INNOVATION IN THE SERVICE SECTOR

Analysis of data collected under the Community Innovation Survey (CIS-2)

CRIC

THE UNIVERSITY OF MANCHESTER & UMIST

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EXECUTIVE SUMMARY

Background

- Services dominate economic activity and employment in Europe, but …
- Almost all of our understanding of innovation derives from studies of manufacturing
- Innovation in services has, until recently, received little attention – it remains under-researched
- Services are often thought to be technologically backward – at best, this is an over-generalisation
- Services include some of the most dynamic sectors – notably telecommunications and software
- Services are central to the diffusion and creative use of new technologies
- The Second Community Innovation Survey provides valuable insights into services innovation

One of the most discussed trends in advanced economies is the long-term growth in services – both in output and employment terms. Services now dominate economic activities in Europe. Market services alone account for half of total value added in the European Union, and for just under half of total employment. But despite the economic dominance of services, services innovation has only recently begun to receive significant attention from innovation researchers and policymakers.

For a long time, most observers considered services to be - in the main - technologically backward, and to take little initiative with respect to innovation. It was recognised that there are some exceptionally dynamic services – such as telecommunications and software. But in general services were presumed to be laggards in adopting new technology, and to be largely passive adopters of major innovations. Now evidence is mounting which shows that many service sector firms play important roles in innovation, not least in the creative use and diffusion of technologies. Thus, the need to address services in innovation policies and policy-relevant research is becoming widely accepted. The second European Community Innovation Survey (CIS-2) reflects this new attitude. It provides the first internationally systematic data on services' technological innovation behaviour.

Twelve European Union countries (Greece, Italy and Spain did not participate) and Norway surveyed several key market service sectors using the CIS-2 questionnaire. These sectors were: wholesale services; transport services; telecommunications services; financial services; computer services; and technical services. The electricity, gas and water distribution utilities were also covered. The survey addressed enterprises with at least 10 employees. Across Europe, over 12,000 service enterprises participated in the survey (about 6.7% of the eligible population of enterprises).

The Incidence of Innovation

- Just under half of service enterprises engaged in innovative activities between 1994 and 1996
- Larger enterprises were more likely to engage in innovative activities, but overall service enterprises were less likely to be identified as innovators than were similarly sized manufacturers
- The proportion of innovators varied by sector, being highest amongst the technology oriented services and lowest amongst services which predominantly use rather than produce technology

Services certainly do emerge as innovators – though slightly less so than manufacturing firms of comparable size. Just under half of the surveyed services enterprises had **engaged in innovative activities** between 1994 and 1996. Larger firms tended to report innovative activities more frequently, so that about three-quarters of firms with more than 250 employees had engaged in these activities. This is in line with trends established for manufacturing firms, and is predictable on the grounds that larger enterprises, tending to have more lines of business, should have more scope for innovation. From the CIS-2, service enterprises emerge as slightly less likely to report that they have engaged in technological innovation activities than manufacturers of similar size.

The proportion of enterprises with innovative activities also varied widely across the different services sectors. Only 29% of the transport service enterprises had engaged in innovative activities, as had 40% of the wholesale service enterprises. These are relatively less innovative sectors. More innovative services include telecommunications, computer services and technical services, whose activities are more technologically orientated – and often technology-producing. Thus 64% of the telecommunications, 68% of the computer service, and 67% of the technical service enterprises had engaged in innovative activities. These "high-tech" services have a lot in common with high-tech manufacturing industries.

The Aims of Innovation

- The most widely cited aim of innovation was improving the quality of the services provided
- Extending the service range and opening new markets were also widely recognised aims
- These service 'product' aims were more widely recognised than process (e.g., cost saving) aims
- Most services enterprises have both 'product' and 'process' related aims of innovation
- The aims of innovation were remarkably similar across all of the service sectors examined

Firms were asked to indicate how important various **aims of innovation** were to them. The main aims of innovation were remarkably consistent across the different sectors examined. The most commonly cited was *improving the quality of the services offered*, which two thirds of the service enterprises with innovative activities recognised as a very important aim of their innovation activities.

About half the enterprises regarded *extending their service range* and/or *opening new markets* as very important objectives of their innovation activities. About 90% recognised these as being relevant objectives of innovation.

These patterns point to a prominence of 'service product', rather than process-related aims of innovation. Product range and quality issues loom high, together with enlarging markets. However, it can be difficult in services to distinguish between product and process (because the service is often produced and delivered as it is consumed). This implies that product and process innovation may also be hard to differentiate – changes in the process of service provision often lead to a change in the service provided, and a new or modified service often requires a new or modified process of provision.

The answers to questions about the process-oriented aims of innovation also reflect the significance of these. About two fifths of the innovating enterprises regarded *improving their internal flexibility* and/or *reducing their labour costs* as very important objectives of their innovation activities, and about 80% recognised these as relevant aims of these activities. Notably, however, relatively few (about 20%) saw *reducing other costs*, particularly materials and energy costs, as very important objectives of their innovation activities. This reflects the relatively low importance of these costs in most services.

In summary, it appears that most service firms primarily aimed to use innovation to improve their service provision. Process side considerations were important, but secondary. This said, most service enterprises have multiple innovation objectives, and record several of the aims as important.

Research and Development (R&D) in Services

- Services are widely assumed not to engage in Research and Development (R&D) activities
- But just under half the innovating service enterprises were engaged in R&D between 1994 and 1996 – a quarter engaged in R&D on a continuous basis
- R&D is more common in large service enterprises, and in those in technology oriented sectors
- Some service enterprises are highly R&D intensive – others innovate without recourse to R&D
- Overall, R&D is less common in services than amongst manufacturers, especially of similar size

Engagement in R&D is widely assumed to be rare in services, and formal R&D departments are thought to be even less common. The CIS-2 data confirms that innovating service enterprises are less likely to engage in R&D than innovating manufacturers. Nearly 70% of the innovating manufacturers conducted R&D, whilst just under half the innovating service enterprises reported having engaged in R&D. But this makes for a large number of service firms undertaking R&D, despite the received wisdom, and clearly many services are highly R&D-active. Indeed a quarter of the innovating service enterprises not only engaged in R&D but did so on a continuous basis.

In relation to R&D there is one class of enterprises that is exceptional - large-scale manufacturers - particularly those in high tech sectors. This class of firms is much more likely than others to conduct R&D, and especially to undertake R&D continuously. Smaller manufacturing enterprises operating in low tech sectors – and most services firms – may well innovate, but they do not depend so heavily, or even at all, on internal R&D to achieve this.

That said, *some* services are heavily dependent on intra-mural R&D for innovation. This particularly applies to the technology providing enterprises within sectors such as telecommunications, computer services and technical services. For example, 45% of the innovating computer service enterprises engaged in R&D on a continuous basis, as did 33% of the innovating technical service enterprise. In contrast, only 18% of the innovating wholesale and financial service enterprises, and a mere 4% of the innovating transport service enterprises did so.

Innovation-Related Activities

- The acquisition of machinery and equipment, the acquisition of other external technologies (including software) and training directly linked to innovation were the three most widely undertaken innovation related activities in 1996
- This illustrates the importance of bought-in technologies (which overall is greater than R&D)
- The acquisition of external technologies was also significant in the technology oriented sectors
- The widespread engagement in training shows the importance of the human element of services

Taking a rather more detailed look at services' **activities in relation to technological innovation**, we begin with intra-mural versus bought-in R&D. The predominant tendency was for R&D to be performed internally, with many fewer firms buying it in. A third of the enterprises that innovated between 1994 and 1996 engaged in intra-mural R&D in 1996, with 12% acquiring R&D services from other enterprises or institutions. The more technologically orientated sectors, such as computer and technical services, were most likely to engage in intra-mural R&D.

The three most widely undertaken innovation-related activities were *acquisition of machinery and equipment*, the *acquisition of other external technologies* (including software), and the *training of staff* (directly in relation to innovation). This illustrates the general importance of bought-in technologies. It also demonstrates the importance of enhancing the skills of the personnel within service enterprises. Enterprises in the more technologically orientated sectors, though most likely to undertake R&D, were as likely as the other services to acquire machinery and equipment, or other external technologies, for innovation. Thus, in these sectors, R&D activities are in general undertaken in addition to buying in technologies. They do not appear to be substitutes for each other. This highlights the need to both purchase external equipment and the internal generation of innovation-related knowledge.

Other innovation-related activities are also found in a good share of innovating service enterprises. Thirty percent incurred expenditures in connection with *preparations related to the introduction of new services* or *methods to produce or deliver new services,* whilst 40% incurred *expenses related to the market introduction of innovations.*

Expenditures on Innovation

- Innovating service enterprises vary tremendously in their commitments to innovation
- One quarter are recorded as spending less than 0.33% of turnover on innovation activities in 1996
- Another quarter are recorded as spending over 7% of turnover on innovation activities in 1996
- Thus it is common to find firms spending twenty times the amount others are on innovation
- Technology oriented service enterprises tend to spend more on innovation than other services
- But all sectors contain some very high spending and some very low spending enterprises
- In any one year, total innovation expenditures will be dominated by a sub-set of the enterprises – unfortunately we do not know if the same enterprises continually dominate these expenditures
- On average, acquired technologies accounted for the largest share of expenditures on innovation
- On average, internal R&D accounted for about a quarter of total expenditures on innovation
- The proportion spent on R&D was higher amongst enterprises in the technology oriented sectors

What is the scale of expenditures incurred in theses activities? Service enterprises vary tremendously in their commitments to innovation. About a quarter of the enterprises that incurred expenditures on the above innovation-related activities in 1996 spent *less than one third of one percent* of their turnover on these activities. At the other end of the scale, a fifth of the enterprises spent *7% or more* of their turnover on these activities. Assessed on a per employees basis, a quarter of the enterprises incurring such expenditures in 1996 spent *no more than 500euro per employee* on these activities, whilst a fifth of the enterprises spent *more than 10,000euro per employee*. Both measures indicate that the top fifth of the enterprises (by size-related innovation expenditures) had an 'innovation-intensity' (i.e., innovation expenditure per employee) at least 20 times that of the lowest spending quarter of innovative enterprises.

As we would expect, on average the firms in the more technologically orientated sectors were more 'innovation-intensive' than those in the less technologically orientated sectors (e.g., wholesale and transport services). However, there is considerable variety within these sectors. Indeed, all sectors contain some enterprises with very high innovation expenditures per employee (or as a proportion of turnover) and some enterprises with very low figures. Thus, in any one year, a few enterprises are likely to account for the vast majority of the total resources committed to innovation by a large group of enterprises. In CIS-2 data, the ten percent of the enterprises that spent most on innovation accounted for about 90% of the total commitment of resources to innovation amongst the service enterprises for which information was provided.[1]

What about the structure of innovation-related expenditures? On average a little over a quarter of these expenditures were on *intra-mural R&D*, with a further 5% being spent on *acquired R&D services*. About a quarter of expenditures directly related to innovation were incurred on *machinery and equipment*, with a further 15-20% being spent on *other external technologies (including software)*. On average, about 25% of the total was spent on *training*, on *preparations for the introduction of innovations* and on the *market introduction of innovations*.

Service enterprises also vary considerably in terms of the structure of their expenditures on innovation-related activities. For example, in the more technologically orientated sectors the proportion of total innovation expenditures spent on R&D tended to be higher, and that on acquired technologies tended to be lower, while amongst the less technologically orientated sectors the opposite was the case.

[1] **A warning**: we do not know how many of the high spending enterprises consistently committed large amounts to innovation year after year. Similarly, we cannot say how many committed considerable resources to innovation in one year followed by much lower resources in the next. Some combination of both possibilities is likely to feature in the data set – perhaps unevenly across sectors. This is one more reason why it is unwise to expect a strong link between innovation expenditures in a single year and commercial performance in that or subsequent years.

Sources of Information for Innovation

- Sources of information within the enterprise were the most widely recognised as very important for innovation – these were particularly widely recognised in the technology oriented sectors
- Many enterprises that did not do R&D said sources of information within the enterprise were very important for innovation – this shows services draw on more than internal R&D to innovate
- Customers were the second most widely recognised source of information for innovation
- Suppliers were important, although only a fifth saw them as a very important source of information
- Competitors were also significant – perhaps indicating a high degree of 'imitative innovation'
- Universities and research institutes were rarely regarded as significant sources of information

The most commonly recognised **source of information for innovation** were "*sources within the enterprises*". About half the innovating service enterprises recognised these to be *very important*. This proportion was even higher amongst the large enterprises and amongst the computer, financial and technical service enterprises. Also significant is that a substantial proportion of the enterprises that did not conduct R&D declared sources of information internal to the enterprise were very important for their innovation activities. This indicates that internal sources other than, and in addition to, R&D are important sources of information for innovation within service enterprises.

Services are often thought to have more intense relationships with their customer base than manufacturers: indeed, "service" is often identified with close customer relationships. This would suggest that customers should emerge as a major source of information for innovation. And, indeed, *customers* (or clients) were the second most widely recognised source of information for innovation. 80% of the enterprises recognised these as a *relevant* source of information for innovation and almost 40% as *very important*. Customers are particularly widely recognised as a very important source of information amongst computer service and wholesale enterprises.

Competitors are also significant as an information source – 80% regarded these as a *relevant* source of information for innovation (and 20% saw them as a *very important*). This may reflect 'competitor watching' behaviour – whereby service enterprises seek to react to, and indeed copy, the moves of their main competitors. However, in some areas of service collaboration of one form or another among erstwhile competitors is necessary to prepare markets, regulators, and other parties for innovations.

Suppliers are also relatively important – with 20% recognising them as a *very important* source of information for innovation. But, in contrast, the 'research system' (of universities, research institutes and patents) was rarely seen as an important source of information for innovation amongst the innovating service enterprises. For example, even amongst computer service enterprises, only 10% recognised universities as a *very important* source of information for innovation. This may be because services tend to be poorly linked into wider innovation systems.

Co-operation and Collaboration

- Most of the innovating service enterprise identified by the CIS-2 did not collaborate to innovate
- Larger service enterprises were more likely to collaborate, but less so than large manufacturers
- Enterprises in the technology oriented sectors were more likely to collaborate for innovation, but collaboration for innovation was not confined to enterprises in these sectors
- Competitors, suppliers and customers were most common external collaboration partners

There is much discussion of the tendency for innovations to be generated within systems of economic actors, rather than within single firms. This remains uncommon amongst the innovations captured in

CIS-2, however. About a quarter of the innovating service enterprises had **co-operative arrangements for innovation** with other enterprises or institutions; only slightly lower than the proportion for manufacturing. As in manufacturing, larger service enterprises were more likely to have such arrangements: but in general large service enterprises were less likely to have co-operative arrangements for innovation than large manufacturing enterprises. Firms in the more technologically orientated sectors were also more likely to have co-operation arrangements for innovation. The picture of intra-sectoral diversity emerges again, however, since in all service sectors some enterprises had these arrangements, while others do not.

Those service enterprises that are part of an enterprise group are most likely to collaborate with other enterprises within their company group (rather than with truly external partners). Of the enterprises that had co-operative arrangements for innovation with *external partners*, a wide variety of enterprises and institutions were engaged as partners. *Competitors* and *suppliers* were the most common partners. 40% of the enterprises that had external co-operative arrangements for innovation had them with one or both of these partner types. A third had co-operative arrangements for innovation with their *customers*. *Consultants* and *research institutes* were partners to 30% of these enterprises, and a quarter had co-operative arrangements for innovation with *universities*.

On the whole, these patterns show many similarities with those commented on above concerning sources of information for innovation. But we see that the relative places of customers and competitors/suppliers are changed. Customers may often be sources of information about the necessary characteristics of innovations, while competitors and suppliers can provide more of the necessary technical knowledge about how to achieve particular ends. But, as always, we can see much diversity within and between sectors – which we would expect, given, for example, the very different levels of technological sophistication that different sets of clients will possess.

Problems with Innovation

- Almost half the innovators had experienced difficulties with innovation, but for most of these the difficulties meant delays to innovation projects, rather than abandoning or not even starting them
- A lack of sources of finance was the most commonly identified difficulty, followed by the excessive economic risk of innovating
- Organisational rigidities and a lack of skilled personnel each hampered a fifth of the innovators
- A lack of skilled labour was the most widespread problem for the highest intensity innovators
- Few innovators claimed to have been hampered by a lack of information about technologies, or about markets, by standards or regulations, or customers responsiveness to innovation

Almost half the innovating service enterprises complained of having **experienced difficulties with innovation**. However, the majority of these complained that their innovation projects had been (seriously) *delayed* rather than *abandoned after being started* (15%) or *not even started* (25%).

Large enterprises, and those in the more technologically orientated sectors, were more likely to complain that they had experienced difficulties with innovation than smaller counterparts and enterprises in the less technologically orientated sectors. A probable explanation is that the large and/or more technologically orientated enterprises engaged in a greater number of innovative activities - and quite plausibly in more ambitious ones - than the other firms.

What were these problems? About a quarter of the innovating enterprises complained that a *lack of sources of finance* hampered their innovation activities, and a fifth complained about the *excessive economic risk* of innovation. *Organisational rigidities*, and a *lack of qualified personnel*, were both identified by a fifth of the innovating enterprises as inhibiting their innovation efforts. Notably, a lack of skilled labour was the most widely identified problem for the highest intensity innovators (i.e., those spending most on innovation on a per employee basis). On the other hand, only about 10% of the innovating enterprises claimed to have been hampered by: *excessive innovation costs*, a *lack of information about markets*, a *lack of technical information*, a *lack of customer responsiveness to innovation*, and/or *standards or regulations*.

Methodological Issues and Recommendations

- The inclusion of services in the Community Innovation Survey (CIS) is an important step forward
- However, the CIS-2 only covered about 20% of economic activity in European market services
- Future CIS should include more service sectors and smaller enterprises, especially as service sectors tend to have larger proportions of very small enterprises than do manufacturing sectors
- In services, what constitutes 'innovation' - especially 'technological innovation' – is contentious. Differences in interpretation are likely to have influenced many of the results from the CIS-2
- In services many 'products' are client specific and bespoke, yet these are not necessarily innovations. Further research in needed on variety, innovation and standardisation in services
- Future versions of the CIS should seek to reduce such differences in interpretation
- A distinction between '(technological) innovation' and 'technology adoption' should be developed.
- Non-technological innovation should be investigated, especially as in services organisational or managerial innovations are closely intertwined with technology, especially information technology
- Forms of innovation beyond products and processes need consideration, such as new means of delivery (as opposed to internal processes) and new means of interfacing with clients

The inclusion of services in the second European Community Innovation survey is a welcome and important step towards advancing our understanding of innovation in the economy. Its is important, given services dominate economic activity in Europe. As we have seen, it sheds a good deal of light on the nature of innovation in services. However, the sectoral coverage of the CIS-2, and its approach to investigating innovation in services, do impose limits on the range of conclusions that can be drawn from it.

Firstly, **sample coverage**. The CIS-2 was significantly biased to manufacturing. Of the 13 countries that included services in the CIS-2, only Portugal and Luxembourg returned substantially larger samples for services than for manufacturing; in many countries services returned only around half the number of responses that were received from manufacturers. Since we know much less about innovation in services than in manufacturing, and because services are more significant economically, it would be unfortunate if this bias were to continue in future CIS. Moreover, only a sub-set of the service **sectors** were included in the survey. Thus, the CIS-2 provides no information on innovation in such consumer-oriented service sectors as retailing, nor on many professional or non-technology oriented business services. Non-market services, furthermore, were not covered at all.

In terms of **size**, the CIS-2 only addressed enterprises with 10 or more employees – but the 95% of market service enterprises have fewer than 10 employees, and these account for about 40% of total employment in market services. While these are likely to be less innovative on average than the larger enterprises captured in the survey, this is still an important limitation. Together, the limits on sectoral and enterprise-size coverage mean that the CIS-2 only addressed enterprises that account for about 20% of all economic activity in market services.

Future versions of the CIS should address a wider range of market services, at least, but consideration should also be given to understanding innovation in public services. It would also be desirable for the size threshold for inclusion to be reduced, perhaps to include enterprises with 5 or more employees. This implies a considerable expansion of the survey in terms of the number of enterprises surveyed. This will enable a fuller picture of the pattern of innovation in services to be understood.

Beyond this consideration should be given to the content of the survey, for there has been considerable discussion in the research literature concerning the interpretation of "innovation" in service firms. What constitutes "innovation" in general, and "technological innovation" in particular, is contentious and ambiguous, and, indeed, its meaning to the CIS-2 respondents may vary in ways we poorly understand. For example, one respondent may consider a new computer system a routine upgrading – and thus not an innovation, while another may see it as being a significant step forward – and thus an innovation. Evidence for this comes from the survey data, in that the interpretation of the

term, despite the use of a consistent definition, seems to vary between countries. Such differences in the interpretation of "technological innovation" are the most likely explanation for most of the wide variation between countries in the proportion of enterprises identified as undertaking innovative activities. The fact that this variation existed for both manufacturing and services only strengthens this conclusion. For this reason, we have not dwelt upon cross-national variations in the data set, being unsure as to how far semantic or cultural differences are shaping the results.

If innovation in services is to be fully understood, survey enquiries may need to place less emphasis on *technological* innovation. Partly, this is because even with an extensive definition of 'technological innovation' there seems to be scope for divergence in responses, and it is possible that many services firms do not recognise their own technology-related activities under this rubric. There is also scope for confusing technology adoption with (technological) innovation. Additionally, the high intertwining of technological and organisational innovation (for example, in the effort to innovate in e-commerce or knowledge management systems) may mean that important elements of innovation are being overlooked. The traditional product-process distinction may make it hard to capture organisational and inter-organisational innovations – new office systems, supply chain-related innovations, delivery and aftersales systems, and so on, but these may have a greater significance on the commercial performance of the enterprises than 'innovation' through the adoption of new technologies.

An alternative approach would be to ask all enterprises (whether or not they declare themselves innovators) a common set of questions. The questions should ask - directly and indirectly - about a wide range of activities related to different types of innovation. The word 'innovation' itself might even be avoided, in favour of a more neutral language, such as 'changed ways of doing things', for example. The questions should include ones relating to: new or improved products and services (including services such as aftersales and delivery supporting the main products); new or improved business relations (within the firm, and with clients and business partners); and to internal processes of production and management. This would help overcome the exclusion of organisational and managerial innovation from the CIS, and enable the analysis of innovation within the context of the activities and circumstances of the enterprises - how they relates to their environments, and how they (seek to) use, innovation to change this relationship.

Policy Issues and Recommendations

- The CIS shows services are often innovators, and some service enterprises are highly innovative
- Services are also likely remain the major source of new jobs and competitiveness in Europe
- Therefore, services should be included in innovation policies and their participation encouraged
- The centrality of the human element in services and service innovation should be recognised. This brings to the fore the importance of education and training for competitiveness
- Innovation centres focused on developing best practice in services might be introduced
- Many services are dominated by professionals - who can be resistant to change, but the introduction of semi-professionals can encourage the diffusion / uptake of sophisticated services
- Regulations and standards can have a significant impact on innovation in services – both encouraging and hindering innovation. Such policy instruments should be considered with care
- The role of intellectual property rights for intangibles should be given greater attention in services
- A spatial division of labour is evolving in services – with, at least in some countries, an increasing concentration of high-level services in a few cities. This can exacerbate regional problems
- Services can and will play an important role in many of the most pressing problems facing our society – such as globalisation, the knowledge economy, sustainability, the aging society
- Services should therefore be included in European R&D, diffusion and foresight programmes
- But service innovation goes beyond technology – innovation policy for services needs to extend beyond encouraging R&D, and beyond encouraging strictly technological innovation

It is evident that services are often innovators. However, many service firms and sectors seem to be less active in terms of innovation (and especially R&D) than their counterparts in manufacturing industry – although in all sectors there appear to be at least a small proportion of highly innovative firms. Whatever the historical reasons for the (relatively) low levels of technological innovation that characterise some services, increasing use of new Information Technology, and growing competitive challenges, mean services innovation should now be firmly on the policy agenda. Moreover, services are likely to be the principal source of economic and employment growth into the future. It is therefore vital that European policies encourage the development of high quality services, which allow scope for innovation and competitiveness. Services should therefore be included in innovation programmes of all sorts, and attention should be given to elements of the structure and content of programmes that may have deterred the participation of services in innovation programmes in the past.

Many of the policy analyses presented below take the CIS-2 data as a starting point, but they also draw on a wider understanding of services and service innovation. An example concerns skills and training. Services are widely understood to be heavily dependent on the knowledge and skills of their employees, and the survey data confirm this. Service workers tend to be more closely involved in the development and provision of services than is generally the case with manufacturing workers. Service workers are often dealing directly with clients, and having to fuse knowledge of service techniques with client requirements.

A first important issue is **training**. Enterprises should be encouraged to train their workers to take full advantage of new technologies and to encourage innovation. One of the difficulties with this is that there is a danger of free riding and poaching behaviour, whereby some enterprises do not themselves undertake training but instead recruit workers which other enterprises have spent resources training. Where this is a common practice, it can reduce the number of enterprises that engage in training, and/or it can change the nature of that training – making it more company-specific and less generic. This possibility should be further researched. If it is found to be a significant problem steps should be taken to encourage training – perhaps through training subsidies, or through the provision of tax breaks for enterprises engaged in training. This argument also implies that the provision of education and training by public sector organisations should be encouraged (e.g., by charging no or minimal fees to the trainees).

Training should enable service personnel to work better with innovations, but it could also help the staff of service firms be more proactive with respect to innovation. It seems likely that innovation in services is less routine or professionally managed than that in manufacturing. This is especially likely to be the case amongst small enterprises, which dominate services to a much greater extent than is the case in manufacturing. Training courses, which focus on “service management” in business schools and further education, should be encouraged to add modules on service innovation, and to encourage innovation-related placements in services as part of their training and outreach programmes.

Related to training are **awareness and benchmarking** activities. Public authorities could play a role in developing or sponsoring innovation centres focused on services. These would study successful innovation in services with the aim of advising about best practice, identifying common pitfalls, etc. The use of web-sites to provide this information online would also be welcome. Techniques such as competitions and awards may be good means of stimulating awareness and rewarding excellence.

Many services are professional activities, and this can be important in terms of organising training, setting quality standards and awarding credentials. However, **professionalisation** can also be a barrier to innovation, as professionals can jealously guard their status and privileges, and some of their representative bodies pay little attention to fostering innovation. There are many exceptions to this, but consideration should be given to encouraging the formation of semi-professional workers, akin to para-legal and para-medical staff in their respective sectors. The introduction of these categories of personnel tends to reduce the price of some sophisticated services, whilst maintaining or even enhancing their quality. Beyond this professional associations may need to be encouraged to take more of a role in sharing good practice and diffusing knowledge of innovations.

This also relates to the geographical localisation of services. **Internationalisation** is underway rapidly in some services, more slowly in others: it is particularly apparent in professional and technology-related services, amongst which high levels of staff are employed by foreign enterprises in

many European countries. This means these are sectors where traditional barriers to trade are eroding, with incumbents challenged to be more competitive and with the possibility of learning from overseas experience. The competitiveness of European services, and their relative innovativeness, requires more attention. Consideration should also be given to the emerging spatial division of labour that is leading to a **spatial concentration of the highest value-added service activities** in certain central cities. This may disadvantage some peripheral areas, which either fail to participate significantly in dynamic service activities, or which become bases for low value-added, routine activities, such as data processing, and such a pattern can exacerbate existing regional inequalities.

Related to the issue of professionalisation (and to the introduction of semi-professionals) in services is the general importance of regulations and standards in these sectors. **Regulations** often shape the pattern of service activities, and by extension influence the pattern of innovation. The effect of new and existing regulations on encouraging or discouraging innovation activities in services needs to be examined.

Standards are also significant. Europe's success with mobile telephony, for example, owes much to the introduction of the common GSM standard. It contrasts with the slower development of mobile technology in the US where there was a lack of a common standard. Common standards should be encouraged across Europe where the industry deems these appropriate; government procurement and awareness activities can help the dissemination of standards. More generally, the problems that service customers face in knowing about service quality in advance of purchase might be eased by wider use of quality standards and accreditation.

The question of **intellectual property rights** and the protection of innovative ideas has also emerged on the services innovation agenda, particularly as these relate to intangibles. The existing forms of intellectual property (IP) protection are either of little relevance to services (e.g., patents, which have mainly been employed to govern tangible innovations) or are weak (e.g. copyrights, which are not really designed to cover technological innovations). There is much debate but little real evidence as to the value or disbenefits - in terms of stimulating innovation - of extending patenting to cover more service-like activities. It might well be that new forms of IP protection are required, more appropriate to services. Clearly there is a need to balance the incentives and rewards to the inventor/innovator, against the wider benefits of diffusion and competition. The nature of such a balance cannot be established without examining the behaviour of actual firms, but should not be left to lawyers alone.

There is also scope for encouraging the inclusion of services in national and **European R&D and diffusion programmes**. Indeed it might be appropriate to consider whether new programmes should be designed to take into account service related problems. Many of the most pressing issues facing our society relate closely to services – globalisation, the knowledge economy, sustainability, and the ageing society, for example. Technological and social innovations may both be required to make inroads into the problems raised by these trends, and innovative services are likely to make very significant contributions.

Foresight has been widely promoted as a policy tool for raising the levels of strategic intelligence and networking about technological and other opportunities and challenges. But in most cases, Foresight activities have been strongly oriented towards manufacturing sectors. Foresight programmes and centres could highlight the major issues for the future of services (as well as manufacturers). Both sectors should have full access to such resources (via web-sites, for example), so as to enable them to play a fuller role in the development of appropriate solutions to the major challenges facing European societies now and in the future. To the extent that Foresight involves constructing better and more dynamic innovation systems, it would seem to have a particularly important role to play in services, where innovation systems are often weak.

Finally, the tendency of services, and innovative service firms, to undertake R&D to a lesser extent than comparable manufacturing firms, and the possible greater emphasis on other innovation-related activities (notably organisational innovation) underline the conclusion that innovation policies should not be reduced to R&D policy. In particular, instruments such as tax breaks for R&D – while liable to increase the visibility and recording of R&D from service firms – may be poorly adapted to stimulating innovation in services. It is necessary to look across the spectrum of innovation-related activities, and consider instruments that may efficiently and effectively facilitate these.

MAIN REPORT

Section 1 A Review of the Issues

1.1 Introduction

Services account for roughly two-thirds of GDP and employment in Europe (Eurostat, 1999), and these shares are increasing, whereas those of manufacturing are in decline. In 1970, services accounted for half the European Union's GDP and less than half (46%) of its total employment, whilst by 1997 'market services' alone accounted for 46% of employment in the EU and 52% its GDP. 'Non-market services' accounted for a further 21% of employment and 15% of GDP (Eurostat, 1999).[2] Thus in 27 years services have increased their share of total employment in the European Union by 21 percentage points; they are the only broad sector of the economy that has expanded in terms of employment, and this trend will undoubtedly continue into the foreseeable future.

Services have often been described as a "Cinderella sector", largely ignored by economists, innovation researchers and by policymakers, but, with the growth in their economic significance, services have received increasing attention in recent years (although they remain under-researched). One consequence of the increased attention paid to services is that they are now increasingly recognised as being prominent in innovation processes – rather than as moribund and technologically backward.[3] Services are increasingly recognised as playing important roles in innovation systems, with some business services in particular serving as important sources and agents for the transfer of technological and organisational knowledge to all sectors.

The changes that have been taking place in some services have also made it evident that preconceptions about the sector being technologically backward with low growth potential are inaccurate. Several widely accepted points undermine the received view of services. These include:

- Services are major users of Information Technologies (IT) - and in many cases vanguard users. But as well as being users of new technology, some services are **innovators** – designing their own system configurations and applications, and/or developing these for wider use when they sell IT services such as software, databases and telematics to clients, or where they directly assist clients in configuring their own systems.

- IT is very important in increasing the technology-intensity of services, particularly as information-processing is at the heart of many service activities. These activities are complex and variable in nature, which made them hard to tackle with earlier technologies.

- Services cannot be treated as monolithic: on the contrary, they are extremely heterogeneous. This is manifest in their use of technology as in other respects. Some services are technology laggards (at least at present - the continuing increases in familiarity, functionality and power of IT, and its declining price, mean that PCs, mobile communications and even e-commerce are liable to be adopted ever more widely in the near future), whilst other services are in the vanguard in terms of IT use, and several long-established market services – such as railways and telecommunications – have always been 'exceptional' in their use of technology, as have some public sector services (particularly health care).

- Services also play substantial roles in helping IT diffuse via marketing, training, and consultancy. Moreover, a number of recent studies suggest that the use of business services contributes significantly to the performance of client sectors. (Miles et al., 1994)

The reappraisal of services' role in innovation is partially acknowledged by their inclusion in the second European Community Innovation Survey (CIS-2). However, there are reasons for thinking that several features of service activities – particularly (but not only) the *intangibility* and *client-*

[2] According to the OECD (1999), services accounted for 46% of civilian employment and for 53.2% of GDP in the G7 in 1960. By 1997, employment in services amounted for 71% of total civilian employment in the UK, 60% in Germany, 73% in the USA, 71% in Sweden, 70% in France, 74% in Canada, while for the overall OECD area employment in services accounted for 64% of total civilian employment.

[3] The traditional view of services is that they play little role in innovation – they are 'supplier-dominated' (Pavitt, 1984), with a lower rate of productivity growth and make little use of advanced technology. This view is increasingly regarded as inaccurate.

intensity of many services – may mean that services are hard to grasp through the established tools for understanding innovation. These features suggest a conceptual reappraisal, which includes, for example, an examination of the applicability of conventional distinctions between product and process innovation in services (Evangelista & Savona, 1998; Hipp et al., 2000).[4]

In the literature review that follows, we examine the results of the first wave of studies on innovation in services. This review will provide us with guidance for the analysis of the CIS-2 data. We can schematically classify the broad approaches that have been taken as encompassing three orientations (Coombs and Miles, 2000):

Assimilation: This approach sees innovation in services as fundamentally similar to innovation in manufacturing, and thus amenable to study according to the methods and concepts developed for the latter. Most current measurement work presumes that only minor amendments to survey instruments are required to include the service sectors within their purview. (Notably, the CIS-2 largely follows this approach, with a few concessions to the supposed specificities of services.)

Demarcation: This approach, by contrast, argues that innovation in services and services innovation are highly distinctive, following dynamics and displaying features that require novel theories and quite different instruments. This approach has been the underpinning of specialised studies on innovation in services, and has been applied in some 'dual approach' surveys that adopt substantially different questioning styles for manufacturing and service firms.

Synthesis: This approach suggests that innovation in services (and services innovation) brings to the fore neglected aspects of the innovation process which are widely distributed across the economy. Though these are displayed most obviously in service firms and industries, at least some of these characteristics are (increasingly) significant in innovation processes within manufacturing and other activities, although these remain largely unstudied. New theories and instruments that better address the wide range of forms of innovation in modern economies are thus required to develop a fuller understanding of the innovation process. This view contends that existing approaches to innovation studies have privileged the role of (formal) R&D to the extent that other innovation sources and other types of innovation have been neglected.

The literature review which follows is divided into two main parts – a review of the conceptual and case study literature (Section 1.2), and a review of the earlier (pre-CIS-2) surveys of innovation in services (Section 1.3). Some conclusions are then provided, together with a review of the guiding hypothesis that will be used to inform the analysis of the CIS-2 data (Section 1.4).

1.2 The Conceptual and Case Study Literature

1.2.1 Services: Commonalities and Specificities

Researchers specialised in studying services have often sought to identify the critical features that differentiate services from other sectors. That is, they have taken the *demarcation* approach outline above. Thus the 'typical service' is characterised in terms of qualities that contrast with the (supposed) manufacturing norm. This brings to the fore:

- **Intangibility, information-intensity:** The service **product** is often intangible, hard to store and/or transport, and difficult to demonstrate in advance to potential clients. They can also be highly information intensive.

- **Interactivity, client-intensity:** There tends to be a high level of interaction between the service provider and the clients/consumers. Indeed, clients are often involved the design and production of the services, and production and consumption of the service can be coterminous in time and space. Because of these features, service **delivery** is especially important

[4] Perhaps in recognition of the uncertainties here, the CIS-2 did not employ the product-process distinction, asking only a single question about 'service innovations and methods to produce and deliver services'.

There are other distinguishing features that are also frequently observed. In terms of **production,** many service firms are of small size, of low technology-intensity, employing relatively unskilled staff; **regulatory** issues also loom large, and many services are either run by the government or are highly dependent upon state funding.

Many exceptions can be found to all such generalisations. The service sector as defined in official statistics is extremely heterogeneous, and exceptions may be becoming more common: new services, especially technology-based ones, are in many ways more like high-technology manufacturing activities than like traditional services. The application of IT and sophisticated management strategies to many services has also resulted in their resembling manufacturing operations more closely. (At the same time, much of manufacturing is be becoming more service-like.)

This heterogeneity is unsurprising given the immense range of activities regarded as 'services' – which itself reflects the impact of technology and innovation on service activities. 'Service sectors' can be identified from the ISIC or NACE classifications, but these have limited conceptual content. Received distinctions between the primary, secondary and tertiary sectors are based on service activities being defined in negative terms – they are activities **not** concerned with extracting, growing or making things. A more positive approach, based on the pioneering work of Terence P. Hill (1977) and Dorothy Riddle (1986) relates economic sectors to their transformative tasks. Thus the **primary sector** is mainly concerned with extracting raw materials from the environment, and the **secondary sector** with transforming these into material goods. Services, the **tertiary sector**, can likewise be seen as being involved with several distinct kinds of transformations. These encompass generic activities such as movement and storage, maintenance and revitalisation, elaboration and intensification. These transformation activities can affect the state of:

- *the environment* - as in waste management, pollution clean-up, park-keeping;
- *the artefacts* produced by manufacturing - e.g. repair and maintenance, goods transport, building services, wholesale and retail trade;
- *people* - as in health and education services, hospitality and consumer services such as hairdressing, public transport;
- *symbols (data, information, knowledge)* - entertainment services; communication services such as broadcasting and telecommunications; professional services.[5]

Such an approach suggests that, instead of discussing 'services' in a generic way, it is viable and useful to consider different types of service activity. Miles (1993) used this approach to identify and describe major and distinctive innovation trajectories in different areas of 'service activity'.

Another approach to classifying different services, with an orientation to understanding their technological innovation processes is that made by Soete and Miozzo (1989). This is rather more of an *assimilation* exercise, and is an attempt to align services and manufacturing innovation by extending Pavitt's (1984) taxonomy of technological activities. Pavitt had characterised private services as being supplier-dominated (i.e., as being dependent on technologies developed by their (manufacturing) suppliers), but Soete and Miozzo argued that at least some contemporary services readily fit into a slightly modified classification of Pavitt's other, more technologically dynamic, categories ('scale intensive', 'science based' and 'specialist suppliers'). In particular, Soete and Miozzo (1989) distinguished four categories of service businesses:

I **Supplier dominated sectors.** Major examples of these are public or collective services (education, health care, administration), and personal services (food & drink, repair businesses, hairdressers, etc.), together with the retail trade.[6] These remain subject to the limitations of Pavitt's original characterisation of services as 'backward' adopters of technologies developed by manufacturers.

[5] The production of new information is a result of transformations of data and other symbolic material.

[6] This is debatable. Some large retailers are themselves significant influences on their suppliers. An obvious example is UK supermarket chains, which set quality and environmental standards, and identify new products, for their suppliers. Moreover, many health care services often lead innovation in their sector rather than passively adopt innovations developed in manufacturing.

II **Production-intensive, scale-intensive and network services.** These services, in contrast, involve considerable divisions of labour with the simplification (and co-ordination) of production (and/or delivery) tasks, and the substitution of (skilled) labour by machines. The application of this organizational logic, and technological innovation, encourages the standardization of service outputs, or, in more sophisticated systems, the adaptation (through customization) of standard services to particular user needs. Within this group, two types of services can be distinguished:

a. **Network services**, which are dependent on IT networks (e.g., banks, insurance and telecommunication services). The development of ITs has facilitated improvements in the complexity, precision and quality of the services offered by these providers; they have especially facilitated customization, but have also had an important role in setting standards in many service activities.

b. **Scale-intensive services**. These are dependent on physical networks (e.g., transport and travel services, and wholesale trade and distribution), which are less flexible than ITs in terms of facilitating customization, but do provide economies of scale and of scope. In these services there is also a heavy dependence on hardware technologies developed in the manufacturing sector.

III **Specialised technology suppliers and science-based sectors**. These include such services as software and specialised business services, laboratory and design services.[7] The main source of technology is the innovative activity of the services themselves. The innovations tend to be 'user dominated', being designed for particular users (or user groups).

This approach distinguishes types of service with regard to their technological activities and technological innovation activities, whilst using a framework drawn from manufacturing. Furthermore it focuses on classes of innovating firms or 'sectors' rather than on classes of actual innovation events. We now turn to issues concerning innovation and services more directly by examining a series of issues prominent in innovation in services.

1.2.2 Service Innovation Tendencies – Part 1: Self-Services and Service Replacement

'Self-service' became a popular phrase to describe the innovation introduced in many retail and catering establishments, by which consumers themselves performed the act of selecting the desired commodities to the point of purchase. This mainly organisational change – which saved labour costs and often increased customer convenience, provided a basis from which more technological innovations (e.g. equipment at check-outs) could be introduced. Similar strategies have been apparent in banks and other services. But, in addition, some analysts have pointed to a self-service trend associated with competition between services and manufacturing industries.

The common assumption that services are relatively non-innovative came to the fore in the 1970s. Jonathan Gershuny (1978) pioneered in services research, and noted that differences in productivity growth between manufacturing and services have important long-term implications. Other things being constant, the share of services in total employment will grow and the price of services will increase relative to goods. A shift in relative prices is liable to promote a shift of demand **from** services **to** goods, where these are substitutable. Classic examples include the shifts from cinemas to TV or from laundries to washing machines, from trains to cars. 'Self-services' of this sort are involved when the final service is produced by the consumer's own efforts using new equipment, rather than being purchased as a service from a service provider. Thus Gershuny's analysis says more about innovations that **compete** with services, than about innovations **in** services. Moreover, innovations from manufacturing appear to be driving the process. But two points arise.

- **First**, many of the "self-service" modes of obtaining requirements involved new services, or new roles for services, even while old services were being displaced. New retail systems developed, such as high street consumer electronics shops. Support services were also essential when the innovations were network-dependent - for example, TV required

[7] The services 'R&D Consultancy, Technical testing and analysis' account for almost 10% of current UK R&D - cf. Business Monitor MO14 April 1995, London, HMSO.

broadcasting services, and automobiles required garages for servicing and repairs. Consumer equipment in general needs service backup for installation, repair and maintenance, especially as it gets more complex – with significant employment generated in these services.

- **Second**, innovation in traditional services may be stimulated by the challenge from new services. For example, cinema audiences have been growing again in many OECD countries after a long period of TV-induced decline, partially as a result of innovations in theatres (multi-screen facilities, stereo sound, etc.) and in film-making. This is a familiar process, often described in the innovation literature as the 'sailing ship effect', where an industry that finds its products threatened by new competition increases its own level of innovation.[8]

If there actually is an innovation problem in services – or a problem in measuring innovation in services - what might underlie it? The two central (but not universal) features of services – **intangibility** and **client-intensity** – have influenced most major efforts to develop theories of service innovation. 'The reverse product cycle' approach conceived by Richard Barras (1986, 1990) combines the client-intensity approach with the 'supplier-driven' to theorise innovation in services.

1.2.3 Service Innovation Tendencies – Part 2: The Reverse Product Cycle

Barras' 'reverse product cycle' model suggests the absorption of new information technologies (IT) into services is a means of increasing service process efficiency, which then provides a catalyst for services to undertake their own innovation trajectories. Thus, from focusing on process innovations, services move through a period of quality improvement to product innovations (of greater client-intensity).[9] Thus Barras characterised the innovation process in services as taking the form of a "reverse product cycle". Barras saw the development of services as driven largely by the adoption of technological innovations developed in manufacturing, but also depicts changes in the relationship between the two sectors over time. In contrast to the view that services are low-technology operations, he noted (through UK statistics) a tendency in many private services for the balance of new capital expenditure to be shifting away from plant and buildings towards equipment - particularly IT equipment - that was largely being acquired by services (Miles and Matthews, 1992).

In more recent work, Barras has augmented the reverse product cycle approach with a model of 'interactive innovation' (Barras, 1990) – this sees innovation processes in services as being influenced by three sets of factors: technological possibilities created by innovations developed in the technology supply industry; demands coming from the market served by the industry; and the organisational and institutional structure of the industry itself. Thus, both 'demand pull' and 'technology push' factors influence the course of the innovation process, but in different ways and to varying extents over time. Interactive innovation therefore evolves over the reverse product cycle.

Moreover, Barras (1990) suggests that as the 'service revolution' progresses, the emphasis of services innovations is likely to shift from vanguard services (such as banking and insurance) to other knowledge-intensive business services. But, according to Barras, the sectors likely to undergo the most radical transformation are personal services with a strong knowledge base – such as education and training, health and welfare, public administration, entertainment and leisure. These are often delivered by the public sector.

Finally, two features of services are identified by Barras as possible grounds for considering services' innovation to be qualitatively distinct (from manufacturing innovation). The first is intellectual property protection, whilst the second lies in the degree to which product innovations (in particular) require new infrastructure, which may well be beyond the capacity of individual firms to institute.

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[8] In the case of the sailing ship, the competition came from ships powered by steam and propellers.

[9] For example, quality improvements may involve the frequency and volume of information provided to clients, the availability of the service outside of normal office hours (automatic bank telling machines are a case in point). In the third stage new services are produced by the industry. Often this is because it becomes apparent that the data being processed by IT can be put to other applications (e.g. on-line data services) or reworked in various ways (e.g. to provide a more flexible service). This may expand markets and create employment.

1.2.4 Service Innovation Tendencies – Part 3: Client Relations and 'Servuction"

Another approach to services innovation introduces the unappealing neologism **servuction** to describe the penumbra of relations that surrounds process, product and indeed consumption (Eiglier and Langeard, 1987). It seems likely that many innovative activities involving interactions between supplier and client (and networks of clients) may be overlooked, under-emphasised, or misrepresented by conventional innovation measurement approaches. The sorts of activities that are involved here include, for example: marketing; transactions; after-sales support; and the input of information from clients regarding the choice, design or customisation of the service.

Belleflamme et al (1986) present one of the earliest studies on innovation and R&D processes in services. This research was based on a panel of 30 firms that had introduced service innovations, 20 of which were providing services to other firms. The sample features a mix of traditional and 'new' services – the latter including research, consultancy, advertising and engineering services, with telecommunications and financial services in the 'traditional' category. Personal services, hospitality, and public services were excluded. The sample also mainly included small (under 50 employees) and large (over 500 employees) enterprises. Belleflamme at al noted that innovation activities in services certainly exist, and that they are carried out along formalised lines with much in common with those in manufacturing. But, they noted, these are usually carried out by ad hoc groups specifically constituted for the innovation in question, rather than by a formal R&D team/system.[10]

The study set out to test a number of theoretically derived hypotheses. A key notion, which builds upon Hill's (1977) ideas, is that there is a continuum of economic activities ranging from the production of pure goods to the 'servuction' of pure services, with most economic activities and products involving some combination of production and 'servuction'.[11] Production and 'servuction' are thus seen as differing in significant ways. Production involves material means for preparing products (this can include some uses of IT in service production, e.g., in performing necessary calculations or database searches). 'Servuction' involves 'means and conditions' for the customisation of products, and adapting them to user specifications. This adaptation process can also apply to goods.

1.2.5 Service Innovation Tendencies – Part 4: Information and Other Technologies

Many commentators have stressed the pervasive applicability of new information technology (IT) to services. Licht and Moch (1997) note that effectively all innovating service firms in their sample of German firms introduced IT based-innovations (whereas some firms which made IT innovations did not use other technologies, they found no innovating service firms which failed to undertake IT innovations). Their conclusion is that IT plays a dominant role in the innovation activities of service companies. Personal computers (PCs) and standard software are the most widely distributed tools; but communication networks for innovative companies have reached a level of diffusion that is comparable to that of PCs (ZEW, FhG-ISI, Infas, 1999l).

On the basis of synthesising a large volume of IT-related analyses and industry studies, we can confirm that the following current IT innovations are extremely important for many services:

- Technologies that support intra-firm communications, such as management information systems, electronic mail and mobile communications. These are allowing more intensive interchange of information within organisations, and the reorganisation of traditional relations. In many cases these technologies are being used to support new spatial divisions of labour.

- Technologies that support contact with suppliers and clients. These range from information sources like websites (for public relations and advertising purposes), to Electronic Data Interchange and now web-based e-commerce initiatives.

- Personal computers (PCs) are widely used for back-office tasks such as book-keeping and correspondence, and have entered the front-office and field activities as programs and online services are becoming widely diffused.

[10] However, the study does indicate (p. 54) that 9 firms had a 'receptive structure' - i.e. a permanent product/project development systems - while 11 set up ad hoc "carrier groups", and another 9 undertook "informal elaboration".

[11] A pure good is described as being a physical object which can be appropriated, stocked, transferred between economic units, and where production and consumption are distinct. A pure service involves co-terminal production and consumption. .

- Large organisations are integrating various functions (such as sales, shelf-stacking, warehousing and ordering) through the use of real-time stock management systems. Logistics and transport systems are being managed by the use of IT-based scheduling and routing systems, with improved data inputs from mobile communications.

- Large organisations, such as the food retailers (particularly in the UK), are also widely adopting and refining data warehousing and data mining systems, for purposes of gaining strategic intelligence on customer behaviours and preferences.

As well as general trends in IT application across services, there are other types of technology that are more important in specific types of services. The classification of services in terms of their core transformative processes introduced earlier is relevant here, since the core processes are differentially amenable to the application of technologies, including IT. Thus,

Physical services – such as transport, repairs and domestic services – effect physical transformations, often involving movement, and the application of pressure or heat. Such services have long been based upon the (increasingly) cheap and reliable provision of motor power.

Human services like health and education, in contrast, typically being produced together with, and highly 'tailored' to, individual clients, require different technologies. The core activity requires processing of often highly specific data about individuals.

Information services have been much more amenable to electronics-based innovations, using electric power and electronic systems for communications (telephony and broadcasting), amplification and visual displays. These have been particularly important in entertainment services.

These three broad subsets of the services sector have diverged in their application of motor power and electronic technologies. But, despite differences of emphasis and in rates of diffusion, IT may be applied to much more general effect across different services.[12] In **physical services**, computers have long been applied to the back office accounting and exchange tasks that surround their core functions. In a reverse-product-cycle-like manner, these applications may set the scene for innovations bearing more on the core functions. The large-scale **human services,** often organised under the auspices of the welfare state, have long been major computer users for large-scale administrative data processing applications and for planning. The recent availability of cheap microcomputers is leading to some integration of services as service workers are able to access information from different databases on the same client. **Information services** are of course major users of IT. Sectors like telecommunications and financial services have used new information technology to limit labour costs as well as to provide improved or new services, so that their levels of output growth are much higher than their employment growth. As in the previous cases, the traditional IT applications involved large-scale electronic systems for massive number-crunching operations, together with specialised applications in broadcasting and other media. IT is enormously important – and often very visible – in these industries, with innovations like automated teller machines and smart cards, new telephone and telematics services, and shifts from broadcasting to 'narrowcasting' all the focus of considerable activity. The pace of innovation in these industries has also been quickened by the shift in regulatory policy in many countries, for instance with privatisations encouraging competition and reducing the universal service provision requirements.

Important lines of demarcation also exist between services organised on private and public lines. Public services were early leaders in the use of mainframe computers, but they now typically face financial constraints which affect their use of advanced IT.

1.2.6 Service Innovation Tendencies – Part 5: Intellectual Property Rights

Another important issue in services innovation, connected with the intangibility of the service product, is Intellectual Property Rights (IPR). Barras is one of many commentators to suggest that IPR problems were a factor rendering services' innovation qualitatively distinct. Product innovations in services are generally easy to copy – this could lead to services concentrating mainly on process innovations.

[12] See, for example, the various statistical overviews and case studies presented in Guile and Quinn (1988a, b) and Faulhaber et al (1986).

However, Thomas and Miles (1989) draw attention to the use, by new telematics services firms, of strategies along the lines of those identified by David Teece (1986), who discusses various approaches to gaining or maintaining market share when innovations are readily appropriable by other parties. There are thus other strategies than focussing on process innovation available when it is difficult to protect product innovation – for example, customer lock-in strategies and innovations in marketing. Miles et al (2000) provide one of the few studies that examine IPR issues in services. Among their main conclusions were:

- Despite a consensus in the literature that imitation is a deterrent to services' innovation, survey studies indicate that it is less often cited as such by services than by manufacturers.

- Against conventional wisdom, some services do use IPR mechanisms like patents, whilst other instruments such as copyright are significant in other service sectors.

- However, the use of particular instruments varies widely across services, although the use of contracts (with partners and employees) is generally an extremely important mechanism.

The question remains open as to how far services innovation strategies are affected by ease of imitation and the orientation of the patent system toward more tangible innovations. Are these deterrents to innovation that are simply accepted by service enterprises (which have found their own ways of working around them), or are they a serious barrier to (certain forms of) innovation.

1.2.7 Service Innovation Tendencies – Part 6: Organizational Innovation

The CIS-2 focuses on technological innovation and deliberately excludes organisational and managerial innovation. However, many technological innovations in services have a close inter-relationship with organisational innovations – the aforementioned case of 'self-service' being a case in point. A strong inter-relationship between organisational change and other innovation activities was also found in a study of innovation in Denmark (Sundbo, 1998): 68% of the surveyed firms which had changed their organisational form had also introduced new products or services compared with 34% which had not changed their organisational form. However, other researchers have found that enterprises find it difficult to distinguish between process and organisational innovations in services (Hipp et al., 2000; Preissl 2000).

1.3 Evidence from Earlier Surveys of Innovation in Services

In the previous section we reviewed the theoretical and case study literature on innovation in services. Here we review the main results from some of the large-scale survey studies that have been carried out in some European countries prior to the CIS-2. We begin with the Netherlands, which was the first country to cover services in its innovation surveys.

1.3.1 Surveys of Innovation in Services – The Netherlands

Various studies have been carried out in the Netherlands on services. In particular, Kleinknecht and others have undertaken analyses based on R&D and patent data, developed the 'Literature-Based Innovation Output' (LBIO) method involving the screening of trade journals, and have developed other 'new' indicators for both innovation inputs and outputs (Kleinknecht, 2000), including an analysis of the first (1992) Community Innovation Survey (CIS-1) for the Netherlands.

With regard to technological innovation, the CIS-1 found services were uniformly lower users of R&D and patents than manufacturers. Of all Dutch firms surveyed, 42% of manufacturers and 18% of services performed R&D, whilst 7% of manufacturers had applied for patents compared to 2% of services. But the share of non-R&D costs within total innovation expenditures was systematically higher for services than for manufacturing. Brouwer and Kleinknecht found a similar picture for the announcement of new products or services in trade journals, at 2.5% of manufacturers compared to 1% of services (Brower & Kleinknecht, 1996, 1997).

However, when 'new output indicators' (Kleinknecht, 2000) were considered, this systematic difference disappeared. Thus, the (self-declared) realisation of sales of imitative and innovative products or services were similar for both manufacturing and services. Indeed, certain classes of services reported higher percentages of these than manufacturing as a whole, appearing to contradict the received wisdom that services are less innovative than manufacturing. Interestingly, analysis of data drawn from trade journals suggested the majority of service sector innovations were *product*, rather than *service*, innovations. Of all reported innovations, only 5% were classified as 'service innovations', while as a whole the service sector accounted for 31% of innovations.

In further analyses, Brouwer and Kleinknecht (1996) investigated the factors that influenced a firm to become an innovator. They found that, as expected, R&D intensity was positively related to innovation output. Market concentration produced no significant influence on innovation, contradicting the Schumpeterian hypothesis, but supporting broader empirical findings in manufacturing (Symeonidis, 1996). Conversely, however, a high 'small business presence' was found to encourage the diffusion of imitative innovations. Regional clustering (or agglomeration) effects also appeared to be in play, with the central Dutch regions being positively associated with higher levels of innovation. Finally, Brouwer and Kleinknecht found positive 'demand pull' effects.

1.3.2 Surveys of Innovation in Services – Denmark

A Danish survey of service firms' innovation activities was carried out in relation to the SI4S project (Sundbo, 1998). 2,850 postal questionnaires were sent out, with 637 returned (a response rate of 22%). Knowledge Intensive Business Services (KIBS), large firms and innovative firms were over-represented. The data suggest that the most important market competition parameter for the Danish service firms is service quality (92% ranking this 'rather' and 'very important'), followed by the ability to adapt to the wants of individual customers. Service or product novelty were considered by only 53% to be 'rather' or 'very important'. Danish services appear to be innovative: between 1992 and 1995, 78% of the firms innovated at least once. The larger the firm, the more likely it was to innovate. The most innovative service industries in Denmark were financial services, publishing, business services, software and – perhaps surprisingly – cleaning; the least innovative services were (surprisingly) health care services, rental services, wholesale and especially retailing (Sundbo 1998).[13] The most technologically-innovative industries were, unsurprisingly, transport and telecommunications.

90% of the service firms actively encouraged their employees to present ideas for innovations. Overall, Sundbo (1998) describes the innovation process in services as a broad organisational process in which many participate. Yet customers and the firm's personnel are by far the most important source of ideas: customers being mentioned by 87% of the firms, sales personnel by 71%, and other employees by 67%. More scientific or formal sources such as universities, conferences, IT providers and consultants were mentioned by less than 20% of the firms.

Most service firms were found to have co-operative arrangements with external partners in the development process, mostly with customers and technology suppliers (79% in both cases), but also with consultants (64%). They co-operate much less with research institutions (30%) and with competitors (35%). The co-operation is more often informal than formal, particularly with research institutions and competitors. However, in the face of increased competition the service firms reacted by using slightly more formalised innovation processes (Sundbo 1998).

In seeking protection from imitation, the service firms have moderately formalised their innovation activities. Formal means, such as competition clauses, are used, but the informal means such as market positions, brand names and advertising are also important. However, when service product novelty is an important market characteristic, all the means of protection become more important, in particular the formal ones, such as patents and other intellectual property rights. For technologically-innovative service firms, the innovation process was found to be more formally organised than for non-technologically-innovative firms.

Comparing the sources of innovative ideas, the technologically innovative firms used the Internet, IT suppliers, consultants, competitors, conferences and the print media to a larger degree

[13] Product (63%) and process (62%) innovations play the most crucial role, followed by market (55%) and organisational innovations (45%) (Sundbo 1998, 6, and DTI Industrial Analyses 1997).

than the less technologically innovative firms. Customers were also slightly more heavily used by technology-intensive firms. There was also a difference in using external co-operation partners: the technologically innovative firms cooperate more (formally) with external partners, especially with their suppliers and customers, but less with their competitors.

1.3.3 Surveys of Innovation in Services – Germany

In Germany, a first (pre-CIS-2) survey on innovation in services was carried out in 1995. This yielded 2,900 responses, amongst which nine types of innovation in services were identified (Hipp et al. 1996).

Product innovation was differentiated by the degree of novelty (market versus company novelty), major versus incremental innovations, the degree to which an innovation is based on new science and technology, and whether it extends the product range or falls within the main product field of a company. Seen from the company perspective, innovations in other than core business areas help the company to diversify by expanding the present product range and opening up new markets. Much of the present dynamic in the service sector is due to the opening up of new markets for (existing and new) service firms (Hipp et al. 1996).

Process innovations were split into four categories: novel to the whole industry or not (diffusion) and technology-intensive innovations or not technology-intensive, which can be viewed as a measure for the interaction between manufacturing and service industries.

Additionally, organisational innovations were assessed. Some confusion arose in distinguishing between organisational innovation and process innovation. The researchers considered that pure organisational innovations only changed the hierarchical or spatial arrangement of a service firm, while innovations focused on increasing the efficiency of daily routines should be viewed as process innovations.

Between 1993 and 1995, roughly 60% of the German service companies introduced innovations. Approximately one third of all innovations were product innovations, one half process innovations, and the remaining 13% were organisational innovations. Product innovations were mostly found in small companies with fewer than 20 employees, while organisational innovations were more frequent in large companies (250+ employees). The largest share of innovations, roughly one third, belonged to non technology-intensive, industry-standard innovations such as process re-engineering according to ISO 9000 standards. Notably, the latter activity is not classified as 'innovation' according to the CIS-2.

With regard to firm size, the share of innovating companies increased with size, the steepest increase being amongst the technologically intensive innovators. Unsurprisingly, by far the largest share of technology-intensive innovators was found in the software industry (Hipp et al. 1996).

A striking result is the relatively large share of innovations tightly focused on the core business and industry standards among different service sectors. The role of technology in service sector innovation is important – but it accounts for a much smaller proportion of all innovations than in the manufacturing sectors. Second, there appear to be significant sector-specific patterns of innovative activity (Hipp et al. 1996).

Another study using this data analysed the pattern of service activities using evidence on the income to service firms from 'standardised', 'partial customised' and 'bespoke' services (Tether et al., 2000). This study also examined the patterns of 'standardisation-particularisation' with respect to the size of the firms, and their broad sector of activity.

As mentioned earlier services are often thought to provide customised services, yet this analysis lent support to those, such as Pavitt, Soete-Miozzo, Silvestrou et al. (1992) and de Jong (1994) who have sought to provide 'combined' taxonomies of service activities, based partially on the nature of their technological underpinnings, and partially on the nature of the markets they serve. For example, the analysis found the generally 'scale-intensive' sectors of *trade*, *transport and communications* and *banking and insurance* to be largely oriented towards the provision of

standardised services – that is services which are not adapted to individual consumers. These sectors also tended to have relatively low proportions of highly qualified employees. By contrast, in the 'specialist supplier' sectors of *technical services* and *other financial services,* university graduates constituted a much larger proportion of total employment, and firms in these sectors tended to earn a larger than average proportion of their income from specialised and partially customised services.

Overall, however, the most striking finding was the tremendous diversity that exists within the population of service firms. Whilst there are broad trends which reflect the sectoral categorisations discussed above, there is also immense variation in behaviour within each broad sector. Whilst useful as starting points, simple taxonomies may mislead us into expecting much more homogeneity within sectors than is actually the case. The diversity amongst service firms needs to be better understood.

One further study using this data assessed the innovative activities of the surveyed firms and examined how the pattern of innovation was related to the size of the innovating firms, the broad sector of their activities, and to the extent to which their sales were due to 'standardised', 'partially-customised' or 'bespoke' services (Hipp et al., 2000). The effects of innovations, first in terms of the relationship between innovation and the (sales) growth, and then in terms of the wider, subjectively identified, effects of the innovations, were also considered. This study also examined the firms' claims with respect to the impacts of their innovations on their own activities, on the services they provided, and on the service users. From that analysis, three principle conclusions can be drawn:

(i) The effects of innovation in services do not separate neatly into service type effects and process (or organisational change) type effects. Service innovations frequently have effects on the service provider's productivity or flexibility, effects which might normally be associated with process innovation. Similarly, process or organisational innovations frequently have effects on the quality and availability of services provided; effects that are normally associated with 'product' innovation. Virtually all of the innovations, whether service, process or organisational, had an important effect on the service provider and on the service provided.

(ii) However, service firms seem less assertive or knowledgeable about the effects of their innovations on their customers' performance and/or productivity than the literature tends to suggest. This is puzzling, because most of the service innovators adapted at least some of their outputs to suit specific customer needs – only a minority provided only standardised services. The service innovators do appear to recognise important improvements to the services they provide, which must relate in some way to (perceived) user needs. But they appear less confident about the consequences of their innovations on the service users. Perhaps this apparent modesty reflects an accurate perception that their inputs only constitute a small part of the inputs and internal efforts that their users require in order to achieve major gains in performance and/or productivity.

(iii) Firms which introduced more than one type of innovation, and particularly those that introduced both service innovations and non-service innovations, were the most likely to identify each of the different sets of effects as important. This pattern suggests innovation in services tends to be more effective when a combination of service and non-service innovations are introduced, rather than when only one type of innovation is introduced. Furthermore, the firms that introduced multiple (types of) innovations tended to be most the aggressive (or, reversing the causation, the most aggressive firms tended to introduce multiple types of innovation). Thus the firms which claimed to have introduced all three types of innovation were both the most likely to have grown (in terms of sales) and were the most likely to expect to grow in the future, suggesting a link between growth and the introduction of multiple types of innovation which (are intended to) have multiple effects.

1.3.4 Surveys of Innovation in Services – Italy

Prior to the CIS-2 a pilot survey of services innovation was carried out in Italy. This covered 6,005 market service firms across 19 service sectors. The surveyed companies included the population of 1,245 firms with more than 200 employees, and a stratified sample of 4,760 firms from

the 18,055 firms with 20-200 employees. Enterprises with fewer than 20 employees were excluded. [14] The survey utilised the OECD's 'Oslo Manual' guidelines, was conducted in late 1996 and early 1997, and concerned the period 1993-95 (Sirilli & Evangelista 1998). The data have also been compared with the findings of the 1995 manufacturing survey (covering 1990-92) where appropriate.

The findings on the extent of innovation were that 31% of service sector firms introduced technological innovations between 1993-95 (Evangelista & Savona, 1998), a very similar proportion to that for manufacturing. There was a positive relationship between enterprise size and innovation in both services and manufacturing. Within the service sector there was considerable inter-sectoral diversity, as there was within manufacturing. More than half the R&D, financial services, computer services, engineering services, and advertising service firms exhibited innovation.

The Italian survey found a significant proportion (around a quarter) of the service firms were unable to distinguish between product and process innovations, and certain sectors (especially cleaning) found the distinction more problematic than others. The Italian survey also encountered a *significant difficulty* in obtaining quantified impacts of innovation upon sales. Less than half (46%) of the innovating firms were able to provide a figure, although this varied across sectors - from 27% in other financial services, to 87% in shipping and sea transportation (Sirilli & Evangelista, 1998).

The sources of innovation in the service sector were found to be heavily skewed towards innovative investments (i.e. purchasing 'embodied' technologies), at 46% of total innovation expenditure. R&D (24%) and software expenditures (14%) were the next most important activities, although excluding the R&D sector itself decreased R&D expenditures to just 14%, whilst investment increased further, to 53%. All other innovative expenditures (design, acquisition of know-how, training, and marketing) were of secondary importance by contrast. The most important sources of information on innovation, for both the service and manufacturing sectors, were internal sources, with production and delivery departments being dominant, suggesting 'learning-by-doing' processes. Of external sources, clients and suppliers were cited as the most important by both manufacturing and services (Evangelista & Savona, 1998, Sirilli & Evangelista, 1998).

The prime objective of innovation was to improve service quality, with 76% of service firms citing this as 'very important'. However, this was typically pursued in conjunction with a number of other objectives, with the increase in market share (59%), extending the range of services offered (48%), and reducing production costs (47%) being the next most important objectives. The main obstacles to innovation in services were the lack of 'appropriate sources of finance' (cited by 23% as 'very important'), the costs of innovation (22%), lengthy pay back periods (14%), and regulatory constraints (13%). In contrast to recent literature, a lack of information, technological opportunities and appropriability conditions were not regarded as very important barriers to innovation in services, although they were obstacles in manufacturing (Evangelista and Savona, 1998).

In terms of the qualitative importance of technology for service firms, only a limited number of firms (22%) believed that it was 'very important', primarily in those sectors with a strong technology base, such as engineering services (44%), R&D (35%), and computing and software (33%). However, those sectors where technology was of less importance were also those expecting technology would become 'very important' in the future, perhaps suggesting a process of cross-sectoral convergence or technology 'catch-up' (Evangelista and Savona, 1998).[15]

1.3.5 Surveys of Innovation in Services – United Kingdom

Prior to the CIS-2 there have been two types of innovation survey carried out in the UK that include (parts of) the service sector. These are the CBI surveys carried out since 1989, and surveys on SMEs conducted by the Centre for Business Research (CBR) at the University of Cambridge.

The CBI survey is a regular postal survey that investigates a wide-ranging set of questions on innovation (Coombs & Tomlinson, 1998). The survey includes both manufacturing and service sector companies. The non-manufacturing sectors included are: electricity, gas and water supply;

[14] This is a fairly large minimum size, as this excludes 99% of firms and 66% of employees in the Italian service sector. Such a high rate of exclusion raises serious doubts as to the heuristic value of the Italian survey (Cainelli et al. 2000).

[15] Evangelista and Savona (1998) also provide a taxonomy of innovation in services.

construction; wholesale/retail and repair of motor vehicles; financial intermediation; real estate, renting and business activities. The survey also focuses upon trends, rather than static levels, which, in conjunction with the annual nature of the survey, allows a longitudinal picture to be built up. Therefore, the latest survey, published in 1999, provides comparable data for the years since 1989. However, the survey is not based on a random sample of firms from the sectors in question, having been chosen to select innovators. The response rates are also low. The survey cannot be used to provide robust comparisons across sectors, although it does reveal something about innovation dynamics.

The key findings of the survey include: The mean level of expenditure on innovation reported by non-manufacturers rose steadily until 1994, when it peaked at over 10% of turnover. Since 1994, the level of expenditure has dropped, falling dramatically in 1997, from 11.8% to 5.4% of turnover.[16] The median is notably considerably lower, indicating a strong skew in innovation expenditures (this also fell from 5.0% in 1996 to 1.8% of turnover in 1997). This relative level of expenditure is actually higher than that found in manufacturing, where the mean also peaked in 1994, but at approximately 6.7% of turnover. However, the decline in expenditure in manufacturing has been less dramatic, such that by 1997 the mean level was 4.9%, and thus similar to the non-manufacturing sector. Moreover, whilst the manufacturing sector also exhibited a lower median (2.1%) than mean level of expenditure, the gap was not as large as for non-manufacturing. This suggests a longer tail of firms that are lagging in innovation terms in services than in manufacturing. However, this tail is not necessarily simply due to the high SME presence in the services – with one third of the non-manufacturing respondents with less than £0.5 million turnover introducing over 10 process innovations in 1997.

The CBR surveys undertaken in 1995 and 1997 investigated UK SMEs across a wide range of their activities, including innovation (Cosh and Hughes, 1992, 1995, 1998). The surveys have covered both manufacturing and business services, split almost equally between the two. Business services are further split between engineering and technical services (including computing and R&D) and 'other' business services (including advertising and finance). The CBR's main survey findings were that business services were marginally less likely to introduce novel process innovations, or novel or imitative product innovations than manufacturers. However, they were marginally more likely to introduce imitative process innovations. Engineering services especially were found to be more likely to introduce product innovations, but slightly less likely to introduce process innovations. Business service firms were also found to have a significantly higher proportion of upgraded products/services than manufacturers and a conversely lower proportion of unchanged products. This was especially true of engineering services. The key rationale for innovation in both manufacturing and services was to maintain or increase market share and to improve product/service quality. Business services were less likely than manufacturers to utilise suppliers as sources of information about innovation.

For business services, the main barrier to innovation was uncertainty over the timing of innovation, with far less emphasis upon skills shortages or imitation by competitors than for manufacturing. However, engineering services reported significantly greater obstacles, which also included excessive costs and risk, a lack of appropriate finance, and a lack of opportunities for co-operation.

Although both manufacturing and services exhibited similar proportions of staff engaged in R&D, the numbers of staff involved amongst those undertaking R&D was higher within business services. Moreover, the employment of technologists, scientists, and other higher professionals was significantly greater amongst business services - with the numbers employed being more than three times greater than for manufacturing. Again engineering services exhibited the highest proportion of both R&D and technologists/scientific staff. The CBR surveys identified this divergence in human capital utilisation as a key issue in service sector innovation.

1.4 Conclusions and Guiding Hypotheses

Much of the conceptual literature on innovation in services, and on service innovation, has stressed the differentiating features of services. Many researchers who have investigated services have suggested that they are significantly different from other sectors in terms of their innovation

[16] Although the CBI (1998) assert that this is partly an outcome of the changing profile of the survey respondents, especially a significant fall in the number of companies from the real estate, renting, and business activities sector, which includes computer and related activities.

dynamics and in the organisation of their innovation efforts (e.g. they are much less likely to feature R&D departments). Early survey analyses, and some case studies, on the other hand, indicate that many of the dynamics of innovation in services are similar to those in manufacturing. The challenge is to move beyond simply stressing similarities or differences between manufacturing and services:

- First, the grand distinctions between manufacturing and services may be concealing as much as they reveal. It is important to develop more finely-grained taxonomies about distinctive types of innovative firms and sectors. Some (technologically oriented) services may be more like some (technologically oriented) manufacturing firms than either are like other members of the grand sectors to which they 'belong'.

- Second, we also need to think about service functions, which may be undertaken by specialised service firms or which may be internalised within firms of any sector. Related to this is the possibility that specific features of innovation processes are brought to the fore in studies of services innovation, casting light upon neglected aspects of the innovation process present in all sectors. Thus, there are liable to be innovations in all sectors around relations with clients, as mentioned above; and the growing prominence of intangibles may similarly be weakening the applicability of traditional patent-based IPR methods.

In relation to the existing (i.e., pre-CIS-2) survey evidence, we have reviewed survey results from a range of European countries. Two important conclusions emerge from these:

- Many services are innovators, and many do not simply adopt innovations developed by manufacturers. Information technology, research, business services and financial services are particularly outstanding as technological innovators.

- There are many commonalities between innovation in the service sectors and that in manufacturing, but there are also both large-scale and more subtle differences between the two. One of these differences would appear to be the greater importance of human capital inputs to service sector innovation. Another is the relatively less formal organisation of innovation in most services, especially those that are not themselves technology-based. This suggests that there are limitations to applying traditional innovation indicators to the analysis of services if the intention is to capture the whole range of innovative activity within the service sectors. There nevertheless remains significant work to be done to make full use of the unique data that the CIS-2 provides.

1.4.1 Guiding Hypotheses

This section provides an outline of some of the patterns in the data we expect to find:

On the extent of innovation: We can certainly expect that many service enterprises will have innovated in the two year period prior to the survey – in terms of having introduced new or significantly improved services, or methods to produce or deliver these. However, the proportion of enterprises that have innovated is likely to vary between sectors – the proportion is likely to be higher in the more technologically intense sectors (such as computer services, technical services and telecommunications), and lower in the less technologically intense sectors (such as wholesaling and transport). However, to some extent this depends on the interpretation of what is meant by technological innovation. By one interpretation, innovation includes the adoption of even standard technologies that might make only minor changes to the services provided and the means of production or delivery. Under such an interpretation there is likely to be less difference between sectors (and by firm size) than if a stricter definition of innovation is used. Thus there is scope for differences in interpretation, which may also reflect different cultural understandings as to what does and what does not constitute innovation in different countries. As such, we should not expect the survey to provide a fully objective measure of the extent of innovation in different sectors or countries.

On the objectives of innovation: Past surveys suggest that improvements to the quality of the services provided will be the most common objective for innovation, with extending the service range or increasing market share also prominent. Cost savings, particularly reducing materials and energy costs are likely to be less widely identified as objectives of innovation, and are likely to be less

relevant than in manufacturing – as reducing the environmental damage of the services is likely to be. One cost saving item that may be important, particularly where there is a high level of routine activity amenable to automation is the reduction of labour costs – this may be significant in financial services, for example.

On sources of information for innovation and the role of R&D: Amongst the innovating enterprises, we can examine the role of R&D in two ways: firstly in terms of whether or not the enterprises conducted R&D, and if they did whether this was on a continuous or an occasional basis, and secondly with respect to the contribution R&D makes to total innovation costs. In general we can expect some service enterprises will conduct R&D, and that some will do so continuously, but fewer than amongst manufacturers. Large manufacturing enterprises especially are likely to conduct R&D, many on a continuous basis. Although we would expect large service enterprises to be more likely to conduct R&D than smaller service enterprises, the relationship with size is likely to be less marked than that in manufacturing. Sector is likely to play a role here too. Whilst (large) enterprises in the more technologically oriented sectors (i.e., computer services, technical services and telecommunications) are likely to conduct R&D - many on a continuous basis - this is unlikely to be the case amongst (small) enterprises in the more 'supplier dominated' sectors, such as wholesaling and transport services. However, large enterprises in services such as transport (e.g., airlines) and financial services (e.g., banks and insurance companies) are likely to conduct research – although it is unclear whether these activities will be considered R&D. In general, however, we might expect the technology intense services to behave more like technology-intense manufacturers than like other services with respect to the role and use of R&D.

The presence or absence of R&D tells us something about the nature and sources of innovation. R&D implies more technological innovation, but the absence of R&D also suggests that either other sources within the firm were used to develop the innovation, or that external sources of information were predominantly used. We anticipate that both these sources will arise – although it will not be possible to investigate which other sources within the firm were used. We also anticipate that suppliers, customers and competitors will be important sources of information for innovation. Suppliers and competitors in the mass service sectors (such as financial services and transport) and customers in the client-intensive services (such as software and technical services).

The innovation costs data will also be interesting – as this will reveal parallel information about the sources of innovation. On the one hand, expenditures on internal R&D, as well as other internal activities such as preparations for the introduction of innovations, can be expected to constitute a larger proportion of total innovation costs in the more technologically oriented sectors. By contrast, bought in equipment and other technologies can be expected to constitute the greater part of total innovation expenditures in the more 'supplier dominated' services such as transport and wholesaling.

On the whole, we would expect that services find the research infrastructure (including universities and research institutes, plus patent databases) to be of little relevance as sources of information for innovation – although technical services may be an exception to this.

On co-operation arrangements for innovation: It is argued that co-operation arrangements for innovation are becoming increasingly common, and given the client intensity of many services we might expect a high level of co-operation between services and their customers and suppliers. More rarely, co-operation between competitors can be expected, perhaps especially where there is a need for standard setting and establishing new markets. We anticipate few service firms will have co-operative arrangements with universities and public research institutes, which tend to be geared towards manufacturers.

On the factors hampering innovation: It is more difficult to anticipate the factors hampering innovation, other than to say that the availability and cost of finance is likely to feature prominently. The provision of finance for innovation is almost always seen as a barrier to innovation – but whether this is a true barrier or whether the respondents are being unrealistic about who should bear the risk of innovation is unclear. Another factor that might arise is a lack of skilled personnel, given the high dependence of skilled personnel in services, and especially if much of innovation is dependent on information technologies, and that the supply of people with good IT skills is often considered inadequate.

Section 2 The Survey, the Data and the Analytical Methodology

2.1 The Questionnaire and Survey Data

This section introduces the CIS-2 survey questionnaire and the datasets that will be analysed in this report. Section 2.2 discusses some of the issues for consideration in the data analysis.

2.1.1 The Survey Questionnaire

The survey was executed through a voluntary postal questionnaire, which was based on the guidelines outlined in the revised 'Oslo Manual' (OECD, 1997). The survey was composed of nine main questions, some of which were further investigated through sub-questions.[17] In the main, the information sought covered the three-year period of 1994-1996. Prior to the main questions, 'general information' was gathered on the firms.[18]

The questionnaire began by asking about the 'scope and impact of technological innovation and innovation activity of enterprise'. Technological innovations were defined thus:

> **Technological innovations** comprise implemented new or significantly improved services and new or significantly improved ways of producing or delivering a service. An innovation has been implemented if it has been introduced on the market or used in producing or delivering services. The service should be new (or significantly improved) to the to enterprise (it does not necessarily have to be new to the enterprise's market).
>
> A new or significantly improved service is considered to be a technological innovation when its characteristics and ways of use are either completely new or significantly improved qualitatively or in terms of performance and technologies used. The adoption of a production or delivery method which is characterised by significantly improved performance is also a technological innovation. Such adoption may involve change in equipment, organisation of production or both and may be intended to produce or deliver new or significantly improved services which cannot be produced or delivered using existing production methods or to improve the production or delivery efficiency of existing services.
>
> The introduction of a new of significantly improved service or production or delivery method can require the use of radically new technologies or a new combination of existing technologies or new knowledge. The technologies involved are often embodied in new or improved machinery, equipment or software. The new knowledge involved could be the result of research or utilisation of specific skills and competencies.[19]
>
> The following changes are not technological innovations if they are not directly related to the introduction of new or significantly improved services or ways of producing or delivering them:
>
> - Organisational and managerial changes such as the implementation of advanced management techniques, the introduction of significantly changed organisational structures and the implementation of new or substantially changed corporate strategic orientations.
> - The implementation of a quality standard such as ISO 9000
>
> **Innovation activities** are all those steps necessary to develop and implement new or significantly improved methods to produce or deliver services.

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[17] Note that the national surveys contain significant variations on the base questionnaire detailed by Eurostat, with additional questions and categories being introduced.

[18] Or was provided by the national statistical agencies which carried out the surveys. This 'general information' included: the main activity (according to NACE) of the enterprises; whether the was independent or part of an enterprise group (in the latter case the country in which the head office was located was specified); significant changes affecting the enterprise between 1994 and 1996 (i.e., establishment, mergers, divestments); the number of employees in 1996; total turnover and exports in that year, and the percentage change during the period 1994-1996 in employment, turnover and exports.

[19] Elsewhere, some examples of innovation in the service sectors are given. These include: the use of cellular phones to reroute drivers throughout the day; a new computer mapping system, used by drivers to work out the fastest delivery route; introduction of a new switching system that allows the digital transfer of information across the telecommunications net, the introduction of smart cards and multipurpose plastic cards; a new bank office system without any personnel where clients conducted business through computer terminals; telephone banking; development of computer software packages with various degrees of support for customers; the introduction of new multi-media software applications for educational purposes; the introduction of qualifications procedures for medical testing methods. What is remarkable about this set of examples is that, apart from the last, they are heavily focused on information technology, with services seen as either being (passive) adopters of technologies develop elsewhere or, in the case of the software sector, producers of new computer software. The last example points, however, to a much broader understanding of (technological) innovation in services, that which involves changes in procedures and in which services are much more active in the innovation process.

This definition is remarkably long, convoluted and contains a considerable amount of 'academic' jargon. Indeed, it seems excessive and, given that this was a voluntary survey, it is doubtful whether most respondents read and fully understood the definition of innovation provided, particularly in relation to what is and what is not technological innovation. The situation is confused further by the fact that 'innovation activities' are defined without reference to technology, thus introducing confusion as to whether the survey is about technological innovation or innovation more generally. Such ambiguities should be reduced in the future Community Innovation Surveys.

The questionnaire is clearly designed within the 'assimilation approach' (see section 1.1), whereby questions asked of manufacturing enterprises were adapted to be suitable to services. Apart from the frequent substitution of the word 'service' for the word 'product', the differences between the service and manufacturing questionnaires were confined to the basic innovation questions and to questions about the resources (i.e., innovation expenditures) devoted to various innovation activities.

The stress on the adjective *technological* as attached to innovation is also significant but open to two interpretations. The first is that the main characteristics of innovative behaviour in service sector are assumed to be basically the same as those ones in manufacturing and that a similar method should therefore be used. The second is that the method sought to compare as closely as possible manufacturing and services, and therefore as few changes as possible were made to the services questionnaire. Whatever the reason, the assimilation process runs the risk of failing to capture core aspects of innovative activities typical in the service sector, and perhaps also quite common in manufacturing. Especially notable is the fact that the definition of innovation in the service sector *excludes explicitly* 'organisational and managerial changes' where these are not directly related to the introduction of new or significantly improved services or methods to produce or deliver them. This is a significant omission, as such changes are often considerably more important to the performance of service firms, and require considerably more effort, than the adoption of standard technologies, such as mobile phones for routing drives, which is considered to be technological innovation.[20]

Question 1 concerns (technological) innovation, asking: 'Between 1994-96, has your enterprise introduced onto the market any new or significantly improved services or methods to produce or deliver services? (see the definition of technological innovation above)'. As simple yes / no answer was required, with a supplementary question for those answering 'yes' asking the enterprise to indicate whether their innovation(s) had been developed mainly by other enterprises or institutions; by the enterprise together with other enterprises or institutions; or mainly by the enterprise itself. A notable feature of this first question is that it does not attempt to divide between 'service product', process and delivery innovations. Instead it is simply a gate question – those enterprises which answered 'yes' to this question were considered 'innovating enterprises' by Eurostat. Note also that innovation was defined as 'new to the firm', so most of the 'innovators' are probably imitators of other enterprises which have introduced 'new to the market' innovations. Unfortunately, and unlike the manufacturing sector questionnaire, the services survey did not ask whether the enterprises had introduced any new to the market innovations, nor did it ask the enterprises to divide their turnover in 1996 into that derived from new services, that from significantly improved services and that from unchanged or marginally modified services.

Question 2 then asked whether the enterprise had undertaken any unsuccessful or yet to be completed (at the time of the survey) innovative activity between 1994 and 1996. Eurostat adds those with such activities to those that had successfully innovated to define 'enterprises with innovative activity'. Enterprises with innovative activities were then required to complete the rest of the questionnaire, whereas those without innovative activities were only required to answer question 9 – the last main question.[21] This is unfortunate – as the survey provides very little information on firms without innovative activities.

Question 3 concerned the 'resources devoted to innovation activities in 1996', with respondents required to answer whether they had engaged in: R&D within the enterprise; the

[20] We appreciate that this is a form of technological innovation which is likely to provide efficiency savings to the firm. However, it is likely to be a form of innovation which is rapidly (and easily) adopted by all enterprises in the activity, providing little or no advantage for early adopters. By contrast, significant managerial or organisational changes may provide long lasting advantages to the enterprise over its rivals. It is this form of advantage, whether technological or otherwise, which is widely recognised as innovation.

[21] This may be a flaw in the survey design – as respondents wishing to avoid completing most of the detailed questions could simply deny their firm had any innovative activities.

acquisition of R&D services; the acquisition of machinery and equipment linked to technological innovations; the acquisition of software and other external technology linked to technological innovation; preparations to introduce new or significantly improved services or methods to produce or deliver them; training directly linked to technological innovations; and the market introduction of technological innovation. For each activity that the enterprise undertook, a request was made for an estimate of the amount of money spent on the activity in question (in 1996). Instruction was given that this expenditure should cover current and capital expenditures, and a definition was given for each of the expenditure items. This is certainly an interesting question, but the accuracy of the response is difficult to gauge as very detailed information is required to categories which are not unambiguous.[22] Moreover, it is unfortunate that data for only a single year was asked for – as these expenditures may be lumpy in some firms. Question 3 then asks simpler supplementary questions about whether the firm had R&D personnel, and whether it undertook R&D on a continuous basis, on an occasional basis, or not at all.

Question 4 then asks if the enterprise has received any government support for innovation activities in 1996, while **Question 5** asks if the enterprise applied for at least one patent between 1994 and 1996 (in any country).

Question 6 concerns the aims or objectives of innovation, with the enterprises asked to score - between 0 (not relevant) and 3 (very important) - the relevance of ten different aims or objectives of innovation. **Question 7** asks, on a similar basis, the importance - scored from 0 (not used) to 3 (very important - of 12 'sources of information for innovation'. 'Sources within the enterprise' are undifferentiated between, for example, R&D, production and marketing, with 'other enterprises in the enterprise group also being considered alongside 10 sources external to the enterprise and its group.

Question 8 concerns innovation co-operation, and asked the enterprises whether they had co-operation arrangements for innovation with seven types of partner. Here:

> Innovation cooperation means active participation in joint R&D and other innovation projects with other organisations. It does not necessarily imply that both partners derive immediate commercial benefit from the venture. Pure contracting out work, where there is no active participation, is not regarded as cooperation.

Those that had these arrangements were asked where these partners were located (i.e., nationally, in the EU, the USA, Japan, or elsewhere).

Question 9 concerns the 'factors hampering innovation' and was to be answered by the firms without innovative activity as well as those with innovative activity (although data was only provided by Eurostat for this report on firms with innovative activities). The enterprises were first asked whether their innovative activities had been seriously delayed, abolished and/or not even started due to factors hampering innovation. Those firms that answered 'yes' to one or more of those questions were then asked about nine factors that may have hampered their innovation activities.

2.1.2 The Data

Services were included in the CIS-2 studies in 13 European countries via the adapted questionnaire outlined above, but, by agreement with Eurostat, only a restricted range of service sectors were surveyed.[23] These service sectors were:

- **Wholesale trades** (NACE Rev.1 51). These were not included in the French survey.
- **Transport services**, including land (NACE Rev.1 60) water (NACE Rev.1 61) and air transport (NACE Rev.1 62) services.
- **Telecommunications** services (NACE Rev.1 64.2)

[22] Note, for example, that the definition of R&D as ('comprising creative work undertaken on a systematic basis in order to increase the stock of knowledge, and the use of this knowledge to devise new applications, such as new or significantly improved services or methods to produce of deliver services') makes no mention of technology and could conceivably include market research, which is widely undertaken by services, whereas technological R&D is infrequently undertaken by services.

[23] Some countries included a wider range of services than that agreed with Eurostat. We confine our analysis to the commonly agreed sectors.

- **Financial services** including financial intermediation except insurance and pension funding (i.e., mainly banking: NACE Rev.1 65), insurance and pensions (excluding compulsory social security: NACE Rev.1 66) and activities auxiliary to financial intermediation (NACE Rev.1 67).
- **Computer services** (NACE Rev.1 72).
- **Technical services** (i.e., architectural and engineering activities and related technical consultancy - NACE Rev.1 74.2).
- **Electricity, Gas & Water Distribution** (NACE Rev.1 40 & 41). Note that these **'utilities'**, although examined here as services, were in some countries (e.g., Germany and the UK) surveyed using the manufacturing sector questionnaire. The Irish survey excluded utilities.

Some significant service sectors were therefore excluded from the survey. These include retailing, business services other than technical services (such as advertising, consulting, legal services and accountancy services), as well as (generally) public services such as education and health. A minimum size of 10 employees was also applied – as the great majority (95%) of service enterprises have fewer than 10 employees, and enterprises with fewer than 10 employees account for about 40% of employment in market services (Eurostat, 1999), this minimum size threshold is significant. Furthermore, Greece, Spain and Italy did not undertake a CIS-2 on their service sectors, although Italy conducted a CIS-2 pilot study in the previous year, and many of the results are comparable with the CIS-2. Excluding the 'utilities' enterprises, 11,668 enterprises responded to the survey. Roughly half of these enterprises had between 10 and 49 employees; only 1,703 had 250 or more employees (Table 2.1.1 summarises the codes that will be used throughout this report).

Table 2.1.1: Country Codes and Descriptions of Categories used in the Tables

Code	Country	Code	Description of Category
A	Austria	Small	Enterprises with 10 – 49 employees
B	Belgium	Medium	Enterprises with 50 – 249 employees
D	Germany	Large	Enterprises with 250 or more employees[24]
DK	Denmark		
F	France	Utilities	Enterprises in NACE sectors 40, 41
FIN	Finland	Wholesale	Enterprises in NACE sector 51
IRL	Ireland	Transport	Enterprises in NACE sectors 60, 61, 62
I	Italy	Telecoms	Enterprises in NACE sector 64.2
L	Luxembourg	Financial	Enterprises in NACE sectors 65, 66, 67
NL	Netherlands	Computer	Enterprises in NACE sector 72
NOR	Norway	Technical	Enterprises in NACE sector 74.2
P	Portugal		
S	Sweden	Adjusted	The data reflects the population of enterprises
UK	United Kingdom	Unadjusted	The data reflects the sample of respondents

Despite the limitations and omissions outlined above, the CIS-2 constitutes a large and unique survey of service enterprises and their innovative activities. Yet the sample is still small relative to the population. Overall, only about 7% of eligible service firms in the various European countries responded to the survey. The survey included a much larger proportion of Europe's large service enterprises; 22% of the eligible enterprises with 250 or more employees responded to the survey, compared with 4.5% of the eligible enterprises with 10 – 49 employees. The response was also fuller in the telecommunications sector (which tends to be dominated by large firms) – in which 25% of the eligible enterprises provided responses, whereas only about 5% of eligible enterprises in the wholesale and technical service sectors responded.

The number of responses varied widely by country, being largest for France (despite the exclusion of the wholesale sector from the French survey) and the Netherlands, and smallest for Austria, Denmark and Luxembourg. As a proportion of the population of enterprises eligible for the survey, the response also varied widely by country. Only 1% of the eligible service enterprises in Germany responded to the survey, as did only 2% of those in the UK. By contrast 29% of eligible service enterprises in Luxembourg responded, as did 26% of those in Finland. More than 20% of the

[24] Note for the Netherlands, large firms are defined (by Eurostat) as those with 200 or more employees, rather than those with 250 or more employees.

eligible French, Dutch and Norwegian enterprises also responded. The pattern of response (excluding the utilities sectors) is summarised in Tables 2.1.2 and 2.1.3.

For this study, Eurostat provided the 'micro-aggregated' data for five countries (Germany, France, Ireland, Norway and Portugal), plus the original data for Sweden. In addition, we have had direct access to the UK data (and to the pre-CIS-2 Italian survey of services).[25] Parts of the analyses that follow in Section 3 concern only these seven countries for which we have had direct access to the CIS-2 data. For brevity, we will refer to these as '**the seven countries**'. Where one of these did not include a sector, such as France with wholesale, we refer to the reminder as '**the six countries**'.

Table 2.1.2: The Sample of Responses

Unadjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	All
All Services	364	846	909	253	2,609	568	283	192	2,521	859	1,016	709	539	11,668
Small	133	459	427	146	1,442	340	185	134	1,013	465	776	465	186	6,171
Medium	159	283	279	53	848	166	70	41	1,182	276	182	122	133	3,794
Large	72	104	203	54	319	62	28	17	326	118	58	122	220	1,703
Wholesale	151	440	230	103	*n.a.*	235	54	59	1,200	265	367	331	97	3,532
Transport	47	177	121	58	1,247	128	69	41	642	141	304	154	120	3,249
Telecoms	6	14	4	2	38	28	16	2	15	30	14	21	22	212
Financial	124	116	268	49	205	55	88	65	308	145	180	70	146	1,819
Computer	19	52	136	14	617	55	34	13	154	106	58	68	55	1,381
Technical	17	47	150	27	502	67	22	12	202	172	93	65	99	1,475

Note - Excludes Utilities. From Eurostat file - C1 – variable ENT_SAMP ABS

Table 2.1.3: The Sample as a Proportion of the Population (%)

Unadjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	All
All Services	7	13	1	5	22	26	9	29	22	21	16	12	2	6.7
Small	3	8	1	4	17	19	8	27	12	15	14	10	1	4.5
Medium	19	38	2	7	36	52	9	30	50	37	26	15	3	13.3
Large	50	76	5	25	32	70	33	85	69	84	60	59	16	22.2
Wholesale	5	12	1	4	*n.a.*	24	4	26	19	13	8	11	1	5.3
Transport	4	11	1	6	24	24	16	32	25	16	37	12	2	7.3
Telecoms	75	45	7	6	35	46	36	29	44	81	45	62	6	25.0
Financial	16	18	5	9	12	45	12	30	35	50	46	28	4	11.5
Computer	9	15	2	8	23	30	7	33	26	42	45	14	2	9.7
Technical	6	17	1	9	21	24	11	33	22	34	40	11	3	4.6

Note - Excludes Utilities. From Eurostat file - C1 – variable ENT_SAMP REL1

Most of the analysis in this report relies on descriptive data analyses provided by Eurostat. These analyses included those provided as part of the standard package of statistical tables provided to the investigators by Eurostat (and designated file 'C_' beneath the tables in the report) and those provided in accordance with the particular requests of this team of investigators.[26]

The data obtained through the questionnaires and processed by Eurostat as well as that available directly to our research group, provided the investigators with the possibility of performing a wide range of analyses, by country and by sector, as well as at the firm level. First we can distinguish the proportion of service enterprises that have undertaken innovative activities. We can also seek an understanding of some of the aims or objectives of innovation, the sources of information used, the role of R&D, and the resources devoted to innovation, as well as the extent of cooperation arrangements used to develop innovations and the factors hampering innovation. The next section provides detailed analyses of these issues across the services sectors (included in the survey) as a whole whilst Appendix A addresses these issues within each of the seven individual sectors listed above. Also included are a section (Section 3.3) which examines the behaviour and characteristics of the enterprises which invested unusually large amounts on innovation (and compares these comparison with other innovators), and an analysis (Section 3.4) which compares innovators according to the source of their innovations.

[25] Indirect access to the Italian pre-CIS-2 study was provided to our research team via ISTAT, the Italian national statistical agency.

[26] We are particularly grateful to Frank Foyn and Jean-Christophe Paulet, both of EUROSTAT, for providing these data and analyses.

2.2 Issues of Data Analysis

2.1.2 Reporting Adjusted and Unadjusted Results from the Survey

An important issue in the analysis of the CIS-2 data, and commentating on the results of the survey, is whether or not the pattern of response to the survey should be adjusted to reflect the population of eligible firms in each of the countries concerned. We call the data that is not adjusted to reflect the population the **unadjusted data**, whilst the **adjusted data** is that which has been altered by use of weights to provide a 'representative' pattern of response.

The advantage of using adjusted data is that it should provide a representative pattern of response, correcting for biases in the sampling methods and pattern of response. Generally, the national agencies that undertook the CIS-2 surveys sampled larger firms much more heavily than smaller firms, and some also sampled the more technologically intense sectors (such as computer services) more heavily than the less technologically intense sectors (such as wholesaling). The response rate also varied – with large firms generally more likely to respond than small firms, and firms in some sectors were more likely to respond than firms in other sectors. Through the use of weights on the data, the results can be adjusted to 'iron out' these inconsistencies and to provide a representative response or the extent and patterns of innovation in each country (amongst the eligible population of enterprises). The adjusted data thereby makes country comparisons more consistent. However, there are arguments against adjusting the data through the use of weights. The first of these is that innovation is about change. It is questionable, therefore, whether a small set of firms in a certain size classification and in a certain sector can be said to be representative, with respect to their innovative activities, of all firms within the same size category and sector – particularly if the sample size is small relative to the population and if the sector is broad. Attention needs therefore to be paid to whether or not the pattern of the results changes significantly if the data are adjusted through the use of weights on cases.[27]

In the event, because the patterns in the data remained relatively unchanged when adjusted thorough the use of weights, this report largely presents adjusted data. The main exception to this is the data on innovation expenditures – where unadjusted data is used. This data is likely to be particularly variable between enterprises (as well as year on year), and as it is especially questionable whether these data can be considered representative, this report presents unadjusted innovation expenditure data.

2.2.1 Extreme Performance

Finally in this section we consider extreme performance. Extreme performance can be considered in terms of (sales or employment) growth or in terms of commitment to innovation (as represented by expenditures on innovation activities, relative to total sales or per employee). The CIS-2 includes sales and employment data for only two years, 1996 and 1994. Thus extreme performance in terms growth can only be assessed over a two-year period. This period is generally considered too short to reliably identify extreme performance in terms of growth. A period of at least five years in preferred. Consequently, we focus on extreme performance in terms of innovation expenditures (per employee), and examine whether the pattern of innovation activities amongst the enterprises that spent very highly (on a per employee basis) differed markedly from the other enterprises. There are also difficulties with this data. As the innovation expenditure data relate to a single year this is an unreliable means of identifying enterprises with a consistently extreme commitment to innovation.[28] However, without further data it is not possible to identify those enterprises that have maintained a consistently high commitment to innovation. This is an issue for the design of future versions of the CIS questionnaire.

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[27] A second issue which arises in adjusting the pattern of response though the use of case weights is that the unit of re-weighting is the enterprise. This makes all firms equally important, whether they employ 10 people of 2,000 – for the weights take no account of the economic significance of the enterprises. However, most of the surveys were stratified to sample large firms more heavily than small firms, thus effectively taking into account the greater economic significance of the larger firms. The question therefore arises as to what is the unit of interest. If the analyst is primarily interested in small firms which will dominate the population and thus dominate the adjusted pattern of response, then the adjusted data is preferred. This does, however, downplay the significance of large enterprises which, although few in number, often employ as many people and contribute as much to value added as many thousands of small firms. Partly to investigate this issue, we examine, in the overview analysis in Section 3, the whether the large firms differed in their pattern of response to the survey from the other (smaller) enterprises.

[28] For innovation expenditures may be lumpy, varying widely from one year to the next. Thus some enterprises with an average commitment to innovation may appear to have very high innovation intensities in one year, but very low innovation intensities in the next.

Section 3 Analysis of the Data

3.1 Introduction and the Structure of the Analysis

This section provides the analysis of the CIS-2 data on the service sectors. The aim of this part of the report is to map the structure of innovative behaviour amongst market service enterprises in Europe, in general and across a range of sectors, and to investigate their innovative performance. In particular, the analysis will describe and attempt to explain within-industry differences of innovation performance across Europe. The study will address the following broad issues:

- Describe the general situation and, within the sub-sectors covered, consider differences in innovative performance across European firms and between countries.
- Consider the sources of information for innovation and barriers to innovation.
- Assess the objectives of innovation, and link this with innovative behaviour and performance.
- Examine the inter-relationship between innovation behaviour and performance.

We note that the design of the survey places some important restrictions on the nature of the analysis we can conduct. We discuss these limitations in Section 4. The analysis in this section has been undertaken with policy makers, the research community, managers and a broader audience in mind as 'the target audience'. Space limitations mean we focus on the CIS-2 data in this section, whilst the commentary in Section 4 highlights the similarities and differences between this survey and previous (survey and case study) evidence. We elaborate possible policy implications in Section 5.

The analysis is divided into four sub-sections:

1. **Section 3.2** provides an **Overview** of the CIS-2 results for the service sectors. This draws out the findings that are consistent across all or most of the sectors included in the survey. This section also considers how the large firms differed from service firms in general with respect to their innovative activities and performance. This is a significant issue, as large firms tend to be more frequent innovators and/or tend to introduce larger innovations.

   Appendix A at the end of the report provides an analysis for each of the seven service sectors included in the CIS-2. These sectors are: Utilities, Wholesaling, Transport Services, Telecommunications, Financial Services, Computer Services and Technical Services. For each sector a number of dimensions of innovation in services are addressed. These include: (i.) the firm size structure (of the sector); (ii.) the incidence of innovation; (iii) the aims or objectives of innovation; (iv.) the extent and role of research and development in the sector; (v.) the sources of information for innovation; (vi.) the distribution of resources committed to innovation (vii.) the extent of co-operation arrangements for innovation; and (vii) the extent to which innovating firms were hampered in their innovation activities, and by which factors.

2. **Section 3.3** provides the first of two experimental treatments of the data. This relates **Innovation Intensity** (in terms of expenditures per employee on innovation) to employment growth performance and to the pattern and purpose of innovative activities within service enterprises.

3. **Section 3.4** is the second of the two experimental treatments of the data. This analyses the behaviour and characteristics of the innovators according to **the source of the innovations**, that is whether their innovations were developed by the enterprise itself (internal innovation), by the enterprise jointly with other enterprises or institutes (joint innovation), or whether the innovations were mainly developed by other enterprises or institutes (external innovation)

4. **Section 3.5** provides an overview of the general findings from the CIS-2 data concerning innovation in services.

3.2 Overview

This sub-section provides and overview of the pattern of innovation amongst the service sector enterprises assessed by the CIS-2. It also highlights the response of large enterprises to examine whether these differed from service enterprises generally in their patterns of innovation.

3.2.1 Enterprise Size Structure

Service enterprises tend to be smaller than manufacturing enterprises. According to Eurostat (1999) 94.8% of market service enterprises in the European Union had fewer than 10 employees, 4.6% had 10 – 49 employees, 0.6% had 50 – 249 employees, and only 0.6% had 250 or more employees. The corresponding proportions for industry were 80.7%, 15.2%, 3.3% and 0.8%. We note that very small enterprises, those with fewer than 10 employees, were not included in the CIS-2 survey of services. Consequently, nearly 95% of the population of service enterprises have been omitted from the exercise. This is a serious omission, as very small enterprises also account for a significant share of total employment and value added in market services (40% of employment - Eurostat, 1999).[29] Meanwhile, in services only 32% of employees are active in enterprises with 250 or more employees, compared with 47% in manufacturing (Eurostat, 1999).

However, services are also diverse. Employment is highly concentrated in large enterprises in the financial services sector, and in transport and communications more than half of employees are in enterprises with 250 or more employees. By contrast, in distributive trades only 22% of employees are in large enterprises.

Table 3.2.1: Number of Enterprises in the EU by Size Class in 1995 (%)

	0 – 9 employees	10 – 49 employees	50 – 249 employees	250+ employees
Market Services	94.8	4.6	0.6	0.1
Distributive Trades	95.1	4.4	0.4	0.1
HORECA	94.2	5.3	0.4	0.1
Transport & Communications	93.1	5.8	0.9	0.2
Financial Intermediation	94.1	3.9	1.3	0.7
Real Estate, Renting and Other Business Activities	95.0	4.2	0.6	0.2
Manufacturing Industries	80.7	15.2	3.3	0.8

Note: HORECA - Hotels, Restaurants and Catering; Source: Table 3.8 – Services in Europe, Eurostat, 1999

Table 3.2.2: Distribution of Employment by Enterprise Size Class in 1995 (%)

	0 – 9 employees	10 – 49 employees	50 – 249 employees	250+ employees
Market Services	40.0	17.6	10.4	31.9
Distributive Trades	48.6	20.0	9.4	22.0
HORECA	55.3	21.8	8.5	14.4
Transport & Communications	22.4	14.0	10.2	53.4
Financial Intermediation	12.8	6.0	9.6	71.7
Real Estate, Renting and Other Business Activities	38.4	17.6	10.4	31.9
Manufacturing Industries	13.8	19.4	19.5	47.4

Note: HORECA - Hotels, Restaurants and Catering; Source: Table 3.9 – Services in Europe, Eurostat, 1999

The size distribution of enterprises across the range of services surveyed by the CIS-2 also differed by country. Amongst 'the seven countries', large enterprises accounted for less than 2% of the eligible enterprises[30] in Ireland and Portugal, whilst they accounted for more than 4% of eligible enterprises in Germany and the UK, and more than 8% in France (which excluded wholesale enterprises – which tend to be small - from the survey). The concentration of employment in large

[29] This is a larger share of employment than that accounted for by very small enterprises in manufacturing - 32% (Eurostat, 1999).
[30] i.e., those in the sectors examined after the exclusion of enterprises with fewer than 10 employees.

enterprises also varies widely. Although we can only assess this approximately,[31] much more than half of total employment in the eligible population of enterprises is in large enterprises in France, Germany and the UK, whilst in Ireland and Portugal only 35% and 41% of employment is in large enterprises. This may reflect the different degrees of 'industrialisation' of services in different European countries, although we would also expect larger service enterprises in the larger countries.

Table 3.2.3: The Enterprise Size and Employment Distributions in the Seven Countries (%)

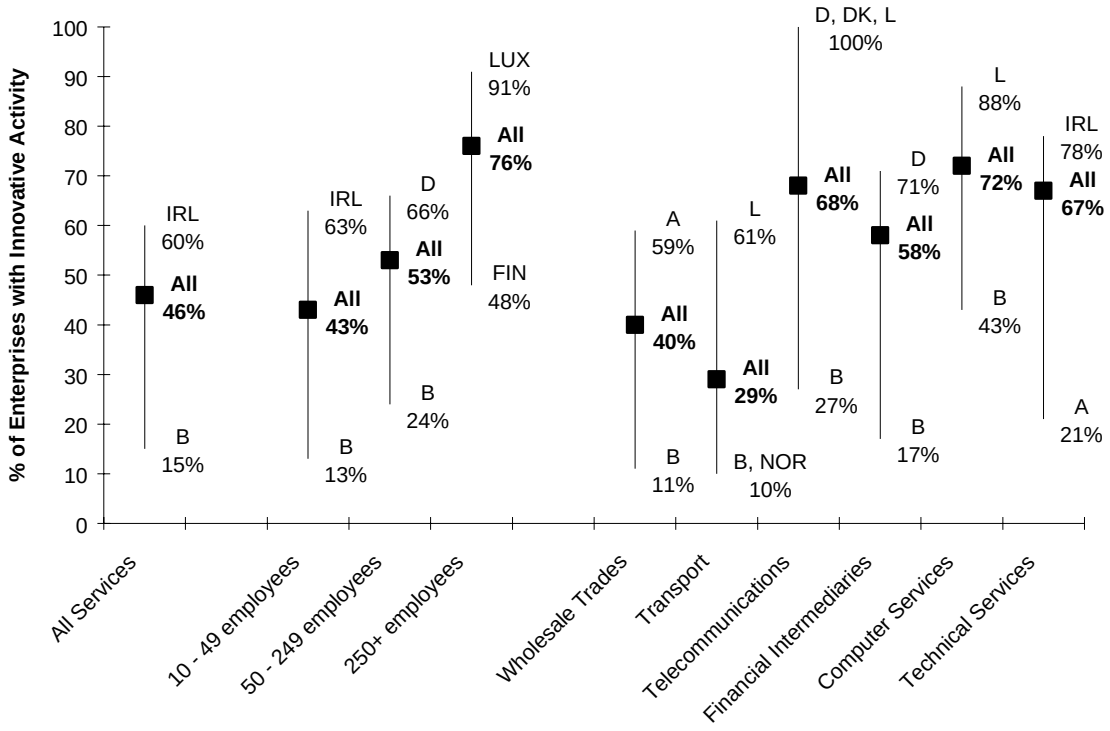
	D	F	IRL	NOR	P	S	UK	7 Countries
Unadjusted								
Small	46.6	55.3	65.0	54.0	76.2	65.6	34.5	56.9
Medium	30.8	32.5	25.4	32.2	18.0	17.2	24.7	27.6
Large	22.6	12.3	9.5	13.7	5.8	17.2	40.8	15.5
Adjusted								
Small	79.3	72.1	72.8	78.2	87.4	82.3	79.1	79.0
Medium	15.9	19.6	25.7	18.3	11.0	14.1	16.5	16.3
Large	4.8	8.3	1.4	3.5	1.6	3.6	4.3	4.7
By Employment*								
Small	9.9	4.8	21.9	25.8	37.2	24.6	18.5	10.9
Medium	9.7	5.9	42.7	27.1	21.9	21.3	18.3	10.9
Large	80.4	89.3	35.3	47.1	40.9	54.1	63.2	78.1

Note - Excludes Utilities; France excludes Wholesale; * 'By Employment' gives an approximate distribution of employment

3.2.2 The Extent and Patterns of Innovation

The proportion of service enterprises that had innovative activities between 1994 and 1996 varied widely between the European countries surveyed, from just 15% of Belgian enterprises to 60% of Irish enterprises. Overall, 46% of service enterprises engaged in innovative activity in this period.

Figure 3.2.1
Proportion of Enterprises undertaking Innovative Activity in 1994-96



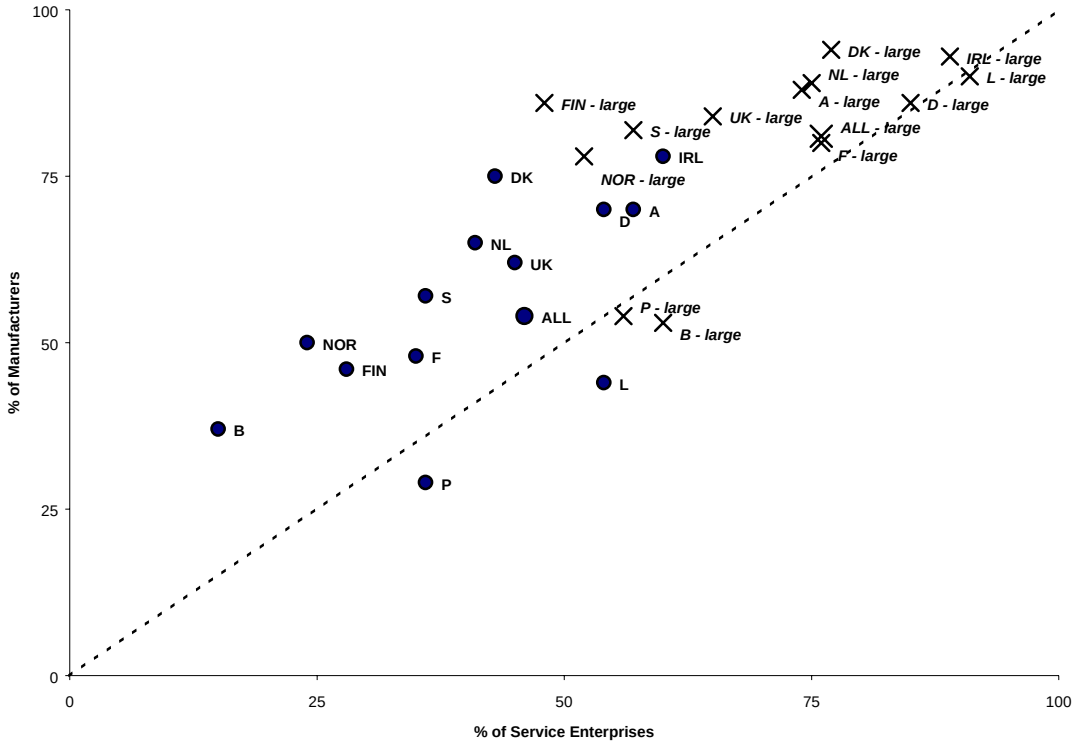
[31] We assess this by multiplying the weights (supplied by Eurostat to adjust the pattern of response to the distribution for the population of enterprises) by the employment given for each responding enterprise. This indicator is subject to distortion if the largest enterprises in the sample are not representative of large enterprises in general in terms of their employment.

The differences between countries are surprisingly large, but there are several reasons that may - at least partially - explain why such large differences have arisen:

- The first is that genuine differences exist between countries. For example, if innovation is largely IT orientated it may be that the state of diffusion of IT is at different 'stages' in different countries. A country with a high rate of innovation in terms of IT adoption during 1994-96 may either be leading or catching up. By contrast a country with a low rate of innovation in terms of IT adoption may be one in which these technologies are already widely diffused or may be a country in which the diffusion wave has yet to start. As such, the proportion of enterprises with innovative activity may say little about the relative position of the different countries with respect to their leading or lagging positions in innovation, if innovation is primarily the adoption of IT. We do not, however, expect that this is the main explanation for the differences, as we would be surprised if the adoption of IT based innovations was so national in character, especially as the diffusion of IT has not been confined to a short period of time. This explanation also ignores other (non-IT) forms of innovation.

- A second explanation is that sectoral composition may differ between countries, such that some countries may have more enterprises in sectors that tend to have high proportions of innovators, whereas other countries 'specialise' in sectors with low rates of innovation. At first glance, the sectoral data does not appear to support this explanation. Of all the countries Belgium has the lowest proportion of innovators in all of the sectors except technical services, where it is still well below average. However, the sectors covered here are generally very broad and it may be that Belgium and other apparently lagging countries have more enterprises engaged in the less innovative activities within most of the sectors analysed than is generally the case in Europe. This difference may reflect a different division of labour with respect to innovation between enterprises in different sectors and within the different European 'national systems of innovation'. Nonetheless, and as with the first explanation, we do not expect that this is a complete explanation.

Figure 3.2.2
Proportion of Enterprises with Innovative Activity in 1994-96
Manufacuturing and Service Enterprises Compared



- The third and most likely explanation of these differences is that innovation is interpreted rather differently in different countries, with enterprises in those countries with high rates of innovation tending to apply a stricter definition of innovation than enterprises in which a high proportion of enterprises claimed to have innovated. The survey was undertaken using various national questionnaires in several different languages. Given this, and different cultural understandings of innovation, it is unsurprising that differences in the proportions of innovators arose, despite the use of a common questionnaire and a common definition of (technological) innovation. It is notable, for example, that the proportion of innovators in services in each country correlated fairly strongly with the corresponding proportion of manufacturing innovators (See Figure 3.2.2). This variation in the proportion of innovators in both manufacturing and services suggests a more sophisticated approach to identifying innovators should be used than the asking simple 'yes' / 'no' questions. We discuss this further in Section 4.

Table 3.2.4: The Proportion of Service Enterprises with Innovative Activity (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	All
All Services	57	15	54	43	35	28	60	54	41	24	36	36	45	46
Small	56	13	50	39	30	26	63	51	36	22	36	32	45	43
Medium	58	24	66	51	39	40	49	63	50	27	31	52	38	53
Large	74	60	85	77	76	48	89	91	75	52	56	57	65	76
Manufacturing	70	37	70	75	48	46	78	44	65	50	29	57	62	54
Small Man.	63	34	64	71	40	36	74	24	56	40	25	45	58	46
Medium Man.	74	37	72	78	53	48	80	54	74	58	32	65	61	60
Large Man.	88	53	86	94	80	86	93	90	89	78	54	82	84	81
Wholesale	59	11	48	42	*n.a.*	19	55	40	40	19	34	33	38	40
Transport	57	10	30	21	15	18	37	61	26	10	38	21	40	29
Telecoms	81	27	100	100	53	86	86	100	83	59	49	61	63	68
Financial	57	17	71	54	48	33	70	53	46	45	43	58	56	58
Computer S	69	43	77	90	57	68	73	88	74	53	57	57	81	72
Technical S	21	47	76	66	45	43	78	77	58	39	40	55	44	67

Note: Excludes Utilities. From Eurostat file - C21 – variable INN_ACT REL1

Table 3.2.5: Service Enterprises identified as 'Innovative Enterprises' (%)

Adjusted	A	B	D	DK	F	FIN	I	IRL	L	NL	NOR	P	S	UK	All
All Services	55	13	46	30	31	24	40	58	49	36	22	28	32	40	40
Small	54	11	41	24	25	22	50	60	46	32	20	28	29	40	36
Medium	58	21	60	45	34	30	50	49	55	45	26	28	48	37	48
Large	74	55	83	71	73	43	74	87	83	71	50	52	45	55	73
Manufacturing	67	34	69	71	43	36	48	74	42	62	48	26	54	59	51
Small Man.	59	33	63	64	34	26	44	68	21	54	39	22	43	54	44
Medium Man.	73	34	70	76	48	40	57	78	52	71	56	30	61	59	58
Large Man.	88	51	85	91	76	77	73	85	85	84	77	52	79	81	79
Wholesale	58	10	39	27	n.a.	15	35	52	37	36	18	26	29	33	34
Transport	54	9	26	13	11	16	30	33	58	21	5	28	19	34	24
Telecoms	81	27	100	100	52	79	41	86	43	74	56	45	51	60	64
Financial	55	13	70	48	45	28	62	67	43	40	44	43	56	49	54
Computer S	69	41	71	89	52	64	54	73	88	68	50	53	55	81	68
Technical S	21	43	61	36	39	31	50	78	77	52	38	30	47	38	55

Note: Excludes Utilities. Italian data (I) is from the Italian survey. From Eurostat file - C21 – variable INNO_ENT REL1

In all countries the proportion of innovators in services increased (as expected) with enterprise size, and in all countries except Finland (48%) more than half of the large firms (those with 250+ employees) had engaged in innovative activity. The countries in which the greatest proportion of large enterprises had innovative activities were Germany (85%), Ireland (89%) and Luxembourg (91%). Much greater variation existed, however, amongst the proportion of small enterprises that had engaged in innovative activities. Belgium had the smallest proportion of small enterprises with innovative activity – at just 13%, whilst Ireland had the largest proportion, at 63%.

In general fewer service enterprises had engaged in innovative activities than manufacturing enterprises – Portugal and Luxembourg being exceptions. However, it should be recalled that service enterprises with 10 or more employees were surveyed, whereas the threshold for manufacturers was 20 employees. Thus the service enterprises were on average smaller and this partially explains the lower incidence of innovative activity amongst service enterprises. This said, in most countries fewer of the medium sized and large service enterprises engaged in innovative activity than their manufacturing counterparts.

Amongst the service sectors examined the proportion of enterprises engaged in innovative activities varied widely – from 29% of transport service enterprises (in all countries), to 72% of computer service enterprises. Enterprises in computer services, telecommunications, technical services and financial intermediation were, on average, more likely to have engaged in innovative activities than the average manufacturing enterprise. Thus, large service enterprises and service enterprises engaged in the more technologically oriented sectors were generally more likely than the average manufacturing enterprise to engage in (technological) innovative activities, whereas small service enterprises, and particularly those in the less technologically intense sectors (e.g., wholesale & transport) were less likely to have engaged in innovative activities than the average manufacturing enterprise. We investigate these patterns in more detail within the individual sector studies below.

3.2.3 The Aims or Objectives of Innovation

The firms were asked to rank the significance of ten aims or objectives of innovation between 0 – 'not relevant', and 3 – 'very important'. In the analysis below, we consider scores between 1 and 3 to be *relevant aims* of innovation.

The most widely recognised aims of innovation amongst the service enterprises were to improve the quality of their services, to open up new markets and to extend their service range. 95% of the innovating enterprises declared improving service quality a relevant aim of their innovation activities, with 68% declaring this 'very important'. Large enterprises were more likely than smaller firms to consider this a relevant aim of their innovation activities – perhaps because they tend to have more innovation activities and are therefore more likely to have undertaken both service 'product' and process innovation. This said, it is notable that large enterprises are more likely than all service enterprises to recognise as relevant all of the aims of innovation except reducing environmental damage. In all countries improving service quality was amongst the most widely recognised of the innovation aims, being considered relevant by no fewer than 84% of the enterprises in all countries and as 'very important' by at least half the enterprises in most countries. The Netherlands is an interesting exception here, as only 35% of the Dutch enterprises declared improving quality to be a 'very important' aim of their innovation activity.

In general, the high significance attached to improving service quality, extending the service range and opening up new markets shows a strong orientation toward the improvement of the service outputs provided by the firms, both in terms of their quality and availability in time and space. Whilst it is tempting to describe this as a service 'product' innovation orientation, it should be noted that such changes in the service delivered may in fact be largely due to (process) innovations in the means of producing or delivering services.

Innovation aimed at improving the flexibility of the production process relates to 'process side' innovation which, although primarily process orientated, may have a direct impact on the nature of the services offered. Many service firms (and indeed manufacturing firms) are thought to be increasing their flexibility in order to respond more fully or rapidly to different and/or changing users needs. Such flexibility can be a source of differential pricing which tends to raise profit margins and profits per unit of output. Given this, it is unsurprising that 84% of the innovating enterprises declared improving their production flexibility to be a relevant aim of innovation, with 90% of the large firms making this claim. Overall, 40% of the firms saw this as a very important aim of their innovation activities. This proportion was also higher amongst the large enterprises – at 52%, with two thirds of large enterprises in Germany and 80% of those in Ireland making this claim.

Services are often assumed to be labour intensive – thus reducing the cost of labour (through for example, simplifying tasks to reduce the level of skills required, or through replacing labour with machines) might be expected to be a significant aim of service firms. Reducing labour costs was

recognised as a relevant aim of innovation by 80% of the firms (and by 88% of the large firms), and as a very significant aim by more than a third of the firms (and 44% of the large firms). This aim tended to be more widely recognised in Austria, Germany and Ireland, and of less significance in France, the Benelux countries and Scandinavia. This perhaps hints at different attitudes to the labour cost component in production – in some countries labour costs are not seen as a basis of competitiveness (i.e., companies have similar labour costs and compete through other dimensions), whereas in others they are seen as a significant factor to be reduced to improve competitiveness.

Compared with the other aims of innovation, reducing materials and energy costs did not rank high – with little more than half the enterprises declaring these to be relevant, and neither of these aims was recognised as very important by more than a fifth of the enterprises. Fulfilling regulations and standards was also amongst the least frequently identified of the aims of innovation, being identified as relevant by just over half the firms and as very important by less than a fifth. This objective was more widely recognised in Luxembourg and Portugal, where more than a third of the firms declared it to be very important, including half the large enterprises in Luxembourg.

Table 3.2.6: Relevant Aims or Objectives of Innovation - All and Large Enterprises (%)

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Improving	All	100	90	99	99	84	96	92	91	84	92	99	94	87	95
Quality	Large	100	99	99	94	86	93	98	85	88	98	98	94	100	97
Open New	All	89	83	89	91	81	95	91	89	83	96	87	95	88	89
Markets	Large	92	90	99	98	86	97	89	85	87	94	79	92	95	95
Extend	All	78	94	88	99	81	94	88	95	76	91	79	92	86	87
Range	Large	84	95	94	94	86	87	92	100	81	95	79	93	90	91
Improve	All	82	83	90	87	62	85	90	75	67	76	77	78	81	84
Flexibility	Large	97	91	94	90	75	89	100	85	81	81	96	75	92	90
Reduce	All	79	71	87	70	55	67	72	46	64	79	74	78	76	79
Labour Costs	Large	94	83	91	83	78	79	98	79	76	88	93	79	88	88
Fulfill	All	73	65	73	61	60	63	64	59	50	78	75	80	78	71
Regulations	Large	79	65	78	78	63	59	83	74	54	79	69	84	91	76
Replace Old	All	72	43	68	96	58	88	45	44	64	83	43	63	61	65
Services	Large	91	46	77	89	52	93	82	64	67	84	71	77	59	71
Reduce	All	53	51	68	49	29	47	38	31	38	41	49	50	45	56
Energy Costs	Large	46	42	68	58	53	42	22	52	44	41	71	36	51	59
Reduce Mat	All	48	46	68	48	31	56	42	30	29	49	57	42	45	56
-erials Costs	Large	46	48	73	63	52	45	79	67	35	50	73	37	55	64
Reduce	All	51	42	65	51	20	51	38	29	47	50	48	61	49	55
Env Damage	Large	43	46	68	67	7	51	19	45	52	48	45	51	57	50

Note: Excludes Utilities. From Eurostat file – C62

Table 3.2.7: Very Important Aims or Objectives of Innovation - All and Large Enterprises (%)

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Improving	All	48	69	77	49	59	54	74	86	35	66	84	58	63	68
Quality	Large	70	75	86	39	66	52	92	85	36	59	88	59	84	77
Extend	All	8	52	60	51	53	32	33	85	30	56	43	45	36	49
Range	Large	33	69	48	46	64	25	29	94	33	60	46	44	42	48
Open New	All	26	56	42	51	56	40	60	71	33	58	60	63	67	48
Markets	Large	42	58	40	47	52	32	27	68	37	59	60	54	63	45
Improve	All	20	29	52	39	19	24	42	35	21	22	31	19	26	40
Flexibility	Large	32	39	66	20	32	45	80	44	31	29	46	24	37	52
Reduce	All	34	20	47	14	16	16	26	20	16	34	40	21	34	37
Labour Costs	Large	52	22	52	20	31	14	63	51	20	48	38	25	43	44
Replace Old	All	23	8	16	32	22	32	16	25	20	39	21	21	22	19
Services	Large	23	6	15	22	25	25	8	34	22	48	39	41	20	19
Reduce	All	4	7	21	4	6	12	7	11	12	10	36	21	20	18
Env Damage	Large	10	13	12	20	12	8	4	16	12	14	7	17	12	12
Reduce Mat	All	6	8	22	5	7	6	11	5	2	12	32	11	20	18
-erials Costs	Large	11	3	17	13	12	0	5	9	4	10	17	6	6	13
Fulfil	All	7	24	14	20	21	11	17	36	11	17	37	25	28	18
Regulations	Large	10	22	15	17	26	11	6	51	10	11	21	22	40	20
Reduce	All	5	9	19	5	7	7	6	9	7	8	28	12	21	17
Energy Costs	Large	15	8	9	14	12	4	0	16	7	9	14	10	10	10

Note: Excludes Utilities. From Eurostat file – C61

Reducing environmental damage was the least widely recognised aim of innovation. A little over half the enterprises recognised this as a relevant aim of their innovation activities, whilst just 18% recognised this as a 'very important' aim of their innovation activities. Notably (and surprisingly) this proportion was smaller for large enterprises than for all enterprises. Also notable was the fact that the proportions recognising it as a relevant or very important aim of innovation tended to be higher in Germany and Scandinavia, although Portugal had the highest proportion of enterprises declaring reduced environmental damage was a very important aim of their innovation activities.

Overall, most firms have multiple aims for innovation. The median number of 'very important' aims of innovation amongst the innovating firms in France, Germany, Ireland, Norway, Portugal, Sweden and the UK (and including the 'utilities' firms) was 3. 8% failed to identify any of these above as very important aims of their innovation activities, whilst 12% cited 6 or more of the aims as 'very important'. Most probably, the firms that had multiple aims for their innovation activities introduced multiple innovation rather than a single innovation with multiple aims.

3.2.4 The Extent and Role of Research and Development (R&D)

Services are widely supposed not to engage in R&D. This is, however, an oversimplification, and amongst the innovating service firms (with 10 or more employees) roughly a quarter undertook R&D on a continuous basis, with a similar proportion undertaking R&D occasionally. Thus half the innovating service enterprises did not undertake R&D at all, but this is perhaps a smaller proportion than that widely supposed. Also of note is that although the proportion of manufacturing firms that undertook R&D was greater, the differences in the proportions were not very large: 36% of the manufacturing innovators (with 20 or more employees) conducted R&D on a continuous basis, and a further 32% conducted R&D on an occasional basis, leaving 31% that did not conduct R&D at all.

The big difference in the role of R&D appears amongst the large enterprises in manufacturing as compared with services. In manufacturing 69% of the large innovating firms with 250+ employees conducted R&D on a continuous basis firms with a further 19% undertaking R&D on an occasional basis, leaving only 11% that did not conduct R&D at all. Contrast this with services, were only 34% of the large firms conducted R&D on a continuous basis with a further 22% doing R&D occasionally, leaving 44% that did not undertake R&D at all.

Table 3.2.8: The Undertaking of R&D - All and Large Innovating Enterprises (%)

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Services															
Continuously	All	15	33	22	29	39	39	15	27	36	29	17	30	20	24
	Large	15	51	27	54	50	42	18	75	54	40	28	41	33	34
Occasionally	All	33	26	22	39	35	42	23	16	23	37	12	26	19	23
	Large	44	21	18	30	32	34	15	0	30	28	5	23	21	22
Not at All	All	52	40	56	32	26	19	62	57	42	34	71	45	60	53
	Large	41	28	54	16	18	24	67	25	16	32	67	36	46	44
Manufacturing															
Continuously	All	42	47	42	38	38	55	46	46	50	29	16	49	36	36
	Large	72	78	69	71	68	92	80	78	78	59	38	79	65	69
Occasionally	All	34	29	37	35	40	37	36	16	24	34	19	32	32	32
	Large	20	16	22	18	22	8	10	5	13	30	18	15	20	19
Not at All	All	24	25	21	27	22	8	18	38	26	37	65	19	32	31
	Large	8	6	8	12	11	1	11	17	9	12	44	6	15	11

Note: Excludes Utilities. From Eurostat file – C51

This provides two interesting insights – firstly in both services and manufacturing the propensity to conduct R&D increases with firm size, but this change with size is much greater in manufacturing. The second is that at least with respect to R&D large manufacturing firms appear to be the exception rather than the rule. R&D has been central to much of the received understanding concerning technological innovation, but whilst not denying its significance (particularly in the production of radical innovations) it should be emphasised that R&D is primarily the province of large manufacturing firms (especially those in technologically intense sectors). Because we have placed R&D and the large manufacturing firm at centre stage in our considerations of innovation, we have neglected the other sources of innovation which appear to be more significant amongst service firms and smaller manufacturing firms. In the service sector as well as in many (smaller) manufacturing

enterprises, human capital often replaces formalised R&D as the main input factor (alongside investments) for developing and implementing innovations. The know-how of service providers (and manufacturers) is often bound up in the experience and expertise of each enterprise's employees.

3.2.5 The Sources of Information for Innovation

The firms were asked to rank the significance of ten sources of innovation for their innovation activities – as before they could rank these between 0 – 'not relevant', and 3 – 'very important'. In the analysis below, we consider scores between 1 and 3 to identify relevant sources of information.

Table 3.2.9: Relevant Sources of Information for Innovation - All and Large Enterprises (%)

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Within the	All	94	89	95	94	80	100	89	88	92	93	82	94	84	91
Enterprise	Large	100	99	97	100	94	100	98	100	98	98	83	95	98	97
Competitors	All	94	81	85	85	55	90	87	52	63	87	64	84	84	82
	Large	90	93	83	94	71	100	98	85	77	87	89	93	88	83
Clients and	All	98	90	77	99	72	98	97	74	73	91	75	91	88	81
Customers	Large	92	92	74	94	83	97	98	100	78	89	76	93	94	80
Professional	All	86	76	83	55	60	80	86	65	70	82	70	66	75	78
Meetings	Large	90	90	91	83	66	92	98	94	84	91	93	73	89	87
Fairs and	All	78	71	83	68	51	76	80	51	62	73	75	79	74	77
Exhibitions	Large	76	64	80	75	51	72	96	55	63	75	72	77	71	73
Suppliers	All	61	77	66	81	72	86	90	78	68	83	83	84	83	72
	Large	56	91	66	88	71	81	92	85	67	95	95	88	97	73
Computer	All	77	71	64	56	55	73	75	45	33	75	48	71	59	61
Networks	Large	79	76	76	79	49	89	94	72	46	90	59	72	81	72
Consultants	All	54	56	66	49	26	65	71	42	36	68	48	63	58	59
	Large	84	86	86	78	54	80	96	78	56	89	93	84	88	80
Universities	All	40	34	51	43	22	58	42	26	22	55	27	54	35	43
& HEIs	Large	56	65	76	69	21	70	37	32	44	71	40	66	59	63
Research	All	30	24	37	33	14	43	37	21	25	51	27	n.a.	46	36
Institutes	Large	37	49	50	62	13	45	28	18	44	62	31	n.a.	57	45
Patents	All	26	15	31	28	11	29	19	3	11	23	9	28	19	25
	Large	23	29	36	41	4	26	18	0	14	29	5	31	22	28

Note: Excludes Utilities. From Eurostat file - C72 - second version

Table 3.2.10: Very Important Sources of Information - All and Large Enterprises (%)

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Within the	All	30	42	59	37	49	48	49	71	42	64	40	56	38	51
Enterprise	Large	29	49	70	27	59	33	35	95	52	48	56	67	39	60
Clients or	All	61	48	28	48	27	43	56	50	12	55	34	57	65	38
Customers	Large	57	48	26	42	31	58	73	41	19	44	32	74	50	33
Competitors	All	18	14	21	28	9	7	21	23	4	20	19	15	20	19
	Large	17	37	25	10	23	15	17	47	6	19	24	27	19	22
Suppliers	All	3	22	16	28	23	10	28	41	10	23	26	22	27	19
	Large	0	20	8	21	19	14	61	37	10	26	16	18	22	13
Fairs and	All	15	9	20	10	5	2	19	19	5	10	26	6	17	17
Exhibitions	Large	2	8	12	2	4	0	2	5	4	3	8	3	3	9
Professional	All	7	14	22	5	8	3	11	20	6	11	19	4	8	15
Meetings	Large	6	8	16	6	8	0	8	27	7	13	7	4	8	12
Consultants	All	1	11	13	10	6	2	14	10	2	9	16	8	10	11
	Large	8	20	28	14	24	3	6	10	5	13	31	2	12	22
Computer	All	11	11	13	12	8	7	20	16	3	14	15	10	9	11
Networks	Large	8	14	9	17	5	11	65	18	3	11	6	12	9	9
Universities	All	1	2	6	0	2	3	6	8	1	5	5	5	4	4
& HEIs	Large	1	8	6	2	3	0	2	0	3	2	6	6	4	5
Research	All	1	3	3	1	2	1	2	4	3	2	3	n.a.	7	3
Institutes	Large	4	8	2	5	1	0	6	0	3	2	5	n.a.	3	2
Patents	All	2	1	1	0	1	0	0	0	1	0	2	0	0	1
	Large	1	2	1	0	1	0	2	0	1	0	0	1	1	1

Note: Excludes Utilities. From Eurostat file - C71 - second version

We have just seen that roughly half the innovating service firms conducted R&D, yet many more than half the firms recognised sources of information 'within the enterprise' as relevant and 'very important' for innovation. Indeed, 91% of the firms recognised sources within the firm to be relevant

sources of information for innovation, and half recognised these to be very important sources of information. Amongst the innovating service enterprises in the seven countries that regarded sources of information within the firm to be very significant it is notable that 34% of these firms did not conduct R&D at all, and a further 28% only conducted R&D on an occasional basis (38% conducted R&D on a continuous basis). This suggests that sources of information within the firms other than R&D were regarded as highly significant for their innovation efforts. Unfortunately, the survey did not disaggregate this category further, so we can only speculate as to the nature of these activities. However, it appears that internal sources of information (and knowledge) are the most important resource for service sector innovations. Much of this may be due to personal experience.

Beyond sources within the enterprise, competitors, customers/clients, professional meetings, fairs and exhibitions and suppliers were all widely recognised as relevant sources of information for innovation – each of these being recognised by 70% or more of the innovating firms. However, with the exception of customers/clients (at 38%), relatively few (i.e., less than 20%) of the firms admitted these were very important sources of information for innovation.

Computer networks and consultants were both recognised as relevant by about 60% of the innovating firms, but as very important by only 11%. Interestingly, large firms are much more likely to recognise consultants as a very important source of information for innovation. Indeed, amongst large firms consultants ranked second equal with competitors amongst the external sources of information in terms of proportion of firms identifying the sources as very important. Consultants appear to be particularly significant as a source of information for innovation amongst large firms in Belgium, Germany, France and Portugal. Notably, computer networks were widely regarded as a very important source of information amongst two thirds of the large service firms in Ireland.

Universities, (government and private) research institutes and especially patents were each recognised as being relevant sources of information for innovation by less than half the firms, and in the case of patents by only a quarter of the firms. Each of these sources was more widely recognised as relevant by large firms, but even amongst these less than 5% declared each of these sources to be very important for information related to innovation – in the case of patents this was 1%.

Most firms admitted that at least one of the external sources of information was very important to their innovation activities (with 7% amongst those in 'the seven countries' admitting three or more). However, 35% of the innovating firms in 'the seven countries' did not identify any of the external sources as very important. Roughly half of these also failed to identify sources within the firm as very important – i.e., these firms failed to identify any source of information as very important.

3.2.6 Resources Committed to Innovation, Innovation Activities and Expenditure Patterns

The amount of money enterprises spent on innovation activities potentially provides a much richer source of information about innovation, and the commitment of enterprises to innovation, than the simple 'yes' / 'no' questions analysed above. The innovating enterprises were asked whether they had engaged in seven innovation related activities in 1996 and if so to estimate the expenditure involved with each activity. In detail, they were asked whether they had engaged in:

Intramural R&D	[Intramural R&D]
The acquisition of R&D services (extramurally)	[Acquired R&D]
The acquisition of machinery and equipment linked to innovations	[Acquired M&E]
Te acquisition of other external technology linked to innovations	[Acquired OET]
Training linked directly to technological innovations	[Training]
Preparations for the introduction of new or improved services	[Preparations]
The market introduction of technological innovations	[Market Introduction]

Table 3.2.11 reports for 'the seven countries' the proportions that stated they were engaged in each of these activities. The table also shows the proportion of enterprises for which there is an estimate of its innovation expenditure in 1996. This ranged from 69% of the German innovating enterprises to all of the Swedish innovating enterprises. Finally, the table also shows the concentration of innovation expenditures amongst the highest spending ten-percent of innovating enterprises for which there was innovation expenditure data. This shows that in all seven of the countries considered the highest spending 10% of the innovating enterprises accounted for over 80% of the total innovation expenditure by all of the enterprises in their countries sample. Innovation expenditures appear to be highly concentrated in a few firms.

Table 3.2.11: Engagement in Innovation Related Activities in 1996 (%)

	D	F	IRL	NOR	P	S	UK	7 Countries
Unadjusted								
Intramural R&D	36%	57%	45%	53%	30%	44%	38%	46%
Acquired R&D	19%	20%	11%	29%	18%	23%	6%	19%
Acquired M&E	47%	51%	61%	51%	63%	54%	59%	53%
Acquired OET	50%	51%	29%	62%	67%	72%	72%	57%
Training	50%	44%	47%	57%	48%	59%	56%	50%
Preparations	37%	24%	22%	34%	26%	39%	29%	30%
Market Introduction	44%	40%	40%	44%	41%	63%	51%	45%
None of The Above	31%	10%	23%	9%	11%	0%	14%	14%
With Expenditure Data	69%	90%	77%	91%	89%	100%	86%	84%
10% Concentration	92%	94%	80%	85%	81%	90%	88%	92%
Adjusted								
Intramural R&D	35%	56%	35%	46%	22%	36%	28%	34%
Acquired R&D	13%	18%	8%	24%	10%	16%	4%	12%
Acquired M&E	51%	50%	55%	53%	51%	50%	55%	52%
Acquired OET	54%	51%	20%	61%	61%	72%	57%	54%
Engaged in Training	51%	43%	39%	51%	34%	59%	41%	48%
Preparations	38%	23%	17%	29%	19%	39%	13%	31%
Market Introduction	40%	40%	35%	35%	25%	62%	45%	41%
None of The Above	31%	9%	27%	11%	23%	0%	20%	26%
With Expenditure Data	69%	91%	73%	89%	77%	100%	80%	73%

Note: Excludes Utilities; France excludes Wholesale. Source: Seven Countries Data

Table 3.2.12: Innovation Expenditures relative to Turnover in 1996 (%)

Unadjusted	D	F	IRL	NOR	P	S	UK	7 Countries
Up to 0.33%	26%	42%	9%	18%	11%	24%	15%	27%
0.33 to 1.5%	21%	35%	17%	23%	28%	23%	30%	28%
1.5% to 7%	25%	14%	35%	33%	37%	32%	32%	25%
7%+	29%	9%	39%	25%	24%	21%	23%	20%

Note: Includes only those enterprises providing expenditure data. Excludes Utilities; France excludes Wholesale

Table 3.2.13: Innovation Expenditures per Employee in 1996 (%)

Unadjusted	D	F	IRL	NOR	P	S	UK	7 Countries
Up to 500 euro	8%	53%	5%	12%	14%	16%	21%	26%
501 to 2,000 euro	24%	25%	26%	25%	34%	21%	23%	25%
2001 to 10,000 euro	43%	13%	34%	34%	39%	37%	37%	30%
Over 10,000 euro	25%	9%	36%	29%	13%	26%	19%	19%

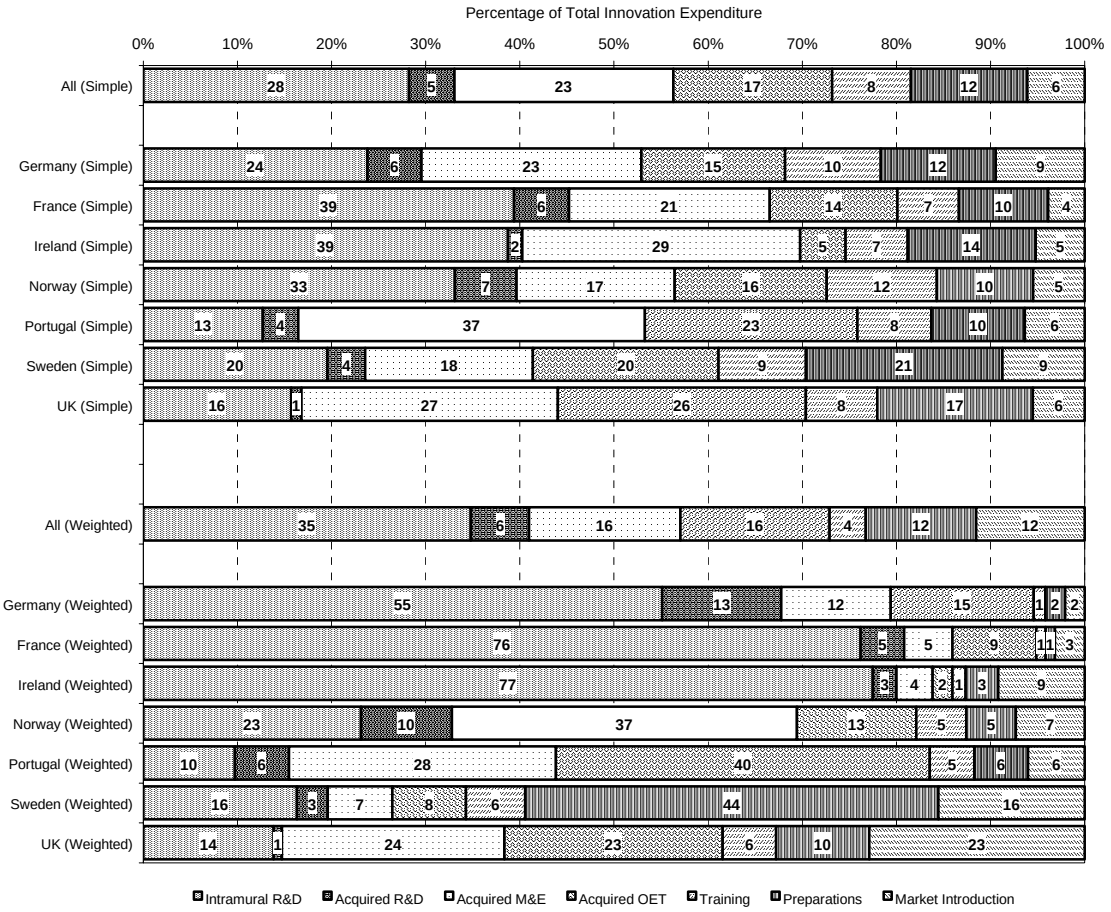
Note: Includes only those enterprises providing expenditure data. Excludes Utilities; France excludes Wholesale

The concentration of innovation expenditures is due partially to the size distribution of enterprises in the response sample – some very large enterprises have very high innovation expenditures. However, as the tables show, there is also tremendous diversity when innovation expenditures are assessed as a proportion of turnover, or on a per employee basis – both of these indicators effectively control for the size of the enterprise. For whilst roughly a quarter of the enterprises that reported innovation expenditures spent less than 0.33% of their turnover on innovation related activities (and a similar proportion spent no more than 500euro per employee) at the other end of the spectrum a fifth of the enterprises providing this data spent over 7% of their turnover on innovation activities (and a similar proportion spent more than 10,000euro per employee). Thus all of the enterprises in the high spending categories spent at least 20 times (on a proportion of

turnover or per employee basis) the amount the low spending enterprises invested in innovation. One difficulty with this data is that because it relates to a single year, we do not know whether the high spending enterprises maintained a consistently high commitment to innovation over many years or whether their commitment was unusually high in 1996.

In most countries the median innovation expenditure per employee was between 2,500 and 4,000euro, but amongst the Irish innovators it was higher, at 5,800euro, whilst amongst the French innovators it was much lower, at only 460euro. Most probably, the difference in the French results reflects a different interpretation of innovation costs – such that innovation related expenditures were interpreted in a stricter fashion than in other countries – we do not know of any other reason why innovation expenditures should be so much lower in France, the differences in the sectoral patterns of response are unlikely to provide a full explanation. Similarly, in most countries the median innovation expenditure as a share of turnover was roughly 2%, but in France it was much lower at 0.4% whilst in Ireland it was higher, at almost 6%.

Figure 3.2.3
The Distribution of Expenditures on Innovation - Simple and Weighted Means



Turning to the categories in which the enterprises incurred these expenditures, we assess these in two ways. Firstly, we provide a simple mean distribution of expenditures – this treats all the firms equally whether they spent a lot or a little on innovation (although firms that spent nothing are excluded). Secondly, we provide the weighted mean distribution which takes into account the amount each firm spent on innovation. According to the simple mean distribution, intramural R&D tends to account for between 15 and 40% of total innovation costs, with acquired R&D accounting for about 5% of costs. Other investments make up the bulk of innovation expenditures. Expenditures on machinery and equipment linked to innovation tends to account for a little over 20% of costs, whilst expenditures on other external technologies account for, on average, a little under 20% of costs. Training directly linked to innovation tends to account for a little under 10% of costs, whilst preparations for the introduction of new services tends to account for a little over 10% of costs.

Finally, the market introduction of innovations accounts for about 5% of costs. We stress that this is just an 'average' picture, and the proportions attributed to each category can vary widely, even between firms of similar size in the same sector. Innovation is, after all, about differences, so we should not be alarmed at this diversity. Having said that, many of the categories do appear open to interpretation as to whether or not particular expenditures were related to (technological) innovations – this scope for interpretation is also likely to have contributed to the variation in the data.

We have already noted that innovation expenditures tend to be highly concentrated in a small proportion of the total sample of firms, so the weighted means effectively show how these high spending firms diverge from the average firms in terms of their innovation expenditure profiles. There appears to be even more 'noise' in these distributions, but it would appear that amongst the high spending firms intramural R&D constitutes a significantly larger share of total innovation costs (particularly in France and Ireland), whilst the importance of investments, particularly in machinery and equipment is reduced. This accords with the Soete and Miozzo's (1989) theory in that many of the high spending enterprises will be 'specialist suppliers' (which undertake their own R&D) whilst most of the low spending enterprises will be 'supplier dominated' (and heavily dependent on the acquisition of technologies developed elsewhere). In Section 3.3 we examine further the behaviour of the enterprises that spent highly on innovation (on a per employee and share of turnover basis) and compare these with other innovators, including those that spent little on innovation.

3.2.7 The Extent of Co-operation for Innovation

Only about a quarter of the innovating service firms engaged in co-operative arrangements to develop innovations. This proportion increased with enterprise size – being 36% amongst the large enterprises, but also varied widely between countries. In Austria and Germany less than one in five firms had co-operative arrangements for innovation, whist half or more of the innovating service enterprises in Belgium, Denmark, Finland, Luxembourg, Norway and Sweden had these arrangements, which seem particularly common on Scandinavia – where two thirds of the large innovating firms commonly had such arrangements.

In most countries, innovating services firms are less likely to have co-operation arrangements for innovation than their manufacturing counterparts. In Belgium, Denmark, Luxembourg and Norway service firms appear more likely to have these arrangements, whilst there is little overall difference in the Netherlands and the UK in the proportion of manufacturing and service firms with these arrangements.

Table 3.2.14: Co-operative Arrangements for Innovation - All and Large Enterprises

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Any Co-Operations	All	18	50	17	71	38	69	23	53	31	63	27	52	33	26
	Large	37	63	22	79	34	64	79	54	56	84	42	76	58	36
Manufacturing (Any Co-op)	All	23	34	26	59	39	82	36	34	29	51	20	63	33	28
	Large	42	70	37	77	63	98	84	43	61	83	35	89	55	51
Within the Group*	All	88	69	74	65	52	84	47	71	69	73	83	75	51	67
	Large	85	67	79	71	53	87	11	50	63	56	64	81	32	56
With Competitors#	All	15	29	39	30	14	27	14	22	29	18	15	16	78	40
	Large	35	15	58	37	20	32	10	58	36	30	11	15	48	42
With Customers#	All	31	43	13	49	37	64	67	20	44	44	52	53	38	33
	Large	60	23	18	62	28	65	85	17	46	50	37	38	36	34
With Consultants#	All	15	16	25	28	20	44	25	19	13	35	32	57	43	30
	Large	37	44	47	52	56	80	18	38	20	57	67	63	68	51
With Suppliers#	All	30	60	31	79	55	58	49	42	45	68	70	59	18	39
	Large	35	59	33	68	50	80	87	31	49	74	46	68	22	42
With Universities#	All	32	34	43	16	17	31	16	7	20	21	25	23	11	26
	Large	35	46	48	42	15	43	2	0	28	30	42	33	16	32
With Res'ch Institutes#	All	14	14	18	13	20	23	11	1	16	24	17	12	80	31
	Large	25	21	37	31	18	32	2	0	24	25	47	23	93	43

Note: * Relative to innovating enterprises with co-operation agreements and belonging to a group; # relative to innovating enterprises with co-operation agreements; Excludes Utilities. From Eurostat files – C81 and C82 - second version)

Of the enterprises that have co-operation arrangements and which are part of a wider enterprise group, two thirds have arrangements with other enterprises within their group. This proportion is higher still in Austria, Germany, Finland, Portugal and Sweden. This suggests there are

network relations within company groups with respect to innovation – perhaps with companies having a centralised department that initiates innovations, whilst in others groups individual enterprises may be encouraged to co-operate when faced with similar problems. Unfortunately, the survey did not enquire further into the nature of these arrangements. Notably, however, the proportion of large group owned enterprises that had co-operation arrangements with other enterprises in their group tended to be lower, suggesting that large group enterprises are less dependent on the group resources or joint problem solving than smaller group enterprises.

Of all the enterprises with co-operative arrangements, 40% had co-operative arrangements with their competitors, and a similar proportion had these arrangements with their suppliers. Meanwhile one third had these arrangements with their customers, 30% had arrangements with consultants and 31% had arrangements with research institutes. Universities were the least common partner, with 26% of the firms with cooperative arrangements for innovation having arrangements with universities. Notably, large enterprises were more likely to have each of these relationships, although the differences were only substantial in the cases of co-operations with consultants and with research institutes.

The low engagement with universities and research institutes is notable. Perhaps because the innovation activities of service companies tend not to be research intensive, but instead depend on development and the customer-oriented implementation of new ideas, most service firms have little need for contact with research institutions and universities. There are of course exceptions. The technology-intensive service providers are not only partners in innovation, but also have the potential to make valuable contributions to the diffusion of new know-how and technologies – and not only within the service sector.

3.2.8 The Extent and Nature of Difficulties Experienced with Innovation

Over a third of the innovating service firms claimed one or more of their innovation projects had been seriously delayed, whilst a quarter claimed projects had not even been started due to difficulties, and 15% claimed innovation projects had been abolished due to difficulties.

Table 3.2.15: Enterprises Experiencing Difficulties with Innovation - All and Large Enterprises

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Seriously	All	32	35	43	43	51	45	13	20	34	34	27	37	24	37
Delayed	Large	37	40	55	60	37	67	14	42	45	41	30	57	44	49
Project(s)	All	8	14	18	29	24	9	5	18	20	13	3	15	5	15
Abolished	Large	3	22	21	31	18	24	0	27	33	23	12	23	14	20
Project not	All	10	19	35	27	20	10	7	13	18	21	5	25	12	25
Even Started	Large	9	11	34	26	13	10	55	36	24	23	12	36	13	27

Note: Excludes Utilities. From Eurostat files – C91

An interesting feature of these distributions is that the proportions for large enterprises in each of these classifications is greater than that for all (and thus smaller) enterprises. This may well be because large firms tend to innovate more, and are therefore more likely to have projects that run into difficulties. However, we might also have expected that large enterprises tend to be more experienced innovators, and to have more resources for innovation than small enterprises, thus reducing the likelihood that their innovation projects would run into difficulties.

Of the various factors the most widely cited as hampering innovation efforts were a lack of sources of finance, organisational rigidities, the excessive economic risk of innovation and a lack of qualified personnel. These factors were identified by between 20 and 25% of the innovating enterprises as hampering their innovation efforts. In contrast, the firms tended to complain less that a lack of customer responsiveness to innovation, or a lack of either market or technical information had hampered their innovation efforts. These factors were identified by between 10 and 15% of the innovating enterprises as having hampered their innovation efforts.

3.3 Innovation and Performance: High and Low Innovation Intensity Enterprises

This section concerns the intensity of innovation activities, and is particularly concerned with comparing the innovation related activities of the high innovation intensity enterprises against other innovators, including low innovation intensity enterprises. In this section we only examine the results for 'the seven countries' that we had direct access to the data for. We also examine only unadjusted data, as this analysis should be considered more experimental than those in the other sections. We define innovation intensity by the innovation effort (measured in terms of innovation expenditures in 1996) relative to the size of the enterprise. We consider the size of the enterprise in two ways – in terms of total employment and in terms of sales turnover. Thus, for this analysis:

- **High Innovation Intensity Enterprises** are defined as those enterprises that spent over 10,000euro per employee and over 1.5% of their turnover on innovation related activities in 1996, OR enterprises that spent over 2,000euro per employee and over 7% of their turnover on innovation related activities in 1996. 614 enterprises in 'the seven countries' were classified as high innovation intensity enterprises, and of these more than half spent both over 7% of their turnover and over 10,000euro per employee on innovation related activities.

- **Low Innovation Intensity Enterprises** are defined as those enterprises that spent no more than 500euro per employee and no more than 1.5% of their turnover on innovation related activities in 1996, OR enterprises that spent no more than 0.333% of their turnover on innovation activities in 1996 and less than 2,000euro per employee on these activities. 800 enterprises in 'the seven countries' were so classified, 61.5% (482) of which spent both no more than 500euro per employee on innovation and no more than 0.333% of turnover on these activities. Note that the low innovation intensity enterprise classification does not include those innovating enterprises that did not provide innovation expenditure data for 1996– these are separately classified (**No IE Data**). **Non-innovators** are also separately classified

- **Mid Innovation Intensity Enterprises** are defined as the remaining enterprises that had innovation activities and provided data on their innovation expenditures in 1996 but which do not qualify as either high or low innovation intensity enterprises. Amongst the unadjusted response from 'the seven countries' there were 1,173 such enterprises.

Table 3.3.1: The Distribution of Enterprises by Innovation Intensity (%)

Unadjusted	D	F	IRL	NOR	P	S	UK	7 Countries
All Enterprises								
Non-Innovators	37%	63%	55%	63%	72%	58%	33%	57%
No IE Data	20%	6%	10%	4%	3%	0%	8%	7%
Low Intensity	7%	17%	3%	6%	4%	10%	15%	11%
Mid Intensity	23%	11%	15%	17%	14%	20%	27%	16%
High Intensity	13%	3%	17%	10%	7%	12%	16%	8%
Innovators Only								
No IE Data	32%	16%	23%	10%	11%	1%	15%	17%
Low Intensity	11%	46%	6%	17%	14%	23%	20%	25%
Mid Intensity	36%	29%	34%	45%	51%	48%	40%	38%
High Intensity	21%	9%	37%	28%	24%	28%	25%	20%

Note: Source Seven Countries data, as with all tables in this sub-section; IE – Innovation Expenditure

Amongst the innovators 20% were classified as high innovation intensity enterprises, whilst a quarter were classified as low innovation intensity enterprises, 17% did not provide innovation expenditure data and 38% were classified as mid innovation intensity enterprises. With the adjusted data, these proportions were 26.5%, 12.5%, 27% and 34% respectively. The unadjusted proportions varied between countries – France had fewer high intensity innovators (9%) and more low innovation intensity enterprises (46%), whilst Ireland had a higher than average proportion of high intensity innovators (37%) and fewer low innovation intensity enterprises (6%). The most likely explanation for these differences is differences in what constituted expenditures related to innovation – French enterprises tending to apply a strict definition, the Irish a more liberal one. A substantial proportion

(31%) of the German innovators failed to provide innovation expenditure data, whereas almost all the innovating Swedish enterprises provided this data. The irregularity in the French data is the most serious, as the French data provides roughly one third of all the cases in the analysis. We therefore undertook the analysis that follows twice: once including and once excluding the French data.

3.3.1 Innovation Intensity and the Creation of Employment

Innovation, particularly product or service innovation, is generally associated with growth and, at the firm level, increases in turnover and employment. From a policymaking perspective, the link between innovation and employment creation is particularly significant. Assessing the relationship between innovation intensity and employment change, this shows that the high intensity innovators were more likely to have increased their employment between 1994 and 1996 than the non-innovators and the low and medium intensity innovators. Over half of the high intensity innovators had increased their employment by 3% (and by at least 3 employees) between 1994 and 1996, with almost 30% increasing their employment by 10% (and by at least 10 employees). This compares with 35% and 15% respectively for the non-innovators, and 47% and 25% for the low intensity innovators. This appears to confirm the expected relationship between innovation and employment creation. However, two significant caveats should be noted; firstly, some non-innovators achieved significant growth despite not innovating in the 1994 – 1996 period. It may of course be that these enterprises innovated in the period just prior to the period assessed by the survey. Secondly, some innovating enterprises, including some high intensity innovators, have reduced their employment, some substantially. This may be due to the introduction of labour saving process innovations, or the innovation itself may have been spurred by a crisis in the enterprise – nevertheless the point is clear – the direct relationship between innovation and employment creation is not straightforward. Unfortunately, the nature of the CIS-2 makes it difficult to unpack this relationship further, as particular innovations and their consequences were not asked about.

Table 3.3.2: Innovation Intensity and Employment Change (%)

Column %	Non Innovator	No Innov. Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Unadjusted					
Employment Declined (3%+*)	16 [14]	22 [23]	23 [25]	21 [20]	15 [15]
Little Employment Change	49 [53]	37 [37]	31 [36]	33 [33]	32 [34]
Employment Increased (3%+*)	20 [19]	23 [22]	22 [20]	21 [21]	24 [23]
Employment Increased (10%+#)	15 [14]	17 [18]	25 [19]	25 [25]	29 [28]
Adjusted					
Employment Declined (3%+*)	15 [15]	27 [27]	18 [18]	19 [20]	9 [9]
Little Employment Change	56 [57]	46 [46]	49 [51]	44 [44]	52 [53]
Employment Increased (3%+*)	22 [22]	21 [21]	16 [15]	21 [21]	25 [26]
Employment Increased (10%+#)	7 [6]	6 [6]	16 [15]	16 [16]	13 [13]

Note: Figures in square brackets exclude France; France excludes Wholesale; * & by 3+ employees # & by 10+ employees

Table 3.3.3: The Concentration of Innovation Expenditures and Employment (%)

Unadjusted	D	F	IRL	NOR	P	S	UK	7 Countries
High Intensity								
% of Enterprises*	31%	10%	48%	32%	27%	28%	29%	24% [31%]
% of All Innovation Expenditure*	23%	31%	74%	86%	24%	91%	84%	59% [63%]
% of All Employment*	10%	2%	23%	32%	4%	33%	41%	16% [25%]
Low Intensity								
% of Enterprises*	17%	55%	8%	18%	16%	24%	23%	31% [19%]
% of All Innovation Expenditure*	1.5%	3.4%	0.5%	0.5%	2.3%	0.5%	0.7%	1.2% [0.9%]
% of All Employment*	15%	39%	23%	17%	31%	22%	22%	27% [20%]

Note: * only amongst those supplying innovation expenditure data. Figures in square brackets exclude the French cases

3.3.2 The Concentration of Innovation Expenditures and Sources of Innovation

We noted earlier that innovation expenditures tend to be highly concentrated in a few firms. The measure of innovation intensity we use here effectively controls for enterprise size, but, by definition, the high intensity innovators are responsible for a greater proportion of the total expenditure on innovation than their size alone would suggest.

Overall, the high intensity innovators, which constitute just 24% of the enterprises providing innovation expenditure data were responsible for 59% of the total spending on innovation recorded by the respondents in 1996. By way of comparison, these enterprises were responsible for only 16% of the total employment amongst the respondents. In Ireland, Norway, Sweden and the UK the high intensity innovators are responsible for three-quarters or more of all innovation expenditures reported for 1996, whereas in Germany, France and Portugal these enterprises accounted for a much lower share of total innovation expenditure (between a quarter and 30%). In contrast to the high intensity innovators, the low intensity innovators, although constituting 31% of the respondents providing innovation expenditure data and accounting for 27% of total employment, were responsible for only 1.2% of total innovation expenditure. This illustrates the high degree of variation in the extent to which enterprises committed resources to innovation related activities.

Unfortunately, only innovation expenditures for one year, 1996, were asked about. It is possible that innovation expenditures may be quite lumpy, especially if the expenditures are on acquired machinery, equipment or other externally acquired technologies, rather than on on-going activities such as R&D. Because of this it is quite possible for an enterprise to be a high intensity innovator in one year, and a low intensity innovator in the next (or vice versa). If follows from this that relating a firm's innovation intensity in any one year to its commercial performance, or employment growth, is problematic.

Concerning the sources of innovation, whilst only half of the low and mid innovation intensity enterprises declared that they themselves had been mainly responsible for developing the innovations they introduced, 70% of the high intensity innovators declared they themselves had primarily developed the innovations they introduced. By contrast, only 9% of the high intensity innovators declared their innovations had been mainly developed by others. This compares with 15% of the mid-intensity innovators and 20% of the low intensity innovators. The proportion of jointly developed innovations was also considerably smaller amongst the high intensity innovators.

Table 3.3.3: Sources of Innovation and Innovation Intensity (%)

Unadjusted	No Innovation Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Mainly by Others	22 [20]	21 [22]	14 [16]	9 [9]
Jointly with Others	37 [34]	43 [34]	43 [39]	30 [27]
Mainly in-House	52 [50]	50 [49]	53 [51]	71 [70]

Note: Some countries permitted multiple sources; Figures in square brackets are distributions excluding France

3.3.3 Innovation Intensity by Sector and Enterprises Size

Neither the high nor the low innovation intensity enterprises are exclusively in any particular sector, or in particular enterprise size classes. High and low innovation intensity enterprises exist in all of the sectors examined in this report, and they are present in all of the enterprise size categories. However, high intensity innovators are more common amongst the technologically orientated sectors or computer services and telecommunications. In those sectors 30% or more of the enterprises from 'the seven countries' were classified as high innovation intensity enterprises. Yet these sectors also contain some low innovation intensity enterprises. The 'utilities', wholesalers and transport services sectors all have lower proportions of high innovation intensity enterprises, and larger proportions of low innovation intensity enterprises. Financial services and technical services have more average distributions across the categorisation. The important point here is that although the proportion of enterprises by innovation intensity varies across the sectors, all sectors have some enterprises in each of the classifications. This shows there is tremendous variation in the innovation behaviour of firms operating in the same broad sector of activity.

Table 3.3.4: Sector and Size by Innovation Intensity (%)

Unadjusted (Row Percentages)	No Innovation Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
All Innovating Enterprises	17 [17]	26 [11]	38 [42]	20 [25]
Utilities	20 [21]	33 [35]	36 [33]	10 [11]
Wholesale Services	18 [18]	28 [28]	40 [40]	14 [14]
Transport Services	23 [21]	40 [23]	23 [33]	14 [24]
Telecommunications	8 [10]	14 [4]	47 [48]	30 [38]
Financial Services	26 [21]	10 [11]	46 [50]	18 [19]
Computer Services	8 [10]	22 [3]	38 [33]	32 [54]
Technical Services	11 [14]	31 [9]	40 [51]	18 [27]
Small (10 – 49 employees)	17 [18]	22 [11]	38 [41]	23 [30]
Medium (50 – 249 employees)	16 [17]	31 [18]	34 [44]	18 [23]
Large (250+ employees)	17 [17]	25 [19]	41 [42]	17 [20]

Note: Source the Seven Countries data; Figures in square brackets are distributions excluding France

The same is true of enterprise size. Although small enterprises are more likely to be classified as having a high innovation intensity (perhaps because innovation expenditures in small firms can be more 'lumpy', whereas that in larger firms tends to be more constant over time), medium sized and large enterprises can also be high intensity innovators. Just as enterprises of all sizes can be low intensity innovators.

3.3.4 The Aims or Objectives of Innovation

The aims or objectives of innovation do not appear to differ greatly across the innovation-intensity categories. Generally, slightly fewer of the enterprises that did not provide innovation expenditure data recognised objectives as relevant or very important than the low intensity innovators, whilst these in turn were less likely to recognise them as relevant or very important than the mid or high innovation intensity innovators. But the ranking of the aims was generally consistent across the categorises. This suggests that rather than having different aims for their innovation activities, the higher innovation intensity enterprises tended to have more aims for their innovation activities. However, a great deal of variation existed in all of the categories in terms of the number of objectives identified as relevant and very important.

Table 3.3.5: The Relevant and Very Important Aims of Innovation (%)

Unadjusted (Row Percentages)		No Innovation Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Improve Quality	Relevant	84 [91]	91 [95]	95 [97]	94 [95]
	V Important	65 [72]	68 [73]	74 [77]	73 [74]
Open New Markets	Relevant	77 [84]	84 [87]	91 [92]	93 [94]
	V Important	42 [45]	52 [49]	56 [53]	64 [63]
Extend Range	Relevant	76 [81]	83 [84]	90 [91]	91 [92]
	V Important	41 [44]	48 [43]	53 [51]	54 [54]
Improve Flexibility	Relevant	73 [81]	73 [86]	81 [85]	82 [84]
	V Important	35 [41]	25 [35]	33 [37]	32 [33]
Reduce Labour Costs	Relevant	72 [81]	66 [84]	76 [83]	79 [82]
	V Important	32 [38]	24 [40]	29 [35]	32 [35]
Fulfil Standards or Regulations	Relevant	66 [71]	66 [76]	73 [77]	77 [78]
	V Important	21 [19]	23 [26]	20 [21]	21 [21]
Replace Old Services	Relevant	58 [62]	59 [61]	67 [68]	71 [71]
	V Important	18 [16]	19 [20]	24 [24]	27 [27]
Reduce Environmental Damage	Relevant	44 [54]	45 [64]	46 [52]	50 [54]
	V Important	14 [17]	15 [23]	15 [17]	16 [18]
Reduce Materials Costs	Relevant	51 [55]	43 [62]	43 [48]	48 [52]
	V Important	16 [17]	11 [19]	10 [12]	13 [14]
Reduce Energy Costs	Relevant	50 [54]	39 [58]	45 [52]	52 [55]
	V Important	15 [15]	13 [18]	9 [12]	11 [14]

Note: Figures in square brackets are distributions excluding France; France excludes Wholesale

3.3.5 The Extent and Role of Research and Development (R&D)

Roughly half the high intensity innovators carried out R&D on a continuous basis between 1994 and 1996, with a further quarter carrying out R&D on an occasional basis. These are high proportions, which are closer to those associated with manufacturing rather than with services. The proportion of service enterprises engaged in R&D clearly increases with innovation intensity. Very few of the enterprises that did not provide innovation expenditure data are recorded as conducting R&D, and only a fifth of the low intensity innovators carried out R&D on a continuous basis, with a further third conducting R&D on an occasional basis. If data were available for a number of years rather than just one, and those firms that consistently spent highly on innovation were thereby identifiable, this pattern is likely to be even clearer.

Table 3.3.6: The Conduct of R&D and Innovation Intensity (%)

Unadjusted (Column Percentages)	No Innovation Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Continuously	5 [2]	20 [14]	33 [26]	53 [49]
Occasionally	10 [5]	37 [28]	30 [30]	24 [26]
Not at all	85 [93]	43 [58]	37 [44]	23 [25]

Note: Source the Seven Countries data; Figures in square brackets are distributions excluding France

3.3.6 The Sources of Information for Innovation

The greater significance of R&D in the high innovation intensity enterprises suggests a high significance of information sources internal to the firms for innovation. The analysis of information sources confirms this – with 96% of these enterprises indicating sources within the enterprises were relevant and 60% declaring these to be very important. Yet the high intensity innovators were also more likely to identify most of the external source of information as both relevant and very important than their lower intensity counterparts. Amongst these it is interesting that half the high intensity innovators identified customers as a very important source of information for innovation, compared with 30% of the low intensity innovators. Computer networks, professional meetings and fairs and exhibitions were also all more widely regarded as very important sources of information for innovation amongst the high innovation intensity innovators, yet patents remained unimportant to the vast majority of service enterprises, including the high intensity innovators.

The median low intensity innovator identified five sources of information as relevant, compared with 6 for the mid intensity innovators, and 7 for the high intensity innovators. Furthermore, only 27% of the low intensity innovators identified two or more sources as very important, compared with 36% of the mid-intensity innovators and 44% of the high intensity innovators. However, as with the aims or objectives of innovation, a difficulty arises in interpreting these patterns, as it is not clear whether the higher intensity innovators were more likely to identify the different sources of information because they have developed more innovations, or whether their pattern of citation is different because the nature of their innovation activities is different (e.g., more radical).

Table 3.3.7: Innovation Intensity & Relevant Sources of Information for Innovation (%)

Unadjusted	No Innovation Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Within the Enterprises	79 [87]	85 [90]	93 [94]	96 [97]
Other Enterprises in Group	34 [35]	36 [47]	44 [49]	48 [50]
Competitors	68 [77]	62 [83]	76 [82]	83 [85]
Customers	66 [73]	70 [81]	81 [83]	89 [89]
Consultants	55 [65]	41 [64]	64 [75]	66 [71]
Suppliers	66 [69]	79 [82]	80 [80]	80 [81]
Universities	37 [46]	34 [50]	47 [54]	58 [61]
Research Institutes	30 [39]	27 [49]	35 [43]	47 [49]
Patents	16 [20]	15 [24]	21 [23]	29 [30]
Professional Meetings	66 [75]	66 [78]	79 [84]	84 [85]
Computer Networks	52 [58]	59 [61]	71 [73]	76 [77]
Exhibitions / Fairs	58 [68]	61 [73]	70 [74]	80 [82]

Note: Figures in square brackets are distributions excluding France; France excludes Wholesale

Table 3.3.8: Innovation Intensity & Very Important Sources of Information for Innovation (%)

Unadjusted	No Innovation Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Within the Enterprises	45 [50]	48 [50]	53 [53]	60 [58]
Other Enterprises in Group	16 [18]	14 [19]	17 [20]	19 [18]
Competitors	19 [23]	12 [20]	17 [21]	17 [18]
Customers	30 [34]	29 [41]	40 [43]	51 [51]
Consultants	13 [15]	7 [11]	12 [14]	8 [8]
Suppliers	17 [17]	25 [18]	22 [21]	19 [21]
Universities	3 [3]	3 [3]	5 [5]	9 [9]
Research Institutes	3 [3]	4 [8]	3 [4]	5 [4]
Patents	1 [0]	1 [0]	1 [1]	2 [2]
Professional Meetings	12 [15]	9 [9]	13 [14]	16 [16]
Computer Networks	9 [10]	9 [9]	12 [12]	19 [20]
Exhibitions / Fairs	9 [11]	6 [7]	8 [8]	13 [13]

Note: Figures in square brackets are distributions excluding France; France excludes Wholesale

3.3.7 Engagement in Innovation Related Activities and the Distribution of Expenditures

About 70% of the high intensity innovators declared they conducted intra-mural R&D in 1996, a significantly higher proportion than those for the low and mid-intensity innovators. The high intensity innovators were also more likely to have engaged in all of the other innovation related activities except acquiring other external technologies, which was most frequent amongst the mid-intensity innovators. The differences in proportions between the high and mid innovation intensity innovators were also small with respect to expenditures on acquiring machinery and equipment for innovation, undertaking training for innovation and undertaking preparations for innovation. Generally, the low intensity innovators were significantly less likely to conduct each of these activities.

Table 3.3.9: Innovation Intensity and Engagement in Innovation Related Activities in 1996 (%)

Unadjusted (Column Percentages)	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Intramural R&D	41 [26]	53 [45]	71 [68]
Acquired R&D	16 [17]	25 [23]	29 [29]
Acquired Machinery & Equipment	47 [45]	65 [65]	72 [73]
Acquired Other External Technologies	54 [56]	70 [74]	68 [70]
Training	45 [49]	63 [65]	65 [67]
Preparations	40 [43]	55 [56]	56 [58]
Market Introduction	21 [25]	36 [37]	47 [49]

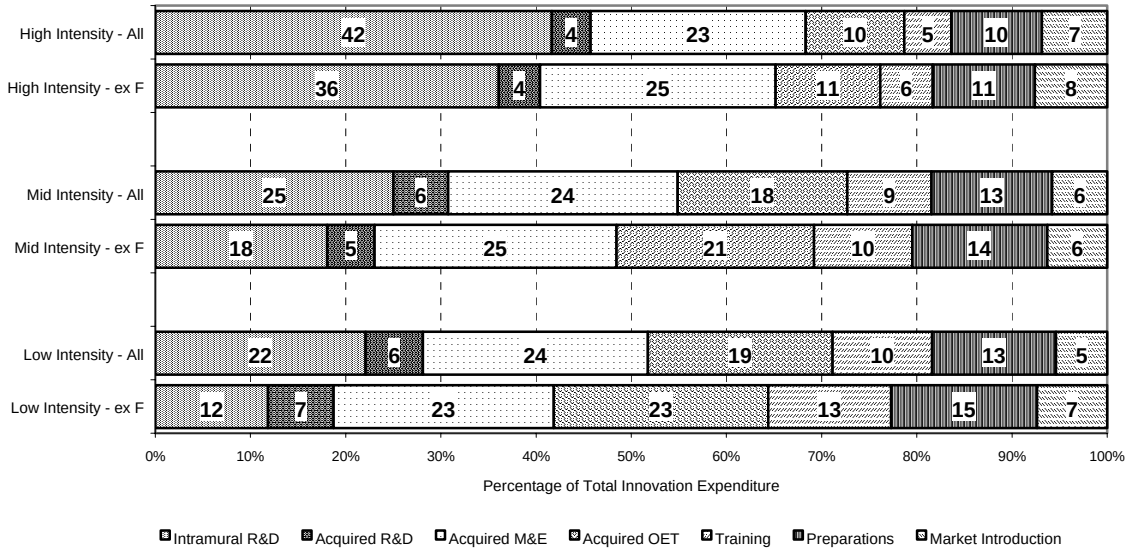
Note: Figures in square brackets are distributions excluding France; France excludes Wholesale

Assessing the simple mean distributions of innovation costs across these expenditure categories, the following patterns were found. Intramural R&D accounts for the largest single proportion of innovation costs amongst the high intensity innovators, at 42% of costs including the French cases and 36% excluding the French cases. Intra-mural R&D accounts for no more than half this proportion amongst the low intensity innovators – at 22% including the French cases and just 12% without the French cases. Acquired R&D generally accounts for only a small proportion of total innovation costs – at about 5% in all categories. The acquisition of machinery and equipment related to innovation generally accounts for about a quarter of total innovation costs in all categories. Thus this expenditure component is the largest amongst the low intensity innovators, whilst it is second to intra-mural R&D amongst the high intensity innovators. As a proportion of total innovation costs, the low intensity innovators tend to spend more on both other external technologies and training related to innovation than the high intensity innovators. The high intensity innovators also spend a smaller proportion of their total innovation costs on preparations, whilst all the categories spend, on average, similar proportions on the market introduction of their innovations.

We should note two significant caveats. The first is that even where their proportional expenditures on innovation activities are much less than half those of the low intensity innovators, the high intensity innovators still tend to spend much more on each item than their low intensity counterparts because their total expenditures are so much larger. The second caveat is that these

are average distributions – at the micro level there is tremendous variation in the distribution of innovation costs across these categories.

Figure 3.3.1
The Distribution of Expenditures on Innovation by Innovation Intensity
(Simple Means)



3.3.8 The Extent of Co-operation for Innovation

A larger proportion of the high intensity innovators engaged in co-operative arrangements for innovation than the lower innovation intensity enterprises, especially when co-operations with other enterprises within the enterprise group are excluded. Thus almost half the high intensity innovators had one or more co-operative arrangements for innovation with an external partner, compared with a third of the low intensity innovators (and 15% of those that did not provide expenditure data).

Amongst the low intensity innovators suppliers were the most widely engaged partner for innovation, being engaged by 20% of the enterprises. Suppliers were also the most widely engaged partners amongst the high intensity innovators (at 27%), but these were closely followed by customers (at 25%), and twice as many high intensity innovators had these arrangements with their customers as did the low intensity innovators. Similarly, twice as many high intensity innovators than low intensity innovators had co-operative arrangements for innovation with their competitors and with consultants, and these firms were also more likely to have these arrangements with universities and research institutes. However, it is notable that in general the proportion of enterprises having co-operative arrangements for innovation with any particular type of partner was small – at a quarter of less.

Table 3.3.10: Innovation Intensity and Engagement in Co-operations for Innovation (%)

Unadjusted (Column Percentages)	No Innovation Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Co-operation – Any	21 [19]	38 [38]	44 [42]	49 [49]
External – Any	15 [13]	34 [35]	40 [38]	47 [46]
Competitors	5 [4]	9 [14]	12 [13]	18 [18]
Customers	6 [3]	13 [13]	16 [16]	25 [23]
Consultants	7 [7]	10 [17]	18 [21]	21 [23]
Suppliers	8 [5]	21 [19]	23 [21]	27 [27]
Universities / HEIs	3 [3]	10 [10]	11 [10]	18 [16]
Research Institutes	3 [3]	12 [15]	13 [15]	18 [16]

Note: Figures in square brackets are distributions excluding France; France excludes Wholesale

3.3.9 The Extent and Nature of Difficulties Experienced with Innovation

Over half the innovators had experienced difficulties with innovation, and the high innovation intensity enterprises were not, in general, more likely to have encountered difficulties with innovation than their less innovation intensive counterparts. However, this is particularly the case with the French data included; with the French data omitted the high intensity innovators were more likely to complain of encountering difficulties with innovation. This show that amongst the French responses the proportion of enterprises experiencing difficulties with innovation tended to decline with increasing innovation intensity. Particularly amongst the low and mid-intensity innovators more of the French enterprises complained of encountering difficulties than did their counterparts in other countries.

Of the particular factors hampering innovation, the most frequently cited amongst the high intensity innovators was a lack of skilled labour (29%), followed by organizational rigidities, the cost of finance for innovation, and the high perceived economic risk of innovation. These were also the more widely recognised factors hampering innovation amongst the low and mid-intensity innovators, although the direct cost of innovation was the most widely cited hampering factors amongst the low innovation intensity enterprises. A lack of market information was the least widely recognised factor hampering innovation in all the categories (except amongst the enterprises which did not provide expenditure data).

Table 3.3.11: Innovation Intensity and the Factors Hampering Innovation (%)

Unadjusted (Column Percentages)	No Innovation Expenditure Data	Low Intensity Innovators	Mid Intensity Innovators	High Intensity Innovators
Experience any difficulties	47 [43]	55 [38]	55 [49]	58 [56]
Perceived Economic Risk	20 [17]	24 [13]	22 [19]	23 [21]
Cost of Finance	17 [15]	19 [13]	18 [15]	23 [22]
Organizational Rigidities	21 [21]	17 [20]	22 [24]	23 [25]
Lack of Skilled Labour	18 [18]	19 [19]	26 [25]	29 [29]
Lack of Technical Information	9 [7]	12 [7]	10 [7]	13 [12]
Lack of Market Information	10 [8]	8 [4]	8 [6]	9 [9]
Direct Cost of Innovation	11 [4]	24 [8]	20 [15]	17 [14]
Regulations / Standards	15 [14]	11 [8]	10 [8]	13 [12]
Lack of Customer Response	17 [13]	17 [9]	14 [10]	14 [12]

Note: Figures in square brackets are distributions excluding France; France excludes Wholesale

3.3.10 Concluding Comments

This section has presented a somewhat experimental analysis in which we have divided the firms according to their innovation intensity. Some notable findings have arisen. These include:

- There is some evidence that the firms that committed more resources to innovation for their size were more likely to create employment than the less intense innovators. However, this is an association, and the pattern in the data should not be over-interpreted. Some high intensity innovators also reduced their employment, whilst some non-innovators expanded.

- High intensity innovators are more common in the technology-based sectors such as computer services, however high and low intensity innovators exist in all sectors. This illustrates the tremendous heterogeneity amongst enterprises within the same broad sectors.

- The high intensity innovators are more likely to conduct R&D; they are also more likely to buy-in R&D services, to collaborate, and to use different sources of information for innovation. This suggests a very wide sourcing of knowledge for innovation amongst these firms.

- Finally, and importantly from a policy making perspective, the most frequent barrier to innovation amongst the high intensity innovators is a lack of qualified personnel.

These are notable findings, which should be researched further. A caveat on the current analysis is that it is based on innovation expenditures in a single year – it is possible for an enterprise to be a very high spender (relative to size) in one year, and spend little or nothing in the next.

3.4 Innovation Behaviour by the Source of the Innovations

This section provides a supplementary analysis of innovation activities within European services enterprises. Its purpose is to examine **innovation performance** in a different way to that provided on the basis of innovation expenditures in Section 3.3. This analysis is based on the information concerning the sources of the innovations introduced by the innovating enterprises. The enterprises were asked whether their innovations had 'mainly been developed by other enterprises or organisations', whether their innovations were 'developed jointly with other enterprises or organisations' or whether their innovations 'had been developed mainly in-house', by the innovating enterprise itself. As a shorthand, we refer to these sources as '**external**' (and thus to those innovators as '**external innovators**', **'joint**' (and thus '**joint innovators**') and '**internal**' (and thus '**internal innovators**')

Arguably, these different sources of innovation reflect very different innovative behaviours – in particular it is questionable whether the 'external innovators' (i.e., the enterprises that introduced innovations 'mainly developed by others') are technological innovators (although they may be organisational innovators), as opposed to adopters of new technologies. Arguably, the question whether or not they are innovators turns on the nature of the technologies introduced – if they were standardised technologies they are technology adopters rather than innovators; if they are bespoke or customised they may be innovators. Unfortunately, however, we have no direct information concerning the nature of the technologies introduced in term of whether they were standard, customised, or bespoke.

The division between those that developed innovations 'jointly with others' and those that introduced innovations 'mainly developed in-house' also suggests a difference in the nature of innovation; with, other things being equal, the joint innovations being more ambitious (or at least involving a greater exchange of information and knowledge between organisations) than those that developed their innovations internally. Of course, this depends on the nature of the enterprises – large enterprises with many capabilities may be able to undertake an innovation internally that a smaller enterprises with fewer capabilities would have been able to develop without assistance from others. However, particularly in the service sectors, where innovation is thought to depend on a high level of interaction between service providers and service users, this categorisation provides an interesting dimension for analysis, which this section seeks to provide. Significantly, however, what follows should be regarded as an experimental analysis (as was Section 3.3); for this reason the analysis has been conducted using the unadjusted (i.e., unweighted) rather than the adjusted (i.e, weighted) data.

This section is organised as follows. 3.4.1 outlines the categorisation of enterprises employed in the analysis. 3.4.2 then examines the product / process orientation of innovation amongst these different types of enterprise, and the different distributions of their innovation expenditures. 3.4.3 then examines the extent to which the enterprises drew on internal capabilities and information sources for innovation, including R&D. 3.4.4 assesses the significance of suppliers and customers for innovation, both as a source of information and as partners in collaborative innovation projects, and the significance for innovation of other external sources of information (such as consultants, universities and research institutes). 3.4.5 concludes the analysis by examining the extent to which the innovators were hampered in their innovation activities. This section is particularly concerned with the extent to which internal factors and customer relations hampered the enterprises' innovation activities. Finally, 3.4.6 draws some conclusions from the analysis.

3.4.1 The Categorization of the Enterprises for this Analysis

For the analysis that follows, we divided the enterprises responding to the CIS-2 for services by the source of their innovations (i.e., 'external', 'joint' or 'internal') and by the type of sector in which the enterprises were active. The enterprises were categories into three broad 'sectors'. The first is composed of the computer and technical service enterprises. These sectors are considered to be '**technology providing sectors**'. Although this does not mean that all of the enterprises in these activities were engaged in the provision of new technologies (some will be primarily users rather than producers of technology), as a whole one of the core features of these sectors is that they create new (and manipulate existing) technological knowledge. By contrast, the wholesale, transport and

financial service sectors are primarily users rather than providers of technologies. Yet there is also a significant distinction amongst these. The wholesale and transport service sectors are concerned primarily with the movement, storage and transaction of physical goods; we therefore refer to these as '**physical services**'. By contrast, **financial services** are primarily concerned with the movement and manipulation of symbols and information – they can be considered information-based services. Telecommunications is not easily categorised in this framework, so telecommunications enterprises, along with those in the utilities sectors, were omitted from the analysis that follows.

Table 3.4.1: The Structure of the Sample for this Analysis (Unadjusted data)

Country	Source of Innovation	Technology Providing		Physical Services		Financial Services	
		Number of Observations	% of Eurostat Innovators	Number of Observations	% of Eurostat Innovators	Number of Observations	% of Eurostat Innovators
Germany	External	21	9%	16	9%	19	10%
	Joint	53	24%	61	33%	79	40%
	Internal	117	52%	74	40%	89	45%
	No Source	34	15%	34	18%	9	5%
	Multiple	0	0%	0	0%	0	0%
France	External	31	5%	42	18%	5[#]	5%
	Joint	153	25%	54	23%	24	26%
	Internal	253	41%	57	24%	30	33%
	No Source	62	10%	50	21%	8	9%
	Multiple	121	20%	35	15%	25	27%
Portugal	External	5[#]	7%	27	20%	12	17%
	Joint	20	30%	22	16%	34	49%
	Internal	31	46%	43	32%	21	30%
	No Source	11	16%	39	29%	3	4%
	Multiple	0	0%	4	3%	0	0%
Norway & Sweden	External	14	7%	26	10%	23	19%
	Joint	44	21%	72	29%	42	35%
	Internal	130	63%	110	44%	44	37%
	No Source	16	8%	37	15%	8	7%
	Multiple	4	2%	6	2%	3	3%
UK & Ireland	External	14	11%	16	12%	16	11%
	Joint	11 (+7)*	9%	20	15%	19	13%
	Internal	69	56%	52	40%	71	48%
	No Source	14	11%	37	28%	16	11%
	Multiple	16 (-7)*	13%	6	5%	25	17%

[#] This number of observations is too small for further analysis. * Seven enterprises that developed innovations jointly and internally have been included amongst the 'joint' innovators to increase the cell count.

In relation to the source of the innovations, all records that failed to provide any information regarding the source of the innovation were excluded from the analysis, as were (with one exception – see note below Table 3.4.1) the enterprises that identified multiple sources of innovation. A third manipulation of the data undertaken for this analysis was that we combined data for two pairs of countries: Norway and Sweden, and the UK and Ireland. We have done this in order to improve the number of cases in the cells for the analysis (and to reduce the complexity of the analysis) and justify doing so on the basis that both pairs of countries have the same or very similar languages – thus the concepts addressed in the CIS-2 are likely to have been understood in very similar ways, which is less clearly the case when the languages are quite different, such as with German and French. As mentioned earlier, the analysis that follows should be regarded as experimental. The number of cases in the cells can be small (see Table 3.4.1) and it is for this reason that we employ the unadjusted data rather than the adjusted data for the seven countries for which data was available. In two cases the number of respondents in the particular cells was too small for further analysis. These were 'external innovators' in Portugal within the technology providing sector, and 'external innovators' in the French financial services sector.

A first look at the distribution of responses shows that in all of the broad sectors innovations can be internal, joint or external, but the proportions vary – with a greater relative share of internal innovations in the technology providing sectors, a greater relative share of external innovations in the physical service sectors, and a greater relative share of joint innovations in the financial services sector. Thus even across the sectors there are different patterns of innovation and technological adoption. Moreover, these patterns are in line with expectations. From the literature we would expect that most of the technology providing enterprises are developing 'product innovations' to be marketed,

whilst many of the 'physical services' are adopters, primarily for 'process innovation', of (standard) technologies developed by manufacturers and equipment providers, whilst many financial service enterprises are introducing sophisticated information technology systems (which have both product and process elements), which are developed jointly with IT equipment providers and software houses.

3.4.2 The Product / Process Orientation of Innovation, and Innovation Expenditures

This section examines further whether differences in the product – process orientation of innovation existed not only between but also within services. It examines this through the declared aims of innovation and through the distribution of innovations costs. For this analysis we considered 'product related aims of innovation' to be: (1.) extending the product/service range, (2.) improving the service quality, (3.) increasing market share, and (4.) replacing previous outputs. We considered the process related aims to be: (1.) increasing the flexibility of business processes, (2.) reducing labour costs, (3.) reducing materials costs, and (4.) reducing energy costs. The enterprises were asked to rank each of these from 0 (insignificant) to 3 (very important). We simply summed these scores for the individual enterprises and compared the summed scores for process and product related aims of innovation. Where the product related aims of innovation out-weighted the process related aims we identified these as product oriented innovators (amongst these some enterprises only identified product related aims). By contrast the process oriented innovators were those that gave greater significance to the process than the product related aims (a few amongst these only identified process aims as important). Finally, some respondents gave equal total scores to both sets of aims.

Table 3.4.2: Process and Product Orientations of Innovation (Unadjusted)

Country	Source of Innovation	Technology Providing			Physical Services			Financial Services		
		Process	Equal	Product	Process	Equal	Product	Process	Equal	Product
Germany	External	24% (0%)	10%	67% (5%)	38% (6%)	31%	31% (13%)	11% (0%)	21%	68% (5%)
	Joint	19% (0%)	6%	75% (8%)	57% (0%)	3%	39% (3%)	22% (0%)	10%	68% (4%)
	Internal	17% (0%)	9%	74% (9%)	33% (0%)	12%	55% (3%)	13% (0%)	8%	79% (4%)
France	External	7% (0%)	7%	86% (34%)	15% (2%)	10%	76% (32%)	n.a.	n.a.	n.a.
	Joint	2% (0%)	1%	97% (25%)	10% (0%)	13%	77% (10%)	22% (0%)	22%	56% (0%)
	Internal	3% (0%)	2%	95% (32%)	27% (0%)	12%	62% (19%)	17% (0%)	10%	72% (10%)
Portugal	External	n.a.	n.a.	n.a.	44% (0%)	22%	33% (11%)	8% (0%)	0%	92% (8%)
	Joint	5% (0%)	10%	85% (30%)	36% (0%)	18%	45% (5%)	21% (3%)	12%	68% (6%)
	Internal	6% (0%)	10%	84% (13%)	37% (0%)	16%	47% (14%)	14% (0%)	5%	81% (10%)
Norway & Sweden	External	0% (0%)	7%	93% (21%)	21% (8%)	17%	63% (13%)	4% (0%)	0%	96% (9%)
	Joint	11% (0%)	5%	84% (11%)	15% (1%)	8%	76% (3%)	2% (0%)	2%	95% (7%)
	Internal	4% (0%)	3%	93% (13%)	18% (0%)	6%	77% (13%)	5% (0%)	2%	93% (0%)
UK & Ireland	External	0% (0%)	7%	93% (14%)	44% (0%)	13%	44% (0%)	6% (0%)	13%	81% (0%)
	Joint	17% (0%)	6%	78% (11%)	15% (0%)	15%	70% (5%)	16% (0%)	16%	68% (0%)
	Internal	12% (1%)	10%	78% (12%)	17% (0%)	13%	69% (6%)	3% (0%)	8%	89% (4%)

The figures in parentheses are those declaring only product or process aims of objectives of innovation.

We have shown earlier in this report that 'product' related aims tend to outweigh process oriented aims, although the majority of the innovators identified both as significant. Table 3.4.2 examines the aims of innovation according to the type of sector and the source of the innovations. The first notable feature of this is the much greater significance of process related aims amongst the 'physical service' enterprises, as compared with the 'technology providers' and the financial service enterprises. This is understandable given the greater significance of materials and energy in these activities, and thus the scope for cost savings. Beyond this, however, a second notable feature is the greater emphasis on process innovation amongst the 'external innovators' as compared with the internal and joint innovators. This is admittedly not a universal pattern, but it is apparent in about half of sub-analyses (of country, sector-type, and innovation-source). This pattern is notable because it is what might be expected if there were a significant presence of 'technology adopters' rather than true innovators amongst the 'external innovators.'

The variation in innovation activities between as well as within sectors is given further support when the average expenditures on innovation (per employee) are examined. In Table 3.4.3 we have indexed, for each country and to 100, the median total innovation expenditure of the 'physical service' innovators that developed their own innovations (i.e., the internal physical service innovators). All other innovation expenditures within each country (or country pair) are then calculated relative to this. Also reported, where there is a sufficient number of observations, is the relative expenditure of the

enterprises at the 33% and 67% point of the distributions – the intention being to show the variation in the reported expenditures within each sector.

If we assume there is a significant proportion of 'technology adopters' amongst the 'external' innovators, then we would expect their average innovation expenditures per employee to be substantially below those of the 'internal' and 'joint' innovators (due to the adoption of cheaper, more standardised technologies, and less internal innovation activities such as R&D). And this pattern was indeed found for several of the sub-analyses (i.e., by country, broad-sector and innovation-source). Amongst the 'physical service' enterprises in France, Norway and Sweden, and the UK and Ireland, the median expenditure by the 'external' innovators was only a fraction of that of the internal innovators. The same is true amongst the 'technology providing' enterprises in these countries and Germany, and amongst the financial service innovators in most countries. Beyond this two other features of this data are notable. The first is that, amongst innovators, expenditure on innovation on a per employee basis tend to be significantly higher amongst the financial service enterprises than amongst the 'physical service' innovators, and higher still amongst the technology providing sector enterprises. The second feature is the tremendous diversity in innovation expenditures (per employee) within each sector. As mentioned elsewhere in this study, it is not clear whether this diversity reflects true variation, or different understandings between otherwise similar enterprises as to what constitutes innovation related expenditures. Most probably, both of these are contributing to the revealed variation.

Table 3.4.3: Innovation Expenditures per Employee - Indexed (Unadjusted)

Country	Source of Innovation	Technology Providing			Physical Services			Financial Services		
		33% point	**Median**	67% point	33% point	**Median**	67% point	33% point	**Median**	67% point
Germany	External	44	**66**	162	n.a.	**137**	n.a.	n.a.	**99**	n.a.
	Joint	65	**107**	240	48	**85**	158	100	**139**	248
	Internal	163	**279**	437	48	**100**	199	90	**172**	348
France	External	110	**155**	226	19	**45**	133	n.a.	**n.a.**	n.a.
	Joint	205	**390**	757	56	**97**	170	n.a.	**112**	n.a.
	Internal	222	**489**	967	46	**100**	203	55	**89**	515
Portugal	External	n.a.	**n.a.**	n.a.	41	**121**	291	n.a.	**190**	n.a.
	Joint	114	**182**	261	72	**144**	312	255	**410**	634
	Internal	247	**372**	570	56	**100**	221	247	**342**	473
Norway & Sweden	External	n.a.	**124**	n.a.	20	**33**	54	48	**73**	127
	Joint	111	**203**	331	44	**94**	193	138	**218**	341
	Internal	183	**415**	754	45	**100**	271	120	**232**	411
UK & Ireland	External	n.a.	**70**	n.a.	n.a.	**19**	n.a.	n.a.	**234**	n.a.
	Joint	254	**314**	955	42	**122**	234	78	**126**	339
	Internal	103	**220**	355	36	**100**	204	127	**298**	595

33% point – 1/3rd of the enterprises are below this; 67% point – 1/3rd of the enterprises are above this

Lastly in this sub-section we examine the composition of innovation costs. Extending our hypothesis that a significant proportion of the 'external innovators' introduced 'innovations' through adopting (standard) technologies, we would expect that amongst these firms innovation expenditures would tend to be dominated by 'acquired technologies', with no expenditure on intra-mural R&D and little on activities such as preparations for innovation, training in relation to innovation and on the market introduction of innovations (we refer to these collectively as 'other activities'). Table 3.4.4 divides the average innovation costs of each of our enterprise types into: (1.) intra-mural R&D; (2.) acquired technologies and (3.) other activities.

The patterns of expenditure suggest that there is some validity to our hypothesis. Amongst the 'external innovators' R&D tended to account for only a small fraction of total innovation costs – in fact, few of these firms conducted any R&D at all, especially on a continuous basis (see Table 3.4.6 below). Instead, amongst these enterprises innovation costs are dominated by the acquisition of machinery, equipment and other external technologies. Amongst the 'external innovators' in the 'physical services' acquired technologies dominated total innovation costs in all countries (although to varying extents). The share of acquired technologies is markedly and consistently less amongst the 'internal' and 'joint' innovators. Amongst the technology providing and financial service sectors, the extent to which acquired technologies dominated the expenditures of the 'external innovators' was less, although still dominant, and significantly greater than the shares of total innovation expenditure committed by the 'joint' and 'internal' innovators to acquired technologies. Instead, these enterprises

tended to commit significant resources to intra-mural R&D and 'other activities'. The large proportion of total innovation costs attributed to R&D amongst the 'internal' and 'joint' innovators amongst the technology providing firms (and to a lesser extent amongst the financial service firms) is particularly notable given the widespread assumption that service firms do not conduct R&D.

Table 3.4.4: The Distribution of Innovation Expenditures (Unadjusted)

Country	Source of Innovation	Technology Providing R&D	Technology Providing Acquired	Technology Providing Other	Physical Services R&D	Physical Services Acquired	Physical Services Other	Financial Services R&D	Financial Services Acquired	Financial Services Other
Germany	External	12%	52%	37%	5%	85%	10%	1%	66%	34%
	Joint	24%	46%	30%	22%	53%	24%	9%	58%	33%
	Internal	44%	26%	30%	14%	49%	38%	28%	35%	37%
France	External	7%	65%	28%	5%	85%	10%	n.a.	n.a.	n.a.
	Joint	43%	36%	21%	14%	60%	26%	20%	58%	22%
	Internal	59%	24%	18%	14%	70%	15%	33%	46%	21%
Portugal	External	n.a.	n.a.	n.a.	2%	88%	10%	0%	77%	23%
	Joint	16%	49%	35%	10%	64%	27%	3%	67%	31%
	Internal	41%	42%	16%	5%	71%	25%	19%	51%	30%
Norway & Sweden	External	7%	60%	33%	2%	63%	35%	3%	58%	39%
	Joint	42%	26%	32%	23%	45%	32%	17%	52%	31%
	Internal	47%	24%	29%	16%	48%	36%	23%	33%	44%
UK & Ireland	External	10%	62%	29%	1%	65%	34%	7%	62%	31%
	Joint	43%	32%	25%	12%	55%	33%	19%	41%	40%
	Internal	36%	42%	22%	17%	58%	25%	22%	47%	31%

3.4.3 The Significance of Internal Sources of Information and Knowledge

We have just shown that R&D constitutes a significant share of total innovation costs amongst the 'internal' and 'joint' innovators, particularly for those enterprises in the technology providing service sectors. This is remarkable given that services are widely assumed to rarely conduct R&D. This section develops further the ideas presented in the previous section by examining the extent to which the enterprises drew on their own internal capabilities (including R&D) and information resources for innovation. In the main report, it was shown that 'source within the enterprises' were always the most widely recognised source of information for innovation. What that analysis could not show was whether the significance of internal sources of information varied with the source of the innovation.

Table 3.4.5: The Significance of Internal Sources of Information for Innovation

Country	Source of Innovation	Technology Providing Mean Score	Technology Providing Relative to Other Sources	Physical Services Mean Score	Physical Services Relative to Other Sources	Financial Services Mean Score	Financial Services Relative to Other Sources
Germany	External	2.0	1.6	2.0	1.8	1.4	1.7
	Joint	2.3	1.7	2.6	2.0	2.5	2.2
	Internal	2.7	2.0	2.2	1.9	2.8	2.7
France	External	1.2	1.5	1.1	1.7	n.a.	n.a.
	Joint	2.2	2.4	1.7	2.0	2.1	2.2
	Internal	2.5	3.0	1.5	2.7	2.8	3.9
Portugal	External	n.a.	n.a.	2.0	2.5	1.3	2.1
	Joint	2.3	2.0	2.0	1.6	2.3	2.0
	Internal	2.2	1.8	1.9	1.9	2.8	2.7
Norway & Sweden	External	2.3	2.4	1.9	1.7	2.0	1.7
	Joint	2.7	1.9	2.4	1.9	2.5	2.2
	Internal	2.7	2.0	2.5	2.2	2.6	2.3
UK & Ireland	External	1.6	1.2	1.8	1.4	2.1	1.9
	Joint	2.7	1.7	2.1	1.6	2.5	1.8
	Internal	2.3	1.7	2.3	1.9	2.5	2.1

The mean score is the mean of the individual scores from 0 (not used) to 3 (very important) for the significance of internal sources of information for innovation. Relative to other sources is this divided by the average mean score for the 10 external sources of information for innovation.

We would expect the 'internal innovators' (and to a lesser extent) the 'joint innovators' to recognise the significance of internal sources of information for innovation to a much greater extent than the external innovators. We would also expect sources within the firm to be more significant amongst the 'technology providing' enterprises than amongst the 'physical service' enterprises. And

this indeed was (largely) the case. Amongst the enterprises that developed their innovations jointly and internally, sources within the enterprise were almost always recognised as 'very important' by at least 40% of the sample, and sometimes up to 80%. By contrast, amongst the 'external innovators' sources within the firm were rarely recognised as very important by more than 40% of the enterprises. This shows a clear and significant difference, which again raises the question whether some the 'external innovators' were true (technological) innovators rather than 'technology adopters' (and perhaps organisational innovators).

In a related analysis, Table 3.4.5 shows the mean score for the significance of internal sources of innovation for innovation. This is the mean of the individual scores from 0 (not used) to 3 (very important). Also shown is this score relative to the average mean score for the 10 external sources of information for innovation. Two reasonably consistent patterns are found. Firstly, the mean score for the significance of internal sources of information tended to be lower for the 'external' innovators than for the 'internal' and 'joint' innovators, and second the relative importance of internal sources of information tended to be greater amongst the 'internal innovators'.

Table 3.4.6: The Conduct of R&D amongst the Innovating Enterprises between 1994 and 1996

Country	Source of Innovation	Technology Providing		Physical Services		Financial Services	
		Conducted R&D	Undertook R&D Continuously	Conducted R&D	Undertook R&D Continuously	Conducted R&D	Undertook R&D Continuously
Germany	External	38%	10%	13%	6%	5%	0%
	Joint	60%	30%	41%	23%	25%	8%
	Internal	74%	44%	41%	19%	37%	18%
France	External	32%	6%	21%	0%	n.a.	n.a.
	Joint	80%	48%	54%	11%	75%	38%
	Internal	89%	53%	33%	5%	77%	60%
Portugal	External	n.a.	n.a.	11%	0%	0%	0%
	Joint	45%	25%	27%	5%	44%	24%
	Internal	74%	45%	23%	16%	76%	57%
Norway & Sweden	External	29%	0%	23%	0%	22%	0%
	Joint	84%	48%	71%	24%	57%	19%
	Internal	86%	57%	51%	27%	70%	34%
UK & Ireland	External	29%	7%	13%	0%	19%	6%
	Joint	67%	56%	35%	20%	63%	32%
	Internal	70%	35%	42%	17%	58%	34%

The conduct of R&D follows a similar pattern to the significance of internal sources of information for innovation (Table 3.4.6) – tending to be lower amongst the 'external innovators' within each of the three 'sector-types', and higher amongst the 'technology providing' enterprises than amongst the physical and financial service enterprises.

Table 3.4.7: The Internal Sourcing of Information for Innovation and the Conduct of R&D

Country	Source of Innovation	Technology Providing		Physical Services		Financial Services	
		Neither*	Both*	Neither*	Both*	Neither*	Both*
Germany	External	43%	19%	63%	0%	89%	0%
	Joint	26%	28%	21%	30%	30%	20%
	Internal	7%	58%	35%	27%	13%	31%
France	External	55%	3%	69%	10%	n.a.	n.a.
	Joint	16%	45%	37%	33%	17%	29%
	Internal	5%	61%	54%	16%	13%	70%
Portugal	External	n.a.	n.a.	48%	7%	83%	0%
	Joint	30%	20%	45%	5%	29%	24%
	Internal	19%	32%	53%	14%	0%	52%
Norway & Sweden	External	43%	7%	50%	8%	57%	13%
	Joint	9%	66%	18%	43%	14%	29%
	Internal	6%	64%	20%	38%	7%	45%
UK & Ireland	External	50%	7%	63%	13%	44%	6%
	Joint	17%	56%	40%	15%	16%	37%
	Internal	22%	38%	31%	29%	15%	39%

* 'Neither' – percentage of enterprises that did not conduct R&D and that failed to recognise sources of information within the enterprise as 'very important' for their innovation efforts. 'Both' - the proportion of enterprises that had R&D and declared internal information sources very important.

Combining these two indicators, it is apparent that half or more of the 'external innovators' did not conduct R&D and did not regard sources of information within the enterprises as very important for innovation. This proportion tended to be larger amongst the 'physical' and financial service enterprises, but was also substantial amongst the enterprises in the technology providing sectors. Meanwhile the proportions of enterprises that neither undertook R&D nor regarded sources of information within the firm as very important were lower amongst the 'internal' and 'joint' innovators, and indeed amongst the 'internal innovators' in the technology providing service sectors (and to a lesser extent in financial services) it was common for more than half the enterprises both conducted R&D and recognised information sources within the firm as 'very important' of for innovation. These patterns demonstrate the great variety within and between sectors in the extent to which enterprises relied on their own internal capabilities for innovation.

3.4.4 The Significance of Suppliers, Customers and Other Externals for Innovation

According to the literature, suppliers and customers are particularly important to the activities of services, and this is likely to be reflected in their sourcing of information for innovation and in their pattern of collaborations. We would expect, however, that the significance of suppliers and customers also varies with the type of service and with the sources of innovation. In general, we would expect the 'external innovators' had a greater reliance on suppliers than the 'internal innovators', and the technology providing sector enterprises are likely to have had greater interaction with customers than the physical service enterprises, amongst which suppliers are likely to have been particularly significant. This section therefore assesses the significance of suppliers and customers as sources of information for innovation and as partners in collaborative innovation projects.

Table 3.4.8 shows the mean scores for the significance of suppliers and customers as sources of information for innovation. In line with our expectation suppliers tended to be of greater significance amongst the physical services than amongst the technology providing sector enterprises (with financial services generally in between). The significance of suppliers was generally highest amongst the external innovators in the physical and financial services (Germany apart). Also in line with our expectations is that the mean score of customers tends to be lower amongst 'external innovators' than amongst the 'internal' and 'joint innovators', but also notable is that the mean score of customers amongst the physical service enterprises is not in general much different than that for the enterprises in the technology providing sectors. Notably, however, the significance of customers appears to be slightly less amongst the 'external' innovators than amongst the 'internal' and 'joint' innovators, suggesting a greater process orientation to these innovations. The significance of competitors is also shown. These are significant in all of the sectors, but especially amongst the physical and financial services.

Table 3.4.8: Customers, Suppliers and Competitors as Sources of Information – Mean Scores

Country	Source of Innovation	Technology Providing			Physical Services			Financial Services		
		Cust-omers	Suppliers	Comp-etitors	Cust-omers	Suppliers	Comp-etitors	Cust-omers	Suppliers	Comp-etitors
Germany	External	1.2	1.2	1.7	1.2	2.0	1.9	0.4	0.5	1.3
	Joint	1.5	1.1	1.5	1.6	1.5	1.8	1.3	0.6	1.8
	Internal	1.8	1.1	1.6	1.7	1.5	1.8	1.2	0.7	1.7
France	External	1.4	2.0	0.8	1.0	1.9	0.9	n.a.	n.a.	n.a.
	Joint	1.4	1.6	0.9	1.4	2.0	0.8	1.7	1.8	1.4
	Internal	1.6	1.3	0.8	1.1	1.4	0.9	1.7	1.1	1.2
Portugal	External	n.a.	n.a.	n.a.	1.3	1.7	1.3	1.1	1.9	0.5
	Joint	2.1	1.6	1.0	1.8	2.1	1.8	1.9	1.9	1.4
	Internal	1.8	1.6	1.3	2.0	1.5	1.3	2.0	1.3	1.4
Norway & Sweden	External	1.8	1.5	1.1	2.0	2.1	1.6	2.0	2.3	2.1
	Joint	2.6	1.7	1.5	2.3	1.8	1.6	2.2	1.6	1.8
	Internal	2.6	1.3	1.7	2.3	1.7	1.6	2.3	1.3	2.0
UK & Ireland	External	1.9	1.9	1.4	2.3	2.2	1.6	2.1	1.9	1.5
	Joint	2.6	2.1	1.6	2.3	2.1	1.6	2.5	1.9	2.1
	Internal	2.4	1.8	1.5	2.5	1.6	1.8	2.2	1.6	1.8

The mean score is the mean of the individual scores from 0 (not used) to 3 (very important) for the significance of these sources of information for innovation.

In a second analysis we compared the significance attached by each enterprise to customers and suppliers – with three classes being identified: those that indicated customers were more important as a source of information of innovation, those that indicated suppliers as more important, and those that gave these equal importance. This shows (Table 3.4.9) that the 'external' innovators tended to be more likely than the 'internal' or 'joint' innovators to identify suppliers as the more important source of information, whilst customers tended to be more important amongst the 'internal innovators' than amongst the 'external innovators'. On the whole, greater proportions of the physical service enterprises tended to identify suppliers as more important than did the technology providing or financial service enterprises – these tended to identify customers as the more significant source.

Table 3.4.9: Customers versus Suppliers as Sources of Information for Innovation

Country	Source of Innovation	Technology Providing		Physical Services		Financial Services	
		Suppliers more Important	Customers more Important	Suppliers more Important	Customers more Important	Suppliers more Important	Customers more Important
Germany	External	38%	29%	56%	13%	21%	16%
	Joint	17%	42%	30%	33%	9%	44%
	Internal	14%	49%	26%	31%	9%	36%
France	External	45%	16%	50%	17%	n.a.	n.a.
	Joint	41%	29%	50%	15%	38%	33%
	Internal	24%	43%	42%	28%	7%	40%
Portugal	External	n.a.	n.a.	41%	30%	50%	8%
	Joint	30%	55%	45%	36%	35%	38%
	Internal	29%	42%	16%	44%	19%	57%
Norway & Sweden	External	21%	43%	31%	38%	48%	35%
	Joint	7%	61%	17%	51%	26%	52%
	Internal	5%	81%	13%	55%	11%	68%
UK & Ireland	External	36%	36%	31%	56%	25%	44%
	Joint	11%	39%	25%	45%	11%	58%
	Internal	17%	54%	10%	65%	18%	58%

In relation to collaboration arrangements for innovation with customers and suppliers, Table 3.4.10 shows that, in general, the 'external innovators' were less likely to have these arrangements than the 'internal innovators', whilst the 'joint innovators' were, understandably, the most likely to have such arrangements. The proportions of enterprises with these arrangements varied widely between counties (e.g., between Germany and Norway-Sweden), probably because collaboration is interpreted more narrowly in some countries than in others. However, it is generally the case that the technology providing sector enterprises were more likely to have collaborative arrangements for innovation, particularly with their customers, than were the physical service enterprises.

Table 3.4.10: Collaborations with Customers and Suppliers for Innovation (% with)

Country	Source of Innovation	Technology Providing		Physical Services		Financial Services	
		with Suppliers	with Customers	with Suppliers	with Customers	with Suppliers	with Customers
Germany	External	0%	0%	6%	0%	0%	0%
	Joint	17%	2%	16%	5%	4%	1%
	Internal	6%	6%	3%	1%	2%	0%
France	External	13%	10%	19%	10%	n.a.	n.a.
	Joint	29%	19%	28%	11%	21%	4%
	Internal	19%	15%	9%	7%	7%	13%
Portugal	External	n.a.	n.a.	11%	0%	8%	0%
	Joint	30%	20%	5%	0%	38%	15%
	Internal	32%	19%	12%	14%	19%	10%
Norway & Sweden	External	36%	7%	38%	12%	48%	26%
	Joint	48%	50%	42%	26%	45%	29%
	Internal	25%	37%	29%	27%	27%	36%
UK & Ireland	External	21%	14%	13%	13%	13%	6%
	Joint	50%	50%	5%	25%	5%	21%
	Internal	12%	14%	6%	19%	13%	18%

The differences are, however, less clear-cut that might have been expected, and perhaps the most notable feature of these distributions is the generally small proportions of enterprises that have collaborative arrangements for innovation with their suppliers or customers. Only in a few cases does this proportion reach half the sample, and the proportions are commonly much smaller. This is notable given that innovation in services is generally thought to be interactive, for it suggests most

service enterprises are 'going it alone' for innovation - developing their own service products, and buying in standard, or customised equipment and services, rather than having these developed on a bespoke basis (at least to the extent that that would require formal collaborations with suppliers).

Finally in this section we assess the significance of other sources of information for innovation, and particularly the significance of consultants, universities (HEIs) and (government and private) research institutes, and 'other sources' – including conferences, meetings, trade journals, computer networks fairs and exhibitions. Table 3.4.11 shows that these sources tend to be of relatively little importance – compared with sources within the enterprise, customers and suppliers. In particularly, universities (HEIs) and research institutes are rarely highly significant sources of information for innovation – particularly amongst the physical and financial service enterprises, but these were also of less significance than the 'other sources' amongst the technology providing sector firms. Notable also is the greater significance of consultants amongst the financial service enterprises.

Table 3.4.11: External Sources of Information for Innovation – Mean Scores

		Technology Providing			Physical Services			Financial Services		
Country	Source of Innovation	Consult-ants	HEIs & Research Institutes*	Other Sources#	Consult-ants	HEIs & Research Institutes*	Other Sources#	Consult-ants	HEIs & Research Institutes*	Other Sources#
Germany	External	1.3	1.0	1.7	1.0	0.5	1.3	1.7	0.3	1.1
	Joint	1.2	1.1	1.7	1.5	0.9	1.4	2.1	0.6	1.4
	Internal	1.1	0.8	1.9	0.9	0.6	1.4	1.4	0.6	1.3
France	External	0.4	0.2	0.9	0.3	0.2	0.7	n.a.	n.a.	n.a.
	Joint	0.4	0.4	1.2	0.6	0.4	1.0	1.3	0.3	0.9
	Internal	0.3	0.3	1.0	0.3	0.1	0.5	0.6	0.2	0.6
Portugal	External	n.a.	n.a.	n.a.	0.1	0.2	1.0	1.3	0.2	0.4
	Joint	0.8	0.6	1.5	1.5	0.4	1.5	1.7	0.6	1.1
	Internal	1.0	0.8	1.5	1.0	0.4	1.0	1.1	0.6	1.0
Norway & Sweden	External	1.1	0.4	1.1	1.0	0.5	1.2	1.3	0.4	1.1
	Joint	1.2	1.2	1.6	1.2	0.8	1.2	1.4	0.5	1.1
	Internal	1.0	1.0	1.5	0.9	0.6	1.1	1.3	0.7	1.0
UK & Ireland	External	1.4	1.0	1.4	1.4	0.8	1.3	1.2	0.4	1.1
	Joint	1.2	1.4	1.8	1.6	0.7	1.3	2.0	0.6	1.4
	Internal	1.1	0.8	1.6	1.1	0.5	1.3	1.2	0.5	1.3

* This is the average mean score for universities and government and private research institutes. # This is the average mean score for conferences, meetings, trade journals, computer networks fairs and exhibitions.

3.4.5 The Factors Hampering Innovation

Finally, we examine the extent to which the enterprises claimed their innovation efforts were hindered, and examine in particular the extent to which internal factors were to blame for these difficulties. Overall about half the enterprises claimed they had encountered difficulties with the innovation process (with innovation projects being delayed, cancelled or not even started due to these difficulties). It is apparent that the enterprises in the technology providing sectors were more likely to experience these difficulties – probably because these tend to be more frequent innovators or have more ambitious innovation projects. However, it is also apparent that, in general and within each sector and country, the 'external innovators' were less likely to have encountered difficulties with innovation than were the 'internal' and 'joint' innovators, although the differences in proportions were not always large.

Table 3.4.12 shows the proportion of enterprises that identified five factors that might have hampered the enterprises innovation efforts. These are: a lack of skilled labour, organisational rigidities, a lack of technical information, a lack of market information, and poor customer responsiveness to innovation. The notable feature of these patterns is that they do not in general seem to vary with the source of the innovations. For example, a lack of skilled labour appears to have been a more significant problem amongst the technology providing sector enterprises, whilst it seems less of a problem amongst the physical services, but there is little difference between the extent that this factor is cited by the 'external innovators' as compared with the 'joint' or 'internal innovators'. We might have expected the 'internal' and 'joint' innovators to identify these internal factors hampering

innovation more frequently than the 'external' innovators, due to their greater frequency and/or ambition of innovation. It is notable, however, that whilst significant proportions of the enterprises in most cells complained that their innovation efforts had been hampered by a lack of skilled labour and organisational rigidities, relatively few identified a lack of technical information, market information or poor customer responsiveness to innovation as factors hampering innovation.

Table 3.4.12: Factors Hampering Innovation amongst the Innovating Enterprises

		Technology Providing			Physical Services			Financial Services		
Country	Source of Innovation	Any Factor	Lack of Skilled Labour	Organisat-ional Rigidities	Any Factor	Lack of Skilled Labour	Organisat-ional Rigidities	Any Factor	Lack of Skilled Labour	Organisat-ional Rigidities
Germany	External	57%	29%	33%	31%	0%	13%	26%	17%	22%
	Joint	55%	29%	38%	48%	25%	30%	49%	26%	33%
	Internal	69%	31%	41%	49%	21%	30%	58%	30%	41%
France	External	65%	19%	10%	48%	10%	14%	n.a.	n.a.	n.a.
	Joint	68%	23%	15%	57%	15%	15%	50%	17%	17%
	Internal	71%	27%	13%	65%	30%	26%	37%	14%	17%
Portugal	External	n.a.	n.a.	n.a.	22%	11%	0%	25%	8%	17%
	Joint	50%	15%	10%	50%	14%	14%	35%	15%	3%
	Internal	58%	16%	10%	33%	7%	7%	29%	0%	10%
Norway & Sweden	External	29%	21%	7%	42%	36%	20%	35%	0%	26%
	Joint	48%	25%	20%	42%	23%	23%	48%	26%	24%
	Internal	57%	38%	25%	53%	28%	25%	57%	35%	30%
UK & Ireland	External	50%	29%	29%	13%	6%	0%	38%	20%	27%
	Joint	56%	22%	33%	65%	32%	21%	47%	11%	28%
	Internal	39%	18%	9%	27%	10%	4%	39%	25%	14%
		Technology Providing			Physical Services			Financial Services		
Country	Source of Innovation	Technical Inform-ation	Market Inform-ation	Customer Respons-iveness	Technical Inform-ation	Market Inform-ation	Customer Respons-iveness	Technical Inform-ation	Market Inform-ation	Customer Respons-iveness
Germany	External	19%	29%	19%	6%	6%	19%	11%	0%	0%
	Joint	8%	12%	12%	10%	10%	12%	5%	9%	13%
	Internal	14%	9%	13%	11%	8%	15%	14%	14%	16%
France	External	23%	26%	29%	12%	7%	5%	n.a.	n.a.	n.a.
	Joint	16%	9%	22%	13%	13%	15%	13%	9%	13%
	Internal	16%	13%	26%	14%	28%	33%	3%	3%	7%
Portugal	External	n.a.	n.a.	n.a.	0%	0%	4%	0%	0%	0%
	Joint	10%	0%	10%	9%	5%	14%	3%	3%	3%
	Internal	6%	6%	10%	9%	2%	7%	5%	0%	0%
Norway & Sweden	External	0%	0%	0%	4%	4%	12%	4%	9%	0%
	Joint	7%	16%	11%	6%	1%	10%	10%	2%	7%
	Internal	8%	8%	12%	8%	5%	11%	12%	9%	16%
UK & Ireland	External	7%	0%	21%	0%	0%	6%	7%	0%	13%
	Joint	6%	6%	22%	11%	0%	5%	0%	0%	11%
	Internal	6%	9%	7%	4%	6%	8%	11%	1%	7%

3.4.6 Conclusions

This section has sought to provide an alternative assessment of innovation performance to that provided in Section 3.3 based on innovation expenditures. This analysis has focused on the sources of innovation, arguing that enterprises that introduced externally developed innovations might not be as innovative as those that developed their own innovations or that developed innovations jointly with others. This is particularly the case if the innovation introduced was based on standard, off-the-shelf technologies, rather than customised or bespoke technologies, although unfortunately we do not have information about this dimension of the innovations. In summary, the analysis found that:

- Across the sectors there were different patterns of innovation by source. For example, most of the technology providing enterprises developed their (largely product) innovations themselves or jointly with others, whilst many of the physical services (i.e., wholesalers and transport service enterprises) were adopters, primarily for 'process innovation', of (possibly standard) technologies developed 'externally' by equipment providers. Thus in general the physical service enterprises displayed a greater 'process orientation'. But beyond this the 'external innovators' also tended to be more process oriented in comparison with the 'internal' and 'joint' innovators. This suggests a presence of 'technology adopters' rather than true innovators amongst the 'external innovators'.

- On the whole the physical service enterprises tended to spend less on innovation (per employee) than the technology providing and financial service firms, and moreover the 'external' innovators tended to spend less than 'internal' and 'joint innovators. Although neither of these were universal trends, these patterns also suggests there may be 'technology adopters' amongst the 'external' innovators, and especially amongst the physical service enterprises. The breakdown of innovation expenditures provided further indications of this, for acquired technologies dominated the expenditures of the 'external innovators' (especially amongst the physical services enterprise).

- Moreover, few 'external innovators' conducted R&D, and many did not regard internal sources of information as significant for their innovation activities. Indeed, half or more of the 'external innovators' did not conduct R&D and did not regard sources of information within the enterprises as very important for innovation, whilst amongst the 'internal innovators' in the technology providing sectors more than half the enterprises both conducted R&D and saw internal information as very important for innovation. Suppliers, meanwhile, tended to be of greater significance amongst the physical services than amongst the technology providing sector enterprises, and were of most importance to the 'external innovators' in the physical services.

Overall, therefore, these patterns suggest a wide variation in the innovativeness of the innovations introduced, which is partly related to the source of the innovations. This variation is to be expected, as innovation is not a 'black and white' issue. Some enterprises are highly innovative, whilst many more are really imitators. However, there is also the question of distinguishing 'technology adopters' from true innovators, which goes to the heart of what is meant by innovation, not least in services. For the CIS-2, some examples of 'innovation in the service sectors' were provided on the questionnaire. The first two of these were: 'use of cellular phones to reroute drivers throughout the day' and 'a new computer mapping system, used by drivers to work out the fastest delivery route'. Presuming the second refers to the use rather than the production of this system, it is questionable whether either of these really constitutes technological innovation on behalf of the adopter, as opposed to technological adoption, particularly if the technologies were standardised. Crucially, however, the adopters can still be considered innovators if the adoption of the innovation led to a significant change in the organisation of the enterprise (e.g., in routing drivers more efficiently), but this should be regarded as organisational innovation on the part of the adopter, not technological innovation, even though the innovation was facilitated by a new technology. The wider point is that, particularly in services, we need to understand more about the nature of innovation (and the nature of the interactions between technologies and organisational forms), and not just settle for classifying enterprises as ['black'] (technological) innovators or ['white'] non-innovators and thereby deriving statistics on 'the proportion of innovators' in each sector or country.

3.5 General Findings from the CIS-2 Concerning Innovation in Services

This section provides an overview of the main findings from the analysis of the CIS-2 data on innovation in services. Of the surveyed enterprises, a little under half had **engaged in innovative activities** between 1994 and 1996. Innovative activities become more common as enterprises become larger. Overall, 43% of the service enterprises with 10-49 employees had undertaken innovative activities, compared with 53% of those with 50-249 employees and 76% of those with 250 or more employees. This is unsurprising; as larger enterprises tend to have more lines of business and thus more scope for innovation. Overall, service enterprises are marginally less likely to engage in technological innovation activities than manufacturers of similar size.

The proportion of enterprises with innovative activities also varied widely between the sectors examined. Only 29% of the transport service enterprises had engaged in innovative activities, as had 40% of the wholesale service enterprises. By contrast 64% of the telecommunications, 68% of the computer service, and 67% of the technical service enterprises had engaged in innovative activities. This stands to reason, as telecommunications, computer services and technical services are more technologically orientated, technology-producing sectors, than wholesale and transport services.

The most widespread of the **aims of innovation** was improving the quality of the services offered. Two thirds of the service enterprises with innovative activities recognised this as a very important aim of their innovative activities. Amongst the large enterprises with 250 or more employees this proportion was even higher, at three-quarters. About half the enterprises also regarded extending their service range and/or opening new markets as very important objectives of their innovation activities, and all but 10% recognised these as being relevant objectives of innovation. These patterns point to a prominence of 'service product', rather than process-related aims of innovation. However, in services it can be difficult to distinguish between the two – changes in the process of service provision often lead to a change in the service provided, and a change in the service provided often requires a change in the process of provision. About two fifths of the innovating enterprises recognised one or both of improving their internal flexibility and reducing their labour costs as very important objectives of their innovation activities, and about 80% recognised these as relevant aims of these activities. These proportions tended to be even higher amongst the large service firms. This shows that many service firms were also concerned with the process side of innovation, although relatively few (about 20%) saw reducing other costs, particularly materials and energy costs, as very important objectives of their innovation activities. Consequently, and in summary, it appears that most service firms primarily aimed to use innovation to improve the services they provide, whilst process side considerations are also important, but secondary. This said, most service enterprises have multiple rather than single innovation objectives. The main aims of innovation were remarkably consistent across the different sectors examined.

Regarding the **conduct of R&D**, services are widely supposed not to engage in R&D. However, the CIS-2 found that almost half of innovating service enterprises engaged in R&D, and almost a quarter did so on a continuous basis. Innovating service enterprises are less likely to engage in R&D than innovating manufacturers, amongst which nearly 70% conducted R&D. The likelihood of an innovating service enterprise engaging in R&D increases with enterprise size, but not as dramatically as amongst manufacturers. A third of the large innovating service enterprises engaged in R&D on a continuous basis, with a further 22% undertaking R&D occasionally. This compares with 69% and 11% amongst large innovating manufacturers. This is a marked and significant difference. With respect to R&D the exceptional group of enterprises is large-scale manufacturers (particularly those in the high technology sectors). These are much more likely than other firms to conduct R&D, particularly on a continuous basis. Most services are more like smaller manufacturing enterprises operating in low technology sectors – they innovate but do not depend heavily of internal R&D to do so. However, some services are heavily dependent on intra-mural R&D for innovation, particularly the technology providing enterprises within sectors such as telecommunications, computer services and technical services. For example, 45% of the innovating computer service enterprises engaged in R&D on a continuous basis, as did 33% of the innovating technical service enterprise. This compares with 18% of the innovating wholesale and financial service enterprises, and just 4% of the innovating transport service enterprises.

With half the innovating enterprises recognising them as very important, sources within the enterprises were the most commonly recognised **source of information for innovation**. This proportion was even higher amongst the large enterprises and amongst the computer, financial and technical service enterprises. The fact that these proportions exceed significantly the corresponding proportions of enterprises that conducted R&D suggests that sources other than, and in addition to, R&D are important source of information for innovation within service enterprises.

Customers (or clients) were the next most widely recognised source of information for innovation – with 80% of the enterprises recognising these as a relevant source of information for innovation and almost 40% regarding them as very important. Customers are particularly widely recognised as very important sources of information amongst computer service and wholesale enterprises. Services are often thought to have more intense relationships with their customer base than manufacturers, and this fits with the significance of customers as a source of information for innovation. Competitors are also significant – 80% regarded these as a relevant source of information for innovation (and 20% identified them as a very important). This may reflect 'competitor watching' behaviour – whereby service enterprises seek to react to, and indeed copy, the moves of their main competitors. Suppliers are also relatively important – with 20% recognising these as a very important source of information for innovation. By contrast the 'research system' (of universities, research institutes and patents) was rarely recognised as an important source of information for innovation amongst the innovating service enterprises. For example, even amongst computer service enterprises, only 10% recognised universities as a very important source of information for innovation.

Services engage in a wide range of **activities in relation to technological innovation**. A third of the enterprises that innovated between 1994 and 1996 engaged in intra-mural R&D in 1996, with 12% acquiring R&D services from other enterprises or institutions. Thirty percent incurred expenditures in connection with preparations related to the introduction of new services or methods to produce or deliver them, whilst 40% incurred expenses related to the market introduction of innovations. But the three most widely undertaken innovation-related activities were the acquisition of machinery and equipment, the acquisition of other external technologies (including software), and training of staff, all directly in relation to innovation. Each of these activities was undertaken by about half the innovating service enterprises in 1996. This illustrates the general importance of bought-in technologies to innovation in service enterprises, as well as the importance of enhancing the skills of the personnel within the enterprises (in relation to the adopted technologies). The more technologically orientated sectors such as computer and technical services were more likely to engage in intra-mural R&D, but enterprises in these sectors were as likely as those in the other sectors to acquire machinery and equipment or other external technologies for innovation. Thus, on a sectoral basis and in the more technologically orientated sectors, R&D activities are in general undertaken in addition to, rather than as a substitute for, buying in technologies.

Service enterprises vary tremendously in terms of their **commitments to innovation**. In terms of expenditures on the above activities, about a quarter of the enterprises that incurred expenditures in 1996 spent less than one third of one percent of their turnover on innovation-related activities, whilst a fifth of the enterprises spent 7% or more of their turnover on these activities. Alternatively, assessed on a per employees basis, a quarter of the enterprises that incurred expenditures in 1996 spent no more than 500euro per employee on these activities, whilst a fifth of the enterprises spent more than 10,000euro per employee. Thus by both measures it can be seen that the top fifth of the enterprises by size-related innovation expenditures spent at least 20 times the amount that the lowest spending quarter committed to innovation. On average the firms in the more technologically orientated sectors spent more on innovation-related activities than those in the less technologically orientated sectors, but in all sectors there were some enterprises with very high innovation expenditures per employee (or as a proportion of turnover) and some very low spending enterprises. Unfortunately we do not know how many of the high spending enterprises consistently committed large amounts to innovation year after year, and how many committed considerable resources to innovation in one year followed by much lower resources in the next. Some combination is likely, but it is difficult to link innovation expenditures in a single year to commercial performance. What we do observe is that, in any one year, a few enterprises are likely to account for the vast majority of the total resources committed to innovation by a large group of enterprises. Indeed, the ten percent of the enterprises that spent most on innovation accounted for about 90% of the total resources committed to innovation amongst the service enterprises providing this information.

Service enterprises also vary considerably in terms of the innovation-related activities they incur expenditures upon. On average a little over a quarter of these expenditures related to intra-mural R&D, with a further 5% being spent on acquired R&D services. About a quarter of expenditures were incurred on machinery and equipment, with a further 15-20% being spent on other external technologies (including software), both directly in relation to innovation. On average about 25% of the total was spent on training, on preparations for the introduction of innovations and on the market introduction of innovations. In the more technologically orientated sectors the proportion of total innovation expenditures spent on R&D tends to be higher, and that on acquired technologies tends to be lower. Amongst the less technologically orientated sectors the opposite is the case.

About a quarter of the innovating service enterprises had **co-operative arrangements for innovation** with other enterprises or institutions. This proportion is similar to, though slightly lower than, that for manufacturing. As service enterprises become larger they are more likely to have these arrangements; the same is true for manufacturers, but in general large service enterprises are less likely to have co-operative arrangements for innovation than large manufacturing enterprises. Firms in the more technologically orientated sectors are also more likely to have co-operation arrangements for innovation, although in all sectors some enterprises have these arrangements while others do not.

Other enterprises within the enterprise group were the most likely partners for those service enterprises that are part of an enterprise group, but of the enterprises that had co-operative arrangements for innovation with external partners, a wide variety of enterprises and institutions were engaged as partners. Competitors and suppliers were the most common partners, with 40% of the enterprises with external co-operative arrangements for innovation having these with one or both of these, whilst a third of this group of enterprises had co-operative arrangements for innovation with their customers. Consultants and research institutes were partners to 30% of these enterprises, and a quarter had co-operative arrangements with universities.

Almost half the innovating service enterprises complained of having **experienced difficulties with innovation**, although the majority of these complained that their innovation projects had been (seriously) delayed rather than abandoned after being started (15%) or not even started (25%). Large enterprises, and enterprises in the more technologically orientated sectors, were more likely to complain that they had experienced difficulties with innovation than smaller enterprises and those in the less technologically orientated sectors. This is probably because the large enterprises and enterprises in the more technologically orientated sectors tend to engage in more innovative activities, and perhaps also in more ambitious innovative activities, than the others firms. About a quarter of the innovating enterprises complained that a lack of sources of finance had hampered their innovation activities, and a fifth complained that excessive economic risks had disrupted innovation projects. Organisational rigidities and a lack of qualified personnel were both identified by a fifth of the innovating enterprises as inhibiting their innovation efforts. On the other hand, only about 10% of the innovating enterprises complained that (each of) excessive innovation costs, a lack of information about markets and technologies, a lack of customer responsiveness to innovation, or regulations and standards had hindered their innovation efforts.

Beyond these general findings the analyses which divided enterprises by their innovation intensities (Section 3.3) and by the source of their innovations (Section 3.4) also provided interesting insights into the diversity of innovation in services. For instance there is some evidence that the firms that committed more resources to innovation for their size were more likely to create employment than the less intense innovators. The high intensity innovators were more likely to conduct R&D; they were also more likely to buy-in R&D services, to collaborate, and to use different sources of information for innovation. This suggests a very wide sourcing of knowledge for innovation amongst these firms. Also notable from a policy-making perspective is that the most frequent barrier to innovation amongst the high intensity innovators was a lack of qualified personnel.

At the other end of the spectrum the analysis which divided the innovators by the source of their innovations suggests some of the ‘innovators’ identified by the CIS-2 might really be ‘technology adopters’. This goes to the heart of what is meant by innovation, not least in services. This points to the need to understand more about the nature of innovation in services (and the nature of the interactions between technologies and organisational forms), and not just settle for classifying enterprises as ‘(technological) innovators’ or ‘non-innovators’, and thereby derive statistics on ‘the proportion of innovators’ in each sector or country.

Section 4 Methodological Commentary and Recommendations

This section discusses the methodological aspects of the CIS-2 survey with a view to providing lessons for future innovation surveys of this type. In particular, 4.1 considers the diversity in services; 4.2 highlights some issues from the literature which have not been addressed by the CIS-2 and therefore not considered by the analysis in this report, whilst 4.3 provides some methodological recommendations for future versions of the CIS. Section 5 will provide a discussion of the policy implications arising from the findings of the literature and from the data assessed in this report.

4.1 Seeking a Fuller Understanding of the Diversity within Services

The first point to emphasise is that there is tremendous heterogeneity amongst services. Both the literature reviewed for this study and the empirical analysis confirm this important point. Immense diversity exists in the sorts of activities undertaken by service firms, as well as in the knowledge bases upon which they draw for their day-to-day and more innovative activities. It seems likely that this diversity is even greater than that within the manufacturing sector. As long as services are broadly defined, often in terms of what they are not (i.e., not manufacturing, and not mining nor agriculture), researchers and policymakers will find it difficult to understand services as 'a sector'. A first step towards a fuller understanding is the grouping or classification of the main services sectors in terms of what they do, or what they transform. There are sufficient broad differences between service activities to make us think that this approach would be valuable, at least to provide an overview of the dynamics that feature across different types of activities within 'the service sector'.

However, a sub-sectoral approach, even if more subtly conceived than in received statistical groups, is also bound to be limited. One reason for this is the great diversity that exists even at the sub-sectoral level. Even within a single category or sub-sector (eg 'transport' – which includes both airlines and taxi firms) differences may be so huge as to restrict the utility of generalisations. A second reason is that, within almost all service sub-sectors (as indeed in manufacturing), there is a strongly skewed size distribution of enterprises, with a few large and often trans-national concerns alongside a large number of medium sized regional or niche players, and a vast number of small and micro-businesses, usually with highly localised markets.

This is not to be defeatist about the ability of sectoral and enterprise-level analyses to yield useful material for understanding the dynamics of innovation within services. Even if internally diverse, the material presented does indicate that sub-sectors differ in ways that are substantial enough to enable us to provide broad-brush accounts of their evolution and innovation dynamics. Likewise, firms differ in important ways, but not in a wholly chaotic fashion. Broad groups of firms can be distinguished, and not only on a sectoral basis. There is much scope for exploring how far there are groupings of firms with common characteristics that exist in different sectors. For example, some types of information-intensive 'network' firm may have very similar patterns of IT use, and more in common with each other than with other firms within their 'sub-sector'. Similarly, the services providing technology development functions across different business service sectors are likely to have more in common, than with other companies nominally associated with them in engineering, design, computer services and telecommunications.

This leads into a third point. In addition to the diversity of scale and function within service sub-sectors, it can be argued that cross-sectoral activities are at the heart of many of the most important developments in contemporary economic life. These take many forms: in the context of innovation an important example is the 'filière'-type structures in the orchestration of network-related innovations at the heart of e-commerce. Many service firms collaborate within networks of innovators – sometimes as partners in the production of a new product (or in the construction of a new market) of common interest, and sometimes as customers, or lead users, helping to define the product and its market. Consequently, there is a need to understand these broader phenomena as well as variations at the sub-sectoral level.

4.2 Beyond Technological Service Innovation – Issues Overlooked by the CIS-2

This section addresses four important issues that arise in the literature on innovation in services which were not (adequately) addressed in the CIS-2 questionnaire, and which have therefore not been analysed in this report. These are: client intensity and the standardization or specialization of service activities; the role of intellectual property protection; the role and significance of organizational and managerial innovation, and the role and significance of regulations and standards in service markets.

4.2.1 Client Intensity and the Standardization-Specialization of Service Activities

Service enterprises are often characterised in the literature as having very close relations with their clients, such that the service provided is tailor made to the client's requirements. This client intensity is also widely supposed to be a critical feature of innovation dynamics in services. Although the CIS-2 provides some information on the role of customers and suppliers in the development of innovations (as sources of information, or partners in co-operative arrangements for the development of innovations) it is not possible to gauge the true nature and importance of supplier-client relations in services and their innovation activities. For example, it is not clear to what extent the services provided are standardized (unchanged from customers to customers), or to what extent they are customized for individual clients. Customization of services can be achieved by various means – for example by the provision of one-off bespoke services, conceived and produced on a one off basis (building designs are usually bespoke), to by the modular composition of a variety of standard components into a customized service package (transport enterprises often provide such services).

This also relates to innovation. Does the provision of a customized service equate to innovation, or is the innovation found mainly in the ability to provide customized services, particularly at a diminishing cost? Information technologies are especially important in facilitating the provision of customized services – and the interaction between the adoption of these technologies and trends in the provision of more standardized or customized services within different service activities requires further investigation. This issue is pertinent for (innovation in) manufacturing as well as services.

4.2.2 Intellectual Property Protection in Services

The relationship between innovation and the protection of the intellectual ideas underlying the implemented ideas has long been a central concern of innovation analysts. After all, the temporary 'monopoly rents' arising from successful innovation are one of the key incentives for innovative behaviour. The CIS-2 demonstrates that, unsurprisingly, patents are rarely important services, particularly as a source of information for innovation, but the survey provides little guidance as to whether and how service enterprises seek to protect their investments in innovation against rapid imitation or even theft (as in the case of software of music piracy). Indeed, as the survey is based on a 'new to the firm' definition of innovation it is probable that most of the innovative activity recorded is imitative rather than 'new to the industry-market' innovation.

It may be that, in the long run, service enterprises tend to derive their competitiveness from process innovation – finding cost savings for the provision of quality outputs, whilst service 'product' innovations and changes in the way in which the enterprise relates to its customer base are important in the short run. If this is the case, service enterprises may expect that their service 'product' innovations are rapidly copied, and may even introduce new service products primarily to maintain a dynamic and up-to-date image. However, it is also possible that service enterprises may expect to compete on the basis of service product innovations and may take steps to prevent rapid copying, either through intellectual property instruments or through building up complementary assets (in distribution, for example), which make rapid copying by rivals more difficult. Unfortunately, the CIS-2 sheds little light on these aspects of innovation and competitiveness in services.

4.2.3 Organisational and Managerial Innovation

The CIS-2 aimed to investigate technological innovation in the service sector. The stress on the term 'technological' is important, for explicitly excluded were 'organisational and managerial

changes such as the implementation of advanced management techniques, the introduction of significantly changed organisational structures …' as well as 'the implementation of a quality standard such as ISO 9000' (Eurostat Questionnaire). On the other hand, innovations such as the introduction and use of 'cellular phones to reroute drivers throughout the day' were explicitly considered to be technological innovations (Eurostat Questionnaire), even though these might be regarded as primarily organizational innovations (which involve the essentially unproblematic use of standard technologies).

This raises two important issues – the role and significance of organisational or managerial innovations in their own right within services (and indeed manufacturing), and the interactions between organisational and technological innovation. Many important innovations in services have strong organisational components, and some, for example self-service innovation, are essentially organisational rather than technological innovations. Organisational change – such as quality improvement methods and just-in-time, have led to the development of new bundles of service products, or to more effective processes for the production and delivery of services. Technologies are of course often used in such changes, but the impetus is primarily organizational or managerial, with technologies used to facilitate or execute the innovation. The case of telephone call centres is a good example. These are both technological and organisational innovations, but, arguably, primarily organizational innovations. Such significant changes may be overlooked in the current survey, unless the respondent considered any new technological element that accompanied what is primarily a change in procedures or the division of labour. While our ability to classify organisational innovations may be less well developed than is the case for new technologies, there is no reason to think that we could not investigate such changes through roughly analogous methods. Moreover, the interaction between technological and organizational change needs to be better understood.[32]

4.2.4 Regulations and Standards in Service Markets

The CIS-2 does not permit much analysis of the role or impact of regulations and standards on innovation in services. There can be little doubt that regulations and standards are important in many, if not most services, in terms of shaping the pattern of activities – encouraging some forms of innovation whilst restricting others. Yet, in general, as with the interaction between organisational and technological innovation, the relations between regulation and (technological) innovation dynamics remain poorly understood. This issue needs to be addressed in more depth than is possible by simply asking whether or not standards and regulations hinder innovation or are sources of information for innovation. Regulation is an important feature of many service sectors, and has considerable bearing on innovation processes. The causes of regulation in services are multifold – the intangibility of some products, and the closeness of relations to clients, has in some cases led to pressure for consumer protection or strong professional standards, while the strategic nature of other services to the national economy and polity, and in some cases the consideration that these are natural monopolies, has led to state ownership or at least heavy control of certain (utility) services. The influence on innovation is likewise manifold. Some service firms are effectively restricted in the innovations they can make by regulatory authorities (this has affected many banking innovations, for instance), and sometimes their core service 'product' is effectively determined (and hence standardized) by regulatory requirements (e.g. much of the core work of accountants). The consequences may include more focus on additional service activities (e.g. support and consultancy services), and/or more focus on process or customer-interaction innovations (e.g. efforts to enhance customer loyalty by more efficient or more customised services, or new modes of service delivery), rather than focusing on the core 'product'.[33]

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[32] A related topic concerns 'servuction' innovations – those centred on client-supplier or other inter-organisational relationships. Often these will involve technological elements – ATMs, Websites, and even motorcycles and cardboard containers for pizza deliveries (and more generally, this related to the issues of the complementarities between hardware and software when dealing with information technologies, such as broadband modems using traditional copper wires, fibre optics, satellite data transfer, general digitalisation processes, and so on). Sometimes there will be little in the way of 'new' technology involved here – a website might already have existed as a marketing tool, the motorbike may have been used for other trips. But whether or not there is a substantially new technological element, we suspect that respondents will frequently overlook such innovation on the grounds that they deal with the organization of the customer relationship, not with the core product or service provided. These are important issues, which unfortunately the CIS-2 does not permit analysis upon. Moreover, it is probable that such innovations are overlooked even more frequently (when they are implemented) by manufacturing firms, which are likely to fail to recognise these as either product or process innovations.

[33] Furthermore, the recent spate of privatisations, especially of (water, electricity, gas and telecommunications) utilities, but also the selling of TV broadcasting rights and the radio-spectrum for mobile communications, have also had important implications for the nature and extent of innovation in services. For example, by changing the competitive environment, and often the management structures as well as access to finance, a new impetus to innovation has been provided to these services. The end result may not always be accelerated innovation – it has been suggested, for instance, that privatised companies have sometimes drawn back from some of the longer-term and 'public good' R&D they previously undertook. The point is that rather than assertions about how the changes have affected innovation, more substantial research is required to document and analyse what changes have actually taken place, and why.

Finally, an issue closely related to regulations is that of standards. These also have a considerable bearing on many services. This relates to many innovations involving large networks, and/or demanding the complementary adoption of new technologies by business partners or clients (e.g. the use of bar codes, credit cards, etc.) The impact of standards-setting can be illustrated by such cases as mobile phones or (digital) TV broadcasting rights. The imposition from above of a single GSM standard (i.e., restricting innovation) for mobile phone systems gave Europe a world leadership in terms of diffusion of cellular handsets, and has resulted in rapidly declining (comparable) prices, both for handsets and for the charge per minute of conversation. The variety of co-existing standards in the US has prevented similar virtuous processes. Clearly, the relationship between standards and innovation in services deserves further attention.

4.3 Methodological Recommendations

The inclusion of 'market services' in the second European community innovation survey is certainly a positive step. 'Market services' constitute over half the European economy (52% of value added in 1997 – Eurostat, 1999) and their economic contribution (together with non-market services) will undoubtedly grow in the future, yet we know relatively little about services, and innovation trends in services. The main results and contributions to our understanding that have been derived from our analysis of the CIS-2 data are presented in Section 3. The purpose of this section is to address the methodological recommendations which we consider would improve the next versions of the community innovation survey. We address two main issues – the first is the nature of the survey in relation to it core purpose, the second concerns the coverage of the service sectors.

4.3.1 The Core Purpose of the Survey

The first issue we address is the core purpose of the survey. We consider that the core purpose of the survey combines two, somewhat opposing, main aims:

- The first is an attempt to measure the extent of innovative behaviour amongst enterprises. The aim of this exercise is to provide summary statistics of the sort: *X*% of enterprises in country *Y* and sector *Z* were engaged in innovative activities between the years *A* and *B*. There is also the aim of providing summary statistics on the extent of expenditures on innovation and, to some extent, on the extent to which various sources of information are used, the various barriers to innovation and the extent to which different partners are engaged for innovation projects. Thus to a large extent this purpose is *an attempt at understanding representative behaviour with respect to innovation* in given countries and in given sectors.

- The second purpose is to enhance our understanding of the inter-linkages between the innovative activities of the enterprises and differences in their (commercial) behaviour.

We consider the survey used for the CIS-2 illuminates important facets of the innovation process, but still poses difficulties in providing evidence with respect to both of these aims. We assess each of them in turn.

4.3.2 The Survey as an Instrument to Measure the Extent of Innovative Activities

With respect to measuring the extent of innovation in enterprises there is a problem with the definition of innovation – particularly technological innovation, and with dividing enterprises simply between those that engaged in innovative activities and those that did not. We have seen earlier in this report that the proportion of enterprises identified as having innovative activities varied widely between countries - from just 15% of Belgian service enterprises (with 10+ employees) to 60% of such enterprises in Ireland. Although there are reasons why the proportion of innovators in one country may differ from that in another, it is likely that a large proportion of the difference is due to differences in the interpretation, within the various national cultures or linguistic traditions, as to what constitutes (technological) innovation. The fact that these wide differences existed in manufacturing as well as in services only strengthens this conclusion. Because of this, it is doubtful whether we can really state that enterprises in one country were more or less innovative than enterprises in another, even if the proportions of enterprises with innovative activities are found to be substantially different. It is also questionable whether comparisons can be made between sectors within the same country

using this data, for even within individual countries the understanding of what constitutes (technological) innovation may differ markedly between enterprises in one sector (e.g., wholesale trades) from that in another (e.g., computer services).

Beyond this, whilst the aim of gathering detailed information on innovation expenditures is laudable, there are two key difficulties. The first is that there are likely to be many occasions in which an enterprise will find it impossible to unambiguously determine whether an expenditure was made (e.g., on training) directly in relation to innovation or not. The question of what constitutes 'training' or 'preparations' also arises – there is considerable scope for interpretation – and this ambiguity builds on the ambiguities in the definition of innovation. Consequently, it is quite possible that two equally informed managers completing the survey for the same enterprises might consider the enterprise had made quite different expenditures on innovation in the year in question. The second difficulty relates to asking about the extent of spending on innovation in a single year – if innovation expenditures are lumpy (i.e., varying widely from one year to the next), as they are likely to be in small firms, this can potentially introduce a significant error in the accounting unless the samples are very large. The use of a single year for this question also introduces a problem in terms of relating innovation expenditures to commercial performance, as we noted earlier.

There is a second reason why the current survey is limited in terms of illuminating the extent of innovation in a particular sector or a particular country. This is that a statement such as '*X*% of enterprises in country *Y* and sector *Z* were engaged in innovative activities between the years *A* and *B*' merely provides an indication of representative behaviour. Yet innovation is not about representative behaviour, but about change, and all genuine innovations are different. Thus in one sense innovations cannot be directly compared, and nor can 'the proportion of innovators' be compared – this is not philosophically the same as assessing the proportion of households with a car or colour television, for example.[34] Introducing an attempt to rank innovations – from minor or incremental to ground breaking or radical would help, but would not eliminate the problem of incomparability. Certainly, the current approach to assessing the extent of innovative activity in different countries and sectors is seriously flawed. Nonetheless, the survey does provide a uniquely valuable basis for enquiry into the nature of innovative activities within enterprises.

4.3.3 The Survey as an Instrument to Understand the Nature of Innovative Activities

As an instrument for understanding the nature of innovation, in terms of the aims of innovation, the sources of information used, factors hampering innovation and patterns of co-operation the CIS-2 provides valuable data. However, limitations of the survey methodology reduce the usefulness of the information gathered, both from an analytical and from a policy perspective.

The first difficulty is that the survey mixes the objective (innovation centred) and subjective (i.e. firm-based) approach to examining innovation behaviour (Archibugi, 1988). Thus it asks what aims or objectives of innovation, and what sources of information, were 'relevant' or 'very important', what collaborations were entered into, what factors hampered innovation, etc., alongside questions on the conduct of R&D, patenting and innovation expenditures. Whilst we see the relevance of the questions on sources of information, collaborations, etc., these are much more informative in surveys which focus on particular innovations – i.e., object based innovation surveys. As it is, especially with large enterprises which have introduced numerous innovations, a large number of information sources are usually identified as relevant or even very important. This is quite possibly because different types of innovation have depended on different sources of information. An alternative approach for the future versions of the survey would be that it ask about these matters in relation to the enterprise's single *most important innovation* (which should be identified and classified as a product, service, process, delivery or organisational innovation – see below). Contextual issues, such as whether the firm engaged in R&D could still be asked about.

Alternatively, the survey should remain an assessment of innovative activities within firms (i.e., using subject based approach). However, for this the current survey also has serious flaws. A basic flaw is that the survey does not contextualise the innovative activities undertaken by the enterprise; this should be done by considering at least two dimensions:

[34] Also because enterprises vary more widely than households, not least in size, so even if innovations could be directly compared it is necessary to control for other aspects of the firms, such as size, before comparisons have meaning.

- The first is the enterprise's current position vis-à-vis its principal competitors and with respect to (the profile of) customer requirements. For example, the enterprise may be a low cost provider of basic services, essentially competing on price where most of its competitors place a greater emphasis on 'quality of service'. The 'no-frills' airlines such as Easy-Jet and RyanAir are examples of enterprises that have taken this position vis-à-vis established airlines. Alternatively, an enterprise might see its competitive position as based on the provision of the most technologically sophisticated services – price being a very secondary consideration. Some software enterprises are likely to follow this strategy.[35] We consider that only by understanding the diversity of the competitive bases of the enterprises can we hope to understand (the diversity of) their innovative activities (and derive from this valuable policy conclusions). We should note here that the competitive context the firm operates in may be changing, so the firm may have to innovate merely to hold its current position.

- The second dimension is the enterprise's strategic intent (Hamel and Prahlad, 1989) – what is the management's ambition for the enterprises in the context of its current position vis-à-vis its (changing) competitors and (changing) customer requirements. For example, an enterprise may seek to go 'up market' – providing higher quality services with higher margins than it currently does; it may seek to become a larger player by providing services on a wider temporal and/or spatial basis; it may also seek to broaden its service provision through the standardization, routinization and/or automation of tasks previously undertaken on a 'craft' or 'professional' basis. Alternatively, it may be content with its position and merely seek to retain it. The question is how does the firm's innovative actions relate to its strategic intent.

We submit that only by understanding the context of innovation can we properly understand the innovative activities of the enterprise, and from this derive policy conclusions which take account of the diversity of behaviour amongst European enterprises.[36] A feasible aim for a CIS-type survey could be to seek an understanding of the inter-relationships between the ambitions (or strategic intent) of the firm, its competitive circumstances (and capabilities to maintain or change these circumstances), and its reactions in terms of innovation. This is undoubtedly difficult to achieve, but such an analysis would relate innovative behaviour and innovative performance to commercial outcomes and commercial performance – which is the basis for the Schumpeterian interest in innovation in the first place, and would provide extremely interesting information from a policy makers perspective. We cannot expect all enterprises to be innovators or equally innovative, but, by better understanding the diversity of enterprises, policy instruments can be (re)designed to better suit the diversity within the population.

In this context, a second flaw in terms of understanding innovation in enterprises is the excessive privileging of technological innovation. We have already discussed this to some extent in Section 4.2.3, but methodologically the first difficulty here is that technological innovation is hard to define (as the long and convoluted definition used on the CIS-2 questionnaires testifies), being interpreted differently in different languages and cultures. A second difficulty is that there is little reason to believe that enterprises only achieve advantages through technological innovations. Even within high technology sectors where technological innovation is at its most important other forms of innovation are also likely to be important (See Section 4.2.3). We therefore propose four changes in relation to understanding the nature and role of (different types of) innovation in the enterprise:

- Firstly, the questionnaire should not rely on an extensive definition of (technological) innovation, nor ask the enterprises whether they have introduced a 'technological innovation', and using this as a gate question that then excludes all 'non-innovators' from the rest of the survey. We doubt that most respondents will have read and considered fully such an extensive definition of (technological) innovation before responding. They are more likely to respond on the basis of their existing intuitive understanding of what is and what is not

[35] In restaurants and hotels (which were not covered by CIS-2) competitiveness might be based on providing highly fashionable services in a very pleasant ambiance, whilst some others compete on the basis of providing low cost fast food.

[36] We note that an attempt at understanding the competitive context of innovation was made in a previous innovation survey – a question about the nature of the enterprise's competitiveness was successfully asked about in the 1995 survey of German service enterprises that was carried out for the German government. We also suggest that this is best done by asking the managers responding for the enterprises to rank a series of statements from 1 (Strongly disagree) to 5 (Strongly agree) concerning the nature of the enterprises competitiveness (relative to its major competitors and to the nature of customer demands). It may be best to tackle this through two sets of questions, the first making a series of statements about the nature of the services provides by the enterprises (some relative to the services provided by the enterprise's principal competitors), which the respondent is asked to indicate a degree of agreement or disagreement to, whilst the second question would focus on how these relationships with the market have changed over time. The aim of these questions is to gain an understanding of whether and why the enterprises has changed its position vis-à-vis its competitors and with its customers

(technological) innovation – which appears to vary by country and by sector. An alternative approach would be to ask a series of questions about actions the enterprise has taken which relate to innovation. By asking a series of question about actions, innovation then need not be explicitly or extensively defined. We would also ask all questions to all enterprises, thus gathering information on what are currently classified merely as 'non-innovators'.

- The second change we recommend is that a wide variety of innovative actions are asked about – not just technological innovation. A flaw of the CIS-2 is that for services it groups together all 'technological innovation' (in terms of 'new services, and methods to produce and deliver them') into a single category. We consider that it is important to understand the extent and nature of different types of innovation, including (at least):
  - **Product Innovation**: Here we consider that products are the core of what the enterprise, be it a manufacturing or a service enterprise, provides.
  - **Service Innovation**. We consider that services are peripheral to products – that is they support or extend the core of what the enterprise provides in terms of its products. We consider that it is important that product innovation and service innovation are not conflated, for such a merger removes an interesting aspect of innovative behaviour.
  - **Process Innovation** relates to the process of production or provision (but not delivery – unless this is integral to the process of production/provision). Process innovation should therefore strictly cover changes to the actual production of the core products; it should not cover changes in 'up-stream' activities such as changes in the designing of new products.
  - **Delivery and Client Interface Innovation** relates to changes in how the enterprise interfaces with its customer base and how it delivers its core products to its customers. The Internet, for example, is changing the way many enterprises interface with their customers, and the ways in which they are delivering their core products to them.
  - **Organisational Innovation**. The exclusion of organisational (and managerial) innovation from the CIS-2 (in addition to the privileging of technological innovation) is unfortunate. Innovation scholars know most about technological innovation (especially in high technology enterprises) and relatively little about organisational innovation (or about the interaction between technological and organisational innovation). Yet organisational innovation (assisted by the use of technology – but not primarily technological in orientation) is at the heart of the innovation strategies of many if not most service firms, as well as in many low technology manufacturing firms.[37] We consider that organisational innovations are changes in the organisation of the enterprise, for example moving to a lower cost location, or changes in the structural division of the enterprise.
  - Questions relating to the magnitude of innovation efforts and impacts in all of these, as well as the interactions between them.
- Thirdly, there can be little doubt that information technologies are having a major impact on (innovation in) service sector activities. We propose that a series of questions are asked about the use of different information technologies and how these are affecting the enterprise in terms of the products and services it provides, as well as the process and organisation of production. The relationship between investments in information technologies and strategic intent and competitiveness should also be investigated. This is certainly an important issue for policy making – for example in terms of the likely economic impact of e-commerce.
- Fourthly, it is well recognised that the 'human element' of services is often very important, and moreover as services expand and manufacturing contracts it is important from a policy making perspective to know more about the nature of service employment and the changing skills requirements of service employers (in the context of the changing nature of services). We therefore propose that a series of questions be asked about the structure of employment by skills, how these are likely to change due to innovation, and the difficulties experienced in relation to recruiting labour with suitable skills.
- Finally, given the importance of and/or unfamiliar shape taken by issues such as the protection of intellectual property, the roles of regulation in driving or restricting innovation, the

[37] e.g., the use by insurance companies of telephone call centres is also at least as much an organisational innovation as a technological one.

salience of standards of various kinds (and service standardisation) to many services, we propose the questionnaire be revised to allow more consideration be given to such factors.

Such changes would move the survey away from being a 'mapping' of the extent of (highly variegated) innovative behaviour. Instead, it would allow for more of an understanding of the diversity of behaviours amongst firms, within the context of the enterprises' competitive positions and strategic intents. It is also important that both technological and non-technological innovations are considered (as well as the interactions between these), together with the important issues of the impact and role of information technologies and of human skills on the (changing) activities of enterprises. In summary, the current survey is too much a tool for counting up the number of innovative and non-innovative firms in each sector of each economy and reporting the characteristics of behaviour amongst innovators, whilst its design makes it much more difficult to answer some of the more interesting (policy relevant) question about how innovation relates to the strategic aims of the firms and their commercial or economic performance.

In this section especially, we have aimed to be provocative and to provide thoughts about how the nature of the CIS might be changed to make it more informative in the future – over and above the specific problems of grappling with services innovation. We have therefore been critical of the current survey. But we must stress that the CIS is an important institution, providing valuable information, whose recent inclusion of services is very welcome. Indeed, the coverage of services should be expanded, as we argue in the next section.

4.3.4 The Coverage of the Survey

Apart from the purpose of the questionnaire, another important methodological issue is its coverage. The inclusion of services in the CIS-2 has been an important step towards a fuller understanding of services and the role of technological innovation within services, yet it is important to understand that the coverage of services by the CIS-2 was still limited in two dimensions – by sector of activity and by enterprise size.

Table 4.3.1: The NACE-Rev.1 Two-Digit Service Sectors Included and Excluded from the CIS-2 and their Contributions to Total Employment in Market Services in the EU 1997

Sectors Included	NACE-Rev.1	% of Total Employment	Sectors Excluded	NACE-Rev.1	% of Total Employment
Wholesale Trades	51	9.8 (9.9)	Motor Vehicle Sales, etc.	50	6.0 (5.9)
Land Transport	60	7.1 (6.6)	Retail Trades	52	25.7 (24.4)
Water Transport	61	0.5 (0.4)	Hotels and Restaurants	55	11.3 (10.4)
Air Transport	62	0.7 (0.7)	Ancillary Transport Services	63	3.4 (3.9)
Post and Telecommunications*	64	4.8 (5.1)	Real Estate Activities	70	2.3 (2.7)
Financial Intermediation	65	2.2 (6.2)	Renting of Machinery, etc.	71	0.6 (0.7)
Insurance and Pension Funding	66	1.4 (2.2)	Research and Development	73	1.1 (1.3)
Other Financial Services	67	2.3 (1.7)			
Computer and Related Activities	72	2.2 (2.4)			
Other Business Services*	74	14.8 (15.7)			

Note: * Sector only partially included; figures in parentheses are for the 12 EU countries with CIS-2 services surveys
Source: derived from data provided in Table 4.3.1 of Eurostat, 1999

Table 4.3.2: Employment in Sectors Included and Excluded in the CIS-2 as a Proportion of Total Employment in Market Services in 1997

	EU15	A	B	D	DK	F	FIN	IRL	L	NL	P	S	UK
Sectors Included	28%	30%	34%	34%	27%	32%	35%	34%	57%	34%	26%	34%	25%
Partially Included	20%	17%	20%	22%	20%	23%	21%	17%	13%	24%	16%	25%	22%
Sectors Excluded	52%	53%	46%	44%	54%	46%	43%	49%	30%	42%	58%	41%	53%

Note: derived from data provided in Table 4.3.1 of Eurostat, 1999

By sector, the CIS-2 included only 'market services' and amongst these only the wholesale trades, the transport sectors (excluding ancillary transport services – such as travel agents), computer services, telecommunications (excluding postal services) and technical services (excluding all other 'other business services'). Amongst the 'market service' sectors excluded were the sale and repair of motor vehicles, retailing, hotels and restaurants, real estate activities and research and development activities. These 'excluded sectors' form a substantial part of 'market services' in Europe. Indeed,

overall and within the 12 EU countries that participated in the CIS-2, the NACE-Rev.1 two-digit sectors that were included in the survey accounted for 29% of total employment in 'market services' (in 1997 – Eurostat, 1999), whilst those sectors that were partially included accounted for a further 21% of 'market services' employment,[38] yet the sectors excluded accounted for half of all employment in 'market services' in 1997. Given that some sectors were only partially included, this means less than half of 'market services' (weighted by employment) were included in the survey. 'Non-market services' such as education and health were also completely omitted. Clearly there is a strong need to expand the coverage of 'market services', but it would also be desirable to (undertake a perhaps adapted survey to) investigate the nature of innovation in non-market services. **By enterprise size**, the CIS-2 for service sectors only included enterprises with 10 or more employees. This, however, excludes almost 95% of all market service enterprises in the European Union and the 40% of employment in 'market service' activities that these enterprises employ.

Taken together, the restrictions by sector and enterprise size on the survey's coverage mean than only around 20% of the economic activity (as proxied by employment) within 'market services' was included in the CIS-2. This is a serious limitation if the survey is an attempt to measure the extent of innovation in services, but also presents a serious limitation if the intention is to seek an understanding of the nature of innovation in services. We therefore urge Eurostat and the national statistical agencies to expand the coverage of the survey in the future, to include a larger number of sectors and to reduce the size threshold of service enterprises included.[39] This would increase the proportion of economic activity covered by the survey.

Table 4.3.3: Distribution of Employment by Enterprise Size Class in the EU in 1995 (%)

	0 – 9 employees		10+ employees	
	Enterprises	Employment	Enterprises	Employment
Market Services	94.8%	40.0%	5.2%	60.0%
Distributive Trades	95.1%	48.6%	4.9%	51.4%
HORECA	94.2%	55.3%	5.8%	44.7%
Transport & Communications	93.1%	22.4%	6.9%	77.6%
Financial Intermediation	94.1%	12.8%	5.9%	87.2%
Real Estate, Renting and Other Business Activities	95.0%	38.4%	5.0%	61.6%
Manufacturing Industries	80.7%	13.8%	19.3%	86.2%

Note: HORECA - Hotels, Restaurants and Catering; Source: Table 3.8 & 3.9 – Services in Europe, Eurostat, 1999

Table 4.3.4: The Number of Responses to the CIS-2 Survey for Manufacturing and Services

	A	B	D	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Manufacturing	846	1,164	1,686	4,986	909	440	116	2,698	1,329	801	727	1,248	16,950
Services*	416	850	1,008	2,663	619	283	192	2,579	961	1,036	749	576	11,932
Services / Man.	49%	73%	60%	53%	68%	64%	166%	96%	72%	129%	103%	46%	70%

Note: Services here includes the Utilities (NACE-Rev.1 40 and 41) sectors

A final issue is the sample sizes used to investigate services, which need to be large if the diversity of activity is to be properly captured. Given the economic importance of the service sectors this is a significant matter, and it is also important that the statistical agencies undertaking the survey do not consider services secondary to manufacturing. It is notable that for the CIS-2 only in Portugal and Luxembourg were the number of responses from the services sectors (here including the 'utilities' sectors) significantly greater than those for manufacturing, despite a lower threshold of employment size threshold for inclusion (10, instead of 20) being used for services than for manufacturing. Although this may be understandable as the CIS-2 was the first survey of services in most countries, whereas CIS-1 had already covered manufacturers, it is vital that the service sectors are more fully and properly covered with large samples in the future CIS. Indeed, for most countries the number of responses from services should exceed those from manufacturing by a ratio of 2:1 – reflecting the greater economic significance of services. We also consider that the reforms we have suggested in this section – aimed at making the survey less focused on (examining the extent or incidence of) technological innovation – would make the survey more appropriate for service sector enterprises.

[38] Most of this was excluded – as most is due to 'other business services' (NACE-Rev.1 74) other than 'technical services'.

[39] For example to those enterprises with 5 or more employees. We appreciate there are difficulties with surveying very small enterprises.

Section 5 Policy Conclusions

The Community Innovation Surveys make an important contribution to understanding the nature and sources of innovation, and provide valuable information for devising policy instruments to support enterprises and their innovative activities. There is a need for both generic and specific policies to support innovation in the service sectors. Policies should give room for the development of diversity whilst, at the same time, tackling common threats, weaknesses and barriers. The aim of this section is to suggest appropriate policy approaches that encourage diversity whilst also seeking to reduce common barriers to innovation. Below, we discuss a number of policy relevant issues which have arisen in the course of the analysis undertaken for this report.

5.1 Services – The Centrality of the Human Element

Services dominate economic activities and employment in Europe; most new jobs are also found in the service sectors. Hence, whilst maintaining the competitiveness of the manufacturing sectors is important, it is primarily to services that policy-makers should look for future employment and wealth creation. It is important therefore to understand the basis of competitiveness in services, particularly in order to maintain and increase the supply of high quality employment in European services. Within this context it is important to understand that in services innovation is typically more about mobilising human intellectual resources than is typical for manufacturing (particularly large-scale manufacturing), and therefore innovation-policies for services need to focus on this.

In many services, employees are more deeply involved in the provision and delivery of the outputs, and in the innovation process, than is typical in manufacturing. In such services, the knowledge and skills of employees are of crucial importance to the competitiveness of the enterprise. Consequently, the need for a well-educated workforce is fundamental, and policies need to take this into account. For example, it makes little sense beyond political expediency to reduce access to education, such as introducing charging fees for higher education.

Training is another important issue. Enterprises which depend heavily on the human capital of their employees may need to invest considerable resources in training those employees, but they may be reluctant to do so where they fear their trained employees will become attractive to their rivals who do not themselves invest in training. This is even more of a problem when the trainee gains knowledge of the core competitiveness of the service firm that trains him/her. This knowledge then becomes transferable, at least to some extent, with the employee. Consequently, even enterprises that train their employees may do so in a highly company specific, or job-restricted ways, in order to reduce the transferability of employees, and to reduce the potential knowledge spillover to rivals when employees do transfer. Of course freedom of labour mobility is an important principle of human rights, which should not be infringed, but steps could be taken to alleviate this situation. For example, training subsidies could be provided, making workers' training a public rather than a private issue. Failing that training levies might be charged on enterprises that do not conduct sufficient training, or the enterprise that invested in training might have rights to compensation from any enterprise that takes their trained employees whilst they are still under contract. These are of course difficult issues, and would have to be considered in detail before measures were taken. Yet the issue is significant.

Alongside this, there is a need for a readjustment on behalf of the training agencies, including much of higher education, which tend to display a manufacturing bias. Many existing specialised groups research manufacturing technology, but few focus on services technology, and those that do consider services only embrace innovation to a limited extent. Knowledge Intensive Business Services (KIBS) in particular face many of the problems of 'hybrid management'[40] that have been identified as critical for the knowledge-intensive economy, so ways of fostering the development of such skills are a priority. For example, attention is required to support the particular mixes of organisational, interpersonal and technical skills that are required by services and KIBS in particular.

[40] That is people in place who are able to fuse knowledge of technical and organisation-specific issues with knowledge of clients, markets and organisational environments.

5.2 The Professionalisation of Services

One of the trends in services is towards greater professionalism, and job definition by function. This is particularly the case amongst knowledge intensive services, and those that conduct their business through interactions with their client base. These services are unlikely to organise their innovation and technology development activities in separate, specialised R&D units, the mode of innovation associated with (particularly large scale and high technology) manufacturing.

The professionalisation of these services can be driven by regulations and standards, set by public authorities or by professional associations – these demark what services are provided, often at what cost and also the methods of provision. Such arrangements may stifle innovation – or particular avenues of innovation, but they may also encourage the provision of high quality services, which can create both barriers to entry for foreign firms, as well as providing export opportunities. Clearly the regulation of such services is difficult, particularly in terms of balancing the acceptable quality (and hence providing guarantees as to the nature of the service that) against providing scope for change.

One area of change that is important and that should be encouraged is the provision of semi-professional services by semi-professionally qualified personnel – for example, para-legals do not provide the full range of legal services but specialise in the more routine legal functions, thus being able to provide high quality legal services at a much reduced cost compared to conventional legal practices. Para-medics perform similar roles in health services. The point here is that professionalism is often used as a barrier to both entry and change, which prevents innovation and the search for new and efficient work practices.

Information technologies are also important in the professionalisation of services, in terms of providing services of more consistent quality. The use of information technologies for the provision of customised services, perhaps through the combination of standard modules in service packages, should also be encouraged as a means of providing quality services at reduced costs.

There is plenty of scope here to identify best practice and to encourage the exchange of information in relation to these issues. This should result in: increased awareness of innovation possibilities and strategies among a wider range of service firms; speedier response to, and better feedback from, policy support measures; and a more level playing-field for competition between service firms. The service innovation centre approach is probably the best way for the public sector to facilitate the growth of a European innovation system within the service sectors.

5.3 Developing Innovation Routines

In general it is possible that service enterprises innovate less frequently than manufacturers – one reason for this is that service enterprises tend to be smaller, and generally the regularity of innovation increases with enterprise size. Consequently, there is likely to be an underdevelopment of management capabilities to induce and carry through innovation processes within individual service firms, and poor development of innovation systems to support services. These capabilities could be improved by the provision of service management training courses, and by more focus on innovation management in services in business schools, but also by the provision of guidance information and/or training materials and demonstration programmes from public authorities over the Internet, for example. Coupled with this might be awards recognising good practice. Mechanisms by which service firms could benchmark their performance could also be useful.

Ultimately, it will probably be seen as less important to distinguish services from other sectors of the economy, than to systematically analyse the range of organisational forms adopted and functions performed across all sectors, and the sorts of innovation associated with each. Arguably, the most exceptional sector in the economy is large scale manufacturing (with its heavy dependence on R&D for innovation for example), rather than services. In the short term, however, there is virtue in focusing on services on account of their general neglect - and because the aspects of innovation which are more generally overlooked seem to be particularly prominent in many services.

5.4 Supporting Service SMEs and Services Supporting SMEs

As mentioned earlier, most services sectors are dominated by small and medium sized enterprises – this is also true of manufacturing, but the dominance of SMEs tends to be greater in services. Existing industrial policies are often focused on manufacturing, and even when not explicitly excluded from programmes, small service firms often fail to recognise that they are eligible for programmes that support innovation and training, or for the invitations to join innovative networks. Some technology (transfer and diffusion) policies have fostered the establishment and growth of service firms, particularly knowledge intensive business service firms (such as consultancies providing management awareness services).

SMEs are also potential users of business services. But many service enterprises have tended to gravitate toward servicing large companies, with the exception of some specialists in niche markets. In part this reflects the relatively expensive nature of some services, particularly knowledge intensive business services (KIBS). But SMEs are likely to be further deterred by problems in defining their needs and identifying appropriate providers. Support could be made available to help SMEs do exactly this.[41] Support could also be forthcoming for programmes which demonstrate to SMEs the scope for their use of the services supplied by KIBS; this might involve schemes designed to introduce sectoral user communities to appropriate services. Moreover, the KIBS themselves will probably be required to change their orientations if they are to adequately serve SMEs. The nature of the advice and other inputs they make will often need to be tailored to the specific circumstances that SMEs face, and support might be provided to assist with this process.

5.5 The Industrialisation, Internationalisation and Consolidation of Services

Although services are often characterised by having close relations with their client base, and therefore with the provision of services on a small scale and localised basis, there is also a trend within some services towards 'industrialisation' (and internationalisation). McDonald's and other fast food restaurants are obvious examples, but more subtle forms of industrialisation are taking place through the use of information technologies which provide scope for the spatial decentralisation of services, and the provision of customised services through the compilation of standard service modules. Telephone call centres – dedicated offices where the work revolves around the computer assisted answering of telephone calls, normally for the provision of routine customer service information – relate to this industrialisation of services phenomenon.[42]

On the whole the industrialisation of services might be expected to lead to the provision of services of consistent quality at a low price. However, such changes can have dramatic effects on the organisation and provision of services. For example, the use of call centres often occurs in tandem with the closure of traditional outlets, such as high street branches. This can leave some people and businesses without access to services they previously depended upon. A flip side of this situation is that the new channels may not be available to everybody – for example digital cable television is not accessible to all. This raises the important issue of exclusion – which is normally considered in relation to social exclusion but can also relate to the removal of access to business services.

A related issue is that the consolidation of services - from provision on a local or regional basis to being provided nationally or internationally – which often leads to the concentration of control functions in particular regions – London in the case of the UK, Paris in the case of France, for example. This then tends to concentrate demand for high-level services in particular cities or regions, exacerbating the existing inequalities. For example, the trend towards the concentration of high level functions in London, has led to a concentration of high value added services in that city; whilst, through the use of telecommunications, routine back office functions are increasingly located in the peripheral northern cities where there are relatively cheap female labour pools with few other opportunities. The result is an increased spatial division of labour in the UK. Moreover, these routine services conducted in the peripheral regions face two threats – firstly that customers will be able to undertake the work currently undertaken at call centres by themselves. For example, it is possible to obtain travel tickets, insurance quotes and many other financial services direct through the Internet, and the range of services that will be provided 'on-line' is only likely to increase. Secondly, there is

[41] An example is the Vanguard project with which the UK's Department of Trade and Industry tried to introduce sectoral communities of firms to the use of EDI and related services.

[42] According to Bristow et al. (2000) in the UK alone approximately 250,000 people worked in call centres in 1998 (around 1% of the workforce) and this was forecast to at least double by 2002.

the danger that the routine work may be transferred to lower cost locations such as Eastern Europe or the third world. This is already happening with call centres being established in India, for instance.

Perhaps the consolidation of service industries should be considered on a regional policy basis as well as on competition grounds. The consolidation of banking, the newspaper industry and now broadcasting in a few key cities is removing the high value added services from other locations. This can reduce severely the supply of well paid jobs in the cities left behind, but can also lead to overheating in the cities which become dominant.

There is also the risk that routine services will be increasingly imported from other countries, like to United States. The early lead the US has built up in on-line services means many of the more advanced Internet services are provided from the US, and this again encourages the clustering of high value added services in the US, the place of origin. One way in which the European Union can reduce the importation of cheap routine services, and encourage the provision of such services in Europe, is by setting high quality standards. This would encourage service providers to set up in Europe and export, rather than the other way around. This would further stimulate the market for high value added services in Europe.

5.6 Regulations and Standards

We have repeatedly referred to regulations and standards as being central to services. Although regulations and standards are often seen as a barrier to innovation (which of course they are), they are particularly important to services where the quality of service is unknown to the user prior to purchase. Standards and regulations shape the playing field – they should not be so tight as to prevent change or initiative – for example if they prevented the provision of the semi-professional services discussed above. They can also be used as a stimulus to the further development of high quality services, and value added services. The example of the GSM standard for mobile telephony demonstrates the value of agreed standards – providing Europe with a considerable lead over the US in mobile communications, and thereby encouraging the development of advanced mobile tele-communications technologies in Europe to greater extent than would otherwise have been the case.

Clearly, monitoring the impacts of regulations on innovation in services is important. Building innovation criteria into the regulatory framework should also be considered, for example insisting that privatised industries reduce prices by certain amounts, that they undertake R&D, or that they meet stricter environmental standards, encourages innovation and higher performance levels.

The regulatory environment and particularly standard setting must seek to respond rapidly to change – the emerging information technologies are primarily destined for use in the service sectors, and the software is provided by the service sector. It is therefore important that standards can be decided upon rapidly to allow innovation to proceed rapidly. A related issue is how open the standards are – on the one hand open standards encourage competition, on the other technologies that become de facto standards can take enormous resources to develop – this raises the problem of rewarding intellectual property investments, and protecting intellectual property rights. We also note that professional standards are at least as significant as technical standards in many services, particularly in professional services such as accountancy, law or medicine.

5.7 Intellectual Property Protection

Services are often heavily dependent on the intellectual input of the employees of the services provider, although information technologies are also increasingly embodying this knowledge. The rights to benefit from these endeavours, as well as to prevent copying and even theft is an important issue for services, particularly where theft and the copying of service concepts is easily achieved. This is an especially important problem for firms that are created on the basis of new service concepts – which are rapidly imitated by larger incumbents. In such circumstances, and without protection, enterprises have little incentive to innovate.

The protection of intellectual property in services is another difficult and complex issue, which we cannot discuss at length here. Suffice to say that patents (and registered designs) are of little relevance to services, except software, while copyrights provide limited protection. Trademarks and

brand names are relevant, but reflect commitments to marketing efforts rather than innovation. Perhaps the way forward is to consider new forms of intellectual property protection. Clearly these would need to balance reward to inventors in the short run against encouraging diffusion and competition in the longer run. This is an area where serious research should be undertaken.

5.8 Issues for R&D and Innovation Programmes

Finally we turn to R&D and innovation programmes. We have stated that services often rely on sources other than formal R&D for innovation, and therefore innovation support programmes need to recognise this fact. However, as some services become more industrialised they are likely to utilise R&D activities to a greater extent, so existing R&D programmes should be available to services as well as to manufacturing enterprises. Moreover, it should also be recognised that manufactured products are often now entwined with services – it therefore makes little sense to support the development of products without services.

It is probable that most countries' existing innovation systems are not effectively geared towards services, and their requirements for human, social and administrative knowledge. Consequently, some thought should be given in research and innovation policy to redressing the balance that is currently towards manufacturing. 'R&D' institutions to support service innovations, such as 'service laboratory' equivalents of industrial research associations might be established. Such service laboratories could also perform technical functions such as standards-development and compliance testing. Policymakers could also stimulate and facilitate more informal networks, to support the management and organisation of innovation in associated services.

What this means for R&D programmes needs to be explored in more detail. If these programmes are to proceed at least in part by means of task forces, or other modes of organisation based around problems or social needs rather than simply around technological disciplines or perceived opportunities, then it is important to ensure that due attention is given to services within these problem-solution sets. (Moreover, this should apply to services of different kinds - not just those involved with information and communications, for example, but also to human and physical services; and not just to conventional public services but also to technical and professional services.)

Indeed, problems such as an ageing society, environmental degradation, requirements for lifelong learning, or limitations on mobility associated with dominant modes of transport, are clearly areas where services have an important role. There is a danger of seeking 'technological fixes' - that is, of only looking for technological solutions to these problems, when in some cases social and organisational change may better address their sources or symptoms. But technological changes are also liable to be part of any reorientation of services and other activities to cope with such problems. Where public services are involved, it is plausible that political acceptance of the associated tax burdens will be conditional on improved efficiency, effectiveness or quality of these services, and this is liable to involve new technologies. Thus the ideal approach is one in which the needs for innovation are assessed within a more general assessment of the problems and opportunities of areas such as the above.

Innovation policies increasingly assist and influence systems of innovation, rather than promote specific firms or innovations, and this is to be encouraged. An example of this is the interest in **Technology Foresight** programmes, designed not to 'pick winners' but to share visions and build networks, thus promoting more co-ordinated and less risky action. In the UK, the Foresight Programme has made a notable effort to build in services like retail and distribution, finance, transport and (to a more limited extent) entertainment, health and education services. There were problems associated with mobilising key actors in some of these activities, indicative of service managers' tendency not to identify their activities with technological innovation, yet this should only encourage policy makers to promote the involvement of service activities in these programmes – particularly, as mentioned above, many of the 'problem-solution fields' (aging society, crime and security) have important services element. European programmes should thus emphasise system-strengthening modes of operation - and they should explicitly incorporate services into these.

Appendix A – Sector Studies

This appendix contains the detailed sector studies. There are seven. **A.1** analyses the CIS-2 data for the **Utilities** sector. **A.2** analyses the **Wholesale** sector data. **A.3** analyses the **Transport Services** sector data. **A.4** analyses the **Telecommunications** sector data. **A.5** analyses the **Financial Services** sector data. **A.6** analyses the **Computer Services** sector data. And **A.7** analyses the **Technical Services** sector data.

Each of these sector studies addresses a number of dimensions of innovation in services. These include: (i.) the firm size structure (of the sector); (ii.) the incidence of innovation; (iii) the aims or objectives of innovation; (iv.) the extent and role of research and development in the sector; (v.) the sources of information for innovation; (vi.) the distribution of resources committed to innovation (vii.) the extent of co-operation arrangements for innovation; and (vii) the extent to which innovating firms were hampered in their innovation activities, and by which factors.

A.1 Sector Study: Electricity, Gas and Water 'Utilities' (NACE Rev.1 40, 41)

The 'utilities' sector in this report includes activities classified under NACE Rev.1 40 and NACE Rev.1 41. NACE Rev. 1 40 includes the generation and distribution (including transmission) of electricity; the manufacture of gas, and the distribution of gaseous fuels through mains; steam and hot water supply. NACE Rev.1 includes the collection, purification and distribution of water.

In much of Europe the utilities sector is undergoing a process of change, particularly following the privatisation of many formerly municipally owned utility companies. In many countries utilities were, until the 1990s, mainly provided by public institutions and enterprises, either on a national or a local/regional basis. They were also mainly considered 'natural monopolies'. This system had disadvantages and limits – with little incentive to innovate as customers were effectively captured. Moreover, the political considerations about ownership often outweighed concerns about the efficiency of provision. Since the 1990s there have been strong pressures for reform, and to increase competition through the introduction of market forces. These pressures have been reinforced by European regulations on competition and monopolies. The utilities sector is now evolving away from monopolistic provision. This has increased the efficiency of provision and has led to improved customer services. There is, however, still a significant role for governments as regulators of the production processes (particularly with respect to quality and pollution), of pricing, and ensuring fair competition. In the countries that have liberalised their utilities, the main innovation trends include:

- Improving the efficiency of production and distribution – as customers increasingly have a choice of suppliers, it has become increasingly important for utilities companies to be able to compete on price – this has required that they find efficiencies in production and distribution. To some extent this is being achieved through the consolidation and internationalisation of the industry. This in turn stimulates innovation in the back office activities of the merged firms.

- New approaches to marketing and enhancing the customer interface. This includes the use of new technologies such as the Internet to create new channels by which customers can pay their bills – some companies have also introduced a variety of payment schemes.

- Aiming to enter new markets – for example some electricity supply companies have sought to supply telecommunications using the existing electricity network, whilst gas companies are seeking to provide electricity and vice versa.

- Aiming to comply with environmental regulations against pollution (and water quality standards, etc.) which in general are becoming more stringent.

A.1.1 The Enterprise Size Structure of the Sector

In the main, the utilities sector is associated with large, scale orientated, enterprises, although variations exist between countries. In France, Portugal and the UK, for example, the sector is concentrated and dominated by some very large enterprises – the mean employment of those included in the CIS-2 exceeding 1,000 in both France and the UK, and 700 in Portugal. Meanwhile in Germany, Norway and Sweden there are many smaller utilities enterprises.

Table A.1.1: Utilities – Firms and the Firm Size Distribution

Adjusted	A	B	D	F	FIN	NL	NOR	P	S	UK	ALL
Sample	51	4	99	54	51	58	101	19	40	40	620
Population			1,700	160			195	25	198	92	
Sample %			6%	34%			52%	76%	20%	43%	
Small			35%	32%			48%	36%	46%	22%	
Medium			33%	41%			44%	24%	41%	22%	
Large			32%	27%			8%	40%	13%	57%	
Median Emp			112	61			50	119	50	321	
Mean Emp			263	1,458			98	729	133	1,164	

Source – Seven Countries Data

The different enterprises size distributions may reflect different organisations of these industries in the different countries, and/or a different composition of activities. In some countries, such as the UK, the utilities are highly concentrated, with a few large enterprises providing these services regionally or even nationally, whereas elsewhere provision may be on a local basis, including that by publicly owned enterprises. In terms of types of the activities included, it is possible that this also varies by country, with, for example more small 'wind farms' or bottled water suppliers in the samples from some countries than in those from others. Such enterprises are quite different from the large power producers or mains water supply companies, and are likely to have quite different innovation strategies, but unfortunately we have no means of disentangling the different types of firm.

A.1.2 The Extent and Patterns of Innovation

In most countries, the proportion of utilities enterprises engaged in innovative activities between 1994 and 1996 was relatively low, at between a quarter and 40% of the enterprises. This is significantly below the proportion of innovators in services and manufacturing in the same countries, and is rather surprising given the fact that utilities enterprises tend to be larger than most service enterprises, and in general the propensity to innovate increases with enterprises size. Two exceptions to this general pattern of a relatively low proportion of innovators are found in the Netherlands and the UK, where about two-thirds of the utilities enterprises were engaged in innovative activities. Particularly for the UK, the propensity to innovate was greater than that for services generally, and was even marginally above that for manufacturing enterprises. This high rate of innovative activity in the UK may be associated with the recent privatisation of utilities enterprises, and that prior to privatisation many utilities suffered from a lack of investment.

Table A.1.2: Utilities Firms with Innovative Activity and Innovative Enterprises (%)

Adjusted	A	D	F	FIN	NL	NOR	P	S	UK
Innovative Activities	24*	38	29	33*	69*	27	36	32	66
Innovative Enterprises	n.a.	37	24	n.a.	n.a.	24	36	23	65

Source – Seven Countries Data; * - unadjusted data is presented for these countries

An interesting feature of the pattern of innovation in the utilities sector is the extent to which these enterprises depended on other enterprises or institutions for the development of their innovations. Of the six countries for which we had direct data access, only in Portugal and Sweden did half the innovators claim they themselves had (mainly) developed their innovations; in France, Germany and the UK less than one third of the enterprises developed their own innovations. Meanwhile there is a relatively high rate of developing innovations in conjunction with others (especially in France and Germany), whilst in the UK more than half the innovators introduced innovations mainly developed by other enterprises or organisations. This shows the sector's relatively

heavy dependence of the sector for innovation on other enterprises and institutions. We anticipate that the main external sources of innovation are specialist engineering firms and IT suppliers.

Table A.1.3: The Sources of Innovation amongst Innovating Utilities Firms (%)

Adjusted	D	F	NOR	P	S	UK
Mainly developed by others	15	21	23	29	11	58
Developed jointly with others	65	72	44	43	38	54
Mainly developed in house	21	15	45	50	51	32

Source: Seven Countries Data; In some countries multiple answers were permitted, so totals can exceed 100%

A.1.3 The Aims or Objectives of Innovation

As in all services, a large proportion of the utilities innovators declared improving the quality of their services was a relevant objective of innovation, although this proportion was smaller than in other services in Portugal, Sweden, the UK, and especially Germany. To some extent the quality of the 'core product' is likely to be controlled by regulatory standards, but there is scope for innovation in the support services, such as repairs or billing. Opening new markets tended to be a less relevant objective for innovation in utilities than in other services, as was extending the service range. Both of these findings are somewhat surprising given that many utilities are now seeking to move into other utilities markets (e.g., gas into electricity, electricity into gas) and that there has been an internationalisation of utility company groups. Meanwhile, reducing costs tended to be a more significant objective than in most services, including labour, energy and materials costs, as was the objective of reducing environmental damage. Indeed, reducing environmental damage was the most widely recognised relevant and very important objective of innovation. Unsurprisingly, this is a more significant concern in this sector than in the other service sectors.

Table A.1.4: Aims or Objectives of Innovation amongst Utilities Innovators (%)

Adjusted		D	F	FIN	NL	NOR	S	UK	ALL
Improving	Relevant	21	84	100	80	98	43	62	39
Quality	V-Imp't	7	41	50	16	66	10	37	16
Open New	Relevant	30	62	81	60	58	18	46	38
Markets	V-Imp't	18	16	43	13	16	13	24	18
Extend	Relevant	28	60	81	45	67	33	24	36
Range	V-Imp't	7	11	37	3	19	8	.	8
Improve	Relevant	33	76	100	64	52	62	79	45
Flexibility	V-Imp't	12	6	31	8	7	23	38	13
Reduce	Relevant	30	22	100	65	80	60	.	42
Labour Costs	V-Imp't	8	.	26	4	47	8	65	14
Fulfil	Relevant	26	82	.	77	76	63	.	44
Regulations	V-Imp't	3	36	19	20	47	25	73	14
Replace Old	Relevant	4	22	100	38	51	20	28	16
Services	V-Imp't	.	3	50	.	20	5	5	3
Reduce	Relevant	33	35	88	80	50	45	94	44
Energy Costs	V-Imp't	15	6	13	30	4	8	57	20
Reduce Mat	Relevant	28	35	69	62	44	33	94	39
-erials Costs	V-Imp't	8	6	.	9	7	3	61	11
Reduce	Relevant	33	88	.	89	58	100	94	51
Env Damage	V-Imp't	25	44	32	25	9	72	70	31

From analysis undertaken by Eurostat – '.' suppressed data due to non-disclosure rules

A.1.4 The Extent and Role of Research and Development (R&D)

The conduct of R&D within innovating utilities enterprises does not follow a clear pattern. In the UK, Sweden and Portugal, utilities enterprises were more likely to conduct R&D than innovating service enterprises generally, whilst in France, Norway and especially Germany they were less likely to conduct R&D. In general, this follows the size distribution of enterprises in these sectors in the different countries. In the UK and Portugal utilities enterprises tend to be large and often conduct R&D. By contrast in Germany and Norway they tend to be smaller and rarely conduct R&D. France and Sweden defy this trend. Although the utilities sector in France has many large enterprises relatively few conduct R&D, whereas in Sweden the conduct of R&D given the large number of smaller utilities enterprises. But there may be other explanations for these differences. In some countries R&D might be centralised in government or private institutions, and the role of R&D may vary between different types of utilities companies in different countries.

Table A.1.5: The Conduct of R&D amongst Utilities Innovators (%)

Adjusted	D	F	NOR	P	S	UK
Continuously	3	20	13	44	24	30
Occasionally	17	26	44	33	38	38
Not At All	80	54	43	22	38	33

Note: From Eurostat file – C51

A.1.5 The Sources of Information for Innovation

With the exception of Germany, utilities enterprises appear to recognise many sources of information as relevant to their innovation activities. In most countries the majority of enterprises recognised all of the various sources except patents as relevant information sources, although sources within the enterprise were the most widely identified relevant source of information. Germany, meanwhile, presents an unusual pattern with regard to the sources of information for innovation, with none of the sources being considered relevant by more than a third of the innovators. The pattern of response for the other countries is more consistent.

Table A.1.6: Utilities - Relevant Sources of Information for Innovation (%)

Adjusted	D	F	FIN	NL	NOR	S	UK	ALL
Within Enterprise	33	97	100	95	90	100	83	57
Competitors	21	66	100	50	77	61	86	36
Customers	16	60	100	54	71	65	76	35
Professional Meetings	28	91	87	81	92	83	79	50
Fairs / Exhibitions	31	26	87	66	65	96	75	46
Suppliers	17	62	100	66	73	100	100	40
Computer Networks	26	91	81	29	58	61	70	36
Consultants	30	29	87	74	71	83	87	48
Universities	22	25	87	48	63	98	78	37
Research Institutes	20	22	68	80	77	n.a.	82	34
Patents	17	14	50	6	31	25	28	19

Note: From Eurostat file - C72

A.1.6 Resources Committed to Innovation, Innovation Activities and Expenditure Patterns

As with all of the service sectors assessed in this report, the amount spent on innovation by the innovating utilities enterprises varied widely, from those that spent nothing or less than 500euro per employee in 1996 to those that spent more than 10,000euro per employee in that year. These proportions also varied within the various enterprise size bands. A sizable proportion of the smallest enterprises (those with 10 to 49 employees) did not provide innovation expenditure data, even though they were innovators in the 1994-96 period. This may well be because they incurred their innovation expenditures in 1994 or 1995, rather than in 1996; such an uneven year on year pattern of innovation expenditures is perfectly possible, particularly for small enterprises and when innovation is 'lumpy'. All of the enterprises size categories included some enterprises with low innovation expenditures (per employee) and some with very high innovation expenditures. Although this data is problematic (it can be difficult to decide categorically whether an expenditure relates directly to innovation or not), this variation also reflects the diversity of behaviours that is a feature of this, and every other (service) sector.

Table A.1.7: Utilities - Innovation Expenditure per Employee (%)

Unadjusted	Small	Medium	Large	All
No Expenditure Reported	40%	33%	7%	20%
Up to 500euro	10%	24%	24%	22%
501euro +	20%	17%	33%	26%
2,001euro +	25%	17%	24%	22%
10,001euro +	5%	10%	11%	10%

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: Seven Countries data – Excludes Ireland

In terms of their engagement in innovation related activities, the innovating utilities enterprises had low propensities to engage in all of the innovation related activities – with less than half engaged in all seven of the specified activities – the most frequently engaged in being the acquisition of machinery and equipment for innovation, and training in relation to innovation. The utilities

enterprises differ from most other services in the relatively large number of enterprises that acquired externally provided R&D services – indeed this proportion is marginally higher than the proportion that conducted their own intra-mural R&D. Very few firms incurred expenditures on preparations for the introduction of innovations, and on the market introduction of technological innovations. This suggests a strong process orientation to the innovation activities of utilities enterprises, rather than a product or service orientation.

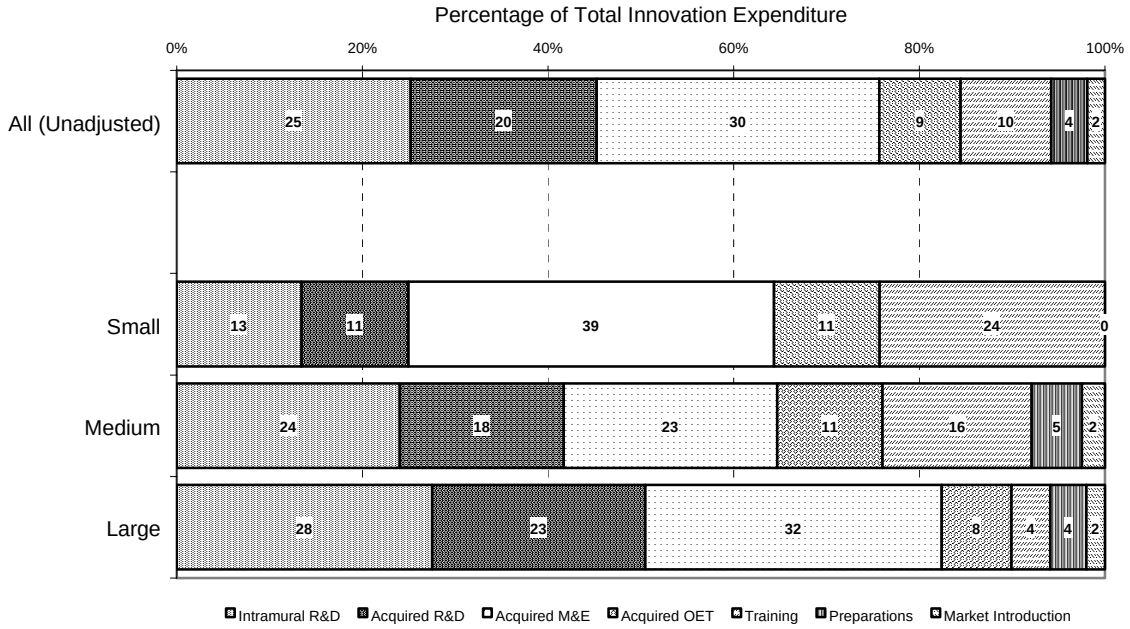
Table A.1.8: Utilities - Engagement in Innovation Related Activities in 1996 (%)

Unadjusted	Small	Medium	Large	All
Intramural R&D	10%	24%	63%	42%
Acquired R&D	25%	24%	63%	45%
Acquired M&E	35%	21%	53%	40%
Acquired OET	10%	10%	33%	22%
Training	40%	26%	47%	39%
Preparations	0%	10%	14%	11%
Market Introduction	0%	5%	17%	11%
None of The Above	35%	31%	7%	17%

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: Seven Countries data – Excludes Ireland

In terms of the distribution of innovation costs, this sector appears to focus its innovation expenditures on three of the seven activities: intra-mural R&D, the acquisition of externally provided R&D services, and the acquisition of machinery and equipment. Together, and on average, these activities account for about three-quarters of total spending on innovation. Other external technologies account for a further 9%, training 10%, preparations 4% and the market introduction of innovations only 2%. Some differences arose between enterprises of different sizes – generally as enterprises became larger the proportion of their innovation expenditures spent on (intra-mural and acquired) R&D increased, whereas the proportion spent on acquired machinery, equipment and other external technologies tended to decline.

Figure A.1.1
The Distribution of Expenditures on Innovation in Utilities - Simple Means



A.1.7 The Extent of Co-operation for Innovation

It was shown earlier that utilities enterprises are unusual in the extent to which they depend on other enterprises or institutions for the development of their innovations. This being the case, we

would expect a relatively high rate of collaboration for innovation between utilities enterprises and other enterprises or institutions. And this indeed is the case – with half or more of the innovating utilities enterprises having co-operative arrangements for innovation in most countries. Only in Germany is the proportion of utilities enterprises with co-operative arrangements for innovation low, at just 16%.

Understandably, suppliers are the most frequently engaged type of partner with which innovating utilities enterprises co-operate for innovation. Germany apart, a quarter of more of the innovators had co-operative arrangements with their suppliers, with more than half the Finnish and Swedish innovators having such arrangements.

Excluding Germany, the extent of collaboration with each of the different partner types is relatively high, although highly variable between countries. For example, a quarter or more of the innovators in Austria, Finland, Norway and the UK had collaborative arrangements with their competitors, but only 8% of French and 7% of Swedish innovators had these arrangements. Customers were widely engaged in France and Finland, but were much less frequently engaged in Norway, Portugal and the UK. Also, and unusually for services, there was a relatively high degree of collaboration with universities and research institutes. A third or more of the innovators in Austria, Finland Portugal, Sweden and the UK had collaborative arrangements with universities, and in most of these countries a similar proportion had collaborative arrangements with research institutes.

These patterns reflect the unusual nature of the utilities sector. It differs from manufacturing in that its products (electricity, water and gas) are effectively standardised by regulations, but are still tangible, unlike services. The sector mainly competes through the price and the service elements (e.g., delivery and billing) elements of its activities.

Table A.1.9: Utilities: Co-operation Arrangements for Innovation (%)

Adjusted	A	D	F	FIN	NL	NOR	P	S	UK	ALL
Any External	57	16	68	87	47	66	52	80	67	33
With Competitors	28	0	8	43	21	27	0	7	31	7
With Customers	24	3	43	62	17	7	0	23	13	10
With Consultants	9	2	5	30	20	23	7	27	35	10
With Suppliers	37	3	19	55	24	40	30	55	48	16
With Universities	52	14	19	43	13	20	33	32	36	20
With Res. Institutes	24	0	16	37	17	43	33	12	32	10

From analysis undertaken by Eurostat

A.1.8 The Extent and Nature of Difficulties Experienced with Innovation

The proportion of innovating utilities enterprises reporting difficulties with innovation activities varied enormously between countries – from just 4% of the innovating German enterprises to 94% of the French. In most countries around half the innovators had experienced difficulties with innovation, although this proportion was smaller for the UK and Portugal (and Germany).

The significance of the individual factors hampering innovation varied widely between countries, however amongst the more widely cited factors hampering innovation were: organisational rigidities, the excessive economic risk of innovation, excessive innovation costs, a lack of qualified personnel, and, unusually for services, a lack of market information.

Table A.1.10: Utilities: Factors Hampering Innovation (%)

Adjusted	A	D	F	FIN	NL	NOR	P	S	UK	ALL
Hampered Firms	59	4	94	56	49	40	22	47	26	19
Excessive economic risk	18	2	11	37	40	18	22	39	18	8
Excessive Innovation costs	18	1	8	24	17	6	22	22	12	6
Lack of sources of finance	0	1	46	5	17	7	0	20	4	5
Organisational rigidities	31	3	43	24	15	17	22	8	18	9
Lack of qualified personnel	9	2	5	24	23	16	22	7	15	5
Lack of technical information	9	1	8	11	14	4	0	2	13	3
Lack of market information	9	.	46	43	28	5	0	0	5	5
Standards / regulations	0	2	49	18	12	6	0	0	5	5
Lack of customer responsiveness	0	1	43	11	17	3	0	0	10	4

From analysis undertaken by Eurostat

A.2 Sector Study: Wholesale Services (NACE Rev.1 51)

Wholesale trades includes the resale of new and used goods to retailers, to industrial, commercial or professional users, to other wholesalers, or to agents. 5.7 million people were employed in the wholesale trades in the European Union in 1997 (Eurostat, 1999) – the sector therefore accounts for almost 10% of the total number of people employed in the European Union's service sectors (excluding utilities). Most enterprises in this sector are very small in terms of employment – 95% employing fewer than 10 people, but in this sector labour costs tend to account for only a small proportion (<10%) of total costs.

The main innovation trends anticipated in this sector were:

- Investments in information technologies, particularly those associated with logistics, supply-chain management and e-commerce, and other technologies that improve the interaction between the wholesalers and their clients.
- Automation technologies, particularly automated warehousing technologies, which replace labour and simple technologies with more sophisticated, systemic technologies.
- Other technologies that are at least as much organisational as technical innovations. These include innovations in storage and containerisation.

A.2.1 The Enterprise Size Structure of the Sector

According to Eurostat there were almost 67,000 enterprises with 10 or more employees in the 12 European countries that included wholesale services in their CIS-2 (i.e., excluding France). By far the largest number of these enterprises were located in Germany and the UK, which together accounted for more than half the eligible enterprises, but, as in other sectors, these countries had the lowest proportional response – with only 1% of the eligible wholesale enterprises responding to the German and UK CIS-2 surveys. By contrast a quarter of the eligible wholesale enterprises in Luxembourg and Finland responded, as did nearly 20% of the Dutch wholesale enterprises. Overall, 5% of the eligible enterprises in the 12 European countries participated in the survey.

The great majority of wholesale enterprises are small. The CIS-2 survey excluded enterprises with fewer than 10 employees, but, of those with more than 10 employees, over 80% have less than 50 employees. The median employment was close to 20, with the mean considerably larger in most countries. In Germany the mean employment was 138 – indicating the presence of a few very large wholesalers that country.

Table A.2.1: Wholesale Services – Firms and the Firm Size Distribution

Adjusted	A	B	D	DK	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Sample	151	440	230	103	235	54	59	1,200	265	367	331	97	3,532
Population	2,957	3,735	22,529	2,845	995	1,320	224	6,469	2,092	4,697	3,063	15,918	66,844
Sample %	5%	12%	1%	4%	24%	4%	26%	19%	13%	8%	11%	1%	5%
Small			78%			81%			85%	90%	85%	80%	
Medium			18%			19%			14%	9%	12%	17%	
Large			4%			-			1%	1%	3%	3%	
Median E			22			20			17	17	19	20	
Mean E			138			46			37	29	47	49	

Note: Mean E – Mean Employment; Median E – Median Employment. From Eurostat file C1 and the Seven Countries data

A.2.2 The Extent and Patterns of Innovation

The proportion of wholesale enterprises with innovative activity was generally slightly below the proportion of innovators in all service sectors, although given the high proportion of small enterprises in this sector this is unsurprising. Only in Austria did the proportion of wholesalers with innovative activities exceed the proportion of all service enterprises with innovative activities, and in no country did this proportion for wholesalers exceed that for the manufacturing enterprises in general. We should recall, however, that the survey focused on technological innovation and it is

likely that many more wholesale enterprises would have engaged in innovation had the definition been broadened to include organisational or managerial innovation.

Table A.2.2: Wholesale Service Firms with Innovative Activity, and Innovative Enterprises (%)

Adjusted	A	B	D	DK	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Innovative Activity	59	11	48	42	19	55	40	40	19	34	33	38	40
Innovating Enterprises	58	10	39	27	15	52	37	36	18	26	29	33	34

Note: from Eurostat file – C21

Perhaps surprisingly, the majority of innovating wholesalers claimed they had developed their own (technological) innovations, rather than having depended on others for the development of their innovations. This is notable as wholesalers might have been expected to be a 'supplier dominated' sector. Apart from self-reliance, the proportion that developed their innovations in conjunction with others was also high, except in the UK and Ireland.

Table A.2.3: The Sources of Innovation amongst Innovating Wholesale Service Firms (%)

Adjusted	D	IRL	NOR	P	S	UK
Mainly developed by others	7	30	15	28	12	17
Developed jointly with others	40	11	35	29	34	13
Mainly developed in house	53	60	57	46	55	70

Source: Seven Countries Data; In some countries multiple answers were permitted, so totals can exceed 100%

A.2.3 The Aims or Objectives of Innovation

Amongst wholesalers, the objectives of innovation identified as relevant followed the same pattern as that for services as a whole, with – apart from reducing environmental damage - just slightly smaller proportions of the innovating enterprises recognising the relevance of the various objectives. Thus improving service quality, opening new markets, extending the service range and improving the flexibility of production were the most widely recognised relevant objectives of innovation. These were also the most widely recognised 'very important' objectives of innovation, again reflecting the same pattern as for services as a whole. Of all the factors, only improving the service quality was recognised as very important by more than half the innovating enterprises.

Table A.2.4: The Aims or Objectives of Innovation amongst Wholesalers (%)

Adjusted		A	B	D	DK	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Improving	Relevant	100	92	98	99	92	89	82	81	87	100	91	71	89
Quality	V-Imp't	40	63	81	59	64	77	73	31	61	83	56	46	62
Open New	Relevant	89	80	88	100	90	95	86	84	95	91	96	72	85
Markets	V-Imp't	32	67	48	62	43	57	74	33	50	65	68	57	50
Extend	Relevant	87	93	83	100	93	79	95	78	86	79	89	72	81
Range	V-Imp't	7	50	51	57	29	17	92	35	49	43	36	29	39
Improve	Relevant	93	81	89	99	82	95	64	61	72	76	79	71	81
Flexibility	V-Imp't	18	29	47	51	35	49	37	22	21	29	19	27	35
Reduce	Relevant	90	65	80	78	64	68	16	63	77	76	84	66	75
Labour Costs	V-Imp't	43	13	38	16	12	29	9	16	30	44	21	24	31
Fulfil	Relevant	81	73	64	59	59	63	37	54	84	76	82	73	68
Regulations	V-Imp't	6	22	15	28	7	13	18	13	22	40	25	12	16
Replace Old	Relevant	77	34	60	99	89	39	37	61	77	38	59	63	62
Services	V-Imp't	23	7	15	36	27	6	26	19	36	20	16	24	19
Reduce	Relevant	56	49	58	58	38	45	25	43	51	51	56	41	51
Energy Costs	V-Imp't	5	8	23	5	7	11	9	7	10	32	8	23	18
Reduce Mat	Relevant	55	44	56	52	57	51	16	36	57	59	52	42	50
-erials Costs	V-Imp't	8	5	17	8	7	17	5	3	16	36	10	21	16
Reduce	Relevant	60	48	61	56	51	56	34	55	68	47	68	46	56
Env Damage	V-Imp't	5	11	23	6	13	13	18	15	11	37	21	23	20

Note: From analysis undertaken by Eurostat

A.2.4 The Extent and Role of Research and Development (R&D)

Slightly fewer innovating wholesalers engaged in R&D than was the case for innovating service enterprises as a whole, but 18% engaged in R&D on a continuous basis, with a further 24% engaging in R&D on an occasional basis, leaving 58% that did not undertake R&D at all. These

proportions varied substantially between countries. In Belgium and the Netherlands over 30% of innovating wholesalers engaged in R&D on a continuous basis, as did around a quarter of these enterprises in the four Scandinavian countries. In all six of these countries at least half of the innovating wholesalers undertook R&D. Meanwhile none of the innovating wholesalers in Ireland conducted R&D on a continuous basis, and in both Ireland and Portugal three-quarters of these enterprises did not conduct R&D at all.

Table A.2.5: The Conduct of R&D amongst Innovating Wholesalers (%)

Adjusted	A	B	D	DK	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Continuously	17	32	18	24	26	0	12	31	23	15	24	13	18
Occasionally	25	30	23	45	44	26	4	20	38	11	27	25	24
Not At All	58	39	60	31	30	74	84	49	39	74	49	62	58

Note: From Eurostat file – C51

A.2.5 The Sources of Information for Innovation

Sources within the enterprises, as well as competitors, customers, suppliers and fairs and exhibitions were the most widely identified relevant sources of information for innovation in this sector – all of these being recognised as relevant by more than three-quarters of the innovating enterprises. Professional meetings were also widely recognised, and consultants and computer networks were regarded as relevant by about half the enterprises. Only universities, research institutes and patents were recognised as relevant by only a minority of the enterprises, but even the lowest of these, patents, were still regarded as relevant by a quarter of the enterprises.

Amongst the six countries for which we had direct data access, customers were (at 49%) the most widely identified 'very important' source of information for innovation. The significance of customers was particularly high in Norway (65%) and the UK (64%), and lowest in Portugal (34%). Customers apart, sources within the group was the next most widely identified 'very important' source of information for innovation, being identified by 43% of the enterprises, and by 64% and 54% in Norway and Sweden respectively. Meanwhile, in the UK and Ireland, only 32% regarded sources within the group as a very important source of information. Competitors (28%), suppliers (27%) and fairs or exhibitions (24%) followed, whilst very few enterprises recognised universities (4%), research institutes (2%) or patents (<1%) as 'very important' sources of information for innovation.

Table A.2.6: Wholesale - Relevant Sources of Information for Innovation (%)

Adjusted	A	B	D	DK	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Within Enterprise	100	85	91	100	100	89	77	89	92	81	96	83	89
Competitors	94	85	83	95	93	95	41	65	88	66	88	86	83
Customers	99	89	70	100	95	100	56	74	86	76	95	83	79
Professional Meetings	98	64	76	60	76	89	47	67	76	71	62	65	73
Fairs / Exhibitions	90	76	81	90	77	85	59	68	64	86	87	80	81
Suppliers	71	78	80	84	89	95	73	71	79	87	88	71	78
Computer Networks	86	63	56	60	57	61	33	28	63	49	76	44	53
Consultants	54	43	57	52	69	66	8	31	62	48	62	51	52
Universities	38	40	45	48	43	34	8	18	44	25	49	27	36
Research Institutes	24	18	34	36	30	34	4	24	46	28	n.a.	43	34
Patents	32	16	33	42	26	22	0	12	23	8	32	25	27

Note: From Eurostat file - C72

A.2.6 Resources Committed to Innovation, Innovation Activities and Expenditure Patterns

Wholesalers, like other services, demonstrate a range of commitments to innovation. Of the innovating enterprises in the six countries for which we had data, around a quarter declared that they had no innovation expenditures in 1996, and a further 15% declared their expenditures were low - not exceeding 500euro per employee. However, another, smaller group of enterprises (about 15%) spent very highly on innovation – at over 10,000euro per employee in 1996. A difficulty with assessing these distributions is that we do not know whether the low spenders were consistently low spenders, and the high spenders consistently high spenders, or whether innovation expenditures are lumpy in this sector, meaning that firms tend to spend very highly on innovation in some years and relatively little in other years. Certainly the large number of small enterprises in this sector – amongst which innovation expenditures are likely to be more 'lumpy' - makes this more likely. However, dividing the

sample by enterprise size shows that although the variance declines with increasing enterprises size, there is still a wide diversity of innovation expenditures (per employee) amongst the large enterprises.

Of the various innovation related activities, the most widely engaged in was the acquisition of 'other external technologies (including software)'; this was followed by the acquisition of machinery and equipment for innovation, and by training and preparations for the introduction of innovations. Between 25% and 30% of the innovators had expenditures on the market introduction of innovations, with similar proportions incurring expenditures on intra-mural R&D. The least widely undertaken activity was the acquisition of R&D services – which between 8% [adjusted data] and 17% [unadjusted data] of the enterprises incurred expenditures on. All of these innovation related activities became more widespread amongst the larger enterprises.

Table A.2.7: Wholesale Services - Innovation Expenditure per Employee (%)

Unadjusted [Adjusted]	Small	Medium	Large	All
No Expenditure Reported	21%	17%	13%	18% [30%]
Up to 500euro	14%	17%	18%	16% [13%]
501euro +	23%	32%	29%	26% [14%]
2,001euro +	27%	23%	26%	26% [28%]
10,001euro +	16%	12%	14%	14% [16%]

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: The Seven Countries data – excludes France

Table A.2.8: Wholesale Services - Engagement in Innovation Related Activities in 1996 (%)

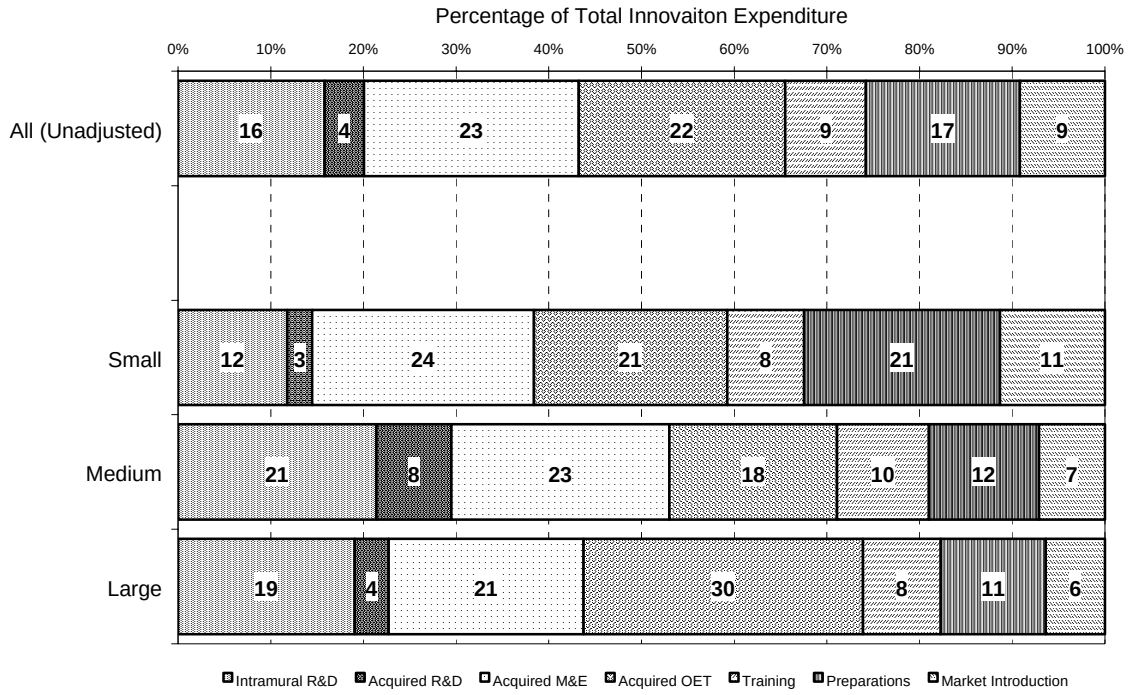
Unadjusted [Adjusted]	Small	Medium	Large	All
Intramural R&D	23%	38%	39%	30% [25%]
Acquired R&D	8%	27%	26%	17% [8%]
Acquired M&E	42%	52%	54%	47% [40%]
Acquired OET	54%	59%	70%	59% [53%]
Training	40%	55%	49%	46% [39%]
Preparations	43%	52%	54%	48% [38%]
Market Introduction	30%	32%	38%	32% [24%]
None of The Above	21%	15%	13%	18% [30%]

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: The Seven Countries data – excludes France

The simple average distribution of innovation costs across the unadjusted sample in the six countries for which we had data reflects the pattern of engagement in the various activities. The acquisition of machinery and equipment and other external technologies constituted the largest shares of total innovation expenditures – together accounting for about 45%. This was followed by expenditures on preparations for the introduction of innovations, and expenditures on intra-mural R&D. This relatively high proportion expenditure on intra-mural R&D despite the relatively small number of enterprises engaged in this activity indicates that amongst the enterprises that do conduct their own R&D this tends to form a significant component of their total innovation costs. Training linked to innovation and the market introduction of innovations both accounted for (on average) about 9% of total innovation expenditures, whilst expenditures on acquired R&D services accounted for only 4%.

Some notable differences emerged across the size distribution of enterprises. R&D tended to be a smaller proportion of total costs amongst the small enterprises, whilst 'preparations' for the introduction of innovations and the market introduction of innovations tended to account for larger shares of total expenditure. The shares of expenditure on machinery and equipment and on training remained stable across the size distribution, whilst the proportion spent on 'other external technologies' was greater amongst the large enterprises.

Figure A.2.1
The Distribution of Expenditures on Innovation in Wholesale - Simple Means



A.2.7 The Extent of Co-operation for Innovation

Only a quarter of the innovating wholesalers had co-operative arrangements for innovation, a proportion slightly smaller than that for innovating service enterprises in general. The most widely engaged types of external partner were competitors, suppliers and customers, but overall only about 10% of the enterprises had each of these arrangements. Particularly with respect to suppliers and customers, this low level of co-operation is notable, as one advantage wholesalers have over retailers is closeness to their customers, whilst closeness to suppliers is a supposed feature of 'supplier dominated sectors', which wholesaling is regarded as being. However, the proportion of innovating wholesalers with co-operative arrangements for innovation also varied widely between countries – being the norm rather than the exception in the Scandinavian countries and in Luxembourg. In Denmark and Norway more than half the innovating wholesale enterprises had co-operative arrangements for innovation with their suppliers, and in the Scandinavian countries roughly a quarter of these enterprises had co-operative arrangements for innovation with their customers. In all countries universities were rarely engaged as co-operative partners for innovation, and only in the UK and Norway were research institutes engaged by more than 10% of the innovating wholesalers.

Table A.2.9: Wholesale Services: Co-operation Arrangements for Innovation (%)

Adjusted	A	B	D	DK	FIN	IRL	L	NL	NOR	P	S	UK	ALL
With Any Partner	10	40	9	63	59	18	56	25	65	27	55	40	25
Any External	10	38	9	63	46	18	52	25	65	22	48	35	23
With Competitors	3	4	2	16	10	0	12	5	5	3	7	34	11
With Customers	7	10	1	27	27	18	20	10	23	15	31	11	9
With Consultants	2	5	3	30	21	0	0	2	22	7	25	12	7
With Suppliers	6	31	5	52	35	12	33	13	52	15	34	0	10
With Universities	4	15	2	14	10	0	8	4	12	5	14	1	4
With Res. Institutes	3	4	1	6	6	0	0	4	17	3	8	24	7

Note: From analysis undertaken by Eurostat

A.2.8 The Extent and Nature of Difficulties Experienced with Innovation

Two fifths of the innovating wholesalers stated that they had encountered difficulties with their innovation activities. This proportion was higher amongst Danish, German and Swedish wholesalers, and lower amongst wholesalers in Ireland, Luxembourg and the UK. Overall, the most widely cited factors hampering innovation efforts were: the organizational rigidities of the enterprises themselves (21%); a lack of qualified personnel (19%), a lack of sources of finance (19%) and the excessive economic risk of innovation (18%). By contrast, excessive innovation costs (8%), a lack of information on markets (9%) and a lack of customer responsiveness to innovation were the least widely recognised factors hampering innovation. However, the importance of factors can vary significantly between countries. For example, organisational rigidities were not recognised as a factor hampering innovation in Portugal, whereas 30% of German wholesalers identified this factor. The German wholesalers were also more likely than those in other countries to identify a lack of sources of finance and a lack of qualified personnel as factors hampering innovation, although this last factor was also widely cited in Sweden, the Netherlands and Norway. Meanwhile, wholesalers in Denmark appear more likely to encounter difficulties with excessive innovation costs (27%) and a lack of customer responsiveness to innovation (20%), factors that are less frequently identified elsewhere. This may be because the Danish enterprises are more ambitious in their innovative activities in this sector than is the norm.

Table A.2.10: Wholesale Services: Factors Hampering Innovation (%)

Adjusted	A	B	D	DK	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Hampered Firms	35	38	49	58	39	25	21	43	38	28	47	27	40
Excessive economic risk	16	20	23	27	13	0	5	22	9	6	19	12	18
Excessive Innovation costs	2	12	0	27	20	18	4	20	10	12	18	12	8
Lack of sources of finance	7	7	27	8	5	6	0	12	1	14	16	20	19
Organisational rigidities	23	10	30	23	22	6	0	11	25	0	21	16	21
Lack of qualified personnel	3	18	27	21	18	6	8	23	24	6	30	13	19
Lack of technical information	1	7	17	23	9	0	0	21	6	3	11	12	13
Lack of market information	3	6	10	4	7	0	0	15	5	0	4	11	9
Standards / regulations	8	5	18	4	7	0	0	10	3	4	14	13	13
Lack of customer responsiveness	3	9	15	20	10	0	5	8	4	9	6	12	11

Note: From analysis undertaken by Eurostat

A.3 Sector Study: Transport Services (NACE Rev.1 60, 61, 62)

Transport services are concerned with the movement, by land, water and air of people and goods. Supporting auxiliary transport services are excluded from this report. According to Eurostat (1999), the whole of the transport services sector (including auxiliary services) accounted for 4.2% of value added in the EU-15 in 1997. In that year more than 3.8 million people were employed in land transport (NACE-Rev.1 60 - 7% of total EU service sector employment), whilst 260,000 were engaged in water transport (NACE-Rev.1 61), and 367,000 were in air transport (NACE-Rev.1 62); with 1.8 million in supporting auxiliary transport services (NACE-Rev.1 63). Land transport enterprises tend to be small, the vast majority employing fewer than 10 employees, but personnel costs also account for a large proportion of total costs (usually between a third and half). Water transport enterprises tend to be larger, and air transport enterprises larger still. Labour costs in water and air transport account for between 15 and 30% of total costs. Relatively few of those employed in land transport (7% in 1997 – well below the service sector average of 18%) have higher education qualifications, whereas 24% of those in water transport and 28% of those in air transport have these qualifications.

The transport services sector is therefore diverse – ranging from taxi and road haulage firms to airlines. In terms of innovation we might expect four main themes:

- The importance of **investments** in new capital equipment, such as vehicles, ships and aircraft. In this sense transport services are heavily dependent on technologies developed by manufacturers to improve the physical qualities of the services they offer. **Training** may be important in preparing the labour force to use this new capital equipment.

- The importance of **information technologies** which have been adopted by transport enterprises to make more efficient (and flexible) use of their vehicles – in terms of logistics, scheduling, yield management and routing.

- **Labour costs** tend to be relatively high, particularly in land transport. Transport enterprises often seek to improve the productivity of their labour forces through the adoption of new technologies which enhance efficiency and/or replace the need for excess manpower.

- The importance of **regulations** in shaping the innovation paths taken by the transport enterprises. This sector is heavily regulated, particularly for health and safety reasons.

A.3.1 The Enterprises Size Structure of the Sector

According to Eurostat there were over 44,000 transport service enterprises with over 10 employees eligible for inclusion in the CIS-2, with Germany providing half of this total. Overall, 7% of the eligible enterprises took part in the survey. As a proportion of their eligible populations, the greatest response was from Portugal and Luxembourg, followed by Finland, France and the Netherlands. Relatively few of the eligible German, Austrian and UK enterprises participated.

Table A.3.1: Transport Services – Firms and the Firm Size Distribution

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Sample	47	177	121	58	1,247	128	69	41	642	141	304	154	120	3,249
Population	1,081	1,658	23,472	996	5,116	544	445	128	2,560	867	825	1,286	5,415	44,392
Sample %	4%	11%	1%	6%	24%	24%	16%	32%	25%	16%	37%	12%	2%	7%
Land			99%		98%		80%			68%	94%	93%	93%	
Water			1%		1%		6%			28%	4%	5%	3%	
Air			<1%		1%		14%			4%	2%	2%	4%	
Small			87%		78%		63%			61%	80%	87%	80%	
Medium			12%		19%		35%			33%	17%	11%	15%	
Large			1%		3%		2%			6%	3%	2%	5%	
Median E			18		29		34			47	19	18	20	
Mean E			96		95		99			99	70	67	105	

Note: Mean E – Mean Employment; Median E – Median Employment. From Eurostat file C1 and the Seven Countries data

The response is dominated (particularly after adjustment) by land transport enterprises. In most countries these contribute more than 90% of the sample – exceptions include Norway were there is a substantial presence of water transport enterprises. Air transport enterprises generally contributed only a very small proportion of the total number of enterprises in the analysis.

Most of the enterprises in this sector are small; in most countries enterprises with 10 to 49 employees accounted for 80% or more of the (adjusted) sample. Ireland and Norway are exceptional, having a greater share of larger – especially medium-sized - enterprises. However, although large enterprises only account for a small proportion of the (adjusted) sample, they make a significant contribution to the total economic activity in the sector. The fact that the mean employment was about five times greater than the median indicates the presence of a small number of very large enterprises.

A.3.2 The Extent and Patterns of Innovation

Surprisingly, substantially fewer transport service enterprises undertook innovative activities than did service enterprises in other sectors. Overall, 29% of the transport service enterprises had undertaken innovative activities compared with 46% of all service enterprises. Only in Luxembourg and Portugal did the proportion of transport service enterprises with innovative activities exceed that in services as a whole. Within the individual sectors, there was no difference in the proportion (both 29% in 'the seven countries') of land and water transport enterprises with innovative activities, but air transport enterprises were much more likely to innovate (at 47% in 'the seven countries'). However, air transport enterprises tend to be much larger, and the propensity to innovate generally increases with enterprise size.

Table A.3.2: Transport Service Firms with Innovative Activity, and Innovative Enterprises (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Innovative Activity	57	10	30	21	15	18	37	61	26	10	38	21	40	29
Innovative Enterprises	54	9	26	13	11	16	33	58	21	5	28	19	34	24

Note: from Eurostat file – C21

Concerning the sources of innovation, the pattern of response for 'the seven countries' divided into two – in Ireland, Portugal, Sweden and the UK, the majority of the enterprises claimed they were mainly responsible for developing their innovations, whereas in Germany, France and Norway more than half of the enterprises claimed their innovations were mainly developed by other enterprises or institutions, or that their innovations were developed jointly with other enterprises or institutions. As a 'supplier dominated' sector, it was expected that transport services would depend heavily on others for the development of their innovations, including the 'joint development' of innovations.

Table A.3.3: The Sources of Innovation amongst Innovating Transport Service Firms (%)

Adjusted	D	F	IRL	NOR	P	S	UK	Land	Water	Air
Mainly developed by others	25	36	20	38	29	14	35	27	26	19
Developed jointly with others	42	40	10	34	12	24	10	36	17	46
Mainly developed in house	33	47	70	31	62	62	66	40	67	37

Source: Seven Countries Data; In some countries multiple answers were permitted, so totals can exceed 100%

A.3.3 The Aims or Objectives of Innovation

The most widespread aim of innovation amongst transport service enterprises, was to improve the quality of service offered. This was also true of all the other service sectors examined in this report. Opening new markets was also widely recognised as an aim of innovation. This suggests a 'product' innovation orientation. However, the process side of innovation was also highlighted by the widespread recognition of the need to improve flexibility and by the need to reduce labour costs.

Also notable was that the need to reduce environmental damage, and the need to reduce energy and materials costs, were, understandably, more widely recognised as aims of innovation in this sector than amongst other services.

Table A.3.4: The Aims or Objectives of Innovation amongst Transport Service Firms (%)

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Improving	Relevant	100	95	100	100	86	93	100	95	78	87	100	88	100	97
Quality	V-Imp't	38	92	67	22	66	52	100	95	29	52	86	55	57	62
Open New	Relevant	100	87	76	41	74	92	99	82	76	72	65	82	100	82
Markets	V-Imp't	5	28	23	19	45	17	72	68	20	50	41	46	91	37
Extend	Relevant	45	95	74	96	70	91	99	91	53	72	65	84	99	77
Range	V-Imp't	1	44	49	4	39	12	31	81	11	30	29	31	30	39
Improve	Relevant	41	81	91	66	66	97	.	73	75	70	71	87	94	86
Flexibility	V-Imp't	5	45	51	22	29	32	73	42	18	13	30	34	26	40
Reduce	Relevant	40	93	91	44	53	80	70	49	75	82	64	78	94	84
Labour Costs	V-Imp't	11	42	56	8	23	42	42	40	21	51	38	20	72	50
Fulfil	Relevant	39	76	67	56	72	76	49	37	53	67	71	70	87	68
Regulations	V-Imp't	5	22	20	19	42	20	11	32	14	31	27	25	71	29
Replace Old	Relevant	41	32	68	92	48	92	57	23	55	65	47	44	44	59
Services	V-Imp't	3	.	12	63	20	43	16	9	9	38	16	13	32	16
Reduce	Relevant	47	88	88	19	52	68	65	42	60	35	53	68	84	79
Energy Costs	V-Imp't	4	29	43	4	25	27	20	23	17	16	31	35	70	41
Reduce Mat	Relevant	37	70	87	26	41	70	44	25	31	46	61	46	77	73
-erials Costs	V-Imp't	1	22	43	4	15	20	20	12	2	17	41	19	49	36
Reduce	Relevant	44	78	81	37	45	69	53	46	61	56	83	82	84	75
Env Damage	V-Imp't	2	7	43	4	12	20	21	24	13	19	67	48	56	39

Note: From analysis undertaken by Eurostat; '.' data suppressed due to non-disclosure rules

A.3.4 The Extent and Role of Research and Development (R&D)

In most countries, less than half of the innovating transport enterprises conducted R&D (the two exceptions being Austria and Finland), and in some – notably Luxembourg, Portugal and the UK less than 10% of innovating transport enterprises conducted R&D. R&D is therefore much less commonly undertaken by innovating transport enterprises than amongst innovating service enterprises as a whole. Moreover, in most countries the vast majority of the innovating transport enterprises that did engage in R&D did so on an occasional rather than a continuous basis.

Table A.3.5: The Conduct of R&D amongst Transport Service Innovators (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Continuously	0	3	3	4	4	12	11	2	17	14	3	11	1	4
Occasionally	63	25	18	19	31	60	2	5	33	31	6	27	4	20
Not At All	37	72	79	78	65	29	87	93	51	55	91	62	95	77

Note: From Eurostat file – C51

A.3.5 The Sources of Information for Innovation

As with all the service sectors examined in this report, the most widely identified relevant source of information for innovation was sources within the enterprise, with customers and competitors close behind. Suppliers, and fairs and exhibitions were also widely identified as relevant, whilst five sources (consultants, research institutes, universities and patents) were regarded as relevant by less than half the firms.

Table A.3.6: Transport Services - Relevant Sources of Information for Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Within Enterprise	73	94	100	85	56	100	90	81	94	75	79	74	52	86
Competitors	98	99	87	48	46	82	100	42	49	66	63	61	94	83
Customers	100	99	82	96	55	99	100	68	59	66	74	78	99	84
Professional Meetings	40	79	67	30	37	82	75	53	60	66	59	59	50	60
Fairs / Exhibitions	44	72	84	8	44	79	90	53	44	89	46	67	46	68
Suppliers	41	97	61	85	65	93	100	61	64	97	67	90	100	69
Computer Networks	38	61	36	30	37	55	89	28	20	66	33	40	32	36
Consultants	43	71	49	30	14	57	100	23	35	70	34	39	46	46
Universities	31	15	42	8	12	57	35	2	9	51	16	33	18	32
Research Institutes	30	16	21	8	9	62	23	5	13	54	15	n.a.	66	29
Patents	7	7	15	4	5	43	21	5	5	21	13	12	11	13

Note: From Eurostat file - C72

In the seven countries, about 40% of the innovating transport service firms considered their customers a very important source of information for innovation, whilst competitors and suppliers were each identified as very important by more than 20%. This compares with only 9% who identified research institutes, and 3% who identified universities, as very important sources of information. Only a fraction of one percent recognised patents as very important. In general, these patterns suggest a strong reliance of transport service firms on 'near to the market' sources of information for innovation. Although this is true of all service sectors, it appears particularly true of transport services.

A.3.6 Resources Committed to Innovation, Innovation Activities and Expenditure Patterns

Transport enterprises do not tend to spend highly on innovation, as measured on a per employee basis. Overall about half the innovating transport service enterprises spent nothing or less than 500euro per employee on innovation related activities in 1996, yet there were some enterprises (6 – 17%) that spent more than 10,000euro per employee on innovation. This sector, like the wholesale services sector, tends to have a very large number of small enterprises, in which innovation expenditures, particularly if they relate to capital equipment, are likely to be very lumpy. Enterprises may therefore have high innovation expenditures in one year but little or no low innovation expenditures in the next. Interestingly, some differences emerge between the sub-sectors in that land transport enterprises tended to have a lower per employee expenditure on innovation than water transport enterprises, with air transport enterprises the highest of all. However, in each of the sub-sectors there were some enterprises with no innovation expenditures in 1996 and some with very high expenditures (over 10,000euro per employee).

Table A.3.7: Transport Services - Innovation Expenditure per Employee (%)

Unadjusted [Adjusted]	Small	Medium	Large	Land	Water	Air	All
No Expenditure Reported	24%	25%	19%	24%	16%	23%	23% [26%]
Up to 500euro	36%	43%	44%	44%	30%	15%	40% [22%]
501euro +	19%	12%	17%	16%	23%	18%	17% [16%]
2,001euro +	12%	15%	15%	12%	16%	26%	14% [18%]
10,001euro +	8%	5%	5%	4%	16%	18%	6% [17%]

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: From the Seven Countries data

Table A.3.8: Transport Services - Engagement in Innovation Related Activities in 1996 (%)

Unadjusted [Adjusted]	Small	Medium	Large	Land	Water	Air	All
Intramural R&D	12%	16%	35%	17%	30%	29%	19% [14%]
Acquired R&D	6%	13%	18%	9%	19%	26%	11% [3%]
Acquired M&E	49%	51%	56%	51%	56%	50%	52% [62%]
Acquired OET	42%	45%	50%	44%	53%	44%	45% [40%]
Training	23%	26%	41%	26%	42%	41%	29% [36%]
Preparations	22%	25%	38%	27%	25%	38%	27% [33%]
Market Introduction	14%	15%	18%	15%	19%	18%	15% [24%]
None of The Above	20%	23%	17%	21%	14%	21%	20% [25%]

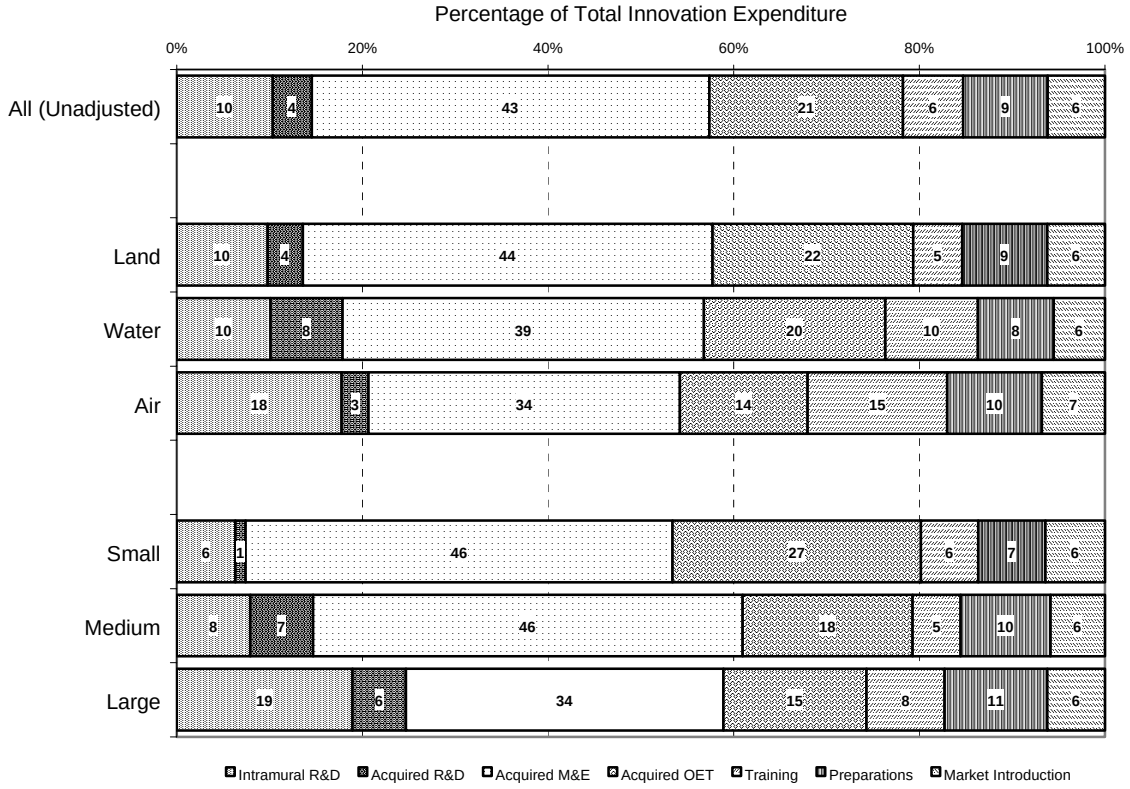
'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: From the Seven Countries data

In terms of engaging in the various innovation related activities, the most widely undertaken activity was, unsurprisingly, the acquisition of machinery and equipment related to innovation. This was done by over 60% of the innovators [using the adjusted data] – and was particularly widespread amongst land transport enterprises. Other widely undertaken innovation activities (undertaken by one third to 40% of the innovating enterprises) were the acquisition of other external technologies (including software), training in relation to innovations introduced, and preparations for the introduction of innovations. A quarter of the innovating enterprises had expenditures on the market introduction of innovations. Only 14% of the innovators had expenditures on intra-mural R&D activities. This proportion was considerably higher amongst the large enterprises (whereas it was especially low amongst the land transport and small enterprises). Overall, these patterns show a heavy dependence on bought-in technologies, which, as a 'supplier dominated' sector, fits our a priori expectations.

Assessing the simple average distribution of innovation costs, it is clear that the acquisition of machinery and equipment related to innovation tends to be the largest single component of innovation

expenditure in this sector – accounting for between a third and 45% of total spending on innovation. This is complemented by expenditures on other external technologies (including software). Acquired R&D tends to account for only a small component of total innovation costs, but when these three categories of expenditure on external sources technologies are combined, they account for (on average) two thirds of total innovation expenditures. Notably, the acquisition of external technologies tends to account for a smaller proportion of total innovation costs in air transport (51%) than in water (67%) or land (70%) transport. Again, these patterns show the heavy reliance of transport services on technologies developed elsewhere – principally by manufacturers and IT suppliers.

Figure A.3.1
The Distribution of Expenditures on Innovation in Transport - Simple Means



Intra-mural R&D accounts, on average, for only about 10% of total innovation costs although this is higher in air transport, and higher amongst the large enterprises. Training linked to innovation accounts for about 6% of total innovation costs on average, as does the market introduction of innovations, whilst preparations for the introduction of innovations accounts for about 9%. Notably training tends to form a larger proportion of total innovation costs in air transport than in land or water transport.

A.3.7 The Extent of Co-operation for Innovation

Less than a fifth of the innovating transport service enterprises had co-operative arrangements for innovation, although this varied widely by country – form only 3% in Ireland, 11% in Portugal and 12% in Germany, to over half the enterprises in Denmark, Finland and Norway. Overall, competitors were the most frequently engaged external partner for co-operative projects, yet there was significant variation between countries. In Denmark, Finland and Norway suppliers were the most widely engaged type of partner, whilst customers were engaged by 30% of enterprises in Belgium and Finland. Consultants and research institutes were the least frequently engaged types of partner, although almost 20% of the innovating Belgian transport enterprises had arrangements with these. Research institutes were also engaged by 20% of the Norwegian transport-sector innovators.

Table A.3.9: Transport Services: Co-operation Arrangements for Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
With Any Partner	27	39	12	59	38	53	3	45	32	62	11	24	14	18
Any External	27	39	12	59	28	46	3	41	26	55	10	21	9	16
With Competitors	0	18	11	0	6	25	1	18	12	20	3	0	3	9
With Customers	0	30	0	19	11	31	1	6	14	5	2	0	5	3
With Consultants	0	18	1	4	6	18	2	2	3	21	2	13	1	2
With Suppliers	0	20	1	59	11	33	2	4	13	38	5	14	0	4
With Universities	0	19	9	0	4	7	0	0	2	12	2	0	0	6
With Res. Institutes	0	18	1	4	6	7	0	0	1	21	1	0	9	3

Note: From analysis undertaken by Eurostat

A.3.8 The Extent and Nature of Difficulties Experienced with Innovation

Thirty percent of the innovating enterprises complained of having experienced difficulties with their innovation projects, although this proportion also varied between countries - from 23% of the innovating Irish enterprises and 25% of the British, to 60% of the Finnish and 63% of the French. Relatively few firms claimed innovation projects had been terminated; the largest proportions said the difficulties encountered delayed projects.

A wide range of factors were identified as having hampered innovation activities: the lack of sources of finance for innovation being the most widely recognised, followed by the perceived economic risk of innovation, and regulations or standards. Few firms complained that they had been hampered in their innovation efforts by excessive innovation costs, or by a lack of either market or technical information for innovation.

Table A.3.10: Transport Services – Factors Hampering Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Hampered Firms	36	28	26	26	63	60	23	52	30	45	37	37	25	30
Excessive economic risk	28	17	15	0	37	13	1	21	14	24	13	12	0	14
Excessive Innovation costs	29	20	0	0	37	20	1	19	13	8	23	3	0	5
Lack of sources of finance	28	16	21	0	24	9	0	7	6	17	21	6	16	19
Organisational rigidities	29	20	2	0	17	34	12	2	11	31	9	11	0	6
Lack of qualified personnel	34	22	1	22	22	27	10	2	17	26	10	14	9	7
Lack of technical information	0	21	1	22	15	19	10	8	14	10	8	0	0	3
Lack of market information	0	23	1	22	14	2	0	5	8	0	5	0	1	3
Standards / regulations	28	19	12	0	22	15	11	14	10	10	14	5	0	11
Lack of customer responsiveness	28	20	6	0	23	0	0	5	2	19	4	15	11	9

Note: From analysis undertaken by Eurostat

A.4 Sector Study: Telecommunications Services (NACE Rev.1 64.2)

Telecommunications is one of the most obviously (technologically) innovative of the service sectors, and one that has received considerable attention from analysts of innovation. The sector experienced de-regulation during the 1980s and 1990s, with many of the former nationalised monopoly 'telecos' being privatised, and with governments encouraging the entry of new competitors into national markets. This has lead to a degree of 'unbundling', such that many new telecommunications enterprises have entered the market specialising in the provision of particular services rather than aiming to provide the full range of services provided by the main telecommunications companies. New technologies are also important and are rapidly diffusing. Amongst these are a whole host of technologies associated with mobile and digital telecommunications, which have been replacing fixed line and analogue systems, and which are much more adept at data communications. Regulation is also a very important issue in this sector, particularly with respect to ensuring fair competition between incumbents and new entrants. We consider the major innovation issues in telecommunications in the late 1990s to have been:

- New product (or service) innovation – such as the introduction of mobile and internet services, and services which use these as platform technologies (e.g., short messaging services).
- Improved infrastructures associated with the new products being introduced – e.g., the installation of mobile telephony cell-stations and new broadband cabling for Internet access.
- Developments in the customer interface – such as the formation of flexible tariffs and designing new methods of payment. Also the provision of intelligent and search agents.

A.4.1 The Enterprise Size Structure of the Sector

According to Eurostat there were less than 1,000 telecommunications companies in the 13 countries which undertook a CIS-2 study of services. The UK had by far the largest number of these enterprises for a single country, accounting for over 40% of the total. This reflects the fact that the UK was the earliest country in Europe to liberalise its telecommunications markets and has a large number of specialised niche market telecommunications service providers.

Most of the enterprises in this sector are small, with 64% having 10-49 employees, yet large enterprises have a very significant presence and are responsible for the vast majority of economic activity in this sector. The significance of a small number of large enterprises is shown by the fact that, in 'the seven countries', mean employment of the telecommunications companies exceeded 1,000, whilst the median employment was just 29.

Table A.4.1: Telecommunications Services – Firms and the Firm Size Distribution

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Sample	6	14	4	2	38	28	16	2	15	30	14	21	22	212
Population	8	31	59	34	109	61	44	7	34	37	31	34	357	847
Sample %	75%	45%	7%	6%	35%	46%	36%	29%	44%	81%	44%	62%	6%	25%

Note: From Eurostat file C1

A.4.2 The Extent and Patterns of Innovation

Telecommunications enterprises were much more likely to undertake innovative activities than other service enterprises (and the average manufacturing enterprise). Indeed, in some countries (Germany, Denmark and Luxembourg) all telecommunications enterprises are recorded as having engaged in innovative activities between 1994 and 1996. More surprising is that only just over a quarter of the telecommunications enterprises in Belgium are recorded as having been engaged in innovative activities – yet this is still above the average for all service enterprises in Belgium.

Overall, only 212 telecommunications enterprises responded to the CIS-2 in the 13 countries. Because this is a small number of responses, and because of the unusual nature of the sector, we

have undertaken a different form of analysis for telecommunications than those for the other sectors assessed in this report. In particular, we have mainly divided the sample by enterprise size, rather than by country. As mentioned above, the enterprise size issue is particularly pertinent in this sector because of the existence of – on the one hand – the large national telecommunications service providers, and – on the other – new entrants which generally specialize in the provision of certain services; rarely do these new entrants aim to provide the full range of services provided by the national telecos. Consequently, these new entrants tend to be small enterprises. Most of the analysis which follows is based on the response from the seven countries for which we had direct data access – these provided 68% of all responses from telecommunications enterprises in the 13 countries and 97 (66%) of the 147 responses from innovative enterprises. This is a small number of responses, and because of this we present unadjusted rather than adjusted data findings.

Table A.4.2: Telecoms Enterprises with Innovative Activity, and Innovative Enterprises (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Innovative Activity	81	27	100	100	53	86	86	100	83	59	49	61	63	68
Innovating Enterprises	81	27	100	100	52	79	86	43	74	56	45	51	60	64

Note: from Eurostat file – C21

Amongst the innovating enterprises in the seven countries the proportion of innovators increased with enterprise size. 52.5% of the small telecommunications enterprises in 'the seven countries' that responded to the survey had introduced an innovation, as had 58.5% of the medium sized enterprises, and 79% of the large enterprises. The proportions of enterprises with innovative activities were 54%, 66% and 86% respectively. As the enterprises grew larger they also grew less dependent on other enterprises or organizations for the development of their innovations. Thus whilst almost a quarter of the innovating small telecommunications enterprises introduced innovations mainly developed by other enterprises or organizations, this was true of only 9% of the innovating medium-sized and large telecommunications enterprises. In general, however, this sector is characterised by a high level of internally developed innovations and a high rate of innovations jointly developed with other enterprises or organisations.

Table A.4.3: Sources of Innovation amongst Innovating Telecommunications Enterprises (%)

Unadjusted	Small	Medium	Large
Mainly developed by others	23	9	9
Developed jointly with others	45	43	55
Mainly developed in house	42	48	52
Number of Enterprises	33	27	37

Source: Seven Countries Data; In some countries multiple answers were given, so totals can exceed 100%

Table A.4.4: The Aims or Objectives of Innovation amongst Telecommunications Firms (%)

Unadjusted		Small	Medium	Large		Small	Medium	Large
Improving Quality	Relevant	91	100	100	V-Imp't	73	74	76
Open New Markets	Relevant	100	93	95	V-Imp't	70	78	84
Extend Range	Relevant	94	100	100	V-Imp't	76	74	81
Improve Flexibility	Relevant	70	74	95	V-Imp't	21	7	43
Reduce Labour Costs	Relevant	58	78	92	V-Imp't	18	18	24
Fulfil Regulations	Relevant	64	59	86	V-Imp't	6	4	22
Replace Old Services	Relevant	67	74	92	V-Imp't	30	37	38
Reduce Energy Costs	Relevant	33	30	54	V-Imp't	0	4	11
Reduce Materials Costs	Relevant	36	22	51	V-Imp't	6	4	5
Reduce Env Damage	Relevant	24	18	62	V-Imp't	0	4	22

Note: From the Seven Countries datat

A.4.3 The Aims or Objectives of Innovation

The three main aims of innovation amongst telecommunications enterprises are the same as those in the other service sectors – namely improving the quality of the services offered, opening new markets and extending the range of services offered. All of these were recognised as very important innovation objectives by over 70% of the small enterprises, and by even larger proportions of the large enterprises.

Most of the other objectives of innovation were recognised as relevant by at least half the enterprises, but only a minority recognised them as very important aims of their innovation activities. Amongst the large enterprises, over 40% considered improving their flexibility a very important objective of innovation, whilst only 30% of the small enterprises, and 38% of the large enterprises, saw the replacement of previous services as a very important aim of innovation. Only about 20% of the enterprises considered reducing labour costs a very important aim of innovation, whilst reducing energy and materials costs were rarely seen as very important. Reducing environmental damage was seen as very important by some of the large enterprises, but by very few of the small enterprises. Perhaps surprisingly, fulfilling regulations or standards was not widely regarded as a very important objective of innovation – although it appears more significant amongst large enterprises.

A.4.4 The Extent and Role of Research and Development (R&D)

The proportion of telecommunications enterprises undertaking R&D varied widely with enterprise size. Over 40% of the small innovating telecommunications enterprises did not undertake R&D, whilst half that proportion amongst the large enterprises did not undertake R&D. Amongst the large enterprises, 70% conducted R&D on a continuous basis – this compares with just a quarter of the small enterprises.

Table A.4.5: The Conduct of R&D amongst Innovators Telecommunications Companies (%)

Unadjusted	Small	Medium	Large	All
Continuously	24	41	70	46
Occasionally	33	26	11	23
Not At All	42	33	19	31

Note: From the Seven Countries data

A.4.5 The Sources of Information for Innovation

The telecommunications enterprises, and especially the large enterprises, recognised a wide range of sources of information as being relevant for their innovation activities. All 11 of the information sources were recognised as relevant by at least half of the large enterprises, with four sources appearing particularly important – sources within the enterprise, competitors, customers and suppliers. Each of these was identified as a very important source by at least a third of the small enterprises and by over 40% of the large enterprises. Oddly, a smaller proportion of the medium sized enterprises saw competitors as a very important source of information for innovation than did the small or large enterprises. Fairs and exhibitions, together with computer networks, were also seen as being of some significance, but professional meetings, consultants, universities, research institutes and patents were rarely regarded as very important sources of information for innovation, particularly amongst the small and medium-sized enterprises.

Table A.4.6: Telecommunications - Sources of Information for Innovation (%)

Unadjusted		Small	Medium	Large		Small	Medium	Large
Within Enterprise	Relevant	94	96	97	V-Imp't	33	48	57
Competitors	Relevant	79	81	89	V-Imp't	33	11	43
Customers	Relevant	82	74	89	V-Imp't	42	41	57
Professional Meetings	Relevant	79	89	87	V-Imp't	9	7	27
Fairs / Exhibitions	Relevant	76	82	86	V-Imp't	18	4	22
Suppliers	Relevant	88	96	100	V-Imp't	45	30	43
Computer Networks	Relevant	76	74	81	V-Imp't	18	11	19
Consultants	Relevant	64	82	84	V-Imp't	0	7	11
Universities	Relevant	30	56	78	V-Imp't	0	4	16
Research Institutes	Relevant	41	48	82	V-Imp't	3	0	18
Patents	Relevant	21	30	51	V-Imp't	3	0	8

Note: From the Seven Countries data

A.4.6 Resources Committed to Innovation, Innovation Activities and Expenditure Patterns

Telecommunications enterprises are not different from enterprises in any of the other service sectors in that within the sector there is wide variation in the extent to which enterprises commit resources to innovation. To illustrate, 15% of the small innovating telecommunications enterprises did not report any innovation expenditure for 1996, and a further 15% spent no more than 500euro per

employee on innovation. At the other end of the scale, 18% of the small innovators spent in excess of 10,000euro per employee on innovation activities in that year. In general the larger enterprises appear to have made heavier commitments to innovation – with only 5% not reporting any innovation expenditure for 1996, with only 3% having spent no more than 500euro per employee, and with 35% spending over 10,000euro per employee.

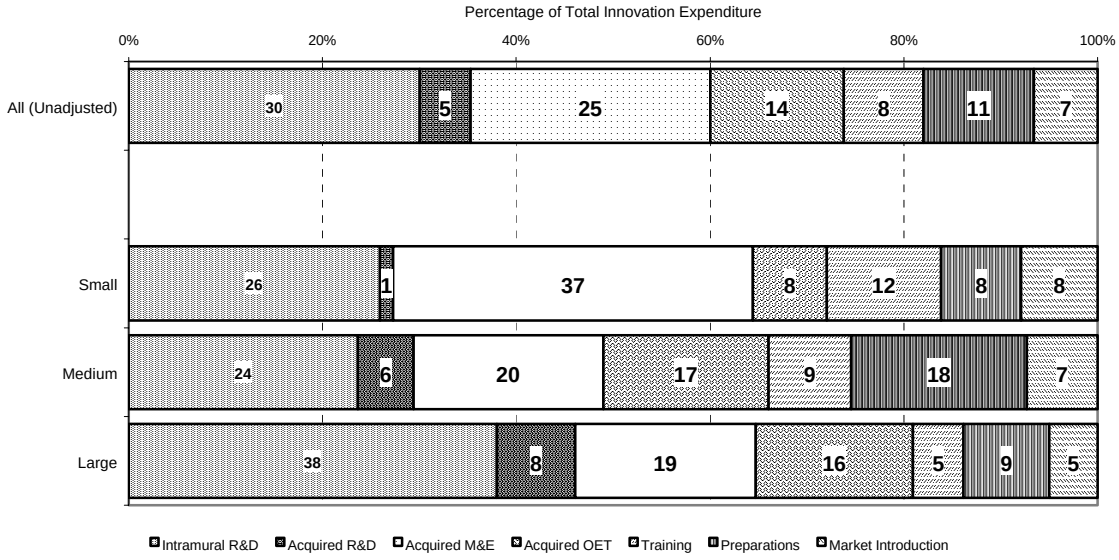
Table A.4.7: Telecommunications - Innovation Expenditure per Employee in 1996 (%) and Engagement in Innovation Related Activities in 1996 (%)

Unadjusted	Small	Medium	Large	All
No Expenditure Reported	15	4	5	8
Up to 500euro	15	22	3	12
501euro +	9	15	22	16
2,001euro +	42	30	35	36
10,001euro +	18	30	35	28
Intramural R&D	48	67	78	65
Acquired R&D	9	30	57	33
Acquired M&E	76	70	70	72
Acquired OET	48	70	78	66
Training	58	59	65	61
Preparations	39	74	70	61
Market Introduction	33	41	54	43
None of The Above	15	4	5	8

Note: From the Seven Countries data

In general, the innovating telecommunications enterprises engaged in a wide range of innovation related activities – with half or more of the large enterprises engaging in all 7 of the specified innovation related activities, whilst half or more of the medium sized enterprises engaged in 5 of the seven activities (the exceptions being the acquisition of R&D services and expenditures on the market introduction of their innovations). Amongst the small enterprises, only the acquisition of machinery and equipment for innovation, and training directly linked to innovation, were undertaken by more than half the innovative enterprises, but almost half conducted intramural R&D and acquired other external technologies. Fewer engaged in preparations for the introduction of innovations and in the market introduction of innovations, and very few acquired R&D services.

Figure A.4.1
The Distribution of Expenditures on Innovation in Telecommunications - Simple Means



In terms of the pattern of expenditure on these activities, on average 30% of spending was on intra-mural R&D (and this increased with enterprises size – as did expenditures on acquired R&D services). This is a much higher proportion than in services such as transportation or wholesaling. Amongst telecommunications, 25% of innovation expenditure was on machinery and equipment

linked to innovation (although this tended to be a much larger component of innovation costs amongst small enterprises). The acquisition of other external technologies (including software) constituted 14% of total innovation costs on average, but formed a smaller proportion amongst the small enterprises. Training directly linked to innovation accounted for, on average, 8% of costs, preparations for 11%, and the market introduction of innovation 7% - the first and last of these both declining as a proportion of total costs with increasing enterprise size.

A.4.7 The Extent of Co-operation for Innovation

The proportion of telecommunications enterprises that had collaborative arrangements for innovation increased with enterprise size – from just one third of the small innovating enterprises to four-fifths of the large enterprises. Amongst small enterprises the most likely collaborative partners were their suppliers or research institutes, but only 15% had these arrangements. The large enterprises were most likely to have collaborative arrangements with suppliers and consultants, with 60% of these enterprises having these arrangements. The high proportion of large enterprises having collaborative arrangements with consultants is notable given that these were rarely seen as a very important source of information for innovation. A third of the large enterprises also had collaborative arrangements with universities, with research institutes and with customers, and a quarter even had these arrangements with their competitors.

In general, the large innovating telecommunications enterprises demonstrate a high rate of collaboration for innovation, often with multiple collaborating partners. This may reflect a highly networked form of innovation collaboration amongst large enterprises in this sector.

Table A.4.8: Telecommunications: Co-operation Arrangements for Innovation (%)

Unadjusted	Small	Medium	Large	All
With Any Partner	32	55	79	57
Any External	32	48	76	53
With Competitors	9	14	24	16
With Customers	6	18	32	20
With Consultants	9	25	60	32
With Suppliers	15	29	62	36
With Universities	0	7	35	15
With Res. Institutes	15	25	35	25

Note: From the Seven Countries data

A.4.8 The Extent and Nature of Difficulties Experienced with Innovation

A large proportion of the innovative telecommunications enterprises had experienced difficulties with their innovation projects between 1994 and 1996. Forty percent of the small enterprise had encountered difficulties, but almost 80% of the medium sized, and 70% of the large enterprises, had had difficulties with innovation. The difficulties were varied – in each size class fewer than half the enterprises complained that any of the particular factors had hampered their innovation efforts – but the five most widely reported difficulties were: the perceived excessive economic risk associated with innovation; the excessive cost of innovation; organizational rigidities; a lack of qualified personnel and a lack of customer responsiveness to innovation. Notably, few telecommunications enterprises complained that a lack of technical information or, more surprisingly, standards and regulations had hampered their innovation activities.

Table A.4.9: Telecommunications – Factors Hampering Innovation (%)

Unadjusted	Small	Medium	Large	All
Hampered Firms	42	78	70	63
Excessive economic risk	27	48	39	37
Excessive Innovation costs	18	32	36	29
Lack of sources of finance	12	24	11	15
Organisational rigidities	15	32	39	29
Lack of qualified personnel	21	44	39	34
Lack of technical information	9	8	6	7
Lack of market information	18	12	11	14
Standards / regulations	9	4	11	9
Lack of customer responsiveness	21	32	25	26

Note: From the Seven Countries data

A.5 Sector Study: Financial Services (NACE Rev.1 65, 66, 67)

In this report the financial services sector is comprised of banking (NACE-R1 65), and insurance and pensions (NACE-R1 66) activities, but also includes auxiliary financial activities (NACE-R1 67). In 1997 financial services accounted for 10.6% of value added and 7.8% of total employment in the EU's market services sectors (or about 5.5% of total value added and 3.6% of total employment – Eurostat, 1999). The sector has a large number of very small firms - 94% of enterprises in financial intermediation have fewer than 10 employees – but economic activity in the sector is dominated by large enterprises. According to Eurostat only 13% of employees in this sector were engaged by the 94% of enterprises with fewer than 10 employees. Compares this with 40% of employees in such enterprises in all market services. Meanwhile, 72% were employed in the 0.7% of enterprises with 250 or more employees (compared with 32% of employees in all market services)

Banking especially is a highly concentrated activity. According Eurostat (1999) around 8,000 credit institutions were active in the EU in 1997. Together these controlled 204,000 local units with an average of 13 persons per local unit. Total employment in banking in the EU has been estimated at 3.3 million for 1997 (Eurostat, 1999), and labour costs tend to account for a high proportion of total costs (typically over 50%). Partially this is because the sector has a relatively high proportion (25%+) of (high cost) employees with a degree from higher education.

Insurance is also a highly concentrated service activity. In 1996 there were approximately 4,200 enterprises active in insurance (Eurostat, 1999), and Eurostat estimated EU employment in insurance and pensions to be 1.2 million (Eurostat, 1999). Like banking, this sector also has a relatively high proportion (25%+) of employees with a degree from higher education.

By contrast, auxiliary financial activities are much less concentrated, and the 'sector' contains a large number of very small and small enterprises engaged in a wide range of activities. Eurostat estimated these employed 760,000 people in the EU in 1997 (Eurostat, 1999).

In terms of innovation strategies, financial services, and banking and insurance in particular, tend to be amongst the heaviest investors in information technologies. These can be applied across of large range of tasks across the financial services sector. Firstly, information technologies can be applied to financial products such that products can be increasingly tailored to particular clients or groups of clients. Meanwhile, these technologies are often used to increase the financial service provider's control over the process of provision. For example, computer programmes are increasingly replacing managers in making judgements as to whether or not a bank should grant a loan. Secondly, financial services often introduce new technologies, particularly information technologies that replace routine labour. Automated teller machines are now widespread, with telephone and Internet banking also diffusing rapidly – these either shift work to back offices where resources are used more efficiently, or alternatively transfer work (in terms of managing accounts) to the user from the provider. Insurance companies are also using the Internet to interact with clients searching for a policy and making claims. In general this sector is probably amongst the more homogeneous of those analysed in this report.

A.5.1 The Enterprise Size Structure of the Sector

According to Eurostat, there were almost 16,000 financial services enterprises with 10 or more employees in the 13 countries eligible for inclusion in the CIS-2. Overall, 12% of these responded to the survey, a larger proportion than for most other sectors. By far the largest numbers of these firms were in Germany and the UK which, combined, accounted for almost 60% of the population. As with the other sectors, however, Germany and the UK had the lowest proportional response relative to their populations. By contrast, 50% of the eligible enterprises in Norway responded to the survey, as did 46% of those in Portugal and 45% of those in Finland.

As mentioned in the introduction, the financial services sector contains some very large enterprises. This is illustrated for Germany and France by the fact that the mean employment in the responding firms exceeded 1,000 whilst the median employment in these countries was also high. In other countries, however, the mean and medium employment of the enterprises was much lower. Partially, this reflects a different composition of response by sub-sector. The French and German response is dominated by banking (NACE 60) responses, whereas the samples from Britain and

Ireland contain much larger proportions of auxiliary financial services enterprises (NACE 62) which tend to be much smaller enterprises.

Table A.5.1: Financial Services – Firms and the Firm Size Distribution

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Sample	124	116	268	49	205	55	88	65	308	145	180	70	146	1,819
Population	796	653	5,297	563	1,725	123	713	216	881	291	388	248	3,974	15,867
Sample %	16%	18%	5%	9%	12%	45%	12%	30%	35%	50%	46%	28%	4%	12%
NACE 65			59%		66%		11%			66%	69%	34%	37%	
NACE 66			22%		34%		31%			17%	16%	30%	18%	
NACE 67			19%		-		58%			17%	15%	36%	45%	
Small			41%		32%		69%			69%	78%	48%	70%	
Medium			30%		28%		27%			21%	15%	38%	19%	
Large			29%		40%		4%			10%	7%	13%	11%	
Median E			81		136		18			29	25	50	28	
Mean E			1,087		1,913		90			154	164	329	224	

Note: Mean E – Mean Employment; Median E – Median Employment. From Eurostat file C1 and the Seven Countries data

A.5.2 The Extent and Patterns of Innovation

Financial services enterprises tend to be more likely to innovate than services generally. Partially, this is due to the large firm size structure of the sector – in general, the propensity to innovate increases with enterprise size – but it also reflects the importance of technology, especially information technologies, in this sector. Like other sectors, however, the proportion of financial services enterprises recorded as having innovative activities varied widely between countries – from just 17% of enterprises in Belgium to 71% of enterprises in Germany.

Table A.5.2: Financial Service Firms with Innovative Activity, and Innovative Enterprises (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Innovative Activities	57	17	71	54	48	33	70	53	46	45	43	58	56	58
Innovating Enterprises	55	13	70	48	45	28	67	43	40	44	43	56	49	54

Note: from Eurostat file – C21

Roughly half the respondent firms claimed to have developed their own innovations. The British and Irish firms were particularly likely to claim they developed their innovations in-house. However, in general, a large proportion also claimed to have developed innovations jointly with others. This may well be due to collaborations with computer systems (including software) providers. Some firms, including many in the UK and Norway, declared their innovations had been developed mainly by others – again these are likely to be IT related.

Table A.5.3: The Sources of Innovation amongst Innovating Financial Services Firms

Adjusted	D	F	IRL	NOR	P	S	UK	N. 65	N. 66	N. 67
Mainly developed by others	8	11	27	44	24	10	56	15	10	44
Developed jointly with others	44	66	21	32	48	50	13	45	41	21
Mainly developed in house	48	59	62	28	27	40	42	46	62	37

Source: Seven Countries Data; In some countries multiple answers were permitted, so totals can exceed 100%

A.5.3 The Aims or Objectives of Innovation

As with the other service sectors, the most widely recognised relevant objectives of innovation were improving the quality of the services supplied, opening new markets, extending the range of services, improving the flexibility of provision and reducing labour costs. Of these, only improving service quality was recognised as a very important objective of innovation by more than half the innovators – with 82% recognising this as very important. This proportion, like many others, varied widely between countries – from less than half the Dutch innovators to 96% of those in the UK.

Notably, both improving the flexibility of provision and reducing labour costs were slightly more likely to be regarded as very important objectives of innovation in this sector than in services in

general. Improving flexibility was particularly widely recognised as a very important aim of innovation amongst German (66%) and Belgian (54%) financial service firms, but was rarely recognised as very important by financial service enterprises in Luxembourg (18%) or Sweden (19%). Reducing labour costs, meanwhile, was only recognised as very important by 7% of the Finnish innovators, compared with 52% of the UK and 63% of the Norwegian innovators. Unsurprisingly, reducing environmental damage, and reducing both energy and materials costs were rarely regarded as very important objectives of innovation in this sector in any country.

Table A.5.4: The Aims or Objectives of Innovation amongst Financial Services Firms (%)

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Improving	Relevant	100	.	99	.	71	.	94	90	94	99	95	.	100	96
Quality	V-Imp't	78	84	88	52	56	52	70	90	45	78	92	57	96	82
Open New	Relevant	90	89	97	95	72	.	87	94	81	97	88	98	100	93
Markets	V-Imp't	28	46	37	54	41	26	53	70	31	51	60	80	64	46
Extend	Relevant	91	97	98	.	72	94	89	97	80	94	91	96	96	93
Range	V-Imp't	13	76	50	56	55	43	50	88	36	68	60	65	26	44
Improve	Relevant	92	92	94	.	66	.	86	78	88	86	87	86	97	91
Flexibility	V-Imp't	30	54	66	39	29	33	48	18	38	31	35	19	23	46
Reduce	Relevant	98	88	91	.	70	65	85	51	80	91	77	86	79	85
Labour Costs	V-Imp't	33	41	46	22	29	7	21	14	22	63	26	22	52	41
Fulfil	Relevant	89	52	77	92	53	54	70	76	29	72	70	91	95	77
Regulations	V-Imp't	17	14	19	16	24	3	22	42	6	3	33	19	39	23
Replace Old	Relevant	90	29	74	.	41	.	38	45	73	94	52	83	66	68
Services	V-Imp't	33	4	17	18	21	27	24	23	23	47	18	36	13	19
Reduce	Relevant	51	15	53	50	49	32	24	19	17	24	41	31	21	40
Energy Costs	V-Imp't	7	3	3	8	11	.	.	0	4	0	7	0	5	4
Reduce Mat	Relevant	40	32	66	61	49	28	28	32	13	44	49	28	28	48
-erials Costs	V-Imp't	5	.	10	3	11	.	3	4	2	9	9	6	6	8
Reduce	Relevant	28	17	52	44	0	32	18	9	12	32	24	45	21	34
Env Damage	V-Imp't	0	0	5	3	0	.	3	0	4	4	12	5	7	4

Note: From analysis undertaken by Eurostat; '.' data suppressed by non-disclosure rules

A.5.4 The Extent and Role of Research and Development (R&D)

Financial services enterprises are less likely than services (analysed in this report) in general to conduct R&D, with only about one third of the innovators conducting R&D, and less than one fifth conducted R&D on a continuous basis. However, this proportion varied considerably between countries – with the majority of innovating financial services enterprises in Denmark, France, Finland, Luxembourg, the Netherlands and Sweden conducting R&D, whilst over 70% of these enterprises in Austria, Germany and the UK did not undertake R&D. One reason for these wide variations is that the definition of R&D in financial services may be particularly difficult, as it is not clear whether financial research should be included, or whether R&D is only technological research and development. Another aspect is the differences between the sub-sectors within the financial sector.

Table A.5.5: The Conduct of R&D amongst Financial Services Innovators (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Continuously	3	29	13	35	40	24	21	46	35	7	26	36	11	18
Occasionally	23	39	16	25	38	45	23	41	20	32	15	24	14	19
Not At All	74	33	72	40	16	31	57	13	46	61	59	40	75	63

Note: From Eurostat file – C51

A.5.5 The Sources of Information for Innovation

Like services generally, amongst financial service firms sources within the enterprises were the most widely recognised relevant source of information for innovation– with only 5% failing to recognise the relevance of this source. Also like other services, competitors and professional meetings were widely regarded as relevant sources of information for innovation. Notably, computer networks and consultants were more widely recognised as relevant sources of information for innovation in this sector than in services generally, whilst fairs and exhibitions, universities, research institutes and especially patents were less likely to be seen as relevant. Overall, only 14% of the innovating enterprises saw the relevance of patents as a source of information for innovation, but this varied by country, from no Finnish and 1% of French enterprises, to 23% of German, 27% of Swedish and 29% of Danish enterprises.

Table A.5.6: Financial Services - Relevant Sources of Information for Innovation

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Within Enterprise	94	99	98	90	88	100	93	97	93	94	89	92	95	95
Competitors	91	89	82	95	78	100	83	76	79	91	65	91	75	81
Customers	92	95	61	100	80	100	94	90	73	92	80	87	80	74
Professional Meetings	95	84	84	52	63	92	82	74	73	80	66	64	89	81
Fairs / Exhibitions	65	39	68	44	38	65	68	33	39	57	36	54	59	59
Suppliers	34	65	45	81	70	76	79	84	65	90	82	92	99	66
Computer Networks	83	72	66	61	43	92	69	54	42	80	50	71	83	68
Consultants	59	76	83	57	48	64	66	77	50	82	66	71	58	69
Universities	35	31	53	32	23	41	33	35	17	49	37	49	13	36
Research Institutes	28	22	31	13	8	6	28	21	15	42	28	n.a.	19	24
Patents	12	10	23	29	1	0	9	4	2	6	9	27	6	14

Note: From Eurostat file - C72

A.5.6 Resources Committed to Innovation, Innovation Activities and Expenditure Patterns

As with all the service sectors analysed in this report, financial service enterprises ranged in their commitments to innovation, with about one third declaring no or low innovation expenditures per employee in 1996 (i.e., less than 500euro per employee) whilst almost 20% had very high innovation expenditures (i.e., over 10,000euro per employee) in that year. This sector, though, unlike others such as transport services and wholesale services, tends to have many more large enterprises, in which we would expect the level of innovation expenditure to be more consistent year on year, and less lumpy than is the case amongst sectors dominated by small enterprises. This may suggest a more stable pattern of expenditure on innovation in this sector.

However, surprisingly the proportion of enterprises that did not provide innovation expenditure data was similar amongst small and large enterprises. The proportion of enterprises with very high innovation expenditures declined with increasing enterprises size, although this sector, like all others, displays a high variance in the (recorded) commitment of resources to innovation.

Table A.5.7: Financial Services - Innovation Expenditure per Employee (%)

Unadjusted [Adjusted]	Small	Medium	Large	NACE 65	NACE 66	NACE 67	All
No Expenditure Reported	24%	26%	28%	31%	23%	17%	26% [33%]
Up to 500euro	2%	7%	7%	7%	6%	4%	6% [5%]
501euro +	16%	17%	17%	18%	14%	17%	17% [13%]
2,001euro +	34%	31%	31%	28%	35%	36%	32% [31%]
10,001euro +	24%	20%	16%	15%	22%	27%	19% [18%]

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: From the Seven Countries data

Table A.5.8: Financial Services - Engagement in Innovation Related Activities in 1996 (%)

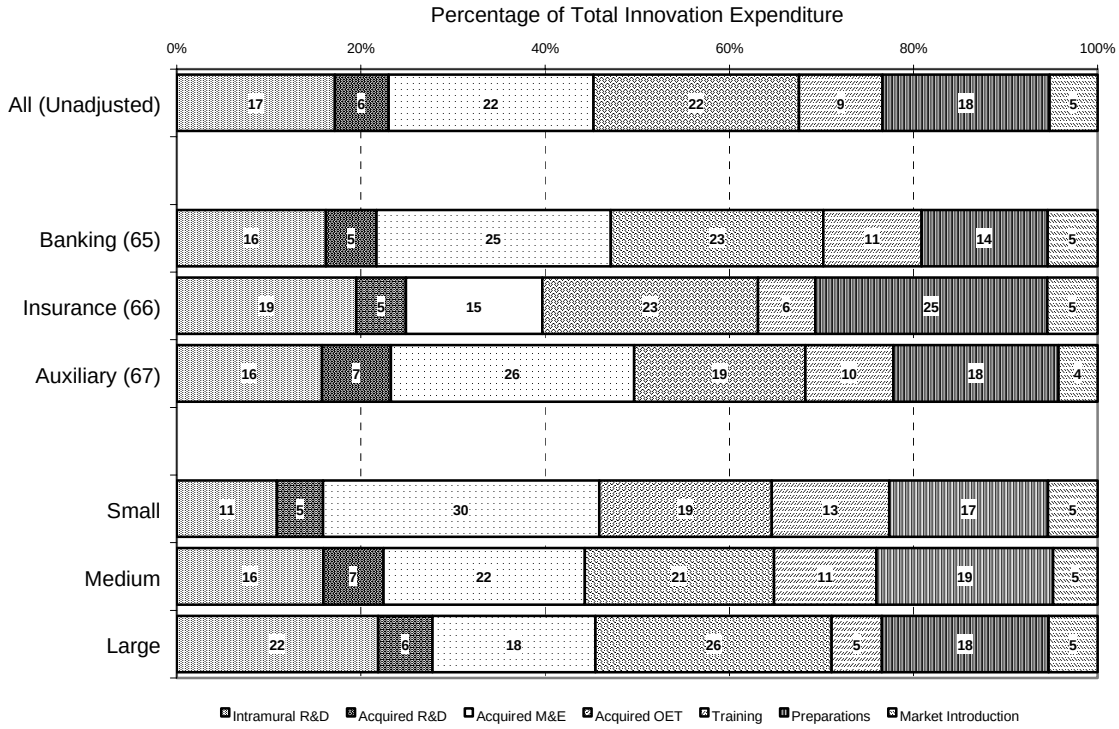
Unadjusted [Adjusted]	Small	Medium	Large	NACE 65	NACE 66	NACE 67	All
Intramural R&D	21%	34%	51%	32%	50%	35%	38% [28%]
Acquired R&D	14%	18%	25%	20%	20%	21%	20% [14%]
Acquired M&E	53%	49%	54%	53%	50%	55%	52% [48%]
Acquired OET	54%	57%	68%	61%	64%	55%	61% [53%]
Training	53%	54%	61%	55%	62%	56%	57% [50%]
Preparations	41%	52%	62%	48%	63%	55%	53% [42%]
Market Introduction	23%	23%	33%	28%	28%	25%	28% [23%]
None of The Above	20%	19%	18%	23%	14%	17%	19% [27%]

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: From the Seven Countries data

In terms of engagement in innovation related activities, about half the innovating enterprises in 'the seven countries' engaged in acquiring machinery and equipment for innovation, acquiring other external technologies for innovation, and incurred expenditures on training linked to innovation. For training especially, this is a high proportion relative to other technology using service sectors, such as wholesalers and transport services. Forty percent of the innovating enterprises incurred expenditures on preparations for the introduction of innovations, and about a quarter incurred expenditures on the

market introduction of innovations. Intra-mural R&D was undertaken by almost 30% of the innovating enterprises, with about half this proportion acquiring R&D services. There were not pronounced differences between the sub-sectors – although the banking enterprises were less likely to undertake all of the activities, especially R&D and preparations.

Figure A.5.1
The Distribution of Expenditures on Innovation in Financial Services - Simple Means



Amongst financial service enterprises, roughly half of all innovation costs were accounted for by the acquisition of machinery and equipment, externally conducted R&D and other external technologies (including software). There is some suggestion of a gradual shift with increasing enterprise size from expenditures on machinery and equipment to expenditures on other external technologies. Meanwhile intra-mural R&D and preparations for the introduction of new services both accounted for, on average, 17% of total innovation expenditures (although this proportion increased with enterprise size), whilst training in relation to innovation accounted for only about 9% of total costs (declining with size), and the market introduction of innovations for only 5% of total costs. This pattern did not vary greatly between the sub-sectors, although intra-mural R&D and preparations accounted for larger proportions of the total in insurance (NACE 66) whilst on average acquired machinery and equipment accounted for a smaller share in that sector.

A.5.7 The Extent of Co-operation for Innovation

Financial services enterprises were no more likely to have co-operative arrangements for innovation than other service enterprises, which, given the greater number of large enterprises in this sector and the fact that larger enterprises tend to be more likely to co-operate for innovation than small enterprises, is surprising. The proportion of innovating enterprises with co-operative arrangements for innovation also varied widely by country – from just 14% in the UK and 15% in Austria to 74% in Denmark, 77% in Sweden, 78% in Belgium and 81% in Luxembourg.

Overall, consultants were the most widely engaged type of external partner, although only 13% of innovating enterprises had arrangements with these. Consultants were particularly widely engaged in Sweden, where half the enterprises had arrangements with consultants. Suppliers were engaged by only 8% of the innovating enterprises, but by much larger proportions outside of

Germany, the UK, Austria and France. Competitors were engaged by one third of innovating financial service enterprises in Belgian and a fifth of those in Denmark, the Netherlands and Norway. Meanwhile 30% of these enterprises had co-operative arrangements with their customers in Belgian, Denmark, Finland and Sweden, whilst only 1% had such arrangements in both Germany and Austria. Research institutes and universities were rarely engaged as partners for innovation, although 17% of innovating enterprises in the UK had arrangements with research institutes and 13% of innovating enterprises in Sweden had arrangements with universities.

Table A.5.9: Financial Services: Co-operation Arrangements for Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
With Any Partner	15	78	19	74	24	50	25	81	42	56	35	77	14	24
Any External	15	65	19	62	23	52	32	60	44	55	36	68	18	24
With Competitors	2	34	8	21	4	8	9	8	20	18	1	9	5	8
With Customers	1	29	1	31	7	31	11	10	15	19	8	33	7	6
With Consultants	10	19	10	12	16	19	8	17	13	17	15	49	15	13
With Suppliers	9	24	2	27	9	31	22	34	17	40	22	38	3	8
With Universities	1	6	2	3	2	4	.	0	6	2	1	13	1	2
With Res. Institutes	0	0	0	0	2	0	0	0	3	2	0	4	17	3

Note: From analysis undertaken by Eurostat

A.5.8 The Extent and Nature of Difficulties Experienced with Innovation

Overall, 40% of the innovating financial services enterprises declared they had experienced difficulties with innovation, although this proportion varied widely between countries – from just 18% of the Austrian and 23% of the UK enterprises, to 72% of the Danish and 82% of the Finnish enterprises.

Overall, the two most widely cited reasons for experiencing difficulties with innovation were organizational rigidities within the enterprises and a lack of qualified staff. Both of these appear to be particularly widespread problems in Finland. Organisational rigidities also hampered a quarter or more of the innovators in Belgium, Germany and Norway, whilst a lack of qualified personnel hampered innovation in a quarter of the German, Danish, Dutch and Swedish enterprises. A lack of information on technology hampered a quarter of the innovating Danish and Dutch enterprises. Meanwhile, a lack of information on markets was rarely a barrier to innovation, as was a lack of customer responsiveness to innovation and (unsurprisingly) a lack of sources of finance for innovation.

Table A.5.10: Financial Services – Factors Hampering Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Hampered Firms	18	44	50	72	34	82	28	61	44	38	34	57	23	40
Excessive economic risk	3	17	17	5	10	12	8	17	18	5	5	13	4	12
Excessive Innovation costs	8	21	0	27	11	31	4	25	17	9	6	14	5	5
Lack of sources of finance	3	7	10	0	3	0	3	1	5	3	6	6	4	6
Organisational rigidities	16	25	34	11	13	44	4	5	16	31	14	17	14	22
Lack of qualified personnel	10	7	26	28	9	58	18	17	31	17	9	27	15	20
Lack of technical information	4	15	11	25	4	17	7	0	23	8	8	10	3	9
Lack of market information	3	5	9	0	4	3	0	4	11	8	7	8	0	5
Standards / regulations	3	10	18	6	7	10	4	15	6	2	16	15	2	10
Lack of customer responsiveness	6	5	13	10	7	0	8	9	5	8	5	11	1	8

Note: From analysis undertaken by Eurostat

A.6 Sector Study: Computer Services (NACE Rev.1 72)

Under NACE Rev.1 72 the computer services comprise hardware and software consultancy services, analysis, design and programming of ready to use software, data processing and database activities, as well as the maintenance and repair of office machinery. The sector is therefore diverse, including technology providing, product oriented activities (such as the production of packaged software) that are very similar to manufacturing, as well as many other service oriented, technology using activities (such as data processing and database analysis).

According to Eurostat (1999) there were around 160,000 computer services enterprises in the 13 countries that undertook the services CIS-2, but most of these enterprises are very small, typically employing around 5 people. Labour costs generally account for between a third and 45% of total costs, this is relatively high in comparison with other service sectors, and reflects both the higher average earnings available in this sector and the relatively high proportion of employees with a degree form higher education. In most countries this was more than half the workforce, which was more than three times the norm in services. This reflects the high degree to which computer service enterprises, particularly the technology providers, depend on the knowledge embodied in their workforces.

The computer services sector is clearly one of the most dynamic and technologically innovative sectors, not only in services but also in the economy as a whole. However, there is considerably diversity within the sector. Some enterprises undertake routine activities whilst others are highly innovative. The main innovation trajectories in the sector are likely to be:

- Solving user needs – by providing bespoke software, and customising standard software.
- Improving the functionality of existing products, and expanding the range of applications.
- Simplifying products in order to execute a shift from the provision of customised outputs to standardised outputs which expands the market and reduces the unit cost of production.

A.6.1 The Enterprise Size Structure of the Sector

According to Eurostat there were over 14,000 computer service firms (with 10 or more employees) in the 13 countries that participated in the services component of the CIS-2. Germany had by far the largest number of these firms (with nearly 6,000) followed by France and the UK. Ireland, the Netherlands, and Sweden also had substantial numbers of computer services firms, with fewer in Austria, Belgium, Denmark, Finland, Portugal and Luxembourg.

Table A.6.1: Computer Services – Firms and the Firm Size Distribution

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Sample	19	52	136	14	617	55	34	13	154	106	58	68	55	1,381
Population	211	341	5,997	181	2,632	184	462	40	590	250	129	483	2,690	14,190
Sample %	9%	15%	2%	8%	23%	30%	7%	33%	26%	42%	45%	14%	2%	10%
Small			81%		75%		66%			81%	87%	71%	78%	
Medium			16%		21%		34%			13%	13%	24%	18%	
Large			3%		4%		-			6%	-	5%	4%	
Median E			20		24		30			19	15	27	22	
Mean E			77		61		41			72	28	71	59	

Note: Mean E – Mean Employment; Median E – Median Employment. From Eurostat file C1 and the Seven Countries data

Like other service sector firms, computer service firms tend to be small. Of the firms with 10 or more employees, between 66% and 87% had fewer than 50 employees in the seven countries, and no more than 6% had 250 or more employees. The median employment in these countries ranged from 15 to 30, whilst the mean was considerably higher (except in Ireland and Portugal), and was usually between 60 and 80 employees. Computer services therefore, whilst being dominated by small enterpises in terms of the number of firms, has a highly skewed enterprise size distribution, with a few large firms responsible for as much economic activity as a large number of small firms.

Overall about 10% of the computer service firms in the 13 countries responded to the survey, however the response was much smaller in Germany and the UK, two countries which together account for over 60% of the computer service firms in the 13 countries.

A.6.2 The Extent and Patterns of Innovation

Unsurprisingly, most (72%) computer service firms engaged in innovative activities between 1994 and 1996. Within the individual countries, the proportion that undertook innovative activities ranged from 43% in Belgium – the only country in which fewer than half the enterprises in this sector undertook innovative activities - to 90% in Denmark. More than three-quarters of the German and UK firms had also engaged in innovative activities. Not only are computer service enterprises more likely to engage in innovative activities than service enterprises generally, they are also more likely to engage in these activities than manufacturing enterprises. Only in Ireland did the proportion of computer service enterprises with innovative activities lag below that for manufacturers in the same country, although the proportion of Irish manufacturers with innovative activities was particularly high.

Table A.6.2: Computer Service Firms with Innovative Activity, and Innovative Enterprises (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Innovative Activities	69	43	77	90	57	68	73	88	74	53	57	57	81	72
Innovative Enterprises	69	41	71	89	52	64	73	88	68	50	53	55	81	68

Note: from Eurostat file – C21

Unsurprisingly, most computer service innovators claimed they were primarily responsible for developing their innovations. Relatively few introduced innovations mainly developed by others, although this proportion was slightly higher in the UK and Ireland.

Table A.6.3: The Sources of Innovation amongst Innovating Computer Service Firms

Adjusted	D	F	IRL	NOR	P	S	UK
Mainly developed by others	8	7	15	2	5	7	12
Developed jointly with others	24	41	10	11	39	15	18
Mainly developed in house	68	67	75	86	56	78	77

Source: Seven Countries Data; In some countries multiple answers were permitted, so totals can exceed 100%

Table A.6.4: The Aims or Objectives of Innovation amongst Computer Service Firms (%)

Adjusted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Improving	Relevant	99	65	98	.	85	.	90	.	97	95	96	.	92	94
Quality	V-Imp't	76	56	80	43	57	43	55	81	50	73	74	64	69	70
Open New	Relevant	37	.	90	75	86	.	86	.	84	.	95	.	.	91
Markets	V-Imp't	11	75	45	55	63	53	75	67	47	87	56	61	82	58
Extend	Relevant	50	.	94	.	86	96	94	.	84	99	87	.	92	92
Range	V-Imp't	.	64	77	71	57	29	26	81	30	55	55	68	55	63
Improve	Relevant	99	81	85	62	60	73	83	84	63	76	68	63	69	76
Flexibility	V-Imp't	62	1	41	2	15	18	18	54	15	17	30	8	25	29
Reduce	Relevant	49	51	82	22	46	47	65	75	46	76	59	63	67	68
Labour Costs	V-Imp't	13	.	40	.	8	.	18	19	9	20	9	14	5	22
Fulfil	Relevant	49	30	71	35	58	46	58	90	31	77	51	75	57	62
Regulations	V-Imp't	1	19	16	.	18	6	19	50	2	13	25	18	7	13
Replace Old	Relevant	89	65	74	.	69	89	58	84	81	91	73	70	61	71
Services	V-Imp't	70	8	29	30	32	42	27	53	36	47	35	30	18	28
Reduce	Relevant	25	30	57	19	11	29	29	47	11	36	19	22	24	37
Energy Costs	V-Imp't	1	.	6	.	2	.	.	.	.	5	6	3	.	3
Reduce Mat	Relevant	25	30	60	30	14	38	38	65	8	45	30	22	18	38
-erials Costs	V-Imp't	.	.	11	.	3	.	10	.	.	12	.	3	.	6
Reduce	Relevant	24	13	60	43	9	19	24	22	12	28	17	26	35	40
Env Damage	V-Imp't	.	1	11	.	1	.	.	.	2	2	5	3	.	5

Note: From analysis undertaken by Eurostat; '.' data missing due to non-disclosure rules

A.6.3 The Aims or Objectives of Innovation

As with the other service sectors, the vast majority (i.e., over 90%) of the innovating computer services firms recognised the relevance of improving their service quality, opening new markets and extending their service range as aims of their innovation activities. More than half the enterprises also recognised each of these as very important objectives of innovation. Three quarters recognised the relevance of innovating to improving their production flexibility, and two thirds stated that reducing labour costs was a relevant objective. Replacing old services, and fulfilling regulations or standards were also widely recognised as relevant aims of these firms' innovation activities.

Reducing energy and materials costs, and reducing environmental damage were only recognised as relevant innovation objectives by about 40% of innovating firms, and only between 3% and 6% recognised these as very important aims of innovation. Notably, reducing materials costs and reducing environmental damage were more widely recognised as very important objectives of innovation in Germany, where 11% cited these factors.

A.6.4 The Extent and Role of Research and Development (R&D)

Unsurprisingly, R&D is much more common amongst computer services firms than amongst service firms generally. Of the innovating computer service firms, 72% conducted R&D, 45% of these on a continuous basis; this compares with just 47% and 24% respectively amongst all services in the survey – and 69% and 36% respectively amongst all manufacturers in the survey). Thus computer service firms are more like manufacturers than service firms in their propensity to undertake R&D.

Interestingly, wide differences were found in the proportion of innovating computer service firms that undertook R&D. In most countries, at least half of these enterprises conducted R&D on a continuous basis, with three-quarters or more doing so in Austria, Finland and Luxembourg. However, in Germany, only a third of the innovating computer service enterprises conducted R&D on a continuous basis, as did 42% of the Danish enterprises. Over a third of the German enterprises did not conduct R&D at all, as did over a third of the Portuguese and nearly half of the innovating Irish computer service firms. This may reflect differences in the nature of the activities conducted by firms in the computer services sector in the different countries.

Table A.6.5: The Conduct of R&D Amongst Innovating Computer Service Enterprises (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Continuously	77	62	33	42	52	75	35	81	68	58	50	61	56	45
Occasionally	12	16	32	43	31	18	17	10	14	31	13	17	21	27
Not At All	11	22	36	15	16	7	48	10	18	11	37	22	23	28

Note: From Eurostat file – C51

Table A.6.6: Computer Services - Relevant Sources of Information for Innovation

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Within Enterprise	100	100	99	75	85	100	86	100	96	100	92	100	100	96
Competitors	97	65	92	75	53	91	75	45	71	90	54	93	73	80
Customers	99	100	85	100	76	100	94	100	91	99	82	97	92	87
Professional Meetings	100	91	97	49	62	80	79	85	85	92	79	67	89	87
Fairs / Exhibitions	99	91	87	74	55	61	74	49	70	91	63	75	96	82
Suppliers	93	81	67	61	71	70	85	88	67	84	71	78	73	71
Computer Networks	98	91	91	62	62	90	90	72	56	96	63	79	92	85
Consultants	84	54	72	43	23	51	68	76	40	66	31	71	69	62
Universities	98	29	58	57	19	62	52	76	40	70	33	72	62	53
Research Institutes	86	26	46	42	10	26	40	76	30	47	11	n.a.	46	40
Patents	82	24	41	0	6	12	28	8	10	32	5	11	21	28

Note: From Eurostat file - C72

A.6.5 The Sources of Information for Innovation

Sources within the enterprise were the most widely identified source of information for innovation, with all enterprises in Austria, Belgium, Finland, Luxembourg, Norway, Sweden and the UK identifying this source as relevant (and the lowest being Denmark, where 75% of the enterprises regarded information sources within the firm as being relevant). Customers, professional meetings

and computer networks were also very widely regarded as relevant sources of information for innovation, as were competitors and fairs and exhibitions. Consultants were more widely regarded as relevant sources of information for innovation in this sector than in other service sectors, as were universities, research institutes and patents, although fewer than 30% of the computer service firms regarded patents as a relevant source of information for innovation.

A.6.6 Resources Committed to Innovation, Innovation Activities and Expenditure Patterns

Computer service enterprises tend to commit greater resources to innovative activities than service enterprises in other sectors. However even within computer services there is wide variation in the extent to which innovative enterprises commit resources to innovation. Around 10% of the innovators in 'the seven countries' failed to record expenditure on innovation in 1996, and a further 7 (adjusted data) – 21% (unadjusted data) spent no more than 500euro per employee. Meanwhile, between 24% (unadjusted) and 36% (adjusted) spent in excess of 10,000euro per employee. We would anticipate that innovative activities in computer services are less lumpy than those in other sectors, as ongoing innovative activities are necessary to most innovation activities within this sector if the enterprise is to sustain its competitiveness, however, this wide variance in the commitment of resources to innovation was a feature of all sizes of enterprises within the sector.

Table A.6.7: Computer Services - Innovation Expenditure per Employee (%)

Unadjusted [Adjusted]	Small	Medium	Large	All
No Expenditure Reported	9%	6%	9%	8% [14%]
Up to 500euro	14%	30%	24%	21% [7%]
501euro +	24%	25%	21%	24% [17%]
2,001euro +	24%	22%	21%	23% [26%]
10,001euro +	29%	18%	24%	24% [36%]

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: From the Seven Countries data

Table A.6.8: Computer Services - Engagement in Innovation Related Activities in 1996 (%)

Unadjusted [Adjusted]	Small	Medium	Large	All
Intramural R&D	68%	70%	73%	70% [63%]
Acquired R&D	18%	24%	28%	21% [18%]
Acquired M&E	55%	60%	56%	57% [59%]
Acquired OET	58%	58%	58%	58% [60%]
Training	51%	63%	67%	58% [59%]
Preparations	46%	51%	58%	50% [51%]
Market Introduction	40%	38%	44%	40% [40%]
None of The Above	9%	6%	9%	8% [14%]

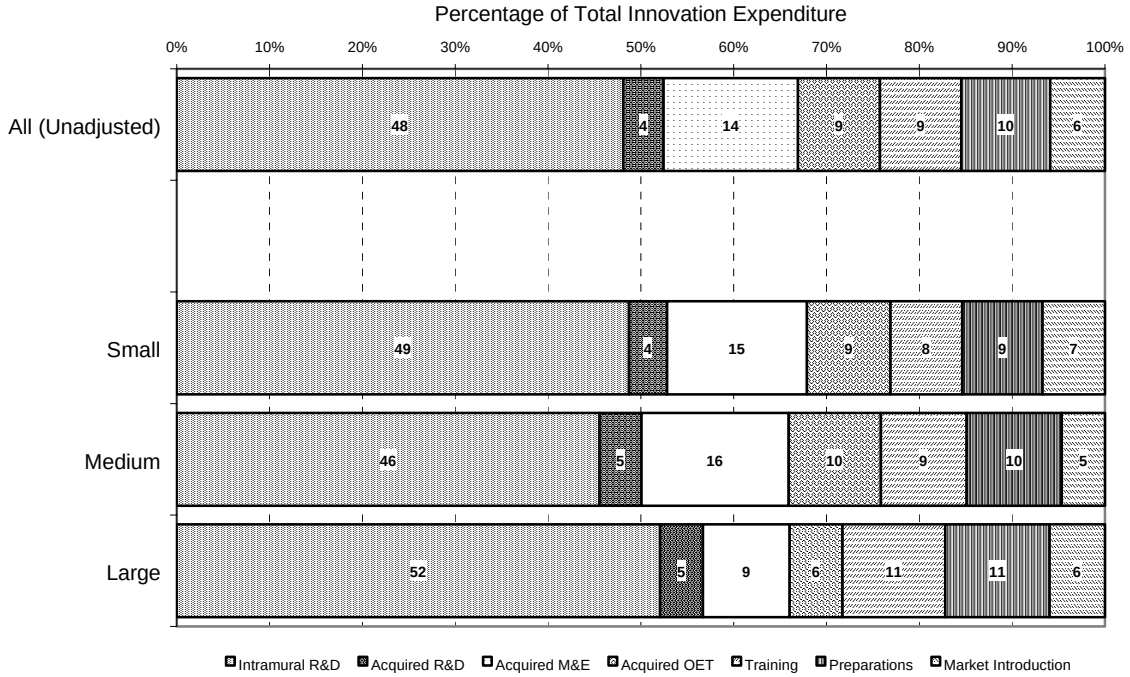
'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: From the Seven Countries data

In the seven countries for which we had direct data access about two-thirds of the innovating computer service enterprises committed resources to intra-mural R&D – this is a much larger proportion than in most services. Notably, this proportion was also similar across the size distribution, increasing only slightly. Also notable is that R&D is not conducted at the expense of engaging in other innovation related activities – about 60% of the innovating computer service enterprises in the seven countries engaged in: the acquisition of machinery and equipment linked to innovation; the acquisition of other external technologies; and incurred expenditures on training directly related to innovation, whilst half the enterprises incurred expenditures on preparations for the introduction of innovations. The two activities upon which innovation expenditures were incurred less frequently were the market introduction of innovations and the acquisition of external R&D services. It might have been expected that more enterprises would have incurred expenditures on the market introduction of their innovations, but these may not have been necessary for those computer service enterprises that are engaged in consulting and specialized service provision, rather than the production of mass market packaged software, as such enterprises have on-going relations with their clients, or rely on reputation effects, rather than advertising to win new business.

In contrast to most service sectors, the distribution of innovation costs in computer services tends to be dominated by activities within the enterprise. On average, intra-mural R&D alone

accounts for almost half of total innovation expenditures, whilst preparations for the introduction of innovations accounts for a further 10%, and training in relation to innovations for a further 9%. In contrast to some of the other sectors, on average acquired technologies contribute only about a quarter of the total innovation costs – this includes acquired R&D services, acquired machinery and equipment and other acquired technologies. On average, the market introduction of innovations accounts for only 6% of total innovation costs. These proportions varied between countries, but in all seven countries for which we had direct data access intra-mural R&D was, on average, the largest single component of innovation costs, whilst externally acquired R&D tended to account for only a small proportion of total costs.

Figure A.6.1
The Distribution of Expenditures on Innovation in Computer Services - Simple Means



A.6.7 The Extent of Co-operation for Innovation

Innovating computer service enterprises were more likely than innovating service enterprises in general to have co-operative arrangements with other firms or institutions for innovation. Overall, one third of the innovating computer service enterprises had these arrangements, but this proportion varied between just 22% of the German firms to 80% of the Finnish firms. In most countries, about 40% of the innovating firms had these arrangements.

Table A.6.9: Computer-Services: Co-operation Arrangements for Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
With Any Partner	49	65	22	87	36	80	38	41	40	66	42	54	44	35
Any External	49	61	21	85	33	78	38	41	36	61	42	54	44	34
With Competitors	10	4	15	62	5	32	2	4	12	14	6	7	27	16
With Customers	2	17	6	61	13	60	26	8	17	42	20	36	16	13
With Consultants	1	1	9	3	4	39	14	10	5	27	6	35	28	13
With Suppliers	1	39	6	83	22	34	12	16	15	33	34	29	14	14
With Universities	40	25	13	13	3	29	11	16	10	17	12	21	9	12
With Res. Institutes	11	3	8	0	4	18	9	4	8	10	3	7	37	14

Note: From analysis undertaken by Eurostat

Remarkably, the most widely engaged type of partner was competitors, closely followed by research institutes, suppliers, customers and consultants, with universities also more widely engaged

than in other service sectors. Of particular note is customers, as it might be expected that the majority of the innovating computer service enterprises would co-operate with their customers for innovation – but this was only true in Denmark and Finland, whilst a surprisingly low 2% of Austrian and 6% of German computer service innovators had such relationships,

A.6.8 The Extent and Nature of Difficulties Experienced with Innovation

Almost two thirds of the innovating computer service enterprises declared that they had been hampered in their innovation activities – this is a far higher proportion than for all of the other service sectors examined in this report. Only in Ireland and Luxembourg did less than half the innovating enterprises complain that they had been hampered in their innovation activities. Meanwhile, three quarters of the French and Danish enterprises had experienced difficulties.

The most widely identified factor hampering innovation was a lack of qualified personnel, which probably reflects the rapid growth of this sector and the tight labour market for people with specialist IT related skills. This factor was cited by at least 30% of innovators in all countries except Ireland, Luxembourg and Portugal. On the other hand, fewer than half the enterprises in all countries complained that a lack of qualified personnel had hampered their innovation efforts. Beyond this, a lack of sources of finance and organisational rigidities were also widely regarded as having hampered innovation activities – both hampered more than a quarter of the firms, organizational rigidities hampering almost half the German innovators, and a lack of sources of finance more than 40% of both the Belgian and Danish innovators. Meanwhile, relatively few firms complained that excessive innovation costs, a lack of information about markets or standards and regulations had hampered their innovation efforts. Finally, few firms complained that a lack of responsiveness to innovation amongst their customers hampered their innovation efforts.

Table A.6.10: Computer Services: Factors Hampering Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Hampered Firms	50	53	71	75	74	45	25	25	57	60	52	61	56	64
Excessive economic risk	1	11	29	40	31	28	0	0	25	24	7	22	3	21
Excessive Innovation costs	13	46	0	42	35	15	11	0	23	22	27	21	19	13
Lack of sources of finance	2	45	26	40	32	21	17	0	18	17	25	21	33	28
Organisational rigidities	36	30	49	2	12	8	2	10	6	31	17	11	4	27
Lack of qualified personnel	45	47	37	32	35	31	5	6	40	39	17	32	35	35
Lack of technical information	34	1	20	16	24	6	0	0	19	14	11	3	16	18
Lack of market information	0	5	11	13	13	16	2	0	24	16	2	7	10	11
Standards / regulations	0	18	22	.	15	7	6	6	1	4	0	4	2	13
Lack of customer responsiveness	0	13	18	5	29	8	0	10	13	10	16	15	11	16

Note: From analysis undertaken by Eurostat

A.7 Sector Study: Technical Services (NACE Rev.1 74.2)

In this report, 'technical services' covers architectural, engineering and technical services (NACE Rev.1 74.2) but not research and development (NACE Rev.1 73), technical testing and analysis (NACE Rev.1 74.3) nor legal, financial or management consultancy (NACE Rev.1 74.1). According to Eurostat there were approximately 1.2 million persons employed in 'technical services' in the mid-1990s, but technical service enterprises tend to be very small, generally employing fewer than 5 people. The sector is also characterised by a relatively high level (20%+) of self-employment. This sector, like computer services, is depends heavily on the knowledge and skills of the people employed

The main innovation trajectories in this sector were expected to be: the use of IT in computer aided design and modelling; the use of communications equipment to share information between sites; innovations induced by regulatory changes, particularly those relating to health and safety; and innovations related to metrology – including the design and development of new instruments.

A.7.1 The Enterprise Size Structure of the Sector

According to Eurostat there were almost 32,000 technical service enterprises with 10 or more employees eligible for inclusion in the CIS-2 in the 13 countries that conducted the survey. Surprisingly, the vast majority of these were in Germany, which alone accounted for over 70% of the enterprises. Overall, 5% of the eligible technical service enterprises in the 13 countries responded to the survey, the proportion within individual countries being highest in Portugal (40%), Norway (34%) and Luxembourg (33%), and lowest in Germany (1%) and the UK (3%).

The great majority of technical services enterprises are small, with three quarters or more of the eligible enterprises having fewer than 50 employees. In 'the seven countries' a maximum of 4% of the enterprises were large, with 250 or more employees. The median employment was around 20 in all those countries, whilst the mean ranged between 30 and 60 – indicating most firms in this sector are small scale operations.

Table A.7.1: Technical Services – Firms and the Firm Size Distribution

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Sample	17	47	150	27	502	67	22	12	202	172	93	65	99	1,475
Population	293	284	22,248	286	2,395	275	205	36	909	512	230	608	3,562	31,842
Sample %	6%	17%	1%	10%	21%	24%	11%	33%	22%	34%	40%	11%	3%	5%
Small			81%		85%		75%			85%	88%	82%	84%	
Medium			15%		13%		23%			13%	12%	14%	13%	
Large			4%		2%		2%			2%	1%	4%	3%	
Median E			20		20		24			18	17	18	19	
Mean E			59		45		45			39	31	48	48	

Note: Mean E – Mean Employment; Median E – Median Employment. From Eurostat file C1 and the Seven Countries data

Table A.7.2: Technical Service Firms with Innovative Activity, and Innovative Enterprises (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Innovative Activity	21	47	76	66	45	43	78	77	58	39	40	55	44	67
Innovative Enterprises	21	43	61	36	39	31	78	77	52	38	30	47	38	55

Note: from Eurostat file – C21

A.7.2 The Extent and Patterns of Innovation

Overall, technical service enterprises are more likely to innovate than other service enterprises, and indeed than manufacturing enterprises. However, this conclusion did not hold for all countries. Only in Austria were technical service enterprises less likely than other service enterprises to have engaged in innovative activities, but in Denmark, France, Finland, the Netherlands, Norway, Sweden and the UK technical service enterprises were less likely to have innovative activities than manufacturing enterprises within the same countries. However, as technical service enterprises tend to be small, and as innovation activities become increasingly common as firms grow larger, it is likely

that, after controlling for size, technical services are amongst the more innovative sectors. Moreover, most of the innovators claim to have developed the innovations they introduced, although substantial minorities introduced innovations developed by others, or jointly with other enterprises or institutions.

Table A.7.3: The Sources of Innovation amongst Innovating Technical Service Firms (%)

Adjusted	D	F	IRL	NOR	P	S	UK
Mainly developed by others	19	16	20	10	16	19	29
Developed jointly with others	29	44	36	38	37	22	7
Mainly developed in house	52	57	67	57	47	59	75

Source: Seven Countries Data; In some countries multiple answers were permitted, so totals can exceed 100%

A.7.3 The Aims or Objectives of Innovation

As with all other services, improving the quality of the services offered, opening new markets and extending the service range were the most widely identified relevant objectives of innovation. Improving service quality was also identified as a very important objective of innovation by more than 70% of the innovators, and nearly two-thirds of the innovators declared that extending their service range was a very important objective of innovation – this is higher than in other services. Almost half the innovating enterprises also declared that opening new markets, improving the flexibility of production, and reducing labour costs were each very important objectives of their innovation activities. These enterprises were also more likely than services generally to identify the reduction of labour, materials and energy costs, as well as environmental damage as relevant objectives of innovation. However, the last three of these were, as in other service sectors, relatively rarely identified as very important objectives of innovation.

Table A.7.4: The Aims or Objectives of Innovation amongst Technical Service Firms (%)

Weighted		A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Improving	Relevant	100	100	100	100	91	98	99	100	92	95	97	96	97	99
Quality	V-Imp't	75	67	75	20	58	59	94	100	37	69	80	62	71	72
Open New	Relevant	100	64	94	100	85	98	87	89	89	99	90	96	96	93
Markets	V-Imp't	90	43	47	14	63	56	48	70	38	58	42	56	58	48
Extend	Relevant	100	88	93	100	89	91	99	89	83	99	82	96	95	93
Range	V-Imp't	61	35	68	49	51	43	60	70	25	64	45	53	55	64
Improve	Relevant	76	90	91	57	59	87	76	89	75	80	85	75	95	88
Flexibility	V-Imp't	58	25	56	37	11	10	28	46	15	22	51	21	34	49
Reduce	Relevant	.	72	88	55	59	83	71	65	61	77	76	72	97	86
Labour Costs	V-Imp't	61	20	50	9	12	27	26	23	14	27	41	31	47	46
Fulfil	Relevant	.	72	80	60	62	71	73	89	53	75	80	81	89	79
Regulations	V-Imp't	6	49	9	5	13	13	27	66	9	17	35	34	54	14
Replace Old	Relevant	76	70	70	60	62	70	55	65	66	86	55	74	64	69
Services	V-Imp't	28	20	12	5	9	17	11	34	17	36	22	28	23	14
Reduce	Relevant	80	61	72	75	24	69	45	47	25	38	44	54	72	67
Energy Costs	V-Imp't	25	1	14	5	1	4	.	11	4	10	19	18	10	13
Reduce Mat	Relevant	80	54	70	48	36	73	52	35	18	40	52	33	70	65
-erials Costs	V-Imp't	24	13	24	2	5	7	7	.	1	7	16	19	24	21
Reduce	Relevant	80	31	66	75	33	82	48	47	47	40	44	59	74	64
Env Damage	V-Imp't	29	9	17	5	9	28	1	11	12	15	16	23	19	16

Note: From analysis undertaken by Eurostat; '.' data missing due to data suppression rules

Table A.7.5: R&D amongst Technical Service Innovators (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Continuously	36	42	33	34	35	51	9	11	53	37	25	29	31	33
Occasionally	59	23	23	62	39	50	44	0	32	46	49	31	24	25
Not At All	4	34	44	4	21	0	47	89	15	18	26	41	45	41

Note: From Eurostat file – C51

A.7.4 The Extent and Role of Research and Development (R&D)

Innovating technical services are more likely than other service innovators to conduct R&D, with 33% conducting R&D on a continuous basis and 25% undertaking R&D on an occasional basis. This profile is closer to that for manufacturing than for services, and the undertaking of R&D is particularly widespread given that small enterprises predominate in this sector. However, wide

differences existed between countries – in Luxembourg only 11% of innovating technical service enterprises undertook R&D, whilst all Finnish and 96% of Austrian and Danish enterprises did so.

A.7.5 The Sources of Information for Innovation

As with all the other sectors the most widely identified relevant source of information for innovation was sources within the firm. Only in Belgium and Ireland did more than 20% of the enterprises fail to identify this as a relevant source of information, whilst all Austrian, Danish, Finnish and Swedish enterprises recognised the relevance of this source. Professional meetings were the next most widely identified source of information, closely followed by fairs and exhibitions, and by competitors and customers. Suppliers, computer networks and consultants were each identified as relevant by 70% of the innovators, with over half also identifying universities as a relevant information source. Research institutes and patents were the only sources deemed relevant by less than half the firms

Table A.7.6: Technical Services - Relevant Sources of Information for Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Within Enterprise	100	78	94	100	81	100	79	89	94	95	87	100	91	93
Competitors	100	63	84	80	45	88	78	42	55	85	34	77	92	81
Customers	100	66	80	100	73	100	95	54	75	99	64	85	97	81
Professional Meetings	100	86	89	80	69	75	100	89	80	93	85	83	97	88
Fairs / Exhibitions	94	51	86	57	63	87	94	77	64	84	82	79	74	83
Suppliers	90	50	66	80	80	94	99	100	63	80	82	66	95	70
Computer Networks	76	86	72	49	69	78	94	54	42	82	66	77	62	70
Consultants	70	65	74	55	18	74	84	42	43	70	60	71	79	70
Universities	92	46	56	71	33	78	84	54	50	73	55	73	72	57
Research Institutes	62	50	45	91	26	77	72	43	42	67	32	n.a.	66	46
Patents	32	13	36	7	28	49	19	0	21	27	13	41	13	33

Note: From Eurostat file - C72

A.7.6 Resources Committed to Innovation, Innovation Activities and Expenditure Patterns

As with all of the service sectors assessed in this report, there was wide variation in terms of the amount of resources committed by the technical service enterprises to innovation activities in 1996. However, this variation was less than in the other sectors. Between a third (adjusted data) and 40% (unadjusted data) of the innovating technical service enterprises in 'the seven countries' spent little or nothing on innovation in 1996 (i.e., less than 500euro per employee), whilst a little over 10% spent in excess of 10,000euro per employee in that year, but about half the enterprises spent between 2,000euro and 10,000euro per employee. We would expect that this sector, like computer services, is characterized by a reasonably stable commitment to innovation, with innovation expenditures tending to be less lumpy than in sectors such as wholesale or transport services.

Table A.7.7: Technical Services - Innovation Expenditure per Employee (%)

Unadjusted [Adjusted]	Small	Medium	Large	All
No Expenditure Reported	13%	9%	10%	11% [27%]
Up to 500euro	26%	35%	30%	29% [5%]
501euro +	23%	20%	16%	21% [18%]
2,001euro +	29%	24%	34%	28% [37%]
10,001euro +	10%	12%	10%	11% [12%]

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: From the Seven Countries data

Like most of the other service sectors examined in this report, the most widely engaged activities in relation to innovation were the acquisition of machinery and equipment and other external technologies for innovation. Training in relation to innovation was also widely undertaken, whilst more than 40% of the innovating enterprises incurred expenditures on preparations for the introduction of innovations, on the market introduction of innovations, and on intra-mural R&D. The least widely undertaken activity in relation to innovation was the acquisition of external R&D services. These patterns were broadly consistent across the size distribution of enterprises, although all of the activities were more frequently engaged in by the large enterprises than by the small enterprises.

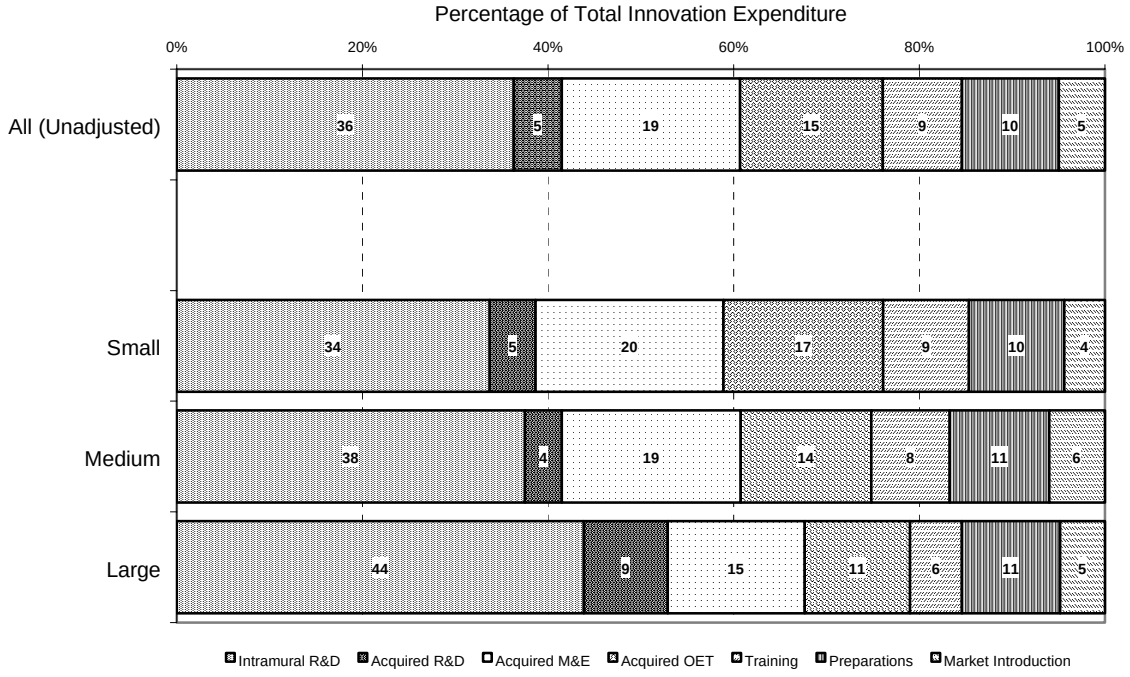
Table A.7.8: Technical Services - Engagement in Innovation Related Activities in 1996 (%)

Unadjusted [Adjusted]	Small	Medium	Large	All
Intramural R&D	53%	64%	74%	60% [44%]
Acquired R&D	16%	22%	40%	21% [16%]
Acquired M&E	49%	54%	51%	50% [56%]
Acquired OET	56%	61%	65%	59% [61%]
Training	47%	63%	64%	54% [56%]
Preparations	34%	50%	51%	42% [43%]
Market Introduction	24%	37%	44%	31% [40%]
None of The Above	11%	8%	8%	10% [27%]

'Small' – Enterprises with 10 – 49 employees; 'Medium' – Enterprises with 50 – 249 employees; 'Large' – Enterprises with 250+ employees. Source: From the Seven Countries data

Overall, intra-mural R&D accounts for an average of about one-third of total innovation costs. This proportion is higher amongst the large technical service enterprises, and lower amongst the small enterprises, but overall it is clear that intra-mural R&D tends to account for a smaller proportion of total innovation costs in this sector than in computer services, but a larger proportion than in most other sectors. The acquisition of machinery and equipment accounted for about 20% of total innovation costs, and other external technologies including acquired R&D for a further 15% - both of these proportions tend to decline with increasing enterprise size. Training in relation to innovation and preparations for the introduction of innovations both accounted for about 10%, whilst the market introduction of innovations only accounted for about 5% of total innovation costs – these three proportions remain, on average, similar across the size distribution of enterprises. The low proportion of expenditure on the market introduction of innovations may be due to most of these enterprises having on-going relations with their major customers rather than accessing the market through advertising or other general marketing activities.

Figure A.7.1
The Distribution of Expenditures on Innovation in Technical Services - Simple Means



A.7.7 The Extent of Co-operation for Innovation

A quarter of the innovating technical service enterprises had co-operative arrangements for innovation with other enterprises or institutions – a similar proportion to that for all services. However, this proportion varied widely between countries, exceeding 80% of innovators in Austria, Denmark and Finland, whilst being only 21% in Germany.

Suppliers and, unusually amongst services, universities were the most widely engaged types of innovation partner – with 10% of the enterprises having arrangements with each of these, whilst customers and research institutes were each engaged by 7% of the technical service innovators. Consultants were the least widely engaged innovation partners – at just 5% of the innovating firms. All of these proportions varied quite widely between countries, with different countries presenting different profiles of collaboration. For example, a quarter of Swedish innovators had co-operation arrangements for innovation with their customers and with consultants, whilst fewer of the UK firms had these arrangements, but more UK than Swedish technical service innovators had co-operative arrangements with their competitors and with research institutes.

Table A.7.9: Technical Services: Co-operation Arrangements for Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
With Any Partner	82	55	21	95	53	85	25	n.a.	37	60	34	51	36	27
Any External	82	46	21	57	49	72	25	n.a.	32	57	31	43	21	25
With Competitors	7	14	4	14	5	10	19	n.a.	12	13	3	5	17	6
With Customers	52	27	3	32	21	54	18	n.a.	17	33	9	25	14	7
With Consultants	1	0	4	7	6	14	14	n.a.	5	19	9	25	9	5
With Suppliers	4	22	8	12	28	38	6	n.a.	9	30	16	21	15	10
With Universities	52	7	9	16	15	32	18	n.a.	13	16	16	8	10	10
With Res. Institutes	9	4	4	34	17	30	5	n.a.	10	22	22	4	18	7

Note: From analysis undertaken by Eurostat

A.7.8 The Extent and Nature of Difficulties Experienced with Innovation

A high proportion of the technical service innovators claimed their innovation activities had been hampered between 1994 and 1996 – although this proportion was particularly high in Germany (75%) and France (76%), and low in Luxembourg (19%). In most countries just less than half the innovating technical service enterprises claimed their innovation activities had been hampered – still a relatively high proportion compared with other service sectors.

A lack of sources of finance was the most widely cited factor hampering innovation – this was especially widely cited in Germany and Austria, whilst the excessive economic risk of innovation and organisational rigidities were also cited by more than a third of the firms. Excessive innovation costs and a lack technical information were, on the other hand, the least frequently identified factors hampering innovation – each being identified by just 7% of the innovating firms.

Table A.7.10: Technical Services: Factors Hampering Innovation (%)

Adjusted	A	B	D	DK	F	FIN	IRL	L	NL	NOR	P	S	UK	ALL
Hampered Firms	62	44	75	41	76	46	24	19	45	48	46	45	47	70
Excessive economic risk	7	0	40	31	39	14	0	0	31	30	22	21	22	37
Excessive Innovation costs	37	0	.	29	52	25	5	0	24	30	31	28	23	7
Lack of sources of finance	58	22	52	12	27	21	5	0	22	20	37	16	31	46
Organisational rigidities	1	1	43	7	13	25	18	0	20	24	3	17	9	36
Lack of qualified personnel	1	29	27	22	28	15	5	7	28	29	6	34	17	26
Lack of technical information	0	6	7	2	12	24	0	0	11	12	0	8	1	7
Lack of market information	1	6	24	0	14	2	0	0	25	8	0	9	12	21
Standards / regulations	6	7	22	2	11	0	0	0	13	6	3	3	5	19
Lack of customer responsiveness	1	1	16	20	20	25	14	19	10	17	3	3	20	16

Note: From analysis undertaken by Eurostat

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