coefficients above the diagonal are for industries defined by 3-digit SIC codes, those below the diagonal are for industries defined by 4-digit SIC codes.

Table 5.14: Correlations amongst users in the importance of protection methods

	PT	RD	CR	TM	CA	SE	CD	LT
Patents (PT)	1.00	0.72	0.40	0.64	0.41	0.38	0.46	0.51
Registered Designs (RD)	0.76	1.00	0.59	0.56	0.28	0.29	0.48	0.45
Copyrights (CR)	0.52	0.60	1.00	0.49	0.44	0.29	0.45	0.32
Trademarks (TM)	0.54	0.62	0.46	1.00	0.36	0.39	0.29	0.32
Confidentiality Agreements (CA)	0.33	0.08	0.49	0.21	1.00	0.70	0.69	0.47
Secrecy (SE)	0.31	0.26	0.39	0.28	0.61	1.00	0.65	0.50
Complexity of Design (CD)	0.38	0.43	0.43	0.28	0.65	0.66	1.00	0.49
Lead Time Advantage (LT)	0.51	0.45	0.42	0.35	0.44	0.56	0.55	1.00

Note: Correlation coefficients above the diagonal are for industries defined by 3-digit SIC codes, those below the diagonal are for industries defined by 4-digit SIC codes.

In summary, it is evident that firms in service industries tend to make rather greater use of strategic methods than formal methods to protect their innovations, but, as with formal protection methods, firms in service industries tend to use strategic protection methods rather less frequently than do firms in manufacturing industries. Taken together, manufacturing and service industries differ markedly by the average number of protection methods used, with services tending to use fewer than manufacturers.

There are probably at least two reasons why firms in most service industries make less use of the various forms of IP protection than firms in most manufacturing industries. The first reason concerns the applicability of

protection. Amongst formal forms of IP protection, patents and registered designs – which are both associated with tangible innovations – are less obviously applicable to services. Amongst strategic forms the same is arguably true of using the complexity of designs to protect innovations. This lower applicability is reflected in the lower average importance ascribed by innovating service firms that use these forms of protection as compared with their manufacturing counterparts.

Another reason might to be differences in information and understanding. In general manufacturers appear to be more aware of the various forms of IP protection available to them than are service firms. This may reflect the fact that manufacturers tend to be exposed to competition from dispersed markets (including international competition) whereas many services firms confine themselves to local markets and rely on their reputation and/or complementary services rather than on other means to protect their activities. The UK Innovation Survey does not, however, ask whether firms consider that their reputation (which trademarks might partially encapsulate) and/or complementary products provide protection for innovations.

FURTHER QUESTIONS

We would like to know whether there is an association between the use of intellectual property protection methods and the extent to which firms commit resources to innovation, such that, as we would expect, firms that commit most to innovation also tend to use more forms of protection, whilst those that commit least tend to use few if any of the various forms of protection.

We will also explore firm level evidence on the relationship between the types of innovations introduced and the methods used by the firms to protect their innovations.

IP PROTECTION METHODS AND FIRMS' COMMITMENTS TO INNOVATION

Correlations between engaging in innovation related activities and use of the various protection methods show interesting differences according to the type of innovation activity engaged in (Table 5.15). The results show strong positive correlations between engaging in intra-mural R&D and using each of the eight forms of IP protection (the weakest correlation being 0.62). There are also positive but weaker correlations between using each of these protection methods and acquiring R&D services, engaging in design activities, and in the market introduction of innovations, and weaker still correlations (but all still positive) with acquiring external knowledge. The association with acquiring machinery and equipment is weaker still, whilst the weakest relationship is with training.

Table 5.15: Correlations between engaging in innovation activities and using the various methods of Intellectual Property Protection

	Intramural R&D	Acquired R&D	Acquired M&E	Acquired External Knowledge	Training	Design	Market Introduction
Patents	0.68	0.49	0.20	0.32	0.08	0.55	0.45
Registered Designs	0.62	0.39	0.14	0.26	-0.04	0.55	0.47
Copyrights	0.65	0.42	-0.02	0.28	0.10	0.53	0.45
Trademarks	0.67	0.41	0.07	0.24	-0.05	0.55	0.51
Confidentiality Agreements	0.66	0.50	0.20	0.31	0.31	0.46	0.42
Secrecy	0.73	0.46	0.25	0.21	0.15	0.59	0.48
Complexity of Designs	0.77	0.39	0.18	0.19	0.01	0.65	0.39
Lead Time Advantages	0.76	0.39	0.19	0.19	0.06	0.66	0.46

This suggests there may be some sort of hierarchy, with firms that only engaged in training and/or the acquisition of machinery and equipment at the bottom – these firms are less likely to use any forms of protection, and especially the formal forms, perhaps because they tend to be oriented to process innovations, whilst at the top of the hierarchy are firms that not only do in-house R&D but also engage in other innovation related activities, such as design and the market introduction of innovations. These firms are much more likely to use all forms of protection, including both formal and strategic forms, and probably orient their innovation activities to new products (as well as to new processes).

Figures 5.22 and 5.23 show the expenditures (per employee) on innovation in 2004 of manufacturing, technical and other service firms by their use of different innovation protection strategies (Figure 5.22) and whether the different types of protection were regarded as being of high importance to the firm (Figure 5.23). Expenditures on innovation are the sum of the firm's expenditures on intramural (in-house) R&D; the acquisition of R&D (extramural R&D) services; the acquisition of machinery, equipment and software in relation to innovation; the acquisition of external knowledge for innovation; training directly linked to innovation; all forms of design for innovation; and expenditures on the marketing of innovations. This sum is then divided by the number of employees in the firm.

Figure 5.22: Expenditures on Innovation by use of IP Protection Methods

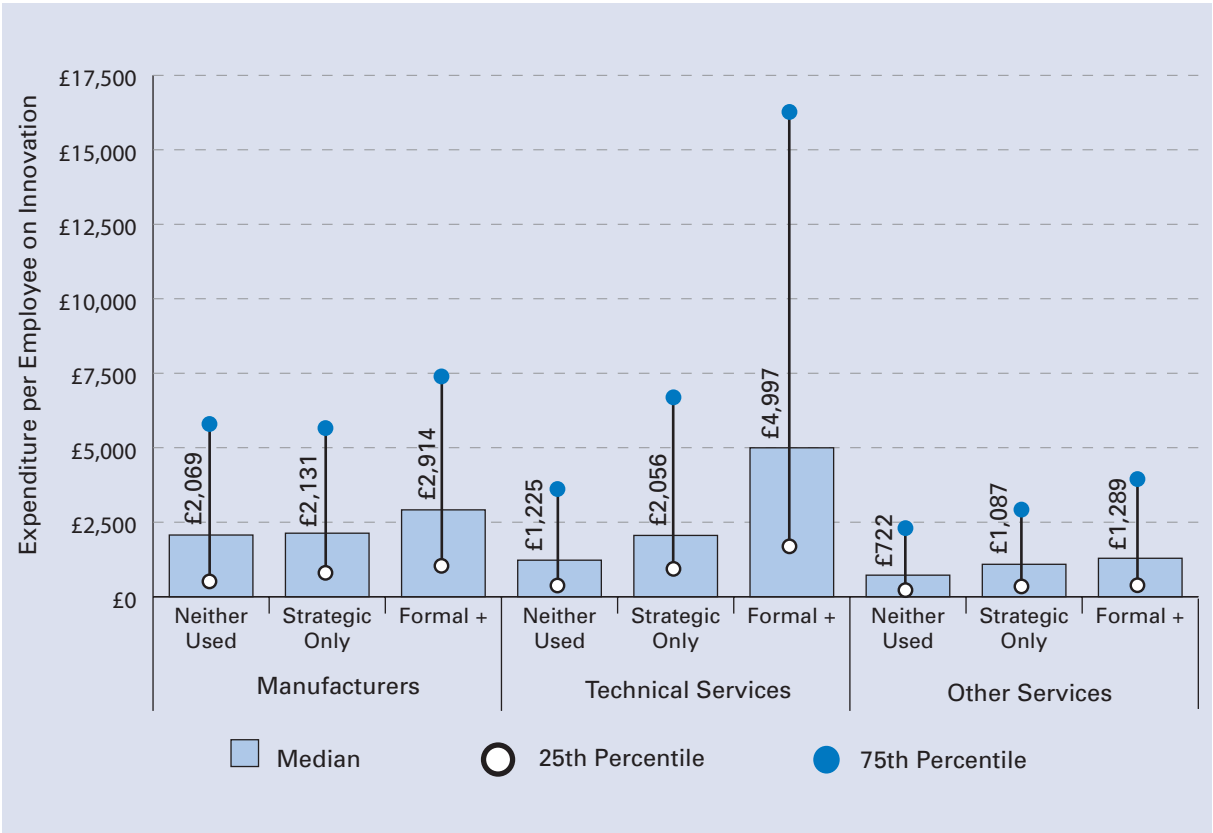
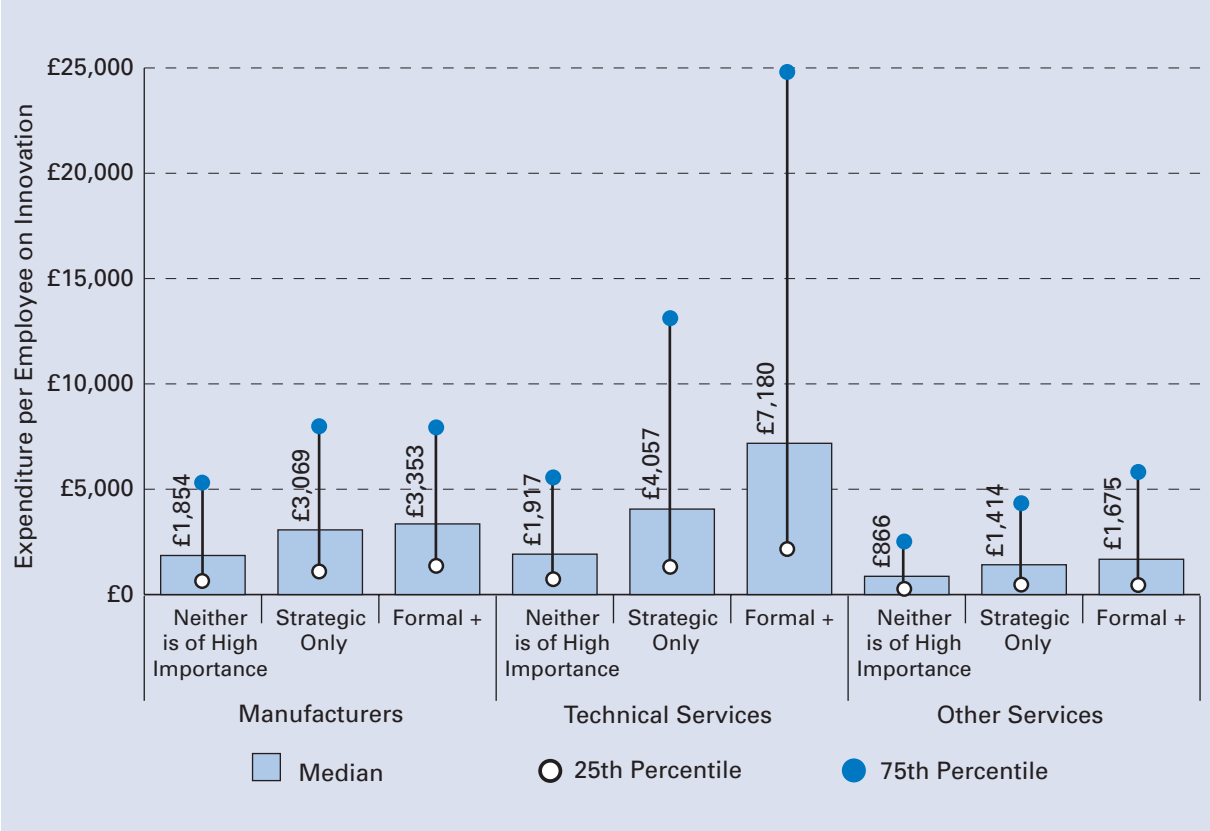


Figure 5.23: Innovation Expenditure and Protection Methods



Here, technical services are telecommunications, computer services, R&D services, and architectural and engineering consultancies. In this analysis we have separated 'technical services' from other services because the firm level analysis concerning the use of IP protection suggests that the behaviour of technical services in this regard is more similar to manufacturers than to other services. The figures show the median expenditure of firms in each of these categories, as well as the expenditures of the firms at the 25th and 75th percentiles of each of the distributions.

The figures clearly show that although expenditures (per employee) on innovation vary widely within each category (i.e., sector and IP protection strategy), on average firms that use formal forms of protection spend considerably more on innovation than those that use only strategic methods, whilst those that used neither form of protection tended to spend the least on innovation. The same patterns hold for whether or not the different types of protection are considered of high importance to the firm. It would certainly appear that the existence of formal forms of intellectual property protection encourages firms to commit more resources to innovation, which is of course one of the reasons for their existence. The much greater expenditures per employee of the technical service firms which used formal forms of protection, or considered this to be of high importance, as compared with other technical service firms is particularly notable.

FIRM LEVEL ANALYSIS OF THE USE OF INTELLECTUAL PROPERTY PROTECTION METHODS

Here, we undertake firm level analyses to explore how firms that have introduced goods, service and/or process innovations (and combinations of these) differ in their use of strategic and/or formal methods of protecting their innovations.

We begin by modelling firms' use of protection methods in terms of three possible outcomes: firm used neither formal nor strategic protection methods, firms used strategic methods but not formal methods, and firms used formal methods (almost always alongside one or more strategic methods). Table 5.16 shows the (simple, un-weighted) distribution of firms by these strategies.

Table 5.16: Innovation protection methods used

	All Firms	Manufacturing	Services
Neither Used	1,189 (20.4%)	311 (13.0%)	878 (25.6%)
Only Strategic	1,439 (24.7%)	546 (22.8%)	893 (26.0%)
Only Formal	105 (1.8%)	45 (1.9%)	60 (1.7%)
Both Formal and Strategic	3,097 (53.1%)	1498 (62.4%)	1,599 (46.6%)
Formal +	3,202 (54.9%)	1543 (64.3%)	1,659 (48.4%)
All Firms	5,830 (100%)	2,400 (100%)	3,430 (100%)

Note: Manufacturing includes mining & quarrying and utilities; Services includes construction.

The variables used in the model are largely those included in the earlier models of information sourcing, although the innovation variables have been substituted, see the Appendix for details (reported in Table A5.3). The text below refers to the results in the Annex.

Protection strategies are influenced by the types and sources of the innovations introduced. Firms that introduced only goods innovations (i.e., new products in the form of goods) were not more likely than the reference group of firms that only introduced new process innovations to protect these using only strategic means. They were however more likely to protect these using formal intellectual property rights (usually in conjunction with strategic forms of IP protection).

By contrast, firms that only introduced service product innovations (i.e., new products in the form of services) were no more likely than the reference group (of process-only innovators) to use either strategic or formal forms of intellectual property protection. This implies that service innovations tend to be protected in a similar way to process innovations, rather than in a similar way to tangible goods innovations.

Firms that introduced both new goods and new services (but not new processes) tended to protect these in a similar way to goods-only innovators (i.e., with greater reliance on formal protection, but no greater reliance on strategic protection).

Interestingly, firms that introduced both service and process innovations tended to make greater use of both types of protection than did firms that only introduced process innovations. This might suggests that some firms combine the introduction of new services and new processes in order to enhance their protection, but it may just reflect a positive association between greater commitments to innovation and a greater awareness of the various types of protection available to firms.

Firms that introduced new goods and new processes (and possibly new services) were more likely to use strategic forms of protection and were still more likely to use formal forms of protection. Again, it is not clear whether this points to more sophisticated protection strategies or simply greater awareness of the protection mechanisms available to the firm.

Beyond this it is notable that firms that introduced new to the market product innovations (i.e., new goods or services which were not just imitative of other firms' innovations) were more likely to use strategic protection than were other firms, and were still more likely to use formal forms of protection. Meanwhile, firms that introduced new to the industry process innovations were more likely to use formal protection (but not only strategic protection) than were other firms.

Also, and understandably, firms that introduced innovations developed by other firms or organisations were less likely to protect these using only strategic means, and were still less likely to use formal protection to defend their innovations. This was true for both externally developed products and externally developed processes.

Size, age and ownership matter. Larger firms are more likely to use strategic protection than smaller firms, and are still more likely to use formal forms of protection (usually alongside strategic protection) than are smaller firms. Firms that are part of a wider group of firms are more likely to use formal protection (but not only strategic protection) than are independent firms, whilst new firms are more likely to use protection, be that formal or strategic, than longer established firms. All of these findings are in line with prior expectations.

Differences between industries remain, even after controlling for the other factors outlined above. Within manufacturing there were few differences.[18] The major differences were found with services, amongst which almost all sectors were less likely to use formal protection methods. Only the technically based telecommunications, computer services, R&D services and architecture and engineering services (respectively SIC_642, SIC_72, SIC_73 and SIC_7423) were not less likely to use formal protection methods than were manufacturing firms. Around half the service sectors were also less likely to use only strategic forms of protection than were manufacturing firms.

To gain further insight we re-ran the models, this time seeking to predict the types of protection firms regarded as being of high importance, be these neither strategic nor formal forms of protection, only strategic forms, or formal forms (usually alongside strategic forms). The distribution of firms by these outcomes is shown in the Table 5.17.

Table 5.17: Innovation protection methods considered of high importance

	All Firms	Manufacturing	Services
Neither	3,060 (52.5%)	1,035 (43.1%)	2,025 (59.0%)
Only Strategic	1,245 (21.4%)	558 (23.3%)	687 (20.0%)
Only Formal	321 (5.5%)	176 (7.3%)	145 (4.2%)
Both Formal and Strategic	1,204 (20.7%)	631 (26.3%)	573 (16.7%)
Formal +	1,525 (26.2%)	807 (33.6%)	718 (20.9%)
All Firms	5,830 (100%)	2,400 (100%)	3,430 (100%)

Note: Manufacturing includes mining & quarrying and utilities; Services includes construction.

The results (reported in Table A5.4 in the Appendix) are similar to those for the use of the different types of protection, and therefore we do not propose to discuss them at length. Two notable findings are: Firstly, that firms that introduced both new service products and new processes are more likely to identify strategic forms of protection as being of high importance, but not formal forms of protection. Secondly, that amongst service firms, those in computer services and especially R&D services are more likely than manufacturers to attribute high importance to formal forms of protection. This probably points to the importance of copyright in computer software and the importance of patents (and other forms of legal protection) for R&D service firms.

18. With the exception of food, drink and tobacco (SIC_1516), there were no significant differences between manufacturing industries in the extent to which firms relied only on strategic forms of protection. Mining and quarrying, food drink and tobacco, printing and publishing firms and metals and metal product firms were all less likely than other manufacturing firms to use formal protection methods.

5.4 Linking analysis on information sources & IP protection

In this section, we undertake analysis which links the findings concerning how firms seek information for innovation and how they protect their innovations using formal and strategic forms of intellectual property protection.

Table 5.18 shows the use of different approaches to protecting innovations amongst manufacturing and service firms against the information search strategy the firm engaged in. Three quarters of manufacturing and service firms that did not use any external source of information for their innovation activities used neither formal nor strategic methods to protect their innovations. Meanwhile, three quarters of the manufacturers and 60 per cent of the service firms that involved near-market, intermediary and research organisations in their information sourcing used formal protection methods (almost always alongside strategic forms of protection). We also know from findings presented earlier that these firms tend to make much greater internal commitments to innovation, spending more money on innovation and engaging in more innovation related activities.

Table 5.18: Use of protection strategies by information sourcing

	No External Source	Near-Market Only	Near Market & Intermediaries	Near Market, Intermediaries & Research	Other Strategies
Manufacturing					
Neither Used	73%	47%	17%	7%	36%
Strategic Only Used	13%	31%	33%	19%	25%
Formal Used	13%	23%	50%	74%	39%
All Firms	100%	100%	100%	100%	100%
Services					
Neither Used	77%	53%	37%	16%	35%
Strategic Only Used	13%	22%	31%	25%	30%
Formal Used	11%	25%	32%	59%	34%
All Firms	100%	100%	100%	100%	100%

Table 5.19 repeats the analysis, but this time shows the protection methods regarded as being of high importance rather than used (regardless of importance). This shows that 90 per cent of the manufacturing and service firms that did not use any external source of information for their innovation activities regarded neither formal nor strategic methods as being of high importance to protecting their innovations. Indeed, we know that most of these firms did not even use these forms of protection.

It is however interesting that the majority of both manufacturing and service firms that used near-market sources, either alone or in conjunction with intermediaries, also considered that neither formal nor strategic forms of protection were of high importance to their innovation activities. The same was true of service firms which extended their information search activities to include research organisations.[19] The one group of firms which were likely to regard strategic and/or formal forms of protection as being of high importance were the manufacturers whose information search activities extended to include research organisations. It is notable, however, that a third of these firms did not regard either form of protection as being of high importance.

Table 5.19: Importance of protection strategies by information sourcing

	No External Source	Near-Market Only	Near-Market & Intermediaries	Near-Market, Intermediaries & Research	Other Strategies
Manufacturing					
Neither of High Importance	90%	68%	56%	35%	68%
Only Strategic Methods are of High Importance	3%	20%	21%	25%	20%
Formal Methods are of High Importance	7%	12%	23%	40%	13%
All Firms	100%	100%	100%	100%	100%
Services					
Neither of High Importance	89%	78%	71%	51%	66%
Only Strategic Methods are of High Importance	4%	13%	16%	23%	18%
Formal Methods are of High Importance	7%	9%	13%	26%	16%
All Firms	100%	100%	100%	100%	100%

Overall, this suggests that knowledge of, and the applicability of, intellectual property protection is an important element in firms' decision making about innovation, and that stronger or more appropriate forms of IP protection encourage some firms to commit more to innovation. This of course is the purpose of IP protection mechanisms.

19. Although a quarter of these regarded only strategic forms of protection as being of high importance, whilst a further quarter regarded formal (and strategic) protection as being of high importance.

5.5 Conclusions

In this paper we have used the evidence provided by the UK Innovation Survey of 2005 to explore two questions, firstly, the extent to which firms, and service firms in particular, use the science base as a direct source of information or knowledge for their innovation activities. Secondly, to what extent do firms, and especially service firms, use formal and strategic forms of intellectual property (IP) protection to defend their innovations? As the science base and formal forms of IP protection (such as patents, registered designs, trademarks and copyrights) are provided by the state partially to encourage firms to innovate, our wider question is: how well are service firms served by the UK's innovation infrastructure?

Before reviewing the findings, we should stress the limitations to our study. This study has been based on one cross-sectional dataset which explores the behaviours of firms. We should emphasise three weaknesses inherent in the survey methodology:

- Firstly, the answers provided by firms are subjective. Clearly answering what information sources or forms of intellectual property protection are of 'high importance' is a matter of judgement which might vary amongst respondents in the same firm with similar information. The data is therefore prone to errors of this type.
- Secondly, the analysis is clearly limited to the sources of information and the types of IP protection mechanisms asked about. It may be that forms of IP protection (such as complementary goods and services) that are not included in the survey are more important in services than in goods based industries.
- Thirdly, and perhaps most importantly, with cross-sectional data such as this it is difficult if not impossible to separate cause and effect. For example, are firms more likely to innovate because they have engaged in wider search behaviours in the conduct of their activities, or do they engage in wider search behaviours because they are determined to innovate, particularly at a higher level? In other words, with cross-sectional data such as this we can find associations between behaviours, but not causation.

Aside from difficulties disentangling cause and effect there are challenges in interpretation. For example, we have found that service firms are less likely to use universities as a source of information or knowledge for their innovation activities than are manufacturers. But what does this imply? One possible interpretation is that is that services are poorly supplied with knowledge by universities (as IBM's 'Service Science' initiative also suggests), with universities apparently better able to forge links with manufacturers. Another interpretation, however, is that there is no need for universities to strengthen their links to services as services appear adequately supplied with knowledge either from internal sources or from other external sources. These are matters which deserve fuller exploration beyond the confines of a dataset such as the UK Innovation Survey.

Perhaps the most controversial area on which we have sought to shed some light is the use and importance of intellectual property protection methods by service firms, and the finding that service firms tend to make less use of these than do manufacturers. There is also a positive association between the use of formal forms of IP protection and firms tending to commit more resources to innovation. Such an association is entirely understandable, and indeed forms of IP protection are made available by the state partially to encourage firms to invest more in innovation. A simple but perhaps dangerous conclusion is that the provision of stronger and more appropriate forms of intellectual property protection would encourage individual service firms to invest more in innovation. Although logical, such a conclusion would fail to appreciate how different 'systems of innovation' have developed in different industries. The introduction of new and stronger forms of IP would change the rules of the game and would therefore change behaviours in ways we cannot predict from our limited analysis. We would certainly not like to draw any strong recommendations from this, inevitably limited, empirical study.

What are our main findings? Firstly, the UK Innovation Survey of 2005 shows most firms use one of four information sourcing strategies for innovation: 1.) they use no external sources, instead relying solely on sources internal to the company or company group; 2.) they use external sources, but only near-market sources, such as suppliers, customers and/or competitors; 3.) they use external sources and extend beyond near-market sources to intermediaries, such as conferences, journals or associations and standards; or 4.) they use internal, near-market and intermediary sources, but also specialist research or knowledge organisations, such consultants, private research organisations, universities or public research institutes. In essence, links with universities as well as public and private research organisations appear to be relatively uncommon, but are perhaps the 'cherry on the cake' in the information search strategies of the firms that also tend to be making the greatest commitments to innovation.

In most industries only a minority of firms used universities as a source of information for innovation, and in general firms in service industries were less likely to use universities than were manufacturing firms. Public research institutes are also slightly more widely used by firms in manufacturing industries than those in service industries. Consultants and private research organisations are used more widely than public research institutes or universities.[20] Firms in service industries also seem to make less widespread use of consultants and private research organisations than do firms in manufacturing industries.

Overall, we conclude that there appears to be something of an elite of innovating firms in the UK which are characterised by relatively high commitments to innovation, both in terms of their expenditures on innovation and in terms of the number of innovation related activities they engage in (e.g., internal R&D,

20. Although when universities and public research institutes are combined into the 'public science base' their extent of use is similar to that of consultants and private research organisations.

acquired R&D, design, training, marketing, etc.). For example, there are over a thousand firms (1,048) in the dataset which indicate they undertook at least four of these innovation activities and spent at least £5,000 per employee on innovation in 2004.

These 'elite firms' appear to exist in a remarkable variety of industries, with about half of them being in manufacturing and the other half services. As a share of the sample of firms in the dataset these 'elite firms' are much more commonly in manufacturing (10 per cent of firms) and technical services (16 per cent of firms) and are relatively uncommon in other services (3 per cent). These 'elite firms' are much more likely than other firms to have far reaching search strategies as part of their innovation activities – e.g., they are more likely than are other firms to engage with public and or private research organisations.

The second part of the study concerned how firms – and service firms in particular – protect their innovations. The evidence shows that innovating firms in manufacturing industries tend to be much more likely to use patents to protect their innovations than innovating firms in service industries. This is probably at least partially due to the nature of their activities, and the extent to which any inventions are patentable. The pattern of use of registered designs is similar to that of patents, with firms in service industries again less likely to use these than manufacturing firms.[21] The use of copyrights and trademarks to protect innovations also show similar patterns to the use of patents and registered designs, with firms in service industries generally less likely to use these methods of protecting their innovations than firms in manufacturing industries.

Aside from these formal methods, firms can also use informal or strategic methods to protect their innovations. These include secrecy, confidentiality agreements, complexity of designs, and lead time advantages. It is evident that innovating firms in both manufacturing and service industries made greater use of these strategic forms of protection than they did formal forms of protection. In general, firms in service industries were less likely to use each of the strategic forms of protection than were firms in manufacturing industries.

Taken together, manufacturing and service industries differ markedly by the average number of protection methods used, with services tending to use fewer methods of protection than manufacturers.

Firm level analyses showed that firms that have introduced goods, service and/or process innovations (and combinations of these) differ in their use of strategic and/or formal methods of protecting their innovations. In particular, service innovations appear to be protected in a similar way to process innovations (with greater reliance on strategic protection, such as secrecy), rather than in a similar way to tangible, goods innovations. Goods innovations are more likely to be protected with patents, registered designs, trademarks

21. Although service firms are also more likely to use these than patents.

and/or copyrights. Beyond this, it is also evident that, with the exception of the technically based service industries of telecommunications, computer services, R&D services, and architecture and engineering services, service industries were significantly less likely to use formal IP protection methods than were manufacturing firms. Firms in many service industries were also less likely to use only strategic forms of protection than were manufacturing firms, but the difference was not as pronounced as with formal forms of protection.

As mentioned above, we are cautious in our interpretation of these findings. They appear to suggest that more sophisticated and systematic approaches to innovation in services may be being held back by two things: a lower awareness of the available forms of IP protection in services than in manufacturing; but also a relative weakness in intellectual property protection for services. In some senses the strongest forms of IP protection for innovations are patents followed by registered designs – these are more clearly oriented and applicable to goods than to services. As it would appear that firms tend to use various types of IP protection alongside one another – like links in a chain – the lower applicability of at least these two forms of IP protection appears to weaken the whole chain of protection, and thus reduce incentives to innovate.

This relative weakness of both individual forms and combinations of protection may be one reason why there are proportionally fewer 'elite innovators' amongst services than in manufacturing. In other words, stronger components and systems of IP protection would probably encourage individual service firms to make deeper commitments to innovation, which may imply more scalable business models in services. However, it is also notable that some service firms do seem to be making deep commitments to innovation already, and given the welfare implications and international nature of policy in this area, much more research or consultation is required before we can come to any firm policy conclusions.

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Appendix 5.1: Regressions

Table A5.1: Multinomial logistic regression of information search strategies

	Near-Market Only vs. None		NM & Intermediaries vs. None		NM & Intermediaries Research vs. None	
	B	Exp(B)	B	Exp(B)	B	Exp(B)
Patents	0.49	0.20	0.32	0.08	0.55	0.45
Constant	-1.06***	0.35	-0.52***	0.59	-1.02***	0.36
Ln(Employment)	-0.22***	0.80	-0.15***	0.86	0.03	1.03
Group Firm	-0.13	0.88	0.03	1.03	0.11*	1.12
New Firms	0.23**	1.26	-0.09	0.92	0.03	1.03
National Markets	0.14	1.15	0.09	1.10	0.09	1.09
International Markets	-0.04	0.96	0.24***	1.27	0.29***	1.33
R&D activities	1.77***	5.88	2.28***	9.79	2.74***	15.54
Prop_S&E Graduates	-0.36	0.70	0.37	1.45	1.38***	3.97
Prop_Other Graduates	0.95***	2.57	0.82***	2.26	1.60***	4.96
P&P Innovation Only	2.21***	9.08	2.11***	8.28	2.20***	9.05
Wider Innovation Only	0.69***	2.00	1.31***	3.70	1.62***	5.05
Both P&P & Wider.	3.07***	21.49	3.29***	26.87	3.97***	52.87
sic_1014	-0.51	0.60	-0.79***	0.46	-0.57**	0.57
sic_1516	0.28	1.32	-0.07	0.94	-0.04	0.96
sic_1719	-0.46	0.63	-0.28	0.75	-0.51*	0.60
sic_2021	0.00	1.00	0.28	1.33	-0.34	0.71
sic_22	0.09	1.09	0.65***	1.91	0.22	1.24
sic_2324	-0.61	0.54	-0.44	0.65	-0.14	0.87
sic_2728	0.23	1.26	0.03	1.03	-0.05	0.95
sic_29	-0.14	0.87	0.25	1.28	-0.05	0.95
sic_3032	-1.96*	0.14	0.07	1.08	0.19	1.21
sic_31	-0.50	0.61	-0.35	0.70	-0.21	0.81
sic_33	-0.33	0.72	0.10	1.11	0.39	1.48
sic_3435	-0.37	0.69	-0.10	0.91	-0.15	0.86
sic_3637	0.01	1.01	0.41*	1.51	-0.03	0.97
sic_4041	-0.16	0.85	-1.36**	0.26	-0.86*	0.42
sic_45	-0.22	0.80	-0.01	0.99	0.23	1.26
sic_50	-0.06	0.94	0.42*	1.52	-0.10	0.90
sic_51	-0.18	0.83	0.27	1.31	-0.01	0.99
sic_52	-0.34	0.71	0.00	1.00	-0.53***	0.59
sic_55	0.17	1.19	-0.19	0.83	-0.60***	0.55
sic_6063	-0.08	0.92	-0.11	0.90	-0.24	0.78
sic_6064	0.14	1.15	0.07	1.07	-0.23	0.80
sic_642	-0.03	0.97	-0.14	0.87	-0.43	0.65
sic_6567	-0.52*	0.59	-0.28	0.76	-0.65***	0.52
sic_7071	-0.76***	0.47	-0.36*	0.70	-0.53***	0.59
sic_72	-0.68*	0.51	-0.23	0.79	-0.67**	0.51
sic_73	-1.48***	0.23	-2.24***	0.11	-0.80**	0.45
sic_7414	-0.84***	0.43	-0.62***	0.54	-0.78***	0.46
sic_7423	-0.79**	0.45	-0.48**	0.62	0.00	1.00
sic_745	0.25	1.29	0.22	1.25	-0.30	0.74
sic_7468	0.19	1.22	0.17	1.19	-0.09	0.92

Note: Cases: 15,197 (missing: 1,249); none used: 3,720; near-market only: 952; near-market and intermediaries: 3,234; near-market, intermediaries and research: 6,677; other strategies 614 (results not reported here). Model Chi-Square: 6975.9, significant at <0.01 per cent; -2LL: 31338.3; Nagelkerke Pseudo R-Square 0.395; McFadden Pseudo R-Square = 0.171.

Table A5.2: Ordinal logistic regressions: use of research organisations

	Universities	Public Institutes	All Public-Science	Private Research
Threshold: no-low	2.26***	2.35***	2.01***	1.91***
Threshold: low-medium	3.82***	3.92***	3.44***	3.44***
Threshold: medium-high	5.54***	5.81***	5.21***	5.35***
Ln(Employment)	0.12***	0.14***	0.12***	0.14***
Group Firm	0.11**	0.14***	0.11***	0.08**
New Firms	0.01	0.05	0.03	0.10**
National Markets	-0.05	-0.10**	-0.05	0.04
International Markets	0.17***	-0.02	0.05	0.08
R&D activities	0.73***	0.66***	0.75***	0.75***
Prop_S&E Graduates	1.33***	1.17***	1.35***	0.82***
Prop_Other Graduates	0.85***	0.90***	0.85***	0.77***
P&P Innovation Only	0.59***	0.57***	0.61***	0.87***
Wider Innovation Only	0.65***	0.70***	0.76***	0.93***
Both P&P & Wider Innov.	0.95***	0.96***	1.05***	1.34***
sic_1014	-0.25	-0.08	-0.22	0.05
sic_1516	-0.19	-0.02	-0.13	0.17
sic_1719	-0.33*	-0.34*	-0.39**	-0.08
sic_2021	-0.51***	-0.53***	-0.49***	-0.45***
sic_22	-0.49***	-0.28*	-0.48***	-0.13
sic_2324	0.30*	0.14	0.22	0.25
sic_2728	-0.06	-0.15	-0.09	-0.09
sic_29	-0.13	-0.11	-0.13	-0.07
sic_3032	0.13	0.17	0.05	0.06
sic_31	-0.13	-0.19	-0.09	0.17
sic_33	0.38**	0.27	0.41**	0.26*
sic_3435	-0.16	-0.10	-0.14	-0.19
sic_3637	-0.59***	-0.29**	-0.51***	-0.17
sic_4041	-0.21	-0.08	-0.20	-0.01
sic_45	0.02	0.24**	0.09	0.25**
sic_50	-0.50***	-0.26	-0.38**	-0.23
sic_51	-0.28**	-0.16	-0.27**	0.00
sic_52	-0.81***	-0.62***	-0.72***	-0.40***
sic_55	-0.70***	-0.30**	-0.52***	-0.46***
sic_6063	-0.58***	-0.01	-0.26*	-0.23*
sic_6064	-0.64***	-0.13	-0.35**	-0.25*
sic_642	-1.08***	-0.37*	-0.69***	-0.28
sic_6567	-1.08***	-0.39***	-0.66***	-0.11
sic_7071	-0.69***	-0.05	-0.31**	-0.15
sic_72	-0.68***	-0.51***	-0.67***	-0.39***
sic_73	1.03***	0.80***	0.92***	0.46***
sic_7414	-0.48***	-0.22	-0.39***	-0.26**
sic_7423	0.12	0.39***	0.23*	0.26**
sic_745	-0.46***	-0.14	-0.20	-0.65***
sic_7468	-0.33**	-0.10	-0.24*	-0.23*
N.	15,200	15,199	15,199	15,197
Model Chi-sq	2,772.9	2,290.2	3,027.1	3,633.7
Residual -2LL	20,107.3	21,177.3	23,767.3	26,829.3
Nagelkerke pseudo R-sq.	0.212	0.176	0.216	0.244
McFadden pseudo R-sq.	0.119	0.095	0.110	0.116

Table A5.3: Multinomial logistic regression: innovation protection methods

	Strategic Only vs. Neither		Formal (% Strategic) vs. Neither		Formal (% Strategic) vs. Strategic Only	
	B	Exp(B)	B	Exp(B)	B	Exp(B)
Intercept	-0.72**		-1.18***		-0.46**	
Ln(Employment)	0.12***	1.13	0.28***	1.32	0.16***	1.17
Group_Firm	0.10	1.11	0.36***	1.44	0.26***	1.30
New_Firm	0.27**	1.31	0.24**	1.27	-0.04	0.96
National_Markets	0.54***	1.72	0.62***	1.85	0.08	1.08
Internat_Markets	0.80***	2.22	1.23***	3.41	0.43***	1.54
Goods_only	-0.06	0.95	0.51***	1.66	0.56***	1.75
Services_only	0.11	1.12	-0.08	0.92	-0.19	0.82
Goods_&_Services	0.16	1.18	0.43**	1.54	0.27*	1.31
Goods_&_Processes	0.55***	1.73	1.30***	3.68	0.75***	2.13
Service_&_Processes	0.56***	1.75	0.47***	1.59	-0.09	0.91
All Three Types	0.65***	1.92	1.03***	2.80	0.38***	1.46
Novel Product	0.46***	1.58	0.90***	2.46	0.44***	1.56
Novel Process	0.08	1.09	0.25*	1.29	0.17*	1.19
External Product	-0.33**	0.72	-0.95***	0.39	-0.62***	0.54
External Process	-0.32**	0.73	-0.63***	0.53	-0.31**	0.73
sic_1014	0.03	1.03	-1.02**	0.36	-1.05***	0.35
sic_1516	-0.58*	0.56	-1.16***	0.31	-0.58**	0.56
sic_1719	-0.22	0.80	-0.38	0.68	-0.16	0.85
sic_2021	0.01	1.01	-0.41	0.66	-0.42	0.65
sic_22	-0.38	0.68	-0.82***	0.44	-0.44*	0.65
sic_2324	-0.25	0.78	0.18	1.19	0.42	1.53
sic_2728	-0.33	0.72	-0.98***	0.37	-0.65***	0.52
sic_29	0.08	1.08	0.08	1.08	0.00	1.00
sic_3032	0.60	1.82	0.28	1.33	-0.32	0.73
sic_31	-0.09	0.92	0.22	1.24	0.31	1.36
sic_33	0.04	1.04	0.16	1.17	0.11	1.12
sic_3435	-0.20	0.82	-0.40	0.67	-0.20	0.82
sic_3637	0.27	1.31	-0.07	0.93	-0.34	0.71
sic_4041	-0.53	0.59	-0.68	0.51	-0.14	0.87
sic_45	-0.45	0.64	-0.80***	0.45	-0.35	0.70
sic_50	-1.23***	0.29	-1.41***	0.24	-0.18	0.84
sic_51	-0.37	0.69	-0.52*	0.60	-0.15	0.86
sic_52	-0.99***	0.37	-1.26***	0.28	-0.27	0.77
sic_55	-1.23***	0.29	-1.36***	0.26	-0.13	0.87
sic_6063	-0.36	0.70	-0.90***	0.41	-0.54**	0.59
sic_6064	-0.73**	0.48	-1.35***	0.26	-0.63**	0.53
sic_642	0.40	1.49	0.06	1.06	-0.34	0.71
sic_6567	0.13	1.14	-0.65**	0.52	-0.78***	0.46
sic_7071	-0.74**	0.48	-0.71**	0.49	0.03	1.03
sic_72	0.25	1.29	0.51	1.67	0.26	1.30
sic_73	-0.36	0.70	0.24	1.27	0.60**	1.81
sic_7414	-0.37	0.69	-0.81***	0.44	-0.44*	0.64
sic_7423	-0.10	0.91	-0.13	0.88	-0.03	0.97
sic_745	-0.72**	0.49	-1.12***	0.33	-0.40	0.67
sic_7468	-0.79**	0.46	-0.97***	0.38	-0.18	0.84

Note: Cases: 5597 (missing: 233); neither used: 1123; strategic only: 1387; both: 3087 Model Chi-Square: 1604.8, significant at <0.01 per cent; -2LL: 9477.5; Nagelkerke Pseudo R-Square 0.289; McFadden Pseudo R-Square = 0.144

Table A5.4: Multinomial logistic regression: protection of high importance

	Strategic Only vs. Neither		Formal (% Strategic) vs. Neither		Formal (% Strategic) vs. Strategic Only	
	B	Exp(B)	B	Exp(B)	B	Exp(B)
Intercept	-2.06***		-3.01***		-0.95***	
Ln(Employment)	0.08***	1.09	0.17***	1.19	0.09***	1.09
Group_Firm	0.14*	1.15	0.28***	1.32	0.15	1.16
New_Firm	0.19*	1.20	0.12	1.13	-0.06	0.94
National_Markets	0.31***	1.36	0.61***	1.84	0.30*	1.35
Internat_Markets	0.64***	1.89	1.20***	3.33	0.57***	1.76
Goods_only	0.32**	1.38	0.83***	2.29	0.51***	1.66
Services_only	0.08	1.08	-0.16	0.85	-0.24	0.79
Goods_&_Services	0.29*	1.33	0.48***	1.61	0.19	1.21
Goods_&_Processes	0.41***	1.51	0.85***	2.34	0.44**	1.55
Service_&_Processes	0.55***	1.73	0.18	1.20	-0.37**	0.69
All Three Types	0.72***	2.06	0.74***	2.10	0.02	1.02
Novel Product	0.48***	1.62	0.70***	2.01	0.22**	1.24
Novel Process	0.44***	1.55	0.53***	1.71	0.10	1.10
External Product	-0.50***	0.60	-0.91***	0.40	-0.41**	0.67
External Process	-0.32**	0.73	-0.30*	0.74	0.02	1.02
sic_1014	-0.10	0.91	-0.07	0.93	0.03	1.03
sic_1516	-0.53**	0.59	-1.02***	0.36	-0.49*	0.61
sic_1719	0.15	1.16	0.02	1.02	-0.12	0.88
sic_2021	-0.09	0.92	-0.30	0.74	-0.22	0.81
sic_22	-0.53*	0.59	-0.31	0.73	0.22	1.24
sic_2324	0.47	1.60	0.54*	1.71	0.06	1.07
sic_2728	-0.35	0.70	-0.62***	0.54	-0.27	0.76
sic_29	0.09	1.09	0.23	1.26	0.15	1.16
sic_3032	0.60**	1.83	0.08	1.08	-0.52*	0.59
sic_31	-0.02	0.98	-0.04	0.96	-0.02	0.98
sic_33	0.57*	1.78	0.60**	1.82	0.02	1.02
sic_3435	-0.26	0.77	-0.22	0.81	0.04	1.04
sic_3637	-0.17	0.85	-0.12	0.88	0.04	1.04
sic_4041	0.23	1.26	0.14	1.15	-0.09	0.92
sic_45	-0.77***	0.46	-1.02***	0.36	-0.25	0.78
sic_50	-0.50	0.61	-0.72*	0.49	-0.22	0.80
sic_51	-0.57**	0.57	-0.12	0.89	0.45*	1.57
sic_52	-0.58**	0.56	-0.85***	0.43	-0.27	0.76
sic_55	-1.61***	0.20	-0.55*	0.58	1.07***	2.91
sic_6063	-0.36	0.70	-0.58**	0.56	-0.23	0.80
sic_6064	-0.71**	0.49	-0.81**	0.45	-0.10	0.90
sic_642	0.45	1.57	-0.08	0.93	-0.53	0.59
sic_6567	0.13	1.14	-0.41	0.67	-0.54**	0.58
sic_7071	-0.54*	0.59	-0.59**	0.55	-0.06	0.94
sic_72	0.22	1.24	0.45**	1.57	0.23	1.26
sic_73	0.31	1.37	1.03***	2.79	0.71***	2.04
sic_7414	-0.13	0.88	-0.28	0.75	-0.16	0.85
sic_7423	-0.08	0.92	-0.18	0.84	-0.09	0.91
sic_745	-0.48*	0.62	-1.20***	0.30	-0.72*	0.49
sic_7468	-0.20	0.82	-0.20	0.82	0.00	1.00

Note: Cases: 5597 (missing: 233); neither: 2919; strategic only: 1199; both: 1479 Model Chi-Square: 1454.0, significant at <0.01 per cent; -2LL: 9918.6; Nagelkerke Pseudo R-Square 0.263; McFadden Pseudo R-Square = 0.127

Variables Used in Tables A5.1, A5.2, A5.3 and A5.4

Ln(Employment)	Firm size as the natural log of number of employees
Group_Firm	Dummy for firms that are part of a group of enterprises (the reference is independent firms)
New_Firm	Dummy for newly established firms (reference is older firms)
National_Markets	Dummy for firms active in national markets#
International_Markets	Dummy for firms active in international markets#
R&D activities	Dummy for firms that engaged in intra-mural R&D activities (the reference is firms without R&D activities)
Prop_S&E Graduates	Proportion of science and engineering graduates in the workforce
Prop_Other Graduates	Proportion of other graduates in the workforce
P&P Innovation Only	Dummy for firms that introduced product or process innovations but not wider organisational or managerial innovations$
Wider Innovation Only	Dummy for firms that introduced wider organisational or managerial innovations but not product &/or process innovations$
Both P&P & Wider.	Dummy for firms that introduced both product and process innovations and wider organisational or managerial innovations$
sic_1014	Dummy for firms active in mining and quarrying*
sic_1516	Dummy for firms active in food, drink and tobacco*
sic_1719	Dummy for firms active in textiles and clothing*
sic_2021	Dummy for firms active in wood and paper products*
sic_22	Dummy for firms active in publishing and printing*
sic_2324	Dummy for firms active in chemicals and fuels*
sic_2728	Dummy for firms active in metals and metal products*
sic_29	Dummy for firms active in machinery*
sic_3032	Dummy for firms active in electronics*
sic_31	Dummy for firms active in electrical goods*
sic_33	Dummy for firms active in instrumentation*
sic_3435	Dummy for firms active in transport equipment*
sic_3637	Dummy for firms active in other manufacturing*
sic_4041	Dummy for firms active in the water and energy utilities*
sic_45	Dummy for firms active in construction*
sic_50	Dummy for firms active in the motor trades*
sic_51	Dummy for firms active in the wholesale trades*
sic_52	Dummy for firms active in retail trades*
sic_55	Dummy for firms active in wholesaling*
sic_6063	Dummy for firms active in transport services*
sic_6064	Dummy for firms active in postal and courier services*
sic_642	Dummy for firms active in telecommunications*
sic_6567	Dummy for firms active in financial services*
sic_7071	Dummy for firms active in rental services*
sic_72	Dummy for firms active in computer services*
sic_73	Dummy for firms active in R&D services*
sic_7414	Dummy for firms active in professional services*
sic_7423	Dummy for firms active in architecture & engineering services*
sic_745	Dummy for firms active in labour provision services*
sic_7468	Dummy for firms active in other business services*

Note: $ The reference group is firms that introduced neither product and process innovations, nor managerial / organisational innovations. # The reference group is firms that only compete in local or regional markets. *The reference sector is SIC 25 & 26: Rubber, Plastics & Non-Metallic Mineral Products

Variables used in Tables A5.3 and A5.4 but not in A.5.1 and A5.2

Goods_only	Dummy for firms that only introduced goods innovations$
Services_only	Dummy for firms that only introduced service product innovations$
Goods_&_Services	Dummy for firms that introduced goods and service product innovations$
Goods_&_Processes	Dummy for firms that introduced goods and process innovations$
Service_&_Processes	Dummy for firms that introduced service product and process innovations$
All Three Types	Dummy for firms that introduced all three of goods, service product and goods innovations$
Novel Product	Dummy for firms that introduced new to the market product innovations (reference is new to the firm product innovations)
Novel Process	Dummy for firms that introduced new to the industry process innovations (reference is new to the firm process innovations)
External Product	Dummy for firms that introduced new products that were mainly developed by other enterprises or organisations (reference is new products developed by the firms itself or jointly with others)
External Process	Dummy for firms that introduced new processes that were mainly developed by other enterprises or organisations (reference is new processes developed by the firms itself or jointly with others)

Note: $ The reference group is firms that introduced only process innovations.

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