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Innovation in the canadian service sector

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1. Introduction

Services dominate the Canadian economy. They contribute to 68% of GDP and employ 75% of total manpower. Several service industries recorded a significantly faster growth rate than the manufacturing industry. The dynamic service industries are using and benefiting from new information and communication technologies (ICT) more than the rest of the economy. Several service industries recorded a significantly faster growth of labour productivity than the overall business sector.[1]

The importance of innovation in services is beginning to be recognised as one of the sources of recent productivity surge of the U.S. economy. Service industries play an essential role in the fast diffusion of ICT which is bringing productivity gains not only in manufacturing industries but increasingly in essential non-production activities (Feldstein, 2002).

In spite of the economic importance of the service sector, innovation and technical change in services have attracted less attraction than in manufacturing. This is partly due to the traditional view of services as being a residual activity and laggard in terms of innovation and essentially a 'supplier-driven' sector. The great heterogeneity of service industries does not help to disperse this perception. On the one hand, there are very important differences between rapid innovation in the manufacturing sector and in the more traditional services. On the other hand, there is a growing trend towards a convergence of the fast growing service industries based on information and communication technologies (ICT) and the high-growth manufacturing industries.

A brief history of ideas about innovation in service industries would start with a period of a benign neglect of innovation in services altogether, followed by a reluctant recognition that some technologically progressive service industries are using selected product innovations supplied by a few high-tech manufacturing industries. Only in the last couple of years, is emerging a body of theoretical and empirical research that is trying to grapple with innovation in services not as with subservient sub-specie of manufacturing innovation but as an object of inquiry with its own distinctive features. It is yet too early to predict whether the end result will be a more coherent and comprehensive picture of a universal innovation understanding as the proponents of convergence would argue or a distinctive conceptual framework for services innovation adapted to the uncomfortable heterogeneity of this vast and important sector.

The objective of this paper is to review the empirical information on the extent of innovation activities in Canadian service industries and to assess how Canada's innovation in services compares with that of its competitors.

Since innovation in services was a long time a non-issue, and the sector is composed of very different industries it is necessary first to introduce and discuss the concepts and measures used in the assessment of innovation in services.[2] The rest of the report is organised in the following way. The next section presents an overview of concepts and measures of R&D and innovation in service industries and their limitations and problems. Follows an overview of innovation in the Canadian service sector. A comparison of Canadian R&D in services with its main competitors in the U.S. and European Union is presented in section four followed by concluding remarks.

2. Innovation in services – concepts, measures and statistics

In his introduction to the collection of essays on output measurement in services, Griliches (1992) notes that owing to their heterogeneity, the concept of service covers many activities that have little in common. In many services it is not exactly clear what is being transacted, what is output, and what services correspond to the payments made to their providers. The prices are not always related to what was delivered and received by the user of the services. The outcome or output of many services does not only depend on the service provider but also on the user or the consumer of the service. This is the case in many services that consist of exchanging, delivering information and/or applying knowledge, e.g. in technical business services.

When the output of a service can not be clearly defined, how to deal with its change? Because of their underlying heterogeneity, for some services it is difficult and often impossible to make output comparisons over space and over time. In many services the boundary between manufacturing activity and service activity[3] is unclear and shifting. All these questions and problems are encountered when we want to measure service innovations.

The emerging empirical research on innovation in services suggests that the conceptual framework based on innovation in manufacturing is missing several key distinctive characteristics when applied to services innovations:

- Much innovation in services has not been well captured by the traditional indicators of innovative inputs (R&D activities) and outputs (patents).
- The organisation of R&D is often problem- or project development -oriented rather than organised in a permanent separate R&D department.
- Many service organisations are typically of small or very small size. They face problems common for any small firm and in addition some obstacles specific to service firms. Their innovation activities are likely not to be captured by the statistical procedures developed for large scale industrial innovation. Insofar as innovation policies are geared to larger industrial firms, the small service innovators may not qualify for the benefits.
- Some services are among the leading users of new technologies, especially ICT. The use of ICT is fast spreading and transforming many traditional services as well.
- Services, as other sectors, are users of ICT hardware. Several service sectors are however creators of software indispensable for its use in other services and in other sectors. It is therefore misleading to consider services as being passive users of ICT technologies.
- Many services innovate in introducing new ways of providing existing and new services. Some innovate by changing the way the service is 'produced', i.e. they introduce what in industry is called a process innovation. And there are important innovations that consist of changing the organisational structure. Increasingly innovations in services are based on technological opportunities provided by the rapidly evolving ICT, others respond to challenges created by them.
- As in manufacturing where the highly innovative, R&D intensive industries co-exist with others less inclined to innovate, high-tech services co-exist with traditional much less innovative services. The gap between the two is probably even larger in services than in manufacturing. Unfortunately, little is known about innovation in the more traditional services.
- Innovation in many services is an interactive process; unlike in many industrial innovations, its 'success' of depends both on the service provider and the user. In some services (e.g. business services) the inputs from the client are crucial for the creation of new or improved service product. This aspect is not well captured by the predominantly 'industrial' focus of innovation studies in the service sector.

- The growing implication of customers in the use or "consumption" of some services, for instance electronic commerce, requires a fair amount of knowledge an involvement on the part of the customer. The end "product" is a sort of self-service, but crucially dependent on the service provider.
- The interactive character of most services and the fact that many services can not be separated from the competence of the persons who provide them underlines the importance of the personal contact, training and tacit knowledge of service providers.
- Intellectual property created by services innovations is less frequently protected by intellectual property rights (IPRs) than industrial artefacts. Many service innovations are difficult to protect against imitation. In conformity with their different character, services display a different pattern of IPRs use. However, as the evolution in the U.S. patent legislation and practice show, IPRs protection in the technologically most advanced services is converging toward the industrial pattern.
- The immaterial character of services and the importance of the interaction with customers create several challenges not found in innovations in goods producing industries. Thus in some respects, the innovation system in service industries is complex and different from the typical innovation system in manufacturing. In other respects, however, there is a growing convergence between innovation in services and in manufacturing and other industries.
- In many respects the difference between good producing sectors and service is being increasingly blurred. Some services resemble manufacturing industries more than they do traditional services.[4] As manufacturing grows more flexible, industrial products may be increasingly customised and presented as a service satisfying a combination of needs. (Gallouj and Weinstein, 1997).
- On the other hand, there is a trend toward standardisation of some services parallel with increasing particularisation (customisation) of others (Hipp, Tether and Miles, 2000).

2.1 Innovation measurement in service industries

Innovation studies were until fairly recently mainly the domain of economic and business historians. Since the early sixties the OECD started to collect and publish R&D statistics, based on common methodological guidelines (Frascati Manual). R&D statistics include selected service industries but the coverage varies from country to country and statistics on R&D in service industries leaves a lot to be desired (Young, 1996).

Students of innovation and technological change were increasingly aware that R&D activities are but one innovation input, even though a very important one. It was however not until the early nineties that major industrial countries started to conduct representative statistical surveys of manufacturing firms aiming at capturing this complex phenomenon in its entirety.[5]

The conceptual framework underlying innovation surveys in manufacturing was built on a long tradition of research going back to Schumpeter (1934). In order to get internationally comparable statistics on innovation, the OECD experts elaborated international guidelines for innovation surveys, the Oslo Manual (OECD,1992). The first version of the Oslo manual was focused on technological innovation in industrial sectors only; service industries were not included.

The first revision of the OECD Oslo manual (OECD/Eurostat, 1997) provides guidelines for surveys of innovation in service sectors. The proposed methodology for surveys of service innovations is heavily influenced by the industrial and technological perspective adopted from manufacturing surveys. The definition of innovation proposed by the Oslo (OECD/Eurostat,1997) manual is as follows:

> *"A technological product innovation is the implementation /commercialisation of a product with improved performance characteristics such as to deliver objectively new or improved services to the consumer. A technological process innovation is the implementation/adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or a combination of these* (OECD/Eurostat,1997, p.9)"

Since the interpretation of the definition in some service activities is less than straight forward, the 'Oslo' manual provides a series of examples of what constitutes an innovation in various service industries (see Appendix 1).

Information on innovation activities in Canadian service sector was until recently limited to R&D statistics which cover most services industries. The first survey of innovation addressed specifically to a subset of 'dynamic service industries' was conducted by Statistics Canada in 1996. Some related statistical information on specific aspects of innovation and/or technological change in services is also available from other Statistics Canada surveys. Before reviewing the principal conclusions and interrogations suggested by these surveys it may be useful to consider some limitations and problems involved in measuring R&D and innovation of service industries.

2.1.1 Limitations and problems of R&D surveys in service activities

In contrast to relatively good, internationally comparable and consistent statistics on industrial R&D (manufacturing industries and utilities) conducted in OECD countries (OECD, ANBERD database), information on R&D in services for most other countries than Canada is sketchy, difficult to compare and mostly unavailable. I the conclusion of its assessment of the state of art in measuring R&D in services Young (1996) wrote:' ….it may be several years before a full set of comparable data for services R&D is available and the quality of existing data for a number of Member countries is still not satisfactorily documented at OECD.' There has not been much improvement since then. It should be stressed, however, that in spite of some problems discussed below, the Canadian R&D statistics have included services in more consistent and detailed manner than most other OECD countries.

Some of the unresolved issues are listed below:

- *Coverage of R&D in service industries*

The current definition of R&D used by Statistics Canada is still entirely focused on natural and engineering sciences.[6] Even though the survey of industrial R&D includes several service industries which are likely to conduct a non-negligible portion of R&D in social sciences and humanities (SSH), their research and development in SSH is not recognised and not included. As social sciences are more likely to be part of R&D performed in service industries than in other parts of the business sector, the existing surveys of R&D in Canada are likely underestimating the extent and the value of R&D done in services (Gault, 1995).

The narrow definition of R&D used in Canada and other industrialised countries is surprising since the internationally recommended definition of R&D activity in the Frascati manual is broader and includes research in social sciences.[7] From the comparison of the Frascati manual definition of R&D illustrated by examples of its application to service industries and the definition of R&D in the Questionnaire of Statistics Canada Industrial R&D survey it is clear that the Canadian definition is too restrictive. But then the situation in Canada is not unique. [8] In his overview of R&D surveys in services, Akerblom (2002) writes that the micro-information on R&D in innovation surveys is generally not consistent with R&D statistics.[9]

- *Content of R&D is often different in services*

The concepts and measures fitting R&D in manufacturing industries are applied –often with no or only minor adjustment – to measurement of innovation in service sectors. This '*manufacturing based paradigm'* (criticized by Gallouj and Weinstein, 1997 and Howells, 2000 among others) characterized by indicators and metrics to measure technological innovation in manufacturing industry does not fit well the practical reality of services. Unlike a good, a service does not have an autonomous existence defined by its technical specifications (Djellal and Gallouj, 1999). As noted by Akerblom (2002), using operational definitions and measures from industrial surveys may seem abstract and difficult to apply in certain services, especially in some sectors such as financial services and personal services. There are clearly problems of interpretation and misinterpretation of what fits and does not fit the definition of R&D. The Frascati manual and the Canadian R&D Survey Questionnaire cites examples of what should and what should not be included in R&D. The problem is that some of these examples are prone to changing interpretation over time; a yesterdays' discovery is today's routine.

- *Organization of R&D and the system of innovation in services is often unlike in manufacturing industry*

In addition to difficulty of applying the standard definition of industrial R&D to service activities the organisation of research and development in service activities is often very different from the typical R&D departments found in industrial firms. Except in some service

activities (certain knowledge intensive business services - see Hipp et al.,2000) where firms are organised similarly as in high-R&D intensity manufacturing industries with R&D departments, in many other service activities innovation is created with little or no activities corresponding to the 'technological R&D' as defined in the manufacturing based paradigm. National reports on innovations surveys conducted in Europe (Sundbo and Galouj, 1999) show that many innovation activities are organised in formalised *"ad hoc groups"*, and that currently many firms are organised as task teams instead of functional departments.

2.1.2 Information on innovation in services

- *The concept and definition of innovation in services*

The guidelines for definitions used in innovation surveys changed over time. Even though the revised version of the Oslo manual (OECD/EUROSTAT, 1997), expanded the definition of the term 'product' to cover both goods and services, the manual does not take into account the specificities of innovations in services. The definition of innovation (introduced above) maintains the qualification of *technologica*l product innovation and *technological* process innovation. This may influence the rate of innovation as suggested by the report on the Dutch and German surveys where the innovation question did not include the adjective *'technological'* (Hipp et al., 2000).

- *Product-process innovations*

Industrial innovations are usually classified as either a product or a process innovation. However, as shown in Baldwin and Hanel (2003), even manufacturing innovations do not neatly conform to this clear-cut classification. A more comprehensive classification allowing respondents to select a combination of the two characteristics was selected quite often. These 'complex' innovations were in many respects more significant than the simpler ones fitting one of the two innovation types. As Djellal and Gallouj (1999) argue, product is a 'nebulous' process in service innovation where it is often problematic to locate the boundaries between the two.[10] The problem is compounded by the fact that a service is generally intangible. The service may be embodied not in technologies but in competencies called on or in an

organisation. Thus organisational innovation should be included in addition to product and process innovations in services.

- *Organisational and disembodied innovation activities*

There is growing evidence from European surveys of innovation in services (Licht et al., 1995; Sundbo and Galouj, 1999 and Howells, 2000 to name only few authors) and from Canada as well (Baldwin et al., 1998; Earl, 2002a,b), which suggests that some innovative activity in services is typically organizational and disembodied in nature and therefore very difficult to capture within *the traditional - industry based* innovation metrics. Typically, other than formal R&D activities account for larger share of total innovation cost in services than in manufacturing. The innovation process in services has become more collective, i.e. the whole organisation is more geared to participate in it.

- *Interaction between service providers and their clients*

When the innovation students abandoned the linear model in favour of a more realistic interactive one (Kline and Rosenberg, 1986) interaction between innovators and their market partners and other external sources of innovation started to receive due attention. One of the important distinctive features of services innovations, especially in the knowledge intensive business services, is their interactive character. The communication between the service provider and user is an important aspect of the service act and so is the technical competence of the client. Both may influence the final outcome of the service act. The intensity, means and quality of interaction involved in service innovations deserves more attention than a simple enumeration of sources of innovation included in the present innovation surveys.

- *Asymmetry of information*

Many services, such as business services, are providing knowledge and as in all markets for information the information asymmetry is an issue here. The clients are often asked to pay a price for information without being able to assess its value. The difficulty is even greater when the service is new (Djellal and Gallouj, 1999).

- *The size of service firms*

In some of the most dynamic service industries such as for example in technical business and R&D services, the typical firms are very small, i.e. employing less than 20 persons.[11] Unless the sampling is adjusted to take this reality into account, their activities, contribution and needs may be underestimated. Insofar as the information from innovation surveys serves to guide the public policies toward innovation, the specific circumstances of smallest firms may not be properly addressed.

- *Is there a 'service innovation system'?*

As Thether and Metcalfe(2003) argue in contrast to innovations in manufacturing where interactions and interdependencies between innovators their suppliers, clients, competitors and institutions of technological and scientific infrastructure form multiple *sectoral* systems of innovations, service innovations are more likely to be structured in function of *problems and/or opportunities* than by sectors. Since problems and opportunities change over time, the boundaries of systems of innovation in services are not fixed, but are dynamic, and evolve.

In conclusion, our information about R&D and innovation in service industries is still very rudimentary and subject to many conceptual and measurement problems. Empirical evidence that illustrates this state of affairs is the fact that two large-scale innovation surveys in the same country- Germany- produced widely contradictory results (Djellal and Gallouj (1999).[12]

3. Canada's innovation in services - an overview[13]

3.1 Incidence of innovation

Most information on innovation in Canadian service industries is available for three "dynamic" service industry groups: communications, finance and *technical services* included in the Statistics Canada Survey of Innovation, 1996).[14] The service activities included in the Survey represent almost two thirds of the value added created by all service industries, i.e. close to one third of Canada's GDP in 2000. The coverage of the service sector is limited to most, but not all,[15] fastest growing service industries.

Survey respondents were asked to indicate whether they had introduced new or improved products, new or improved processes or significant improvements in organisational structures or internal business routines. An example of a product innovation is the offering of a new

service, such as life insurance in the financial sector. An example of a process innovation is the introduction of new analytical techniques and associated computer software. An example of an organisational innovation is increased computerisation. [16]

Over the course of the 1994 -1996 period, respondents in financial services were typically the most likely to have reported the introduction of a new or improved product, process or form of organisation (62% of respondents), followed by communications (45% of respondents), and technical business services (43% of respondents). See Table 1 for a slightly more detailed breakdown of innovation incidence by major service sectors.

It is worthwhile noting that these innovation rates exceed the innovation rate observed in Canadian manufacturing, where 36% of firms either introduced or were in the process of introducing an innovation in the 1989-91 period. They are, however, in the same range as the more innovative manufacturing industries—electrical and electronic products, pharmaceuticals, chemicals and machinery (Baldwin and Hanel, 2003, also Baldwin and Da Pont, 1996).[17]

The incidence of innovation in all three service industry groups is strongly associated with the size of the firm, especially in financial and technical business services. Only about 20% to 40% of the smallest firms employing less than 20 persons reported an innovation, while the innovation incidence ranged from 60% to 100% in firms employing more than 500 persons. New or improved services (products) were reported more frequently than process innovations. Organisational innovations were reported even less frequently. Nevertheless, process innovations are still more frequent in services than in manfacturing.

The classification into product, process an organisational innovation is not very satisfactory. As in manufacturing (Baldwin and Hanel, 2003) many innovators in services engage in multiple types of innovation, product innovation often being the core activity. Three types of innovators dominate:

Product-only innovators,

Comprehensive innovators (innovators engaging in product, process and organisational innovation), and

Product and process innovators (Figure 1).

In technical and communication services, product-only innovation was the most common. Conversely, comprehensive innovation —involving all types of innovation—was most common in large firms in communications and in financial services (Baldwin et al.,1998).

Figure 1
About here

More than one third (in communications and financial services) and almost one half (in technical services) of innovators reported product innovations. On the other hand, process innovation is far less frequent. Only 7% of innovators in financial services, 12% in technical services[18] and 16% in communications reported process innovations. Not only is process innovation much rarer than the product or the combined process-product innovation, respondents are finding it difficult to distinguish them.[19] About the same percentage of respondents in each sector that reported process innovations indicated that they had difficulties in distinguishing product from process innovation (Rosa, 2002).[20]

The use in service sectors of the analytical division of into product and process innovations adopted from manufacturing innovation surveys and especially the distinction between organisational change and process innovation in services is therefore debatable (Mills, 2001 April). Owing to the heterogeneity of service industries innovations take various forms. The product and process innovations do respond to different factors across the three service sectors and the data support their analytical distinction (Rosa, 2002). Italian (Sirilli and Evangelista, 1998 and German (Hipp et al. 2000) came to similar conclusion. However, the concept of process innovation in services seems to be too narrowly defined as Rosa (2002) admits. The distinction between process and organisational change innovations seems particularly unsatisfactory with regard to various modes of delivering the service and the interaction between the service-provider and its client as shown by distinction between the frequency of delivery of bespoken, customised and standardised services which is correlated with the size of firms; the proportion of standardised services increasing with the size of firm (Hipp et al. (2000); also cited and discussed by Miles (2001). These aspects are especially important in knowledge intensive services.

3.2 Organisational and technological change in service industries

The Survey of Innovation, 1996 did not cover the whole spectrum of service industries. The more recent survey-based[21] study by Earl (2002a) presents an overview of organisational and technological change in all sectors of Canadian economy" It provides interesting information on organisational[22] and technical[23] change in services.'

The results show that in the service sector the proportion of firms that adopted organisational change was slightly lower (38%) than in manufacturing (50%) but higher than in the primary sector. On average, firms in the goods related services innovate about as frequently (37%) as those providing intangible services (38%) (See Table 2) The averages cover, however, significant differences within those two types of services (Table 3.).[24]

Table 2 and Table 3

About here

As shown in the earlier report (Baldwin et al., 1998) for innovations in dynamic services, there is a striking difference between the smaller (1- 99 full time employees) and the larger firms in the rate of adoption of organisational and technological change (Earl, 2002a). In all sectors the rate of adoption of both organisational and technological change is more than twice as high in the larger firms than in the smaller ones.

Since the coverage of the services sector in Earl's study is broader than in the Innovation Survey, 1996 the results of the two surveys are not directly comparable. They suggest, tentatively, that the rates of adoption of organisational change over the 1998-2000 period are generally higher than those found in the 1996 survey.

The information on adoption of new technology provides also interesting insight in changes affecting service industries. First, the rate of introduction of technological change in services producing sector (43.4%) was again lower than in the manufacturing sector (50.6%) but by a smaller margin than observed for the organisational change. Again, the rate of adoption of technological change is increasing sharply with the size of the firm.[25] The highest adoption rates for technological change were observed in information and cultural industries (63%) and in finance and insurance (60%). The lowest rates were reported by accommodation and food services. In good-related services the wholesale sector led the three other sectors (retail,

transport and storage) with 45% of wholesalers introducing new or improved technology between 1998 and 2000.

Surprisingly, public organisations introduced both organisational and technological change twice as often as private firms. However, this is largely because of the large size of public organisations. When private firms and public organisations of the same size are compared, the difference between the two is negligible (Earl, 2002b).

Both measures, the rate of adoption of organisational and technological change adoption are conceptually closely related to operational definition of innovation in services. Unfortunately, to my knowledge, owing to the lack of comparable data for service industries, no attempt has been to examine this relationship more thoroughly. We are thus left with impressionistic information suggesting that on average the rate of introduction of organisational and technological change and presumably of innovations of other types as well, is in services only slightly below the level reported in manufacturing industries. Given the important intra-sectoral differences in the rate of technological change, the adoption rate in the most dynamic services exceeds the average rate in manufacturing.

Introduction of organisational and technological change requires training and retraining of employees. Earl's (2002a) study show that about 70% smallest firms and almost all the largest firms accompanied organisational and technological changes by training. Overall, the percentage of firms with training activities in the service sector was similar to that in manufacturing.

Many firms use technologies purchased off the shelf (standard ICT equipment, software etc) or license them. Others have to customise or modify existing technologies and some firms develop new technologies for their exclusive use. Again, the purchase practices of service sector firms were mostly similar to those reported by manufacturing companies.

3.3 Sources of innovation in services

The innovation process can be viewed as a learning process through which the firm generates new knowledge by acquiring, adapting, processing and generating ideas and information from within and outside the firm. Some ideas come from scientific and technological advances; others are market opportunities, generated by the management and/or sales and marketing people inside the firm and by the firm's market partners. As in

manufacturing, innovative ideas in service industries come from various sources, some inside the firm, others from outside. The competencies available in the firm are crucial but not sufficient to create and introduce commercially a new or improved service (product), an improved or new way of performing a service or an organisational change. Like in manufacturing, firms rely to a varying degree on inputs from external market partners, competitors and various public sources regrouped under the heading 'technological infrastructure' (Baldwin et al. 1998).

One of the particularities of services innovation, particularly the knowledge- intensive ones, is the high degree of interaction between the service provider and her client. The service relationship, i.e. the interaction between the two, sometimes called "servuction," (producing and sustaining the service relationship (Miles, 2001, p8) varies enormously across the broad spectrum of services. Information on innovative ideas originating from clients reflects, very imperfectly, only one aspect of this relationship.[26]

The information on sources of innovative ideas is in Canada available only for the "dynamic" services, which were included in the 1996 Statistics Canada Survey of innovation in service industries. (Baldwin et al.1998) Management is the most important[27] internal source of innovative ideas in two out of the three service sectors, ranging between about 50% in technical business services and 60% in communications and financial services. In small firms where the cost considerations preclude separate R&D, marketing and other specialised divisions, management is naturally the central source of innovation ideas. Sales and marketing come second, ranging from about 46% in communications and technical business services to 54% in financial services. In-house R&D is most important in technical business services (57%), less in financial services (38%) and least in communications (22%) as illustrated in Figure 2.[28]

Figure 2. Internal sources of innovative ideas in dynamic service industries

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The crucial innovation input in all three service industries are however new information and communication technologies. The widespread use of computers connected by internal and

external high speed communication networks provides the technology underlying most of innovations in services (Table 4.).

Table 4.
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Innovation is often introduced in reaction to or following suggestions by clients who are the most important source of innovation ideas and information. Emulation of competitors, interaction with suppliers and technology acquisition are all related to innovating firm's market transactions. Another important category of external inputs to innovation comes from the technological infrastructure, i.e. participation at conferences, trade fairs and exhibitions, government information services and consultants (Figure 3 and Figure 4.).

Figure 3. Importance of external sources of information about innovation
About here

Figure 4. Importance of technological infrastructure for information about Innovation
About here

The absolute and relative importance of various internal and external sources of ideas and information that service firms use to create and introduce their innovation is remarkably similar to sources of innovations in manufacturing (Baldwin and Hanel, 2003).[29] The only notable difference between innovations in dynamic services and in manufacturing is that in-house R&D is somewhat less important in service innovations. Importance of R&D as an internal source of innovation varies between the groups of industries, from low in communication (22%), medium (34% in financial services to relatively high in technical services (60%). In technical business services R&D is about as important as in the manufacturing sector. [30] In contrast to manufacturing firms and in agreement with their interactive nature, almost half of service providers that innovate, especially those in communications and financial services, are engaged in R&D partnerships and alliances.

The comparison of the most important sources of information for innovation reported by firms in Canadian dynamic services with those reported by service firms in several European countries suggests that Canadian firms draw more information from their customers and suppliers than the European firms. They also seem to rely more on external sources of technical information from private and public research institutes (Table 5.)

Table 5.

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3.4 Objectives and impacts of innovation in services

In keeping with their emphasis on product innovation, service sector innovators focus more on market and product-related objectives than on production-oriented goals. Maintaining or increasing the market share, improving the quality, variety, flexibility of their services, adjusting to user's needs and finding new foreign markets are the most frequently declared objectives of innovation activity in the three service sectors surveyed in 1996. As befits their larger scale, innovators in financial services focus are reducing costs more often than innovators in the two other sectors. Innovating firms in the technical business services typically strive for production flexibility (Baldwin et al. 1998). Between one third to one half of firms that emphasised market related objectives reported that innovation helped them to increase their market share (Rosa, 2002, Table A7).

Aside from having an important impact on quality, reliability, user friendliness, speed of delivery and flexibility of services, innovations also have a decisive impact on improved motivation of their employees and their productivity. The highest incidence on own productivity (reported by 25-30% of innovating firms) is found in the financial services, followed by technical business services. Innovations introduced by firms in technical business services improve even more frequently (40%) productivity of their client's.

Technical change fuelled by accelerating rate of innovation is often accused of creating unemployment. According to information from the innovation survey the reality is less alarming. Most innovations had no effect on employment or on workers' skills. When they do, the percentage of firms reporting increased employment is significantly higher than that of

those that cut jobs. Similarly, the number of firms that report that innovation increases the skills of workers is significantly larger than those that decrease them (Baldwin et al. 1998).

Overall, innovations in technical business services seem to have larger incidence than those in communications and financial services. Their positive impact on various aspects of quality, availability and flexibility, not only improves the productivity of a sizeable proportion of their downstream clients, it is also one of essential inputs to innovation activity of their clients both in services and other economic sectors.[31] The trend of manufacturing firms to outsourcing, i.e. replacing in-house technical business services by using specialised professional services from outside is blurring the distinction between manufacturing and services. It also explains, in part at least, the fast growth of the technical business services and it underscores its contribution to manufacturing.[32]

3.5 Intellectual property protection in service industries

In face of the fierce competition service firms focus on retaining customers who can relatively easily switch to competitors. Even though they do not use intellectual property rights (IPRs) as often as manufacturing firms, they use them nevertheless frequently but differently. They use trademarks often in combination with copyrights and patents to develop brand loyalty. Copyright and, increasingly patents are used to protect and trade IPRs involved in computer software, business methods, communication and multimedia technologies. Firms in R&D intensive technical business services use patents more often than those in communications and financial services. The small technical services firms rely frequently on trade secrets which are often more effective and less costly than patent protection.

The growing importance of knowledge in all spheres of economic activity led in some countries, notably in the US, to reforms that extended IPRs to new fields. Some of them are directly related to innovation in certain service industries, especially to those using intensively information and communication technologies (ICT). In the same time, court decisions involving IPRs became more « friendly » towards proprietors of IPRs rather than to infringers.

- *Protection of IP in the software industry*

The U.S. Patent Office was refusing patents on software and mathematical algorithms « per se », i.e. independently from a device using it until the early 1970s. The protection of software

was initially ensured by copyrights[33] rather than by patents. [34] This practice seems to be continuing in Canada (Vaver, 2001).[35]

The arrival of personal computers was associated with an explosive growth of the software industry and beginning of software patenting in the U.S. More recently the development of internet and e-trading led to introduction of patenting for business methods and multimedia in the United States.

The earlier history of the software industry and the use of IPRs to protect software and business methods (both by copyrights and patents) are documented in Graham and Mowery (2001). The authors argue that the changing judicial climate for copyright along other decisions affirming the strength of software patents, may have contributed to increased reliance by U.S. software firms on patents.

Evolution of the share of overall US corporate patents accounted for by software, electronic data transmission and encryption patents has been increasing over the 1984-2002 period with the expansion of ICTs. Graham and Mowery (2001) show the evolution of the share until 1997. The extension of observed period to 2002 show that the share of software patents continue to increase even more until it declined in 2000, mimicking nicely the stock market bubble (Figure 5.).

One way to compare Canadian innovation performance in the field of software and related ICT technologies is to look at the evolution of the share of U.S. patents assigned to Canadian corporations in the software related classes. This is illustrated by the two curves in the lower section of Figure 5.The first curve (Canada's %) shows that the share of software related patents assigned to Canadian corporations remained very low, rarely exceeding the one percentage point mark until the mid-nineties. Since then, it has increased notably. A perusal of the patent assignees shows that in the recent period Nortel has accounted for an important portion of the Canadian share of U.S. patents in these classes. To assess the evolution of patents assigned to computer service and related activities I deducted the patents awarded to Nortel. The second curve (Canada (-Nortel) % is still showing a clearly increasing trend lately (Figure 5). The increasing trend of the Canadian share of all U.S. patents in the software and e-commerce related IPC classes suggests that in the second half of the nineties Canada improved in this field its position in the world patent ranking. However, at one to two percent

points the share is still very low for a country that is among the leading users of ICT, Internet and E-commerce.

Figure 5 about here

- *Patenting of Business methods and e-commerce*

Since the 1998 decision of the U.S. Court of Appeals for the Federal Circuit in the case of State street Bank versus Signature Financial Group that validated a controversial software patent on "transformation of data, representing discrete dollar amounts, by a machine trough a series of mathematical calculations into a final share price…." . Since the State Street decision, the number of patent applications for such business methods patents expanded from 1275 in fiscal 1998 to 2600 in fiscal 1999 (Graham and Mowery, 2001). These include patents for e-commerce such as the ordering of books and other goods by "one click" method at Amazon.com etc. These developments show that patent protection is becoming increasingly relevant for financial services, business services and trade. As of 2001 business methods were not patentable in Canada (Vaver, 2001).

- *Multimedia*

The increasingly important field of multimedia is also closely protected by patents in the U.S. since awarding of the fundamental patent to Compton Encyclopaedias in 1993 (Graham and Mowery, 2001).

- *Databases*

The latest additions of a new type of intellectual property subject matter are databases that received a « sui generis protection » i.e. specific right to protect them against copying from the EU in 1998. In Canada, as in the U.S., databases are protected by copyright and/or by business methods (Scotchmer and Mauer, 2001).

- *IPRs and the Internet*

Internet illustrates well the fundamental dilemma that the digital revolution created for the protection of intellectual property. The dilemma is the result of the progress in digital technology that enables reproduction at very low costs and the existence of the World Wide Web that enables everyone to publish world-wide on the one hand, and the intellectual property law, on the other hand. This led to two opposite attitudes to IP. On the one hand the

some innovating firms realised the potential patents offer to secure and defend profitable position in the e-commerce economy and patent intensively.[36] On the other hand, Internet is also the medium which saw the emergence of the Open Source Initiative - a loose group of volunteer programmers who collaborate to develop free software for Internet.[37] The current situation leads to various examples of infringement of IP, e.g. the use and misuse of the trademark law to protect internet site names (cyber squatting).[38] It is likely that at some point public policy with respect to IPRs related to internet will intervene, but at present the situation is still in flux. [39]

3.5.1 Use of IPRs in Canadian service industries

Information on the use and effectiveness of IPRs in Canada comes from Baldwin et al. (1998). In the early nineties fewer than half of the innovators in the three « dynamic » service industries of their study report using any one of the property rights.

Firms used mostly copyrights and trademarks. Patents were used less frequently. This pattern contrasts with manufacturing where firms use rarely copyrights and rely much more on patents and trade secrets. It is likely, that as in the U.S. (Graham and Mowery, 2001), the use of patents may have increased since the time of the study.

As in manufacturing, there are significant inter industry differences in the use of IPRs in service industries as well. Firms in communications services use intellectual property rights least frequently. Innovators in financial services focus on trademarks. The greater diversity of technical business services is reflected in their tendency to use several IP instruments (Figure 6).

Figure 6

Use of Intellectual Property Protection by Innovators

About here

Like in manufacturing, even those innovators that use IPRs protection do not necessarily consider them very effective.[40] Use of various business strategies such as being first in the market and protecting against imitation by complexity of design proves often to be more effective than statutory IPRs for protection against imitation and loss of customers. Why then are firms using statutory protection at all? Increasingly, especially firms using complex ITC

technologies use statutory rights such as patents and copyrights for strategic purposes to trade them with their allies and competitors (Hall and Ham-Ziedonis, 2001; Hanel , 2003).

3.6 Obstacles to innovation in service industries

Respondents to the Canadian Survey of Innovation, 1996 were asked to identify impediments they encountered in their innovation activity. Perception of obstacles depends on the type of service industry, the size of firm and the competitive environment.

1. The high cost of innovation is the most important obstacle in all three industries.
   - Aside from high cost, innovation in communications industry is more affected by government laws and regulations than in the two other industries.
   - The lack of qualified personnel is a major obstacle in technical services.
   - Overall, all obstacles to innovation are cited less frequently by firms in financial services than in the other two industries. This is likely explained by the larger firm's size in financial services than in the two other industries.

2. The smallest firms (employing less than 20 persons) report obstacles in their innovation process more frequently than the larger ones. The difference is staggering, the percentage of smallest firms reporting an impediment being four to ten times more important than the percentage of the largest ones (>500 employees). However, the relative importance of different types of problems does not vary much with the size of firm. The high cost of innovation is first on the list in firms of all size categories. Large firms are more concerned than the smaller ones with risks related to feasibility and success of innovation.[41] On the other hand, small firms are more concerned than the larger ones with the lack of qualified personnel and difficulties obtaining external financing and specialised equipment.
   Since almost half of all innovating service firms employ less than 20 persons, impediments reported by this category are worthy of particular attention.

   The smallest firms in all sectors have difficulties obtaining external financing. These firms have little to offer as tangible collateral to financial institutions. In contrast to small manufacturing up-start firms that may obtain venture capital based on the strength of their patent portfolio, innovations in many services are less easily protected by intellectual

property rights and can rarely use patents as collateral. This problem is likely to be particularly important for example in technical business service where 95% firms are very small employing less than 20 persons (Gellaltly, 1999).

3. Innovation in services is less dependent on R&D than in manufacturing and if conducted, R&D is often organised less formally. It is therefore likely that innovators in service industries qualify less frequently for the main public support programs of innovation in Canada, the experimental research and development tax credits and various grant programs subsidising R&D expenditures.

   The eligibility and performance criteria for access to private and public funding of innovation has so far been mainly geared to the manufacturing sector; innovators in service industries compare on these criteria unfavourably with typical manufacturing innovations.[42]

4. There are important differences between firms that conduct R&D and those that do not. Those that conduct R&D introduce innovations that are more complex and more original and as such constitute a greater technological and administrative challenge. They face obstacles more frequently than the technically less sophisticated firms that innovate without recourse to R&D. Similar pattern was found in manufacturing. Baldwin and Hanel's (2003) study shows that firms that introduced the more original innovations (the "world–first" or "Canada-first") relied more on R&D and encountered various obstacles more frequently than their less original counterparts. Using the data on advanced technology adoption from the same survey[43] Baldwin and Lin (2002) examine the factors related to obstacles firms face when adopting advanced technology. They also conclude that the more innovative firms face greater obstacles.

5. In contrast to non-innovators, the small, R&D intensive innovative firms[44] develop an overall strategy stressing financial management, quality management, improvement of market position and foreign market penetration, improving and motivating human resources and protecting intellectual property. Since by definition innovating firms are

agents of change, they are facing various obstacles more often than their non-innovating counterparts pursuing routine activities.

6. A larger proportion of innovating than non-innovating firms is facing risk related to market acceptance and imitation of their products. Another problem more acutely perceived by innovators is lack of skilled labour. Both these difficulties are perceived more often by firms in computer services than in computer reparation and in engineering.[45]

In contrast, non-innovators reported more often than innovators lack of technical equipment, long administrative approval, high cost and lack of equity capital. However, the difference between the two groups with respect to high cost and lack of equity capital is not statistically significant.

7. Impediments to innovation are also related to the degree of competition the innovating firms are facing. Mohnen and Rosa (1999) found that:

> "*Firms which faced less competition had a tendency to consider questions related to impediments not relevant or the impediments themselves insignificant, whereas firms facing more competition had a tendency to consider obstacles more significant."*

Introducing new and improved services, the way they are produced and delivered is in an example of Schumpeterian "creative destruction" that is risky, costly and difficult. The fact that in spite of experiencing various obstacles, innovating firms succeeded in developing competencies needed to overcome them shows that they were not insurmountable. The proportion of firms that encountered impediments in their innovation activities is presented in Table 6.

Table 6.

About here

4. Canadian R&D in services

Canada's overall R&D effort does not compare advantageously with that of other developed industrialised countries. The Canadian business sector's expenditures on R&D were only about 1 percent of GDP in 2000, about one third of Sweden's R&D intensity and half of Canada's principal economic partner and competitor, the United States. The comparison of the rate of growth of total business sector expenditures on R&D in Canada (5.6%/year) and in the U.S. (10.5%) over the 1997-2000 period shows that lag is increasing. This raises the question whether the situation is any different in the service sector.

As discussed earlier and in more detail by (Gault ,1997), the R&D statistics give in many ways an incomplete and deformed picture of research and development activities conducted in various service industries.[46] With that caveat in mind, the available statistics on business sector[47] R&D in services suggest several interesting findings.

- The R&D intensity, i.e. the ratio of expenditures on R&D/revenues, in the service sector is in Canada about as important as in manufacturing (1.8% and 1.9% retrospectively in 1999). It is noteworthy that several "high tech" service industries (Scientific R&D, Health care, Management, scientific and technical consulting, computer services and Engineering & Scientific services have R&D intensity as high or higher than those of the most R&D intensive manufacturing industries (see Figure 7 based on R&D/Revenue in Table 7.).

- A comparison of R&D intensity in service industries between Canada and the US shows that, similarly as in manufacturing, American firms in service industries are significantly more R&D oriented than their Canadian counterparts (see Table 8). According to the latest available data from both countries and with all reserve due to differences in coverage, the US lead appears particularly significant in trade, scientific R&D services, finance & insurance and in other professional, scientific and technical services. On the other hand, Canada seems to be spending more on R&D relative to sales in management consulting and in private health care services.[48] Differences in data availability make other comparisons impossible or too risky.

- Except for a pause and dip in the mid nineties, expenditures on R&D in the Canadian service sector were increasing over the last decade. There were, however, significant inter-

industry differences. The most dynamic growth was displayed by R&D services, wholesale and retail trade and by computer and related activities. On the other hand, R&D by firms in the financial sector, in post and telecommunications and in other business activities declined (Figure 8.)

- Owing to statistical difficulties, an international comparison is at best risky. According to available international (OECD, ANBERD, July 2002) statistics on R&D, the service sector's share of total business sector in Canada and the US is higher than the average for the European Union. It is, however, impossible to say to what extent the difference is due to differences in statistical coverage. There are some OECD countries whose service sector's share of total business sector R&D is higher than Canada's (Norway, New Zealand, Denmark and Australia (OECD, ANBERD, 2002, July).

- R&D in the private sector service industries represents about 28.5% of total R&D performed in the Canadian business sector. While the share of services R&D in the total business R&D expenditures was higher in Canada than in the US and increasing up to mid- nineties, it declined from then. In contrast, the services share of business R&D in the US shot up significantly in the late nineties and is, as of 2000, superior to Canada's share by 5% points. The evolution of R&D expenditures in services as % of total business sector R&D expenditures in Canada and U.S. is illustrated in Figure 9.

- Government and manufacturing firms have been contracting out R&D to private firms. There is some evidence that Government R&D was contracted more to service industry firms than to manufacturing (Dalpé and Anderson, 1997 (cited by Gault 1997). There is also some evidence that service firms dominate the R&D for contractual purposes (Rose 1997). It is however not clear what proportion of the growth of R&D in services can be attributed to contracting out of R&D by industrial firms.

- Service firms are very active in R&D networking. Service firms performed about two thirds of all R&D resulting from an agreement between firms or research institutes (Gault, 1997; Rose, 1997).

5. Concluding remarks

After many years of neglect, innovation activities in services are being increasingly recognised as an important part of the national innovation system. The concept, the definitions and the measurement of innovation in service industries is more problematic than in manufacturing industries. The information on innovation activities in the service industries is, so far, less complete and less reliable than information on innovation in manufacturing industries.

Judging from the studies that analysed results of the innovation survey in dynamic services, an important proportion of firms belonging to the three service industries- communication-financial services and technical business services- innovate quite extensively. Organisational and technological change, mostly related to introduction of ICT is almost as widespread in services as in manufacturing industries. The limited information on patenting in the software and e-business related fields shows that Canadian firms have been lately increasing their share of U.S. patents.

Unfortunately, there is little information on innovation in other vital dynamic service sectors such as wholesale and retail sales which are believed to be one of the principal sources of increasing productivity in the U.S. It is unfortunate that the new Statistics Canada survey of innovation in services which is currently in the field[49] does not include wholesale and retail trade.

The studies reviewed in this chapter have consistently demonstrated that there are huge differences in innovation performance, behaviour, sources and impediments between small and larger service firms. Many service industries are dominated by very small firms. In view of this fact it is hard to understand that the ongoing innovation survey (see above) does not

cover firms employing less than 15 employees. The survey results are unlikely to be representative of those segments of service industries dominated by the smallest firms (e.g. some business services).

The information on Canadian R&D in services is among the most complete and consistent among the OECD countries. It shows that R&D in services was growing more rapidly than R&D in total business sector. On the basis of the available information it is possible to assert that the innovation effort in the Canadian service sector is far from negligible and plays a significant role not only in the development of services but also in other sectors.

Broad international comparisons of R&D expenditures in the service sector are still risky and make little sense. The data enable only a meaningful comparison of the Canadian and U.S. R&D performance. Even though the service industries in Canada accounted until the mid-nineties, for a larger share of total R&D expenditures than their U.S. counterparts,[50] the situation was reversed recently. At any rate, as in manufacturing, the US service industries spend on R&D a larger proportion of their revenue than do Canadian services. The recent increase of R&D performed in the U.S. service sector will further increase their lead over Canadian service industries.

Tables

Table 1. Rate of innovation in service sectors, 1994-1996

Service sector	Rate of innovation (% of all firms)
Communications	**45.0**
Telecommunications	85.0
Television and radio broadcasting	41.0
Financial services	**61.8**
Banks and other fin. institutions	54.2
Life insurance	75.5
Other insurance	56.1
Technical business services	**42.6**
Computer services	55.8
Engineering services	40.7
Other technical business services	35.3

Source: Baldwin et al. (1998) and Hamdani (2001 March)

Table 2. Adoption rates for organisational and technological change

	Organisational Change Adoption Rate	Technological Change Adoption Rate
Total Private Sector	38.3% B	43.6% B
Total Goods Producing Sector	44.2% B	45.6% B
Total Services Producing Sector	37.6% B	43.4% B
Goods Related Services	37.0% B	38.7% B
Intangible Services	37.9% B	45.5% B

Source: Adapted from Earl (2002,Table 1). Based on Statistics Canada: The Survey of Electronic Commerce and Technology 2000 (SECT) Reprinted with author's permission

Note : The letters in this table and the following one indicate data quality rating A: Excellent B: Very good C: Good D: Acceptable E: Use with caution F: Unpublishable

Table 3 Organisational and technological change by sector

	Organisational Change	Technological Change
	%	%
Total private sector	**38.3 B**	**43.6 B**
Goods producing sector	***44.2 B***	***45.6 B***
Forestry, Fishing and Hunting	22.6 C	27.3 C
Mining and Oil and Gas Extraction	30.2 D	31.5 D
Utilities	46.4 D	64.0 D
Manufacturing	50.2 B	50.6 B
Services producing sector	***37.6 B***	***43.4 B***
Goods related services	*37.0 B*	*38.7 B*
Wholesale Trade	45.6 C	45.4 C
Retail Trade	35.9 B	37.6 B
Transportation and Warehousing	28.1 C	32.6 C
Intangible Services	*37.9 B*	*45.5 B*
Information and Cultural Industries	51.8 D	62.9 C
Finance and Insurance	45.6 C	59.7 C
Real Estate and Rental and Leasing	31.0 B	37.1 B
Professional, Scientific and Technical Services	39.8 B	58.6 B
Management of Companies and Enterprises	21.1 C	30.9 C
Administrative and Support, Waste Management and Remediation Services	48.2 C	53.5 C
Educational Services (excluding public administration)	52.1 D	54.4 D
Health Care and Social Assistance (excluding public administration)	50.2 C	49.5 C
Arts, Entertainment and Recreation	39.4 C	42.3 C
Accommodation and Food Services	29.0 C	29.3 C
Other Services (excluding public administration)	33.4 B	38.3 B

Source: Survey of Electronic Commerce and Technology, 2000; Statistics Canada.

Table 4. – Proportion of Firms Using Information Technology by Sector, Canada, 2000*

	Use of Computer	Use of Internet	Use of e-mail	Uses of a web-site	Uses of Internet for sale of goods or services	Uses of Internet to buy goods or services
Wholesale	90%	75%	74%	34%	14%	23%
Retail Trade	76%	53%	48%	23%	9%	13%
Transport and Storage	76%	57%	51%	13%	2%	15%
Finance and Insurance	84%	76%	76%	34%	7&	20%
Real estate and renting	71%	51%	50%	22%	5%	9%
Professional, Tech.& Sci. services	95%	84%	85%	30%	7%	36%
Information & Cultural Ind.	94%	93%	91%	54%	19%	53%
Management consult.comp.	63%	53%	49%	17%	1%	8%
Administrative & support Services	87%	75%	70%	33%	6%	22%
Educational services	95%	89%	84%	70%	16%	41%
Health Care & Social assist.	90%	62%	59%	16%	1%	14%
Arts, Spectacles and leisure	87%	69%	62%	36%	5%	16%
Lodging and Food services	66%	44%	40%	18%	5%	10%
Other services	76%	52%	48%	22%	3%	10%
Manufacturing Sector	89%	78%	75%	38%	8%	21%
PrivateSector Total	81%	63%	60%	26%	6%	18%

Source: Statistics Canada, Survey of Electronic Commerce and Technology, 2001
* According to the North American Industries Classification System (NAICS)

Table 5. Sources of information considered as very important for innovation in the service sector*

	Germany	Belgium	France	United Kingdom	Ireland	Sweden	EEC	Canada		
								Communi-cation	Financial Services	Technical Services for Business
Costomers	28%	48%	27%	65%	56%	57%	38%	66%	65%	76%
Competitors	24%	14%	9%	20%	21%	15%	19%	44%	60%	45%
Suppliers	16%	22%	23%	27%	28%	22%	19%	48%	13%	33%
Fairs and exhibitions	20%	9%	5%	17%	19%	6%	17%	20%	4%	20%
Conference, meetings	22%	14%	8%	8%	11%	4%	15%	32%	22%	38%
Consultants	13%	11%	6%	10%	14%	8%	11%	10%	19%	19%
Higher education institutions	6%	2%	2%	4%	6%	5%	4%	10%	4%	24%
Internet or data base**	13%	11%	8%	9%	20%	10%	11%	17.9%	8.6%	16.0%
Private research institutes	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	11%	10%	13%
Government R&D institutes	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	7%	negligible	11%
R&D Institutes***	3%	3%	2%	7%	2%	n.a.	3%	9%	10%	12%

Sources : Baldwin et all(1998), *Innovation in Dynamic Service* and Eurostat : The Community investigation into the innovation (CIS2 1997-98) as reproduced in: Conseil de la Science et de la Technologie, *L'innovation dans les services,* Pour une stratégie de l'immatériel, Québec, 2003.

Note : *Proportion of the companies indicating that the source of information is very important

** For Canada the source is : "Government information programs"

*** For Canada average of the private and Governement R&D institues.

Table 6. Distribution of perceived barriers to innovation by intensity and by service sector

	Not relevant (6)	Crucial (5)	Very significant (4)	Moderately significant (3)	Slightly insignificant (2)	Insignificant (1)
Communications	31%	8%	18%	19%	11%	14%
Financial services	25%	3%	19%	24%	18%	11%
Technical services	19%	8%	23%	22%	14%	14%
All three sectors	25%	6%	20%	22%	14%	13%

Source: Mohnen and Rosa (1999).

Table 7. Current litramural R&D expenditures as a percent of performing company's revenues

	1991	1993	1995	1997	1999p	1999r	2000p	2000p	2000p
									Control
Services								Canada	Foreign
Transportation and storage	0.20	0.40	0.30	0.10	0.20	0.10	0.20	0.20	0.10
Communication	1.00	1.50	1.00	0.50	0.40				
Information and cultural industries						1.5*	1.60	1.40	13.2
Wholesale trade	1.00	1.20	1.00	1.30	1.90	1.70	2.50	1.70	4.20
Retail trade	0.70	0.40	0.90	2.60	1.90	0.80	0.40	0.40	7.80
Finance, Insur. & real estate.	0.80	0.90	0.40	0.40	0.30	0.20	0.40	0.40	4.60
Computer and related services	18.30	13.30	10.00	14.00	15.10	13.00	10.80	11.50	8.80
Engineering & scientific services	18.70	10.40	9.40	10.40	9.00	15.20	10.00	8.70	12.20
Management consulting services	8.60	8.80	6.30	10.60	11.00	11.00	13.90	14.10	5.90
Scientific R&D						34.7*	39.10	40.10	30.90
Other services	5.10	5.70	3.60	3.70	5.40	1.5*	1.30	1.00	16.50
Total services	1.60	1.80	1.40	1.80	2.00	1.80	2.30	1.90	4.60
Total manufacturing	1.90	1.80	1.50	2.00	2.00	1.90	2.20	3.80	1.10
Construction	1.30	3.50	0.70	0.90	1.20	1.60	5.00	5.30	3.50
Utilities	1.00	0.80	0.60	0.60	0.80	0.80	0.80	0.80	0.00

Source: Stat. Canada Cat.No. 88-202-XPB, Industrial Research and Development , Intentions 2002, Appendix
Notes: Data for 1999 are classified according to NAICS and are not strictly comparable for those industries marked by *.
All entries are revised figures unless marked p=preliminary

Table 8.
Comparison of US* and Canada# R&D Expenditures as a Percent of Performing Company Revenues

			US %	Canada %
year			2000	1999
Manufacturing			3.6	1.9
Utilities			nd	0.8
Construction*			5.8	1.6
Trade			5.4	1.9
Transportation and warehousing			nd	0.2
Information			4.1	1.5*
	Publishing		16.3	nd
		Newspaper, periodical, book, and database	2.0	nd
		Software	20.5	nd
	Other information		5.1	nd
Finance, insurance, and real estate			1.2	0.2
Professional, scientific, and technical services			18.3	nd
	Architectural, engineering, and related services		10.8	15.2
	Computer systems design and related services		12.3	13.0
	Scientific R&D services		42.9	34.7*
	Other professional, scientific, and technical services		6.6	1.5*
Management of companies and enterprises			4.4	11.0
Health care services			3.2	35.4
Other nonmanufacturing			1.1	1.3

Source: Author's computations from : Stat. Canada Cat.No. 88-202-XPB,
Industrial Research and Development , Intentions 2002, Appendix

National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2000, Table A1 and A4

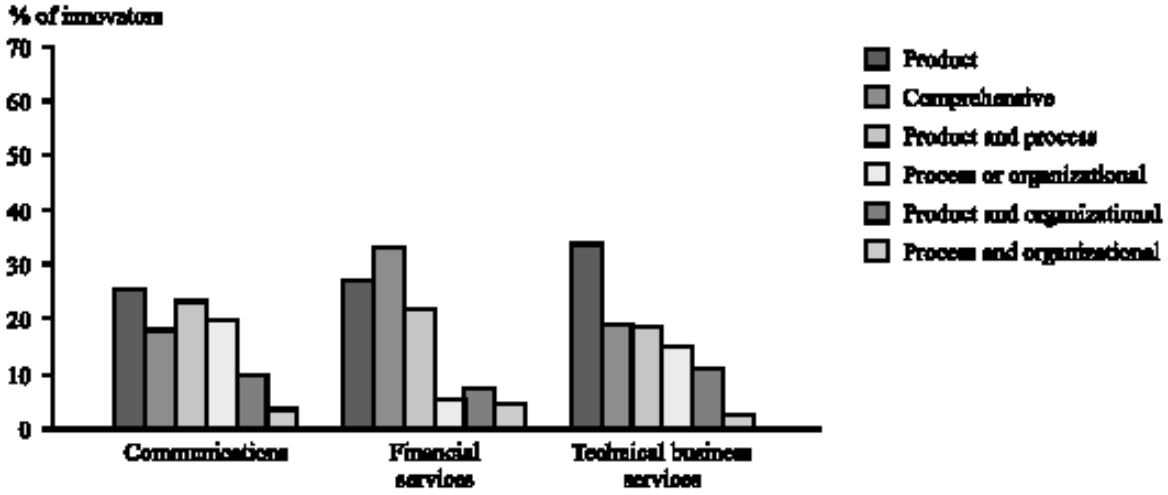
Notes: Construction US =R&D1999/sales 2000

*The figures for U.S. are total R&D funds/domestic sales

#The Figures for Canada are Current Intramural R&D Expenditures as a Percent of Performing Company Revenues

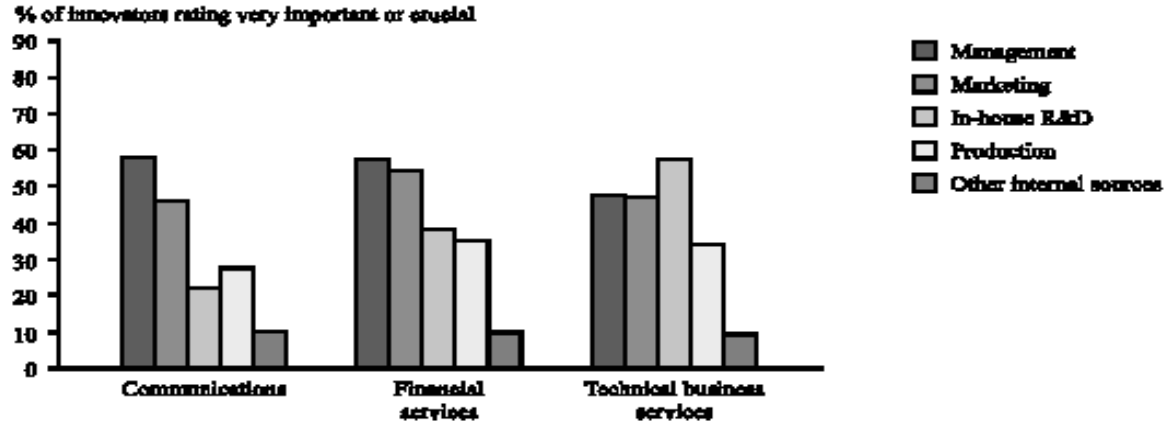
Figures

Figure 1. Distribution of innovation types



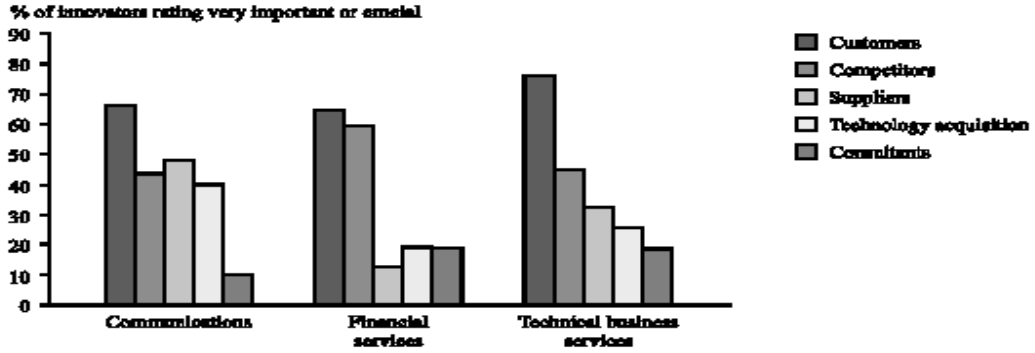
Source: Baldwin et all, 1998, based on Statistics Canada's, "Survey of Innovation, 1996."

Figure 2. Internal sources of innovative ideas in dynamic service industries



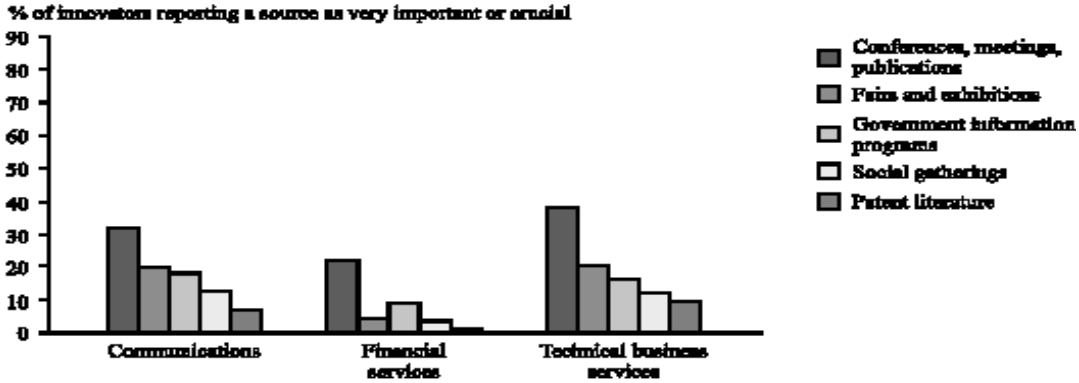
Source: Baldwin et al.(1998) based on Statistics Canada, Survey of innovation, 1996

Figure 3. Importance of external sources of information about innovation



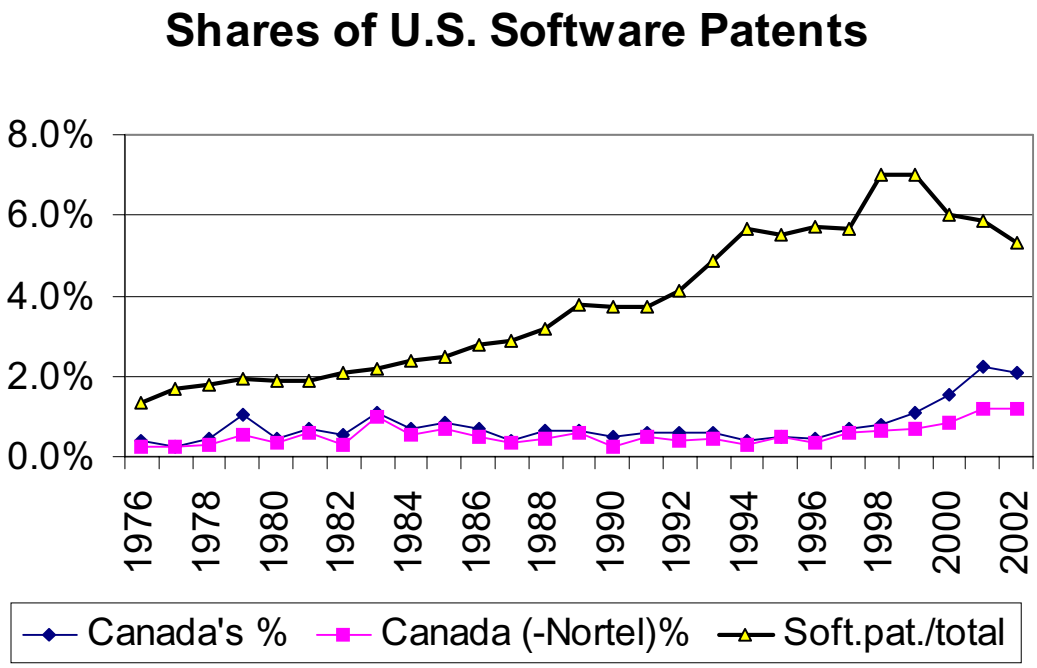
Source: Baldwin et al.(1998), based on Statistics Canada, Survey of innovation, 1996

Figure 4. Importance of technological infrastructure for information about innovation



Source: Baldwin et al.(1998), based on Statistics Canada, Survey of innovation, 1996

Figure 5.

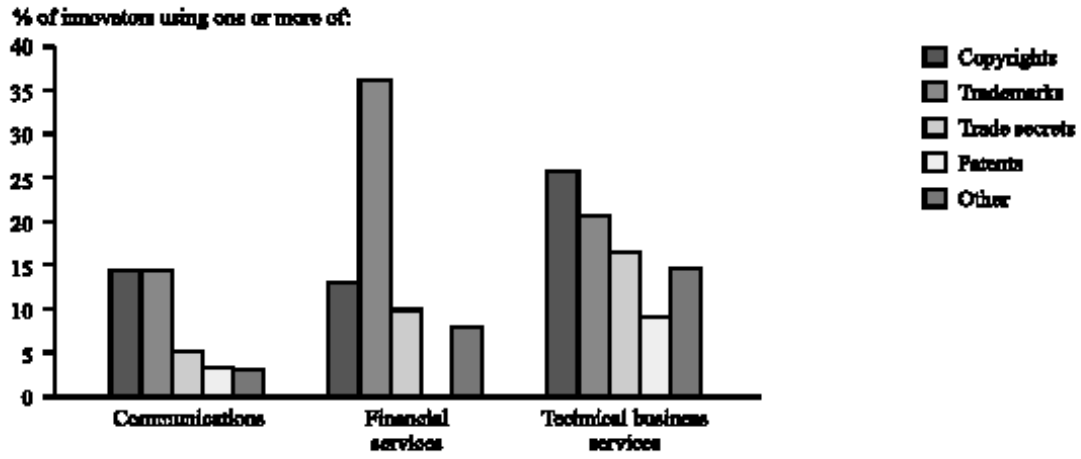


Source : Observatoire de science et technologie-CIRST
Note : The number of U.S. Patents in International patent classes:
IPC section, classes and subclasses and groups :
G06F Electrical digital processing
3/ Input arrangements for transferring data ….
5/ Methods or arrangements for data conversion…..
7/ Methods of arrangements for processing data by operatingupon the order….
9/ Arrangements for programme control….
11/ Error detection, correction monitoring…
12/ Accessing, addressing or allocating within memory…
13/ Interconnection of , or transfer of information or other signals….
15/ digital computers in general…

G06K Recognition of data :
Presentation of data; Record carriers; handling record carriers
9/ Methods or arrangements for reading……
15/ Arrangements for producing a permanent visual presentation ….

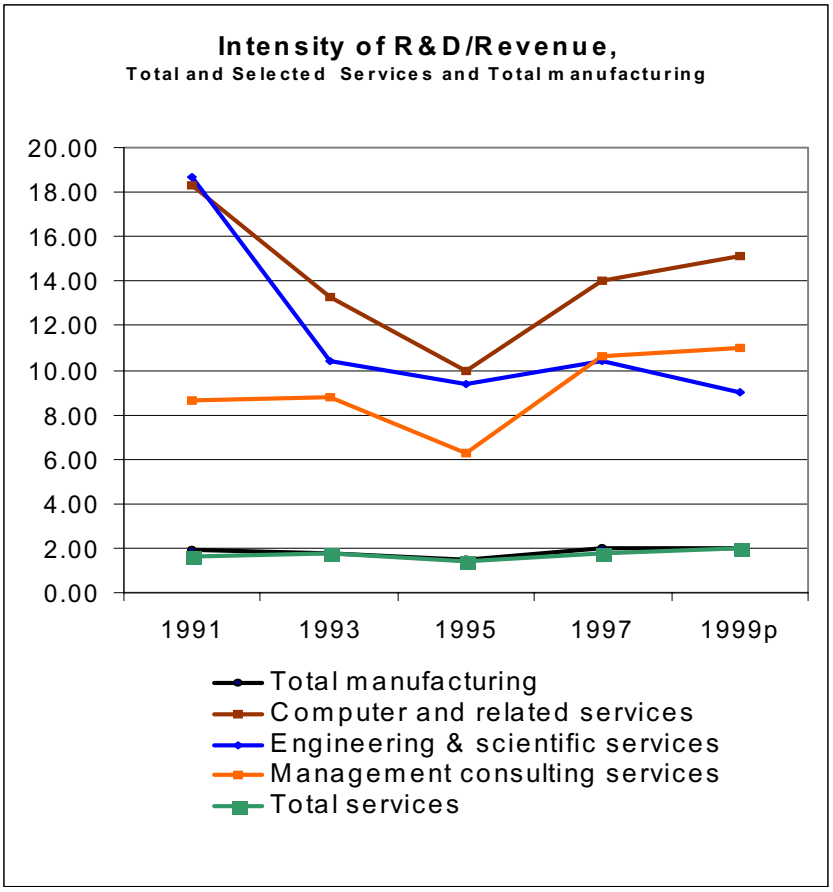
H04L Electric Communication Technique
9/ Arrangement for secret or secure communication

Figure 6. Use of Intellectual Protection Rights



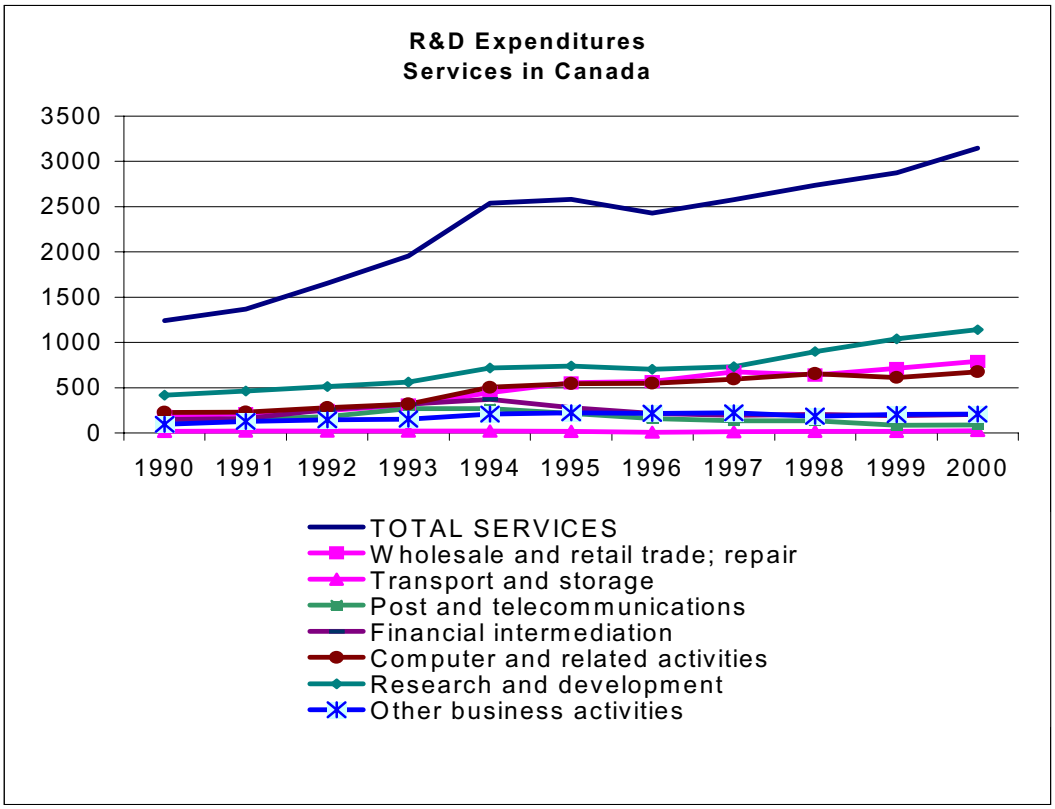
Source: Baldwin et al.(1998), based on Statistics Canada, Survey of innovation, 1996

Figure 7.



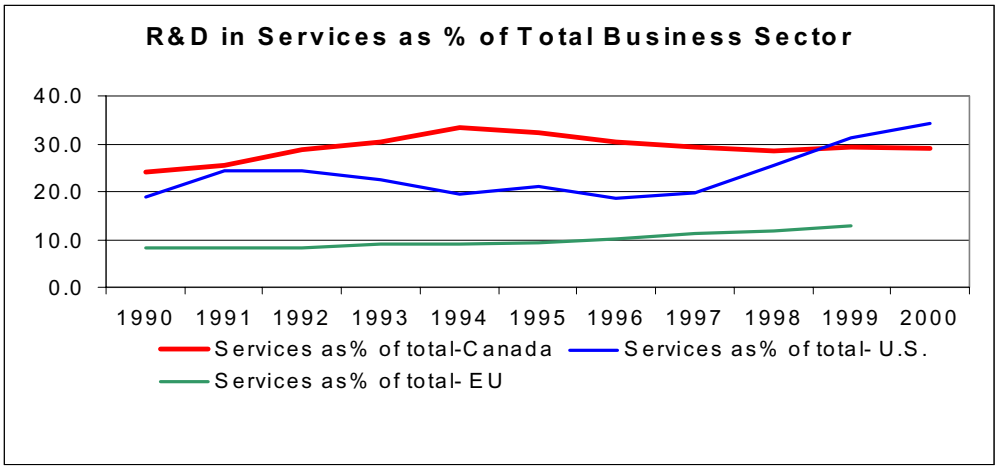
Source: Authors computation from Statistics Canada : *Industrial Research and development* Cat.No. 88-202-XPB, Appendix.

Figure 8
Source: Author's computation from Statistics Canada : *Industrial Research*



and development Cat.No. 88-202-XPB, Appendix

Figure 9



Source: Authors computation from the internationally comparable R&D data base OECD (ANBERD).

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Appendix

Examples of TPP innovations in selected service industries

Wholesaling of machinery, equipment and supplies

- Creation of web sites on the Internet, where new services such as product information and various support functions can be offered to clients free of charge.
- Publication of a new customer catalogue on CD (compact disc). The pictures can be digitally scanned and recorded directly on the CD where they can be edited and linked to an administrative system giving product information and prices.
- New data processing systems.

Road transport companies

- Use of cellular phones to reroute drivers throughout the day. Allows clients greater flexibility over delivery destinations.
- A new computer mapping system, used by drivers to work out the fastest delivery route (*i.e.* from one destination to another). This makes it possible to offer clients faster deliveries.
- The introduction of trailers with eight globe-shaped containers instead of the usual four.

Post and telecommunications companies

- Introduction of digital transmission systems.
- Simplification of the telecommunications net. The number of layers in the net has been reduced by using fewer but more highly automated switching centres.

Banks

- The introduction of smart cards and multipurpose plastic cards.
- A new bank office without any personnel where clients conduct "business as usual" through the computer terminals at hand.
- Telephone banking which allows clients to conduct many of their banking transactions over the phone from the comfort of their own homes.
- Switching from image scanning to OCRs (Optical Character Readers) in the handling of forms/documents.
- The "paperless" back-office (all documents are scanned for entry into computers).

Software consultancy and supply companies

- The development of a whole range of different customer packages in which clients are offered varying degrees of assistance/support.
- The introduction of new multimedia software applications that can be used for educational purposes and thus eliminate the need for a real life human instructor.
- Making use of object-oriented programming techniques in automatic data processing systems development.
- The development of new project management methods.
- Developing software applications through computer-aided design (CAD).

Technical consultancy companies

- A new method of purifying water abstracted from lakes for use as household drinking water.
- Offering customers a new "supply control system" which allows clients to check that deliveries from contractors meet specifications.
- The development of a standard for construction work carried out in already densely built-up areas (where care has to be taken not to inflict damage on any of the surrounding buildings).

Advertising and marketing companies

- Delivering lists of potential customers on diskette together with a list filing system (software) that allows the client firms themselves to analyse and draw samples from the list.
- Being able to assist clients in direct marketing campaigns by offering to distribute pre-labelled advertising leaflets, etc.,addressed to selected households.
- Initiating a control process to check by phone with random households that they are actually receiving the adverts/leaflets they are supposed to.
- Delivering the software applications needed for clients themselves to be able to analyse data along with statistical databases.

Source: Oslo manual 1997, p.33.

Notes

[1] According to OECD study Pilat (2001) labour productivity in the following service industries : Communications, Wholesale and retail sale, Transportation and storage and Finance grew faster than the average productivity of the whole business sector.
[2] See also the review of recent studies by the Conseil de la science et de la technologie, Québec, (2003). It provides a good starter for a timely overview of the literature on innovation in services in the Canadian context.
[3] For example until the early seventies IBM (Canada) was considered a manufacturing firm, producing goods, since then it became a provider of services.
[4] The increasing popularity of leasing cars, computers and other durable goods instead of buying them is a good example of this trend. The client is in fact consuming and paying for a combination of financial, maintenance and transport service (or in the case of computers information processing service etc.).
[5] Innovation surveys of varying scope and coverage were undertaken by individual researchers and various economic and industrial institutions in many industrial countries well before the national statistical agencies became involved in Innovations surveys based on guidelines of Oslo manual. Canada's Economic Council (Economic Council Canada, 1980).
[6] Research and Development (R&D) is systematic investigation carried out in the natural and engineering sciences by means of experiment or analysis to achieve a scientific or commercial advance. The reason for exclusion of social sciences is administrative. The information on R&D is collected in part from corporate tax returns to the Canadian Customs and Revenue. Since the R&D in social sciences is not eligible for the Scientific Research and Experimental Development tax credits the information on R&D in social sciences is not collected. As Gault 1995) remarks, 'As social sciences R&D is more likely to be performed in services industries than in other parts of the business sector, the present surveys are expected to underestimate the value of R&D done in service industries.
[7] The definition of R&D in the Frascati manuel is as folows:
"Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge , including the knowledge of man, culture and society (underlined by the author) , and the use of this stock of knowledge to devise new applications."
[8] According to Young (1996) R&D in Social sciences and Humanities was not included in Canada, Greece, Turkey, UK, US and Germany, Japan, Netherlands and Norway were dissatisfied with the way the SSH were treated in their national surveys.
[9] Djellal and Gallouj, (1999) present a useful review of national and international surveys of innovation indicators in services and discuss some of these issues at more length.
[10] However, empirical evidence (Baldwin et al., 1998) suggests that survey respondents do not have that much difficulty to distinguish the two types of innovation.

[11] For example according to Rosa (2002), most of the Canadian firms in technical services are very small 78% have <20 employees (this is even more pronounced in *computer services (80 and 86%).*
[12] As cited in Djellal and Gallouj (1999) in the ZEW survey the hierarchy of frequency of innovations is: process innovation (53%); product innovations (34%) and organisational innovations (13%). In DIW which focused on Berlin, the hierarchy is completely reversed:
organisational innovations (40%); product innovations (38%) and process innovations (22%). Their article cites also notable discrepancies among results from various national surveys based on the more restrictive definition of innovation.

[13] Unless stated otherwise, this paper examines the innovation in the private service sector, leaving aside public services.

[14] The *communications* industries include telecommunication carriers, radio broadcasters, television broadcasters, cable companies, combined radio and television broadcasters, and other telecommunication industries.
The *financial services* industries contain chartered banks, trust companies and life insurers. Finally, *technical business services* includes four industries from Business Service Industries: computer services, related computer services, the offices of engineers, and other scientific and technical service industries. Business services considered *non-technical* such as employment agencies, advertising, architects, lawyers, and management consultants are not included. Neither are personal and government services.
[15] Wholesale, the fastest growing service industry in the 80s and 90s (Industry Canada, March 2001), is not included in the Innovation Survey, 1996.
[16] Note that this is a more comprehensive, and in my view better, definition than the one suggested by Oslo II manual. It includes explicitly organisational innovation which is absent in Oslo II.
[17] Note that a more recent survey conducted by Statistics Canada, Innovation Survey ,1999 covered a sample of larger firms (firms included in the Business register and employing more than 20 persons) and a more recent period (1996-1999). The survey found that about 80% of these larger manufacturing firms innovated. Since a very important share of firms in services are in the smallest size category employing less than 20 persons, a more meaningful comparison is with the Survey of Innovation and Advanced Technology Survey of 1993 that also included the smallest firms employing less than 20 persons. Several other methodological differences make a comparison of the 1993 and 1999 Statistics Canada Innovation surveys difficult. The 1996 Survey of Innovation in service industries is methodologically closer to the former than to the latter of the two surveys of innovation manufacturing.

[18] An example of heterogeneity of services innovation is provided by analysis of innovation in engineering services (Hamdani, 2001 Mars, Table 1) which shows that in this sub-sector product innovations were far less frequent than organisational and process innovations ((3.6%versus 15.6% and 23.2% respectively) compared with technical services (36%, 23.9 and 16.4% respectively).
[19] After indicating the type of innovation (product-process or organisational change) respondents were asked whether they had difficulties distinguishing between the product, process and organisational change innovation.
[20] The information on the % of innovators that had difficulties identifying organisational innovation is apparently available but not published Rosa(2002).
[21] Statistics Canada. The Survey of Electronic Commerce and Technology 2000 (SECT) contains two questions on organisational and technological improvements. These two questions provide the first cross-economy data on this issue, covering both firms in the private sector and organisations in the public sector.
[22] Organisational change is defined by a positive response to this question from SECT(2000):
"During the last three years, 1998 to 2000, did your organisation introduce significantly improved organisational structures or implement improved management techniques?" An additional question on training due to organisational change was asked.
[23] The following two questions determined if firms were involved in technological change and, if so, how were they involved:

> "During the last three years, 1998 to 2000, did your organisation introduce significantly improved technologies?"

"If yes, how did you introduce significantly improved technologies? (*Check all that apply*):
- by purchasing off-the-shelf technologies?
- by licensing new technologies?
- by customising or significantly modifying existing technologies?
- by developing new technologies? (either alone or in conjunction with others)"

[24] As Earl (2002, p.10) writes "Within the services producing sector both the highest and lowest rates of adoption of organisational change fell within intangible services (see Table 2). For intangible services the adoption rates for organisational change ranged from a low of 21% for firms in management of companies and enterprises to 52% for educational services and information and cultural industries. In fact, the two private sector industries with public sector counterparts – educational services and health care and social assistance -were amongst the top three industries that underwent organisational change between 1998 and 2000. Within the goods related services, the adoption rate for organisational change ranged from 28% for transportation and warehousing to 46% for wholesale trade with retail trade (36%) in the middle."

[25] There are, however, important differences between the intangible and goods related services. Smaller firms (employing under 100 persons), providing intangible services introduced technological change more frequently than firms providing goods-related services. The relationship for the larger firms (employing over 100 persons) was reversed; the goods producing firms introduced technological change more frequently than firms providing intangible services. According to Earl (2002) the adoption of technological change reported in the study probably reflected to a great extent steps taken by firms to ensure that the technology in place would function when the date changed to Year 2000.

[26] Questionnaires used in surveys of services innovations inspired by the Oslo Manual dominated by the technological (industrial) perspective ignore this specific trait of services.

[27] The percentage indicates the percentage of firms that rated the item crucial (5) or very important (4) on a scale ranging from (1) negligible to (5) crucial.

[28] These percentages are very similar to the percentage of firms conducting R&D in each of these service industries.

[29] Since the design of the questionnaire used in the Statistics Canada Survey of Innovation, 1966 (Service industries) resembles more the questionnaire of the Statistics Canada Survey of Innovation and Advanced technology, 1993 (Manufacturing)) than the more recent Statistics Canada Survey of Innovation, 1999 (Manufacturing) we compare results of the 1996 survey in services with those of the 1993 survey of manufacturing firms.

[30] Remarkable is the strong dependence of technical services on information from Universities and higher education 25% versus 5 to 8% for the other two industries (Rosa, 2002).

[31] Consultants and private R&D institutions were considered important or crucial sources of innovation by about 20% of innovators both in manufacturing and service industries. In addition, some technical services are also likely to be included in the external source of innovation information under the heading "Suppliers ", which represented one of the two most important external inputs to innovation in manufacturing firms (Baldwin and Hanel, 2003) and the third most frequent in service innovations (Baldwin et al. 1998).

[32] See Tomlinson (2000) who examined the contribution of knowledge intensive services to manufacturing in the UK.

[33] Computer programs were specifically included in the U.S. Copyright Act in 1980.

[34] There were several celebrated cases of litigation over the infringement of copyright for software. After a US court decision strengthening the copyright holder's right in the *Apple Computer against*

Franklin Computer case, the tendency was reversed by a more liberal decision regarding the spreadsheet software in the case of Lotus against Borland (Graham and Mowery, 2001).

[35] Vaver (2001) provides a very timely comparison of Canadian and U.S. intellectual property protection.
[36] The number of US Internet patents jumped by 300% from 1997 to 1998 (2,193 patents issued in 1998) according to Rivette and Kline, (2000).
[37] The clash between those two attitudes and the patent wars related to Internet are well described in Rivette and Kline (2000),
[38] Further examples of and references to cases of infringement of IP can be found in Hanel (2003).
[39] The report by the Committee on Intellectual Property Rights and the Emerging Information Infrastructure of the National Research Council, *The Digital Dilemma- Intellectual Property in the Information Age*, (2000) recognized that given the multitude of IP business models, legal mechanisms and technical protection services possible, making one-size-fits-all solution to the dilemma would be too rigid. The Committee recommended that: "Legislators should not contemplate and overhaul of intellectual property laws and public policy at this time, to permit the evolutionary process (described above) to play out."
[40] Baldwin et al (1998) report that over 40% of innovators in communications who use intellectual property find copyrights to be effective and over 50% find trademarks to be effective. In financial services, close to 60% report that trademarks are an effective means of protecting their intellectual property. In technical business services, trademarks and trade secrets are considered to be effective, copyrights less so.
[41] Mohnen et Rosa (2000) include among impediments specific to largest firms also internal resistance to change. However, internal resistance to change is reported by only 0.54% of largest firms, while about 5% of the largest firms complain about the high cost of innovation.
[42] See Preissel (2000) for a more detailed discussion of this kind of obstacles based on interviews conducted in Germany. Except for the lack of qualified personnel which is not an important impediment to service innovation in Germany, the importance of other obstacles is similar in both countries and therefore we can expect that the German findings are likely to apply to Canadian situation as well. Canadian survey of innovation in service industries was not
[43] Statistics Canada Survey of Innovation and Advanced Technology, 1993.
[44] More than half (57%) of innovators in technical business services carry out R&D activities compared to 10% of non-innovators.
[45] See Hamdani's (2001) study of innovation in Canadian engineering services also based on Statistics Canada Survey of innovation , 1996.
[46] For instance:

- R&D statistics for the service sector do not include research and development activities in social sciences and humanities which are particularly important in many service activities.
- The recent (1997) fundamental revision in industrial classification from the Standard Industrial Classification (SIC) to the North American Industrial Classification (NAICS) may make it difficult to compare R&D in services over time.
- The replacement of Statistics Canada surveys of R&D in smaller firms by information from tax returns collected by Revenue Canada (today "Canada's Customs and Revenu Agency") (Gault, 1997) may lead to underestimation of R&D in many smaller firms which perform R&D but often do not claim R&D tax credits because their their R&D actvities are not organised and acounted according to the dominant manufacturing industry model. Baldwin and Hanel (2003) show that, out of about 65% of manufacturing firms (based on Statistics Canada, 1993 Survey of Innovation and advance Technology in manufacturing which included also very small firms employing less than 20 employees) that conducted some R&D only 16% applied for the tax credit for R&D in the 1989-1991 period. According to the Statistics Canada Survey of Innovation, 1999 which included

only manufacturing firms employing more 20 persons, only about 53% of firms of all size that conducted R&D claimed tax credits; however, only 37% of smaller firms (employing 20 to 49 persons) in low technology sectors did so (Hanel, 2003b).

[47] These findings cover only R&D performed by business enterprises. R&D performed by the federal and provincial governments, universities and colleges and non-profit organisations is not included.

[48] This sector's R&D/sales is 35.4%, probably the highest of all industries in Canada may be a statistical fluke. In comparison in the US the ratio is only 3.5%.

[49] A summary description of the survey and its coverage were handed out to conference participants.

[50] Statistics Canada is about to launch a new Survey of Innovation in services that will fill the gap in our knowledge of innovation in services.

94-01 BILODEAU, Marc et Al SLIVINSKI, ***Toilet Cleaning and Department Chairing: Volunteering a Public Service***.

94-02 ASCAH, Louis, ***Recent Retirement Income System Reform: Employer Plans, Public Plans and Tax Assisted Savings.***

94-03 BILODEAU, M. et Al SLIVINSKI, ***Volunteering Nonprofit Entrepreneurial Services.***

94-04 HANEL, Petr, ***R&D, Inter-Industry and International Spillovers of Technology and the Total Factor Productivity Growth of Manufacturing Industries in Canada, 1974-1989***.

94-05 KALULUMIA, Pene et Denis BOLDUC, ***Generalized Mixed Estimator for Nonlinear Models: A Maximum Likelihood Approach.***

95-01 FORTIN, Mario et Patrice Langevin, ***L'efficacité du marché boursier face à la politique monétaire***.

95-02 HANEL, Petr et Patrice Kayembe YATSHIBI, ***Analyse de la performance à exporter des industries manufacturières du Québec 1988.***

95-03 HANEL, Petr, ***The Czech Republic: Evolution and Structure of Foreign Trade in Industrial Goods in the Transition Period, 1989-1994.***

95-04 KALULUMIA, Pene et Bernard DÉCALUWÉ, ***Surévaluation, ajustement et compétitivité externe : le cas des pays membres de la zone franc CFA.***

95-05 LATULIPPE, Jean-Guy, ***Accès aux marchés des pays en développement***.

96-01 ST-PIERRE, Alain et Petr HANEL, ***Les effets directs et indirects de l'activité de R&D sur la profitabilité de la firme***.

96-02 KALULUMIA, Pene et Alain MBAYA LUKUSA, ***Impact of budget deficits and international capital flows on money demand: Evidence From Cointegration and Error-Correction Model.***

96-03 KALULUMIA, Pene et Pierre YOUROUGOU, ***Money and Income Causality In Developing Economies: A Case Study Of Selected Countries In Sub-Saharan Africa***.

96-04 PARENT, Daniel, ***Survol des contributions théoriques et empiriques liées au capital humain (A Survey of Theoretical and Empirical Contributions to Human Capital)***.

96-05 PARENT, Daniel, ***Matching Human Capital and the Covariance Structure of Earnings***.

96-06 PARENT, Daniel, ***Wages and Mobility : The Impact of Employer-Provided Training***

97-01 PARENT, Daniel, ***Industry-Specific Capital and the Wage Profile : Evidence From the NLSY and the PSID***.

97-02 PARENT, Daniel, ***Methods of Pay and Earnings: A Longitudinal Analysis***.

97-03 PARENT, Daniel, ***Job Characteristics and the Form of Compensation***.

97-04 FORTIN, Mario et Michel BERGERON, Jocelyn DUFORT et Pene KALULUMIA, ***Measuring The Impact of Swaps on the Interest Rate Risk of Financial Intermediaries Using Accounting Data***.

97-05 FORTIN, Mario, André LECLERC et Claude THIVIERGE, ***Testing For Scale and Scope Effects***

in Cooperative Banks: The Case of Les Caisses populaires et d'économie Desjardins.

97-06 HANEL, Petr, ***The Pros and Cons of Central and Eastern Europe Joining the EU***

00-01 MAKDISSI, Paul et Jean-Yves DUCLOS, ***Restricted and Unrestricted Dominance Welfare, Inequality and Poverty Orderings***

00-02 HANEL, Petr, John BALDWIN et David SABOURIN, ***Les déterminants des activités d'innovation dans les entreprises de fabrication canadiennes : le rôle des droits de propriété intellectuelle***

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