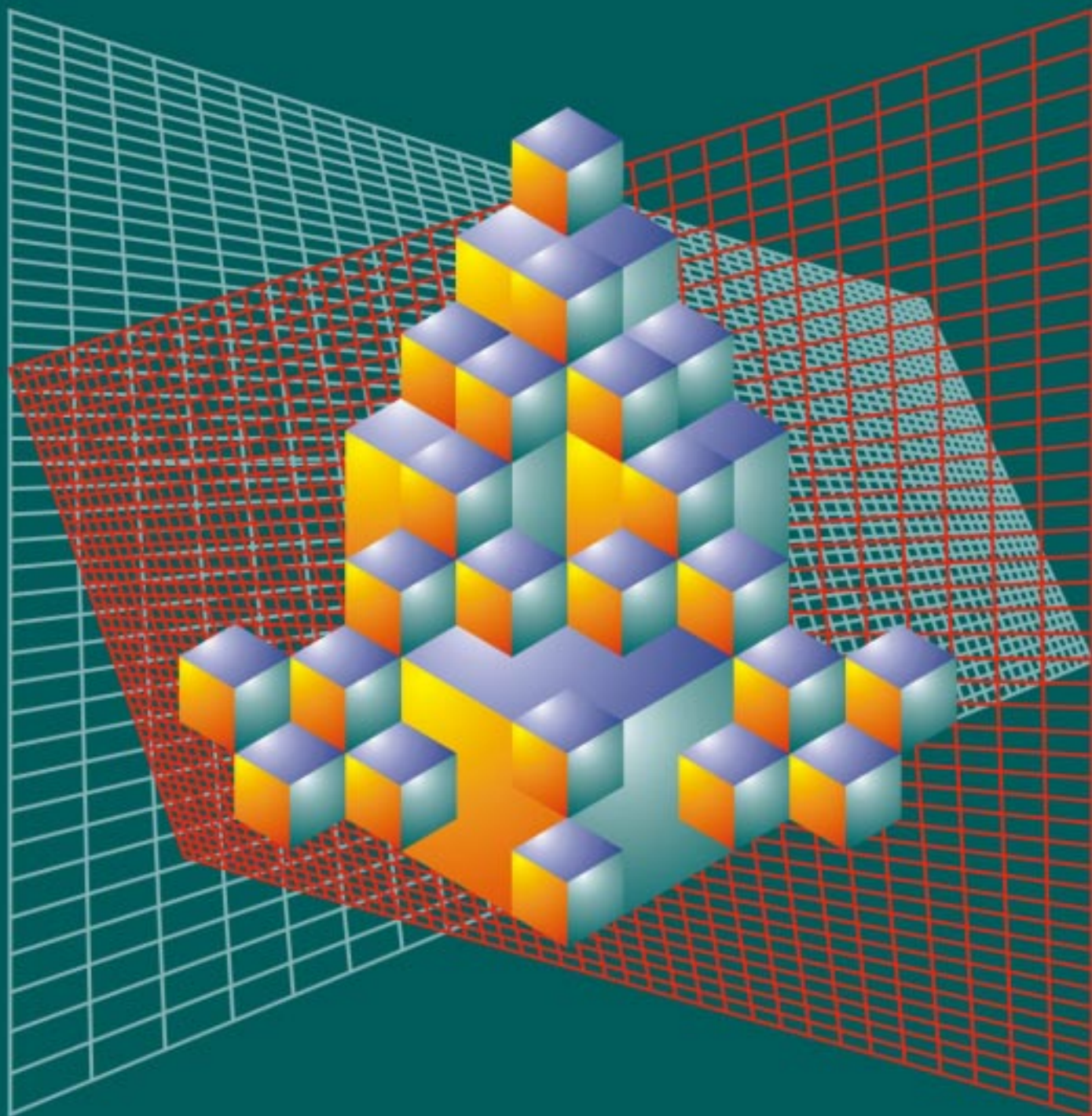




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# Innovation in Dynamic Service Industries



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# Innovation in Dynamic Service Industries

John R. Baldwin, Guy Gellatly, Joanne Johnson, Valerie Peters

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## Preface

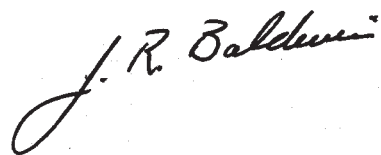
Innovation is at the heart of economic growth and development. It is through innovation that new products are brought to market, new production processes developed and organizational change realized. Given existing cross-industry variations in structure, competitiveness and maturity, it is reasonable to expect that firms in different industries will innovate for different reasons, in different ways and with different results. This report focuses on how the innovation activities of firms in three dynamic service industries are conditioned by their different environments.

Through an understanding of what competitive pressures come into play and how these pressures affect the type of innovation that is performed, *Innovation in Dynamic Service Industries* goes some way in illustrating how innovation regimes differ substantially, and quite logically, from one industry to another.

This is the fifth in the series of publications on innovation and technological change in Canada. One of the earlier studies investigated the type of innovation taking place in the manufacturing sector (Baldwin and Da Pont, *Innovation in Canadian Manufacturing Enterprises*, Catalogue No. 88-513-XPB). Two others focused on advanced manufacturing technologies. The first (Baldwin and Sabourin, *Technology Adoption in Canadian Manufacturing*, Catalogue No. 88-512-XPB) outlined the intensity of use of these technologies. The second (Baldwin, Sabourin, and Rafiquzzaman, *Benefits and Problems Associated with Technology Adoption*, Catalogue No. 88-514-XPE) investigated the determinants of adoption. Another study (Baldwin, *Innovation and Intellectual Property*, Catalogue No. 88-515-XPE) examined how innovative firms protect their intellectual property after they have innovated.

There are several other publications that also focus on the importance of innovation, but concentrate on small- and medium-sized firms and place their innovation activity in the context of other business strategies being pursued. The first (Baldwin, Chandler, Le and Papailiadis, *Strategies for Success: A Profile of Growing Small and Medium-sized Enterprises*, Catalogue No. 61-523R-XPE) provides an overview of the strategies and activities of small- and medium-sized firms that were growing during the last half of the 1980s. It focuses on the differences between faster and slower growing firms and finds that innovation is the key to success. The second (Johnson, Baldwin and Hinchley, *Successful Entrants: Creating the Capacity for Survival and Growth*, Catalogue No. 61-524-XPE) develops a profile of entrants who manage to survive to their teen years and investigates the differences between innovators and non-innovators.

The first set of publications focuses on innovation in the manufacturing sector. The second set covers firms in both manufacturing and services sectors but is restricted to small- and medium-sized firms. This publication is our first to investigate service industries directly.

A handwritten signature in black ink that reads "J. R. Baldwin". The signature is written in a cursive style with a large initial "J" and a distinct "B".

John R. Baldwin  
Director  
Micro-economic Analysis Division  
Statistics Canada





## **Executive Summary**

This report investigates innovation in Canadian service industries. It focuses on organizations in three distinct sectors of the service economy: communications, financial services, and technical business services. Within these industries, the analysis provides a comprehensive overview of the innovation process, ranging from the objectives and sources of innovation, to the market outcomes that result from innovation—its impact on a firm's performance. The report also examines, among other issues, those factors hindering the commercialization of new products, processes and organizational methods. This discussion is set within the context of the competitive environment within which the organization operates and the general business strategies it pursues.

### **The Survey**

The current study is based on data collected from Statistics Canada's *Survey of Innovation, 1996*, conducted in early 1997. Three target industry groups were surveyed. A census was taken of communications firms (excluding postal services), amounting to some 895 firms. A census was taken of banks and trust companies and a near-census was taken of life insurers, totalling approximately 160 firms. A sample of 3,830 establishments was taken of businesses engaged in computer or related services, offices of engineers, or other technical services.

### **The Importance of Services**

These industries are at the heart of the innovation system. All have been undergoing rapid transformation—driven by innovative products, advanced technologies, and increased competition. Regulatory reform affecting the communications and financial services industries has also contributed to a dynamic business climate.

Innovation in these industries is widely felt, often providing the impetus for innovation and change in other sectors of the economy. Advanced computer-based technologies have transformed much of the manufacturing sector and software provided by computer services firms is critical for the workings of these new technologies. Financial services have also felt the effects of computer technology. In turn, new financial products have had profound effects on wealth creation and financial management.

### **Incidence of Innovation**

A substantial portion of the businesses surveyed introduced a new product, process or organizational form in the 1994 to 1996 period. The percentage of respondents who innovated in any of these three ways was 43 percent in technical business services, 45 percent in communications, and 62 percent in financial services.

Product innovation is central to the innovative activity of firms in each of the industry groups with process innovation following in terms of importance. Organizational innovation is least common of the three types of innovation. More complex forms of innovation spanning product lines, production processes and organizational forms are most common in financial services. In large part, this is due to the larger firm size in these industries.

The high incidence of innovation, combined with the preponderance of product innovation, and the fact that these industries provide supporting services to all Canadian businesses, indicates that these industries are both leaders and drivers of innovative activity in Canada.

### ***Competitive Environment and Competitive Strategies***

Several common sources of uncertainty are shared by the industry groups studied. The ability of customers to substitute and the threat of new competitors are important sources of uncertainty in all industries. Marketing and management strategies are universally considered to be the most important.

Nevertheless, substantial differences exist in the incidence of the other causes of uncertainty—in product and technology obsolescence, the importance of sunk costs, and the difficulty in predicting consumer behaviour. In the financial sector, competitive pressures due to the ability of customers to easily switch products and the threat of new competitors, foster an environment where there is intense competition along numerous dimensions. Innovators in this sector are generally the largest. They attribute their success to using their extensive resources to acquire, train and manage their people and market their products.

Communications industries are characterized by a high degree of technological uncertainty due to rapid changes in production technology, and low liquidation values of machinery and equipment. Innovators respond to these demands by placing greater relative emphasis on using high quality suppliers, purchasing technology and seeking and maintaining sources of financing.

Technical business service providers are generally smaller than innovators in the other industries. They face more sources of uncertainty in their environment than do innovators in other industries. They place greater relative emphasis on both satisfying their existing customers as well as targeting new foreign markets. Research and development is more important here than in other industries. In keeping with the wide variety of uncertainties that they face, their business strategy is balanced across many areas. Production and management strategies that emphasize quality, speed and efficiency are crucial here.

### ***Objectives of Innovation***

Firms in all three industries innovate to maintain or increase market share and improve product quality. Opening new markets and extending product range are important secondary objectives in all areas.

As a complement to these market-related objectives, innovative firms pursue production-related objectives to reduce costs and improve production flexibility. There is more variation in the rankings of specific production-related objectives across industries than there is for market-related objectives. This variation reflects, in part, the differences in industry environment.

Financial services innovators, operating in a price-sensitive environment where new competitors are a threat and consumers can easily substitute a competitor's product, tend to be motivated more by the desire to keep production costs down than are innovators in the other two groups.

Innovators operating in the technical business services industries, where markets are global and new, and customer diversification strategies are important are the group most likely to innovate in order to open up foreign markets. This market-related objective is buttressed by related objectives such as improving product quality and production flexibility in the product and production areas.

Communications services innovators tend to give more emphasis to market-related and product-related objectives than they give to production-related objectives, reflecting the fact that they focus more than other industries on buying their technology from others. Communications services industries work to maintain market share through innovations designed to extend product lines and increase product quality. Consistent with the fact that they face rapidly changing production technology and low liquidation values for machinery and equipment, firms in this sector give relatively greater emphasis to using high quality suppliers.

## ***Impacts of Innovation***

Within each of the three groups of innovators, one or another category relating to “quality of service” was found to be the most common of all the impacts of innovation. However, the specific aspect of quality of service that was most affected varied across the groups.

Innovators in financial services focus primarily on flexibility and speed of delivery. This group of innovators has also had success in translating production-related innovation goals into productivity gains for their own employees, an outcome that is essential for success in an intensely price-competitive industry.

Communications services innovators report that their innovation activities are most likely to have affected product/service reliability.

Innovation has had the broadest impact in the technical business service industries. It is in this industry where the largest proportion of innovators report significant impacts of innovation in the greatest number of areas—across reliability, adapting to consumer needs, speed of delivery, user friendliness, and access to services.

## ***Sources of Information***

In keeping with the strong customer orientation of all innovators, customers are deemed to be the most important source of information. The introduction and development of computer-based technologies is a critical complement to innovation in each of these industries, but especially so in financial services. Beyond this finding, however, the value of other sources varies across sectors.

In the financial sector, innovators look to their competitors for ideas. In the communications group, where changing technology poses a serious threat to firms, linkages with suppliers are crucial. Finally, in the technical business services, customization strategies result in an emphasis on both working closely with customers as well as having highly developed research capabilities.

## ***Impediments to Innovation***

High costs prove to be the dominant factor hampering innovation. This result finds support in previous innovation studies undertaken in Germany.

While high costs impede innovation in financial services, innovators in this sector generally face the fewest financial barriers. Among innovators in technical business services, financial restrictions are important obstacles. Similar to technical business services, innovators in communications consistently cite financial factors as important impediments. Impediments related to market and technical risks, however, are less important. Legislation is also a significant obstacle within this industry, reflecting its regulatory environment.

## ***The Importance of Intellectual Property Rights***

The investment in intellectual property required for innovation is protected by legally derived rights like patents, industrial designs, trademarks, trade secrets and copyright.

Generally, fewer than half of the innovators in each industry use any form of intellectual property protection. The primary instruments utilized by innovators in these sectors are copyrights and trademarks. Trade secrets come third in each case.

Across the service sectors, there are considerable variations in usage. Innovators in communications are least likely to use the dominant two instruments. Financial service innovators are heavy users of trademarks. Innovators in the technical business service sector use copyrights most heavily, but trademarks are close behind. In addition, innovators in technical services make some use of patents. Innovators in this sector then are the most diversified when it comes to intellectual property use. They are also more likely to rank a wide range of these instruments as being 'effective' when it comes to protecting their innovation from being copied by others.



## 1. *Introduction*

A study of innovation contributes significantly to our understanding of the economic system. Innovative firms act as conduits through which new ideas are brought to market, thereby increasing the choice of products available to consumers. In this sense, innovation enhances economic well-being. On another level, innovation may improve the performance of the firm, affording it an advantage over competitors. Previous work has shown that firm performance is closely tied to innovation. Innovative firms tend to exhibit greater increases in profitability and market share than do non-innovative firms (Baldwin et al., 1994). Moreover, fast-growing new firms—an important component of many industries—place a greater emphasis on innovative strategies than do their slower-growing counterparts (Baldwin and Johnson, 1999a).

This report investigates innovation in Canadian service industries. It focuses on businesses in three distinct sectors of the service economy: communications, financial services, and technical business services. The analysis examines the intensity of innovation, the competitive environment, firm strategies in general, objectives of innovation, impacts of innovation, sources of innovation, impediments to innovation, and the use of intellectual property rights.

The study focuses first on the intensity of innovation in order to quantify the prevalence of innovation. It then asks whether all firms are innovating, or trying to innovate, with only some succeeding or whether the population is divided into innovators and non-innovators, with the latter group neither trying nor succeeding.

Innovation activity needs to be set in context. This is done first with an examination of the competitive environment that determines the degree of pressure placed on firms to innovate. Then we ask how innovation fits into a firm's overall strategies. Understanding whether the competitive environment is associated with more or less innovation contributes to our understanding of the extent to which competition aids innovation. Investigating whether firms' competitive strategies focus on product differentiation, introducing new products, product quality, flexibility, customer service or customization serves to determine the extent to which innovation is primarily an instrument supporting these strategies. Understanding how these competitive strategies are translated into competencies in the areas of financing, human resources, marketing, management, production and technology allows the importance given to research and development (R&D) to be set in the context of a firm's other capabilities.

Objectives of innovation can be related to market, product, or production characteristics. An investigation of what a firm hopes to achieve through innovation serves to indicate how innovation contributes to a firm's general strategies. It allows us to determine if firms are innovating just to maintain market share or if their aim is to expand into other domestic or foreign markets. It investigates whether innovation is used to improve

product quality or to create new products, and how innovation serves to reduce production costs.

Success can be measured by the extent to which objectives are realized. Analysis of the impacts of innovation demonstrates whether the results of innovation accord with the objectives of innovation, that is, how innovation serves to maintain customers by affecting product reliability, customization, delivery time, or through improving the customer's productivity.

An innovation strategy can be implemented in quite different ways. It may involve a traditional R&D division. It may involve the creation of networks with outsiders. An investigation of the sources of innovation allows us to determine whether service firms rely on research and development, how they network with other firms in the vertical customer/supplier chain, or with competitors.

During the innovation process, firms face serious obstacles that affect the success or failure of innovative efforts. Studying the impediments to innovation provides information on the type of problems innovators face—whether it is just cost factors that matter, or whether there are particular bottlenecks, some of which might be amenable to public policy. Since financing the type of soft assets associated with innovation is often seen to provide an obstacle to innovation, the study asks if firms perceive that they are capital constrained and whether risk is partially at fault. Areas such as lack of skilled labour and legislative and regulatory barriers are examined.

Public policy is perhaps most active in supporting innovation in providing protection for investments in ideas via intellectual property rights. An investigation of how innovators in the service sector use these rights provides an indication of the usefulness of this policy instrument to support innovation.

Such a comprehensive framework, as outlined above, is essential for understanding the dynamics of the innovation process. Far from constituting a singular event, an innovation represents the culmination of numerous decisions taken by the firm, each designed to further its competitive position. Innovation may be motivated by a need to reduce production costs, extend the product range, or gain market position in new sectors. In pursuit of such objectives, the firm must first draw on certain resources, whether internal to the enterprise (e.g., research and development departments) or external to the enterprise (e.g., consultancy firms, partnerships). An innovative firm, in bringing new products to market, or in implementing new production techniques or organizational forms, must also overcome a myriad of factors that may impede the innovation process (e.g., aversion to risk, prohibitive cost conditions). Successfully doing so may lead the firm to realize certain benefits (e.g., productivity gains, expansion into new markets).

Previous studies of the Canadian innovation system have focused on the manufacturing sector. Baldwin and Da Pont (1996) have investigated innovation within manufacturing firms based on Statistics Canada's *1993 Survey of Innovation and Advanced Technology*. Drawing on this survey, Baldwin (1997a) has demonstrated that substantial differences in

innovative strategies exist among manufacturing firms, and that innovation is not the exclusive domain of large businesses. Baldwin, Hanel and Sabourin (1998) have found that innovation in manufacturing firms is related not only to their propensity to engage in research and development but also to the emphasis they place on technology and marketing. Recent work in other countries has focused on innovation in the service sector (Licht et al., 1995; Evangelista and Sirilli, 1997). The current study extends the analysis of innovation in services to the Canadian context by focusing on select high-performance service industries.

Innovators in the service sector may have quite different characteristics from innovators in manufacturing because inherent differences in the two sectors are likely to have an impact on the innovation process adopted by each.

### ***Service and Goods Producing Industries: Across Time and Space***

How do goods and services differ? They differ in the extent to which customized products that take into account a variety of customer preferences are offered to consumers. By their very nature, most manufacturing industries provide relatively homogeneous products compared to those produced by service industries. For example, flour is a homogeneous product milled by the flour milling industry. But pancakes that use flour are provided by the restaurant service industry in ways that tailor the product to different consumer tastes. The service sector offers pancakes at different locations (pancake houses, crepe restaurants, local restaurants) and at different times (in the morning, for Sunday brunches, in the evening).

This example illustrates the point that physically identical commodities delivered at different points in space or time are in fact different commodities because consumers will pay different amounts for them. Take, for example, the production of automobile services. Here manufacturers provide a somewhat more heterogeneous product than does the flour milling industry—but the service industry that rents automobiles provides even more differentiated products—autos by destination, for short-term or intermediate term lease, with varying limits on mileage, on weekdays or weekends, for business or pleasure.

Service industries provide differentiation in time and space to satisfy the large variety of consumer tastes. Differentiation in space is accommodated by moving a commodity between two points—by transportation which is a service industry. Differentiation in time is accomplished by storing a non-perishable commodity—through the use of storage facilities, which is a service industry. Two other service industries—retailing and wholesaling—provide spatial service to consumers by both storing and moving commodities to geographically convenient locations. Service industries tend then to offer substantial differentiation to the consumer in the sense that they tailor delivery across both time and space dimensions.

The three industries studied here accomplish this differentiation in various ways.

Communications carriers provide information and entertainment differentiated by space in the sense that they connect two different locations. The permutation of products then depends basically on the number of geographic locations served. Traditional

telecommunications carriers using fixed wires differentiate local and long-distance service but are restricted to fixed locations where the wires are connected. More recently, the advent of wireless systems has given customers more flexibility regarding where they can access service—thus differentiating service further along the lines of geographic location.

Broadcasters also cater to different tastes in both geographic and time dimensions. Television allows consumers to enjoy visual entertainment in their homes rather than in just theatres and cinemas, which require costly and timely relocation for some consumers. Radio broadcasters differentiate products to meet a wide range in consumer tastes—music that varies from classical to rock, and information that varies from news to talk shows. Broadcasters also compete with regards to the time the product is delivered in trying to satisfy consumer preferences concerning the time they have available for recreation.

Of course, crafting products that suit specific, individualized needs is also an important method of meeting differentiated consumer tastes in the service sector. The telecommunications industry provides a variety of products: 1-800 and 1-888 service, facsimiles, debit and calling cards, cellular paging, other mobile radio services, data transmission, voice mail, call waiting, teleconferencing, and video conferencing. Customers see the primary benefits of competition in telecommunications products as facilitating their own responsiveness to their customers' demands (Mozes and Sciadas, 1995).

Business service firms also provide time, space and other customer-specific services. By definition, these service firms provide inputs into other businesses and tend to customize products to suit specific needs. The technical business service firms investigated here consist of computer services, computer equipment servicing firms, engineering and other scientific and technical service firms. Each of these provides services essentially tailored to the specific requirements of customers. While there are some companies providing standard software packages that are retailed in the same package to all customers, the majority of business service firms provide unique products to businesses or adapt software packages to the special requirements of businesses. The differentiation is location-specific in the sense that it varies business by business.

The banking component of financial services competes in two dimensions—both the input (supply of funds) and the output (lending) side—with products that are differentiated in terms of space and time. It was once the case that customers were primarily restricted to using their home bank branch. This has changed dramatically in recent years as the entire geographic network of a bank is more accessible to customers as a result of electronic and computer innovations. In addition, time differentiation has occurred both as a result of automatic teller machines and electronic banking.

Life insurance firms also provide product differentiation along two main lines. These insurance firms provide two services—an insurance component and a savings or financial intermediation component—to customers. Whole life policies are long-term insurance contracts involving a substantial intermediation component. Customers agree to a long-term contract that allows the insurance firm to invest the premiums paid and offer the insurance contract at a fixed price over a long term. In contrast, term contracts do not have a fixed price and



have less of an intermediation component. Because there is less of an investment, the price of the term insurance policy escalates with age more quickly than does the price of a whole life policy. Thus, contracts differ depending upon the degree of intermediation desired by a customer. Over the last twenty years, the mix of policies has shifted away from intermediation—whole life—towards term life. Competition for the savings component offered by insurance firms has come from several sources—one of which is mutual funds. As consumers have become more sophisticated about their savings options generally, life insurance companies have developed new products that compete with alternatives outside their narrowly defined industry—one of which is annuity products to serve the growing class of retired individuals.

Thus, the very nature of the service sector facilitates more innovation than might be expected elsewhere because of the numerous time and space dimensions that come with any service product. For example, while an automobile can be offered in numerous shapes and sizes, auto rental service firms start with these variations in products and then build options on top of them. Even when the product is not a good that is differentiated in terms of time or space, the service itself has many possible permutations that can be offered without undue cost disadvantages. Thus, innovation possibilities are probably considerably greater in the service sector than in the manufacturing sector.

There are other reasons having to do with the production process and process technology that suggest that innovation regimes in services may be expected to differ from those in manufacturing. The latest technological revolution involves the micro-electronic chip and the computer. In manufacturing, the microchip has had an impact since the new technologies have been introduced via new machines with these chips imbedded in them (Baldwin and Sabourin, 1995). However, the diffusion rates have been slow. The microchip has had a more direct effect in the service sector where the diffusion rate of computers has been rapid. Computers have been applied directly to the production process in ways that have greatly increased productivity.

One of the differences between service industries and manufacturing industries involves the perishability or storability of the commodity. Many services cannot be stored. An airplane seat not filled for a flight in February cannot be stored for use on another flight in July. Matching demand to supply is therefore more important here than elsewhere. Computers have facilitated this. Airlines with sophisticated reservations systems and modeling have increased their load factor—the percentage of seats on flights which are actually sold. Computers have allowed the linkage of banks to facilitate transactions. Telephone companies have moved from relying on mechanical devices to being computer-based operations. Innovation in computer-driven process technologies in the service sector has dramatically reduced costs over the last two decades.

It is also the case that the complementarity between process innovation and skilled labour may be different in services than in manufacturing. Baldwin and Johnson (1996a) find that innovators generally place greater emphasis on recruiting skilled labour and training workers. In manufacturing, this often goes hand in hand with the acquisition of new equipment. In services, skilled labour alone is often key to the innovation strategy because the main input is labour.

Therefore, whether we consider the demand or the production side of manufacturing and services, innovators may very well have quite different profiles in the two sectors. For this reason, a specific examination of services is warranted.

## ***Dynamic Service Industries***

The three service industries chosen for this study—communications, financial services, and technical business services—all possess a common characteristic. Each is an example of a dynamic service industry. Firms within these industries often share many characteristics: they are innovative; they are knowledge-intensive; they compete within a volatile marketplace; and they provide services utilized extensively in other sectors.

While the industries examined here resemble one another in that they are each dynamic and innovative, they differ in terms of average firm size. Firms in technical business services tend to be the smallest and those in financial services the largest. Over 85% of technical business services firms have less than 20 employees, while only 2% have over 500. On the other hand, less than 20% of financial institutions have fewer than 20 employees while 16% have more than 500. The population of communications firms resembles technical business service firms more than financial firms—primarily because of the large number of small broadcasters.<sup>1</sup>

On the whole, business service firms are small. In 1994, there were over 8,000 computer service firms and 14,000 architectural, engineering, and other scientific and technical service firms. Over 90% of firms in these categories had revenues of less than 2 million dollars in 1991, though less than 5% of firms had over 70% of total revenues. Entry and exit rates in this industry are high. Growth in computer services has been higher than in the economy as a whole—as it has in architectural, engineering and technical services.<sup>2</sup> These industries are much more R&D intensive than most other industries. The ratio of R&D to GDP in business services is about 4% compared to the average of 1% for all R&D performers in the business sector. Over 90% of total business service R&D expenditures are performed in computer and engineering services.

In the telecommunications industry, there are fewer players.<sup>3</sup> The largest firms are the telecom wired carriers—with over \$14 billion in annual revenue. Next are the wireless and cable television carriers with between \$2 and 3 billion of revenue. While local market services are tightly regulated, competition in the long-distance market has increased as the regulatory environment has allowed competition from both facilities-based carriers and resellers. Resellers lease the use of trunk lines at bulk discount rates and then retail them. The latter had captured about 10% of the long-distance market by 1994 (Mozes and Sciadas, 1995). About half of all firms use one of the new competitors. Competition also occurs when customers become their own suppliers. About 15% of firms have their own private communications networks.

<sup>1</sup> The respondent to the survey for communications was the Canadian Radio-television and Telecommunications Commission (CRTC) licensee.

<sup>2</sup> For a description of the business service sector, see Sciadas (1994).

<sup>3</sup> For a description of the telecommunications sector, see Mozes and Sciadas (1995).

The other major communications sector covered here is radio and television broadcasting. Television has essentially two national networks with a third emerging, serving a variety of markets that differ by location across the country. At one time, local markets faced little competition. The advent of cable television has changed this and fragmented markets. Initially, cable dramatically increased competition for the national chains by bringing in US channels. More recently, competition for viewer audiences has come from the development of specialty channels—that further serve to satisfy a diversity of consumer tastes. Cable is now facing competition from satellite transmission. As a result of this competition, consumers who only recently were restricted to less than a handful of channels can now access well over 100 channels in many cases.

Radio broadcasting is the most fragmented sector of the communications industries studied here, with a large number of stations spread across the country serving separate geographic markets. As of 1998, there were 147 companies owning about 500 stations. Two companies owned 44 of these. The Canadian Radio-television and Telecommunications Commission not only regulates content, but also ownership structure. Until recently, firms were not allowed to own more than one station in a geographic area.

The financial sector is highly concentrated.<sup>4</sup> There are only a handful of large domestic banks. Consolidation has been occurring as banks acquire trust companies and securities dealers. Retail banking services offer chequing and cash services differentiated in terms of geographic location. Here the regulatory environment has recently allowed banks to expand into a number of new markets—first with the right to own securities dealers, then with the right to enter the trust business. Regulations concerning foreign banks have also changed, allowing for their entry into the Canadian marketplace. Banks have also been increasingly active as distributors of mutual funds. Despite this, retail banking—deposit taking, chequing, personal loans—continues to account for the majority of revenue—over 80%. Services to corporate customers accounted for a modest 10% of revenues. New services like treasury and investment banking account for 7%, while electronic financial services account for 3%.

Because of these differences in size, competitive environment, and the essential differences in the products supplied to customers across these service industries, we might expect to find differences in their innovation processes. For this reason, we treat each of these industries separately in the report.

## **The Report**

The analysis is organized as follows. Section 2 reviews the evidence of dynamism within each of the target industries. Several characteristics relating to innovation and competition are discussed, as is the role that communications, financial service, and technical business service innovations play in supporting innovative behaviour in other sectors. The relation between innovation and knowledge is also examined, focusing on labour income within these industries.

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<sup>4</sup> The financial sector is described in Harchaoui (1997).

Section 3 outlines the survey that forms the basis for the current analysis. Topics of discussion include the questionnaire design, survey response patterns and imputation and weighting.

Section 4, comprised of several parts, investigates the innovation process by reviewing the findings of the survey. The incidence of innovation within each of these industries is examined first. Distinctions based on size and innovation type (e.g., product innovation versus process innovation) are emphasized. Pursuant to this, the competitive environment within each of the target industries is examined. Several basic issues are explored, including the nature and intensity of competition, as well as the importance of various business strategies. For this and all subsequent topics, the analysis focuses solely on innovators—those that introduce a new product, process or organizational method.

The study then moves to consider the objectives of innovation. Various categories of objectives are examined, including market-related objectives, product-related objectives, and production-related objectives. The impacts of innovation—quality of service, productivity, and product or market expansion—are then investigated.

This is followed by a discussion of the sources of information used in developing innovations, and the importance of computer-based technologies in the innovative process. The sources include internal sources, such as management and in-house R&D, and external sources, such as competitors or suppliers, and other sources of information, such as education and research institutions. The focus then shifts to the roles played by various factors in hindering innovation activity. The factors examined here include financial (or cost-related) impediments, aspects of market or technical risk, as well as some that are more idiosyncratic in nature (e.g., labour skills). Finally, the use that is made of intellectual property rights is examined.

Section 5 summarizes the central findings of the study.

Section 6 contains an appendix of statistical tables. These tables contain the survey questions used in the report, along with tabulations of the answers. Measures of statistical reliability are also included.



## 2. The Importance of Dynamic Services

*Communications, technical business services and financial services are at the heart of the innovation system. All have been undergoing rapid transformation driven by innovative products, advanced technologies, and increased competition. Innovation in these industries is important since its impact is widely felt—often providing the impetus for innovation and change in other sectors of the economy.*

Service-providing industries have come to dominate the Canadian economic landscape. In 1996, service industries accounted for 75% of total employment, an increase of 8% over the preceding two decades (Heisz and Côté, 1998).<sup>5</sup> More importantly, from 1978 to 1986, service-providing firms accounted for 93% of net job growth, evidence of their increasing importance vis-à-vis goods-producing industries in creating jobs (Economic Council of Canada, 1991). Taken together, service-based activities now account for over two thirds of Gross Domestic Product (Services Indicators, 1998).

A comprehensive review of the service sector, conducted in 1991 by the Economic Council of Canada (ECC), classifies service industries into three distinct subsectors: dynamic services, traditional services, and non-market services. Dynamic services share, in varying degrees, an emphasis on advanced technology, an international orientation, and a critical role in supporting the production and distribution activities of other sectors. Dynamic services also tend to be high value-added and knowledge-intensive. Traditional services, though certainly not immune from technological change or competitive restructuring, generally have lower-value added, and are less exposed to foreign competition. Finally, non-market services refer to those not traditionally driven by market forces (i.e., health, education, social services and public administration). The current study focuses on specific target groups—communications, financial services and technical business services—within these dynamic service industries.

As the ECC taxonomy suggests, evidence of dynamism within these industries abounds. In the first instance, dynamic industries are often highly innovative. Many firms within these industries stress the development of new products. Others stress the integration of advanced technologies into their production process. Studies of the innovation process in other countries generally support such a characterization. For example, a recent analysis of German service industries found that the banking and insurance industries were highly innovative relative to other sectors. The same is true of the software and technical service industries in West Germany (Licht et al., 1995; Hipp et al., 1995). A study of innovation in Italian industries found that the telecommunications, computing and software, engineering, and financial sectors were the most innovative in terms of the financial resources devoted to the innovation process (Evangelista and Sirilli, 1997). This emphasis on innovation within technical service industries was also found in a study of small- and medium-sized enterprises in the United Kingdom (Cosh et al., 1996).

<sup>5</sup> This is comparable to British and American employment shares for service industries. On the former, see Bryson (1997); on the latter, see Waldstein (1989).

A central characteristic of a dynamic industry is rapid change. Innovation and competition are at the heart of this change. All the target industries provide examples of dynamic change. Consider first communications industries. Firms within these industries are at the forefront of managing and integrating advanced technologies. In recent years, the mass commercialization of new carrier technologies (e.g., wireless service) has served to increase competitive pressures within the industry. These developments have coincided with the gradual liberalization of regulatory policies designed to further encourage competition (Industry Canada, 1997). Similar trends are evident for the broadcasting industry. The advent of pay-TV and specialty channels, along with the introduction of new products, such as infomercials, attest to an increasingly dynamic marketplace, one where the influence of foreign competitors is considerable (Gorman and Crompton, 1997).

Firms in technical business services industries are also at the forefront of the new technology-based revolution that has transformed much of the industrial sector. These firms are a vital part of the new industrial revolution dependent on the microchip. Software is the means of telling computers what to do. The growth of advanced technologies that rely upon the computer chip has created a need to develop software to integrate these technologies into the production processes of the firm (Baldwin, Sabourin and Rafiquzzaman, 1996). This has precipitated a rapid growth in computer services. Similar evolutions have occurred within other scientific and technical services fields.

Innovation and competition have greatly transformed the financial services sector. Electronic technologies have dramatically changed everything from production processes to the offering of new products like automated teller machines. The development of new instruments has brought about an increase in the scope and complexity of financial transactions while providing consumers with increased choice. These developments have coincided with a relaxation of regulatory constraints, and concomitant increases in competition. Chartered banks and trust companies now face sharp competition from foreign subsidiaries. Life insurance companies must compete with other institutions for long-term savings (Harchaoui, 1997). Increased competition, in turn, has led to further innovation, leading companies to adopt alternative product strategies (such as, for life insurance firms, an increased emphasis on term-based instruments) or service strategies (such as tele-banking or internet-based banking).

One key dimension of innovation within communications, financial services, and technical business services contributes fundamentally to their central role in the innovation process. Innovations generated within these industries are broadly disseminated throughout the economy—that is, they are widely utilized in other sectors. Consequently, innovations originating in communications, technical business services and financial services often serve as drivers for innovation and change in other industries.

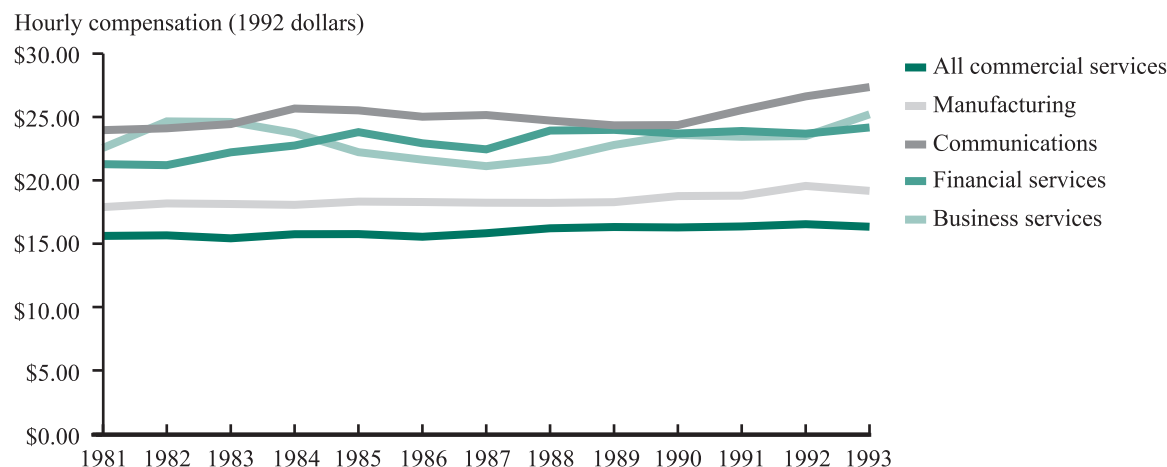
This technological diffusion is particularly important in the manufacturing sector. A study of advanced technology use found that communications technologies—including, among others, local area networks and inter-company computer networks—are extensively used in Canadian manufacturing establishments (Baldwin and Sabourin, 1995). The adoption of advanced communications technologies, in turn, has been associated with superior

performance among manufacturing firms. Firms using these computer-based technologies exhibit, on average, greater increases in market share, wages, productivity and employment than do non-using firms (Baldwin, Diverty and Sabourin, 1995). These advanced manufacturing technologies depend on software produced by firms in the computer services industries.

As with communications, innovation in financial service industries has broad economic consequences, both for consumers and business. Financial service innovation may lead to new means of wealth generation (e.g., derivatives) or result in more effective methods of service-delivery (e.g., electronic commerce). In addition, access to financing plays a central role in conditioning innovative behaviour. A recent study, focusing on growing small- and medium-sized enterprises, has shown “that more-innovative firms place a greater emphasis on financing issues than less-innovative firms” (Baldwin and Johnson, 1996a).

Innovation depends on knowledge, which in turn arises from the skills embodied in the workforce. Baldwin and Johnson (1996a) have found that innovative firms differ from non-innovative firms in that they place much greater stress on various aspects of skill development. This is especially true of the service sector where the innovation strategy focuses primarily on developing the human capital embodied in a firm. A greater knowledge base, in turn, will be reflected in higher wage rates. Figure 2.1 shows real hourly compensation over the 1981-93 period for the sectors under study, and for all commercial services and manufacturing.<sup>6</sup>

**Figure 2.1: Average Hourly Compensation, 1981 to 1993 (1992 dollars)<sup>6</sup>**



<sup>6</sup> Limits on the degree of industry detail require that several of these estimates be presented for a more highly aggregated level than is used for the rest of the report. In addition to chartered banks, trust companies and life insurers, data for financial service industries include data on deposit accepting mortgage companies, other deposit accepting or banking-type intermediaries, as well as other types of insurers (deposit and property & casualty). In addition to the above-noted business service industries, estimates also include data on architectural firms.

The real wage in communications, financial services and technical business services is considerably higher than the average for commercial service industries. Wage rates in target industries are also significantly higher than in manufacturing. Sharp increases in these rates are evident in recent years. Growth rates in hourly compensation and employment, calculated for the entire 1981-93 period, are reported in Table 2.1.

Whether measured on a cumulative or annual basis, wage gains in the communications, financial services, and technical business services have outpaced the industry averages for manufacturing and commercial services. Real wage growth in communications was twice that of the manufacturing sector. Gains in financial services and technical business services were also significant.

Moreover, in two of these three industry groups, wage gains coincided with a period of rapid employment growth. The number of jobs in financial services increased by roughly 20% over the 1981-93 period. Those in technical business services increased by 50%. Consequently, wage gains are not simply due to the substitution of capital for labour. Wage gains, in concert with employment gains, are reflective of an increasingly knowledge- and human-resource-intensive business climate.

**Table 2.1: Growth in Hourly Compensation and Employment, 1981 to 1993 (1992 dollars)**

	Percentage increase in hourly compensation	Annual average <sup>†</sup>	Percentage increase in employment	Annual average <sup>†</sup>
Communications	14.15	1.11	-1.39	-0.11
Financial services	13.55	1.06	19.29	1.48
Technical business services	11.72	0.93	50.14	3.44
All commercial services	4.57	0.37	28.63	2.12
Manufacturing	7.18	0.57	-12.34	-1.09

<sup>†</sup>Calculated as the geometric mean.





### 3. **Survey Strategy**

The current study is based on data collected from Statistics Canada's *Survey of Innovation, 1996*, conducted in early 1997. The survey focused on businesses in three service industries: communications, financial services, and technical business services. Data were collected on a wide range of topics. Several questions were posed concerning the innovation activities of the organization, including: the incidence of innovation, the competitive environment in which innovators operate, the objectives and impacts of innovation, the sources of information used in developing innovations, and the impediments to innovation.

In addition to these general questions pertaining to the innovative stance of the firm, questions were posed concerning the most important innovation. The survey also collected data on a range of other issues, including: Internet use and electronic commerce, expenditures on innovation, organizational structures relating to innovation activities, research and development, and the use of intellectual property. The questions on the survey referred to business activities over the 1994 to 1996 period. This report, being the first resulting from the survey, is directed at providing a broad overview of innovation in the service sector. As such, it focuses on the incidence of innovation; the objectives, impacts, sources of, and impediments to innovation; the use of intellectual property; as well as the general competitive environment that innovators operate in, and the business strategies they pursue.

All data presented refer to the 1994 to 1996 period unless otherwise indicated.

While Statistics Canada had previously collected information on innovation in the manufacturing sector, the *Survey of Innovation, 1996* represents the agency's first attempt at collecting data on innovation from businesses in service-providing industries.

#### **Target Industries**

Three broad industry groups were targeted for the survey. The *communications* industries include telecommunication carriers, radio broadcasters, television broadcasters, cable companies, combined radio and television broadcasters, and other telecommunication industries (see Table 3.1.1). The *financial services* industries are comprised of 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. Their classification here as '*technical*' is purely *arbitrary* and is intended only to distinguish them from the larger group of Business Service Industries which also includes industries such as employment agencies, advertising, architects, lawyers, and management consultants.

**Table 3.1.1: Target Industry Groups and Sub-groups**

Industry Group	SIC	Industry
Communications	4811	Radio Broadcasting
	4812	Television Broadcasting
	4813	Combined Radio and Television Broadcasting
	4814	Cable Television
	4821	Telecommunication Carriers
	4839	Other Telecommunication Carriers
Financial services	7021	Chartered Banks
	7031	Trust Companies
	7311	Life Insurers
Technical business services	7721	Computer Services
	7722	Computer Equipment Maintenance and Repair
	7752	Offices of Engineers
	7759	Other Scientific and Technical Services

### **The Frame**

The frames for each of the industry groups were drawn from three distinct sources. For the communications industries, a census was taken of all business organizations licensed to operate in Canada by the Canadian Radio-television and Telecommunications Commission (CRTC). For financial services, a list of chartered banks, trust companies and life insurers, based on the survey strategy developed by Statistics Canada's Industrial Organization and Finance Division, was used. This consisted of a census of banks and trust companies and a near-census of life insurers (a small sample was drawn of some of the smaller units). For technical business services industries, a sample was drawn from Statistics Canada's Business Register, which is a comprehensive database of all businesses in Canada. For the first two industry groups, the survey was conducted at the firm level. For the latter group, the survey was conducted at the establishment level.

### **Collection**

The survey was conducted in three stages. Initial contact with some larger companies confirmed the name of the person who would receive and complete the questionnaire. This was followed by a mail-out of the questionnaire to survey respondents. Finally, interviewers conducted follow-up telephone interviews with respondents who had returned incomplete questionnaires or who had not responded to the mailed out questionnaire. The majority of responses to the survey were collected through telephone interviews.

### **Response Rates**

Table 3.1.2 presents the population, sample and respondent counts. With response rates between 84% and 89%, non-response bias was minor.

**Table 3.1.2: Population, Sample and Respondent Counts**

	Population	Sample	# of completed responses	Response rate (%)
Communications	895	895	755	84
Financial services	168	160	143	89
Technical business services	21,053	3,830	3,363	88

### ***Imputation and Weighting***

Response rates on a question-by-question basis were generally between 95% and 100%. In light of this, imputation for missing data (the process of assigning a response to a question left unanswered) was not extensively required. However, the importance of having data on firm size, as measured by employment, necessitated imputing data for a small number of cases where information on firm size was not provided. The value imputed was based on a variety of factors known to be related to employment size, including industry, revenue, and innovation status.

Responses were weighted to reflect the average respondent within that population. Within technical business services and financial services, responses were weighted to reflect both the sampling strategy and non-response. Within the communications sector, only the latter correction was necessary, given that a census was taken.





## 4. Survey Findings

### 4.1. Incidence of Innovation

*Innovation is extensive in the dynamic service sector. A substantial portion of the businesses surveyed introduced a new product, process or organizational form in the 1994 to 1996 period. The percentage of respondents who innovated in any of these three ways was 43 percent in technical business services, 45 percent in communications, and 62 percent in financial services. Product innovation is central to the innovative activity of firms in each of the industry groups with process innovation following closely behind in terms of importance.*

One of the primary reasons for surveying these specific service industries is the finding that they are typically more innovative than other service industries. Surveys in the UK, Italy, and Germany have found that firms in these industries were substantially more likely to innovate than firms in other industries (Cosh et al., 1996; Evangelista and Sirilli, 1997; and Hipp, 1995).

In order to investigate the prevalence of innovative activity within these industries, respondents were asked to indicate whether they had introduced new or improved products, new or improved processes or significant improvements in organizational structures or internal business routines.<sup>7</sup> The term innovation is generally intended to exclude aesthetic changes that do not affect the construction or performance of the product. 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 organizational innovation is increased computerization. Respondents were asked to indicate whether they experienced difficulty in distinguishing between product and process innovations and process and organizational innovations. Such difficulties were rare.<sup>8</sup>

Innovation is a key factor in the competitive strategy of the service industries studied, evidenced by the extent to which respondents indicated that their organizations have introduced new innovations. 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 organization (62% of respondents), followed by communications (45% of respondents), and technical business services (43% of respondents). It is worthwhile noting that these innovation rates exceed the innovation rate observed in

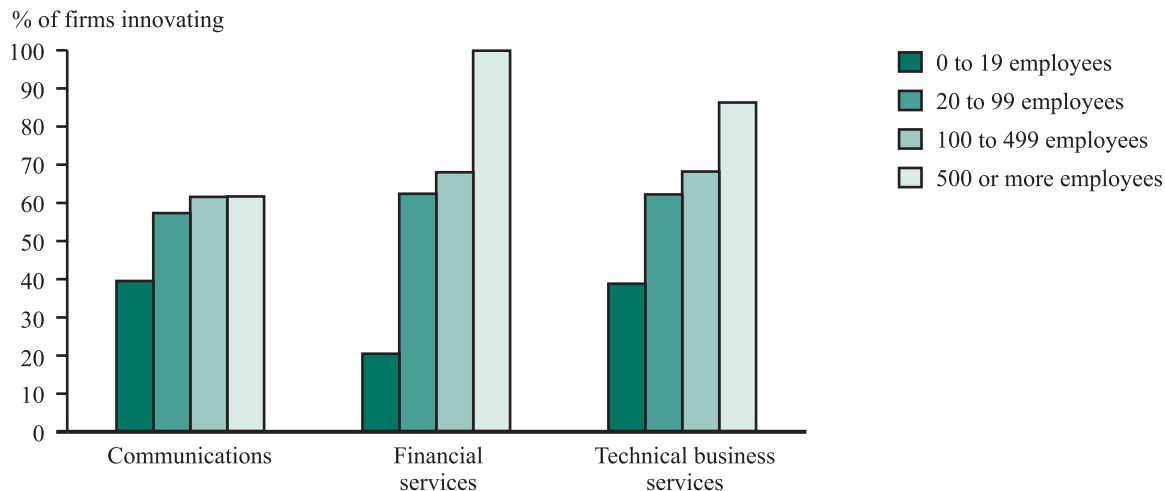
<sup>7</sup> This follows the guidelines in the OECD/EU Oslo Manual (1992).

<sup>8</sup> Concerns have been raised, in response to past surveys, regarding the ability of firms to distinguish various types of innovation. For example, in a survey of service firms in Italy, 34% reported that they had difficulty distinguishing between types of innovation (Evangelista and Sirilli, 1997). Only a small percentage of respondents to the Canadian survey reported such difficulty. Between 9% and 14% of innovators experienced difficulty distinguishing between product and process innovations, while between 8% and 14% experienced difficulty distinguishing between process and organizational innovations.

Canadian manufacturing, where 36% of firms either introduced an innovation in the 1989-91 period or were in the process of introducing an innovation in the 1992-93 period (Baldwin and Da Pont, 1996). They are, however, in the same range as the more innovative manufacturing industries—electrical and electronic products, pharmaceuticals, chemicals and machinery.

Within these three broad service-sector groups, variance in the rates of innovation is observed at the more detailed industry level. For example, within the communications category, telecommunications firms were more than twice as likely to innovate (85%) than radio, television and cable firms (37% to 45%). Within the financial sector, life insurers were generally the most likely to innovate (71%) while banks and trust companies were less likely to innovate (50%). Innovation was more common in computer services (51%) than in other technical business services (37% of respondents in engineering services innovated, and 35% of respondents in other scientific and technical services innovated).

**Figure 4.1.1: Innovation Rates by Firm Size\***



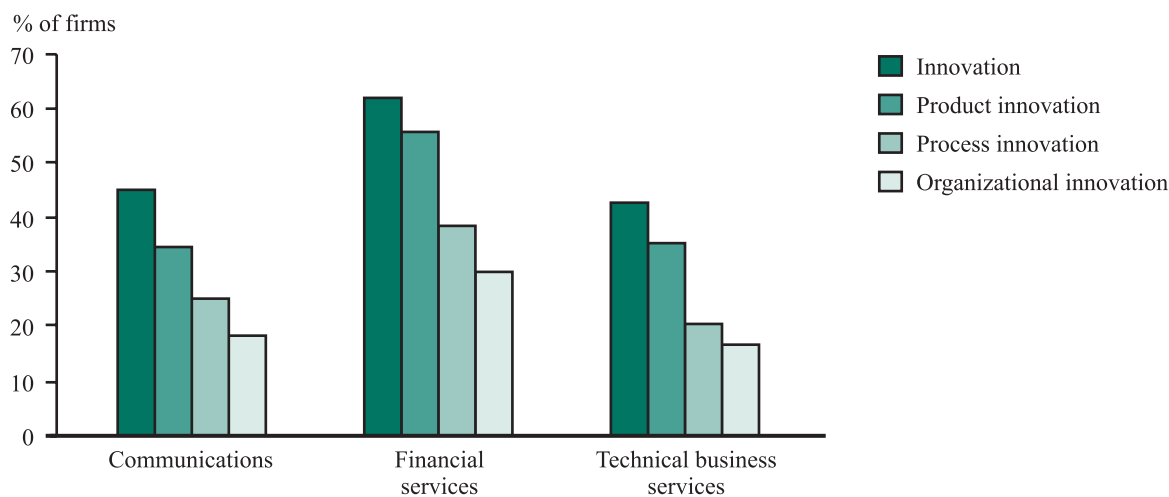
\*Note: In technical business services, the percentage reported corresponds to the percentage of establishments belonging to firms of the given size range.

It is worth noting that much of the difference in innovation rates is associated with differences in firm size distributions within the three groups. The tendency for larger firms to be more likely to innovate than smaller firms is well documented (Baldwin et al., 1994; Evangelista and Sirilli, 1997; Cosh et al., 1996; Licht et al., 1995; and Baldwin, 1997a). Indeed, the innovation rates, by firm size, as depicted in Figure 4.1.1, are similar across the three groups. The greatest differences occur for the largest size class, which by definition is open ended and is not perfectly comparable across sectors. The financial services firms in this class are generally larger than communications and technical business services firms.

The specific form of the innovative activity was relatively consistent across industries. Product innovation was most common, followed by process innovation (Figure 4.1.2). Organizational innovations were cited least frequently but were still important.

The preponderance of product innovation over process innovation is worth noting. Robson et al. (1988), in a study of goods-producing industries, have argued that some industries are more innovative than others. Moreover, the highly innovative industries introduce product innovations that are sold to other industries, where their use translates into a process innovation. The dynamic service industries studied here produce innovations that are consumed elsewhere in the economy. The high product innovation rates in these industries show that these industries follow the type of pattern found by Robson in the goods sector and, hence, play a key role in disseminating innovation.

**Figure 4.1.2: Proportion of Firms\* Introducing Innovations**



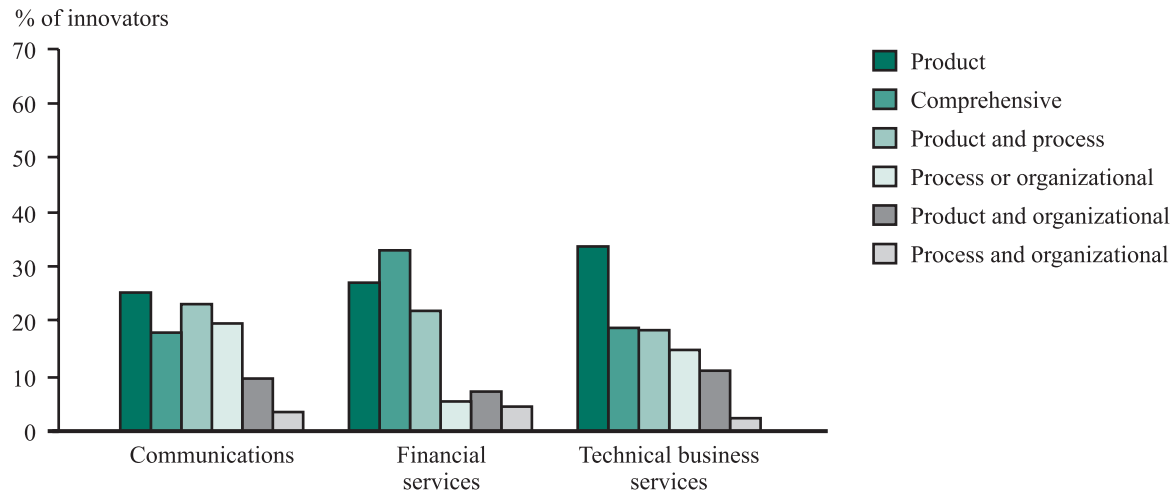
\*Note: In technical business services, the percentage reported corresponds to the percentage of establishments belonging to firms of the given size range.

This pattern also shows that service industries are not simply absorbers of innovations produced elsewhere. A study of German service firms found that innovation among firms in these industries primarily involved using product innovations of manufacturing firms. Hence, innovative German service firms were substantially more likely to be engaged in process innovation than product innovation (Licht et al., 1995). Conversely, product innovation was much more common than was process innovation in service firms in the UK (Cosh et al., 1996).

Many innovators 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 organizational innovation), and product and process innovators (Figure 4.1.3). In both technical and communication services, product-only innovation was most common. Conversely, comprehensive innovation—involving all types of innovation—was most common in financial services.

The high incidence of comprehensive innovation in the financial sector is consistent with the finding that financial services are typically the largest and most innovative and, hence, may be expected to be engaged in the most complex organization of innovative activities. Baldwin and Johnson (1998) demonstrate that comprehensive innovation is the most

**Figure 4.1.3: Distribution of Innovator Types**



complex in that it is accompanied by a greater emphasis on almost all other competencies—marketing, finance, technology and management.

While previous work (Baldwin and Johnson, 1996a) has shown that innovation is associated with stronger performance in general, innovation is not without risk. Respondents who reported that they had undertaken innovation projects that had not resulted in a new product or process were asked why this had happened (i.e. whether the activity was ongoing or abandoned). More than one out of four projects were abandoned (Table 4.1.1).

Information on the percentage of firms innovating only tells us something about the success rate—not the extent to which firms are attempting to innovate. It is important to note that the group of firms reporting that they had introduced one innovation was basically the same group as those reporting that they had innovation programs that were ongoing but not yet successful or had been abandoned. Thus, the population divides itself into two groups—firms that have innovated successfully and are working, or have worked, on other innovations versus those that have not innovated and do not have ongoing innovation programs.

**Table 4.1.1: Innovative Activity Undertaken But Not Introduced\***

	Communications	Financial services	Technical business services
	% of firms		
Innovation activity undertaken, but not introduced, 1994-1996	11	21	19
	% of firms not introducing		
Innovation was not introduced because the activity was ongoing	86	84	81
Innovation was not introduced because the activity was abandoned	24	35	33

\* totals do not add to 100% because of multiple responses, i.e. both ongoing and abandoned.

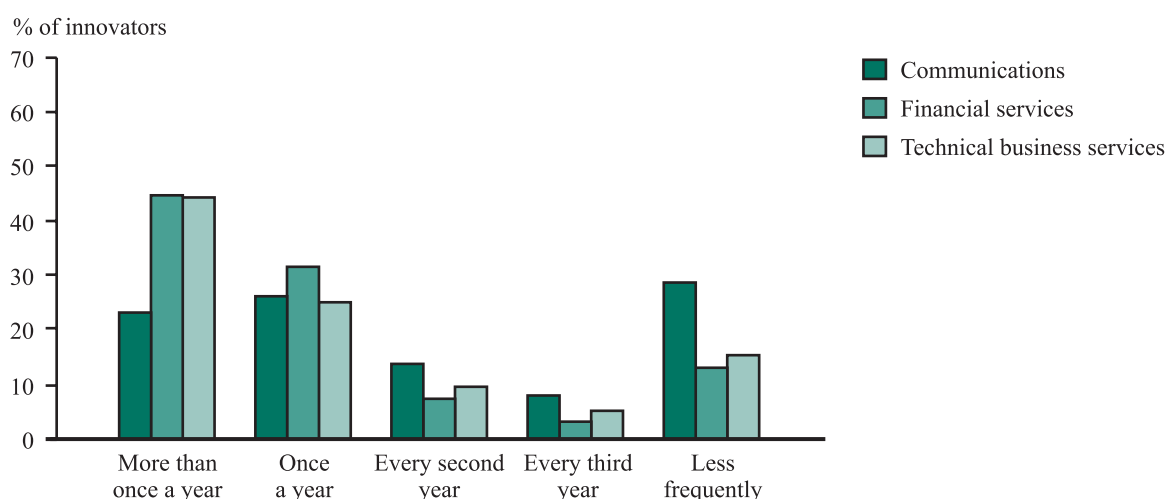
**Note:** In technical business services, the percentage reported is the percentage of establishments belonging to firms reporting the specified innovation activities.



The measure of innovative activity that has been described above only tells us whether a firm has introduced an innovation over a three-year period. Other dimensions are important—such as the frequency of innovation, the novelty of innovation, and the specific types of innovation.

How often new, innovative products and processes are introduced sheds additional light on the intensity of innovation in an industry. The frequency of innovation is affected by the cost and technical risks associated with innovative activities, the level and nature of competition within an industry as well as by the competencies of individual firms. To gather information on the frequency of innovation, survey respondents were asked how often they introduced new products or processes. The majority of innovators report that they introduce new products or new processes at least once a year (Figure 4.1.4).

**Figure 4.1.4: Frequency of Introduction of New Products or Processes**



Moreover, in both technical business services and financial services, innovations are being introduced more than once a year by over 40% of the innovators. Innovators in financial services and technical business services are twice as likely as their counterparts in communications services to innovate more often than once a year. Innovators in communications services are the most likely to innovate at intervals greater than once every three years.

The innovations that are introduced vary substantially in terms of novelty. Some are brand new; others are adaptations of products that are already in the market. In the manufacturing sector, most innovations are of the latter variety. For instance, about 20% of large innovators reported that their innovations were world-firsts, another 36% introduced innovations that were new to Canada and the remainder introduced innovations that fell in neither of these two categories and were more imitative (Baldwin and Da Pont, 1996). The same question was put to service sector firms. However, because of the inherent nature of the differentiation that takes place on the basis of time and space, this question is more difficult to answer for service firms. Moreover, because of their lack of experience with international trade, service firms are less likely to know whether their new products have been

introduced elsewhere. In any case, the percentage of innovators indicating their innovations were world-firsts was less than 10% for communications and financial services but around 17% for technical business services. Generally, communications firms were ten times more likely to report local-market innovations than they were world-firsts.

What were the examples that were given of the types of innovations? In technical business services, new products that were outlined included highly specialized software, task-oriented computer products, data management tools, and internet-based services. In financial services, new products consisted of new insurance policies and new investment instruments. In communications, new products consisted of new channels, cable packages and specialty programs as well as internet-based services.

Process innovations in technical business services ranged from computerized networking in the development of software, adoption of ISO standards, and the development of new project standards and methodologies dealing with evaluation methods and quality testing. Very generally, many examples were given in this industry of process innovations that led to greater automation in support of product development, whether it be for design, database management, or product applications. In finance, computer-based automation was stressed. In communications, firms emphasized the conversion from analog to digital-based processes, the adoption of fibre-optic technology, and the general incorporation of computer-based technologies.

## **4.2. Competitive Environment and Competitive Strategies**

*The environment faced by dynamic service firms is highly competitive. All industry groups face customers who can easily switch to other products and a substantial level of threat from new firms. In response to this environment, business strategies are aimed at sound management, marketing and financial practices.*

*Differences exist in the ways firms translate these strategies into specific policies. The financial sector responds by placing the most importance on using information technology and by stressing various human resource practices. Communications firms suffer from uncertainty due to rapid changes in production technology and low liquidation values if they make mistakes in technology acquisition. They respond by placing greater relative emphasis on using high-quality suppliers. Technical business services stress customer diversification and the research and development process.*

Innovation—clearly important at both the firm and economy-wide levels—is but one element of a firm’s business strategy. Innovation activity needs to be set in context by examining, first, the competitive environment that determines the degree of pressure on firms to innovate; and second, the overall firm strategies, of which innovation is just one.

Other studies have shown that innovators perceive their competitive environment to be substantially different than do non-innovators (Baldwin and Johnson, 1999a). Innovators require skilled staff to develop and implement new products, marketing capabilities to bring new products to market successfully, flexible production facilities to accommodate change, sophisticated financial competencies to fund these inherently risky activities and, finally, superior management to acquire, allocate and manage the required resources (Baldwin and

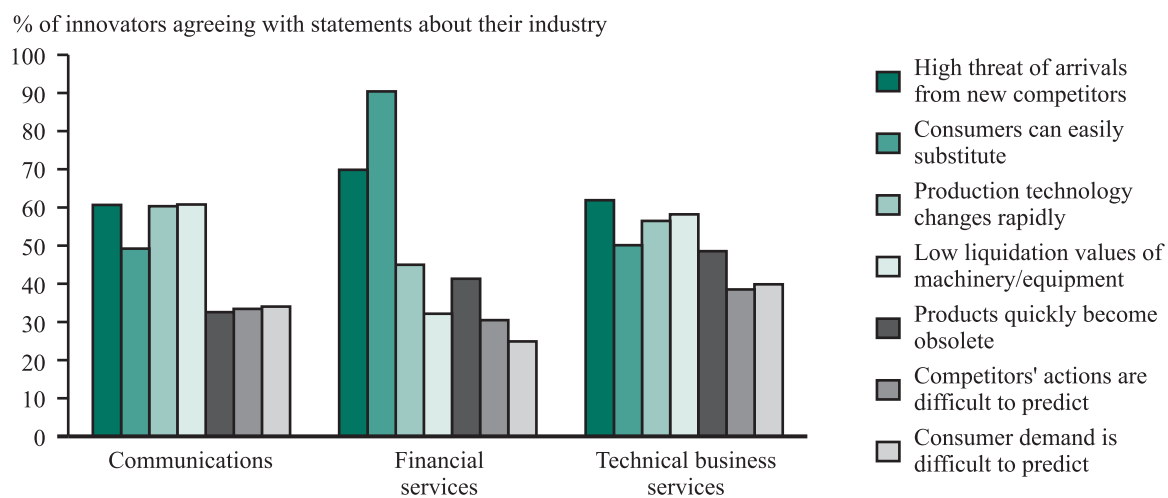
Johnson, 1996a; Baldwin and Johnson, 1999a). In summary, the perception of the competitive environment and the competencies possessed by the firm condition the nature of innovative activity undertaken. Consequently, prior to investigating the innovativeness of these industries, an overview of the environment within which they operate and the business strategies they pursue is provided. Several issues are investigated here, including sources of volatility in the industry, the nature of competition, and the importance of various business strategies.

## Competitive Environment

Understanding the competitive environment associated with more or less innovation contributes to our understanding of the extent to which competition is supportive of the innovation process. The nature of the competitive environment that innovators face conditions their willingness to undertake various sorts of innovative activity. Specifically, the nature of the risks and uncertainties may make certain types of innovation more critical and others less attractive. For example, in industries where customers substitute products based on small price differences, producers may be forced to introduce cost-related innovations. Similarly, rapid changes in production technology may encourage continual innovation to keep pace with the changes.

The uncertainty faced by firms is derived from a number of sources. It depends upon the threat of new entrants, the extent to which competitors act predictably, whether consumers can easily substitute, whether the demand for their products is easily predicted and whether obsolescence is rapid for both products and processes. Hence, innovators were asked to indicate whether they agreed or disagreed (on a scale of 0 to 5, where 0 corresponds to not applicable, 1 corresponds to strong disagreement, 5 to strong agreement and 3 to neutral) with a series of statements about the extent to which these uncertainties affect their industry. Figure 4.2.1 indicates the percent of innovators strongly agreeing (assigning a score of 4 or 5) with these statements.

**Figure 4.2.1: The Competitive Environment**



The responses demonstrate that innovators in these industries face a very uncertain environment. Many similarities across the industry groups are observed with respect to sources of risk or uncertainty in the competitive environment. Innovators—in each of the three industry groups studied—agreed that their customers could easily substitute and that they faced a high threat from the arrival of new competitors. This probably explains the high degree of product innovation throughout the groups.

Despite these similarities, there was considerable variation in the incidence of other elements of uncertainty. Within financial services, substitutability and new competitors present the greatest sources of risk—relative to both other sources of uncertainty in financial services and relative to the degree to which innovators in other industries report them. Indeed, all other factors are relatively less important here. Conversely, risk in the other industries is diversified across more categories. In the communications sector, changes in production technology and low liquidation value of machinery and equipment are two of the most important challenges, followed closely by risk due to both product substitutability and the threat of new competitors. In technical business services, uncertainty occurs across more dimensions than it does in the other industries. Not only were each of these aforementioned factors common sources of uncertainty, but product obsolescence and lack of predictability regarding competitors and customers were oft-cited secondary sources of uncertainty.

### ***Competitive Strategies***

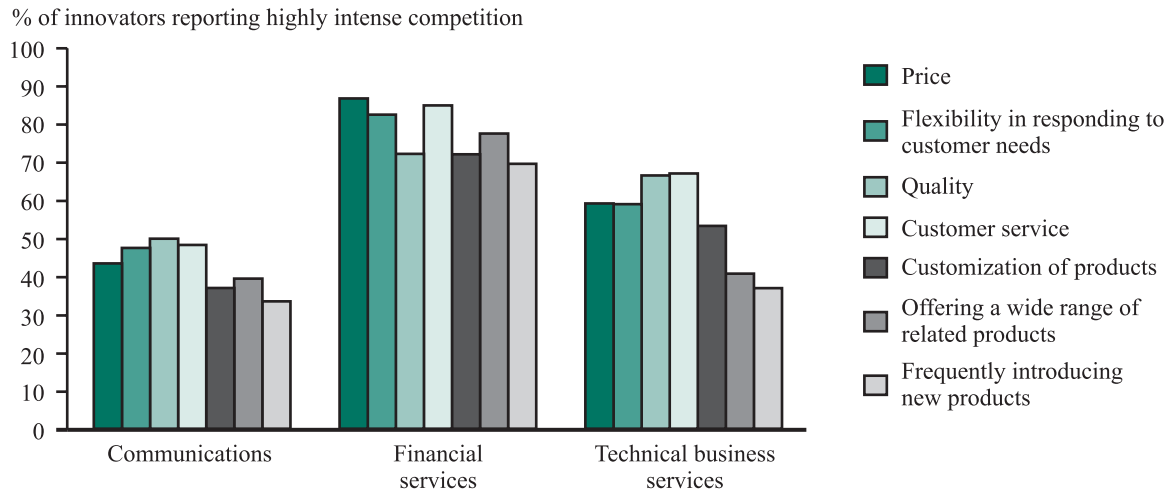
Investigating whether a firm's strategies focus on product differentiation, the introduction of new products, quality, flexibility, customization, or service competition serves to explain how innovation supports these strategies.

The nature of competition also affects the innovativeness of firms. Intense price competition will stimulate, or be associated with, very different innovative activity than a competitive environment characterized by rapid product enhancements. For example, adopting a product life cycle model, it might be expected that firms in the later stages of a product market will be engaged in intense price competition and will focus on cost-saving and process development; whereas firms in the early stages will find new product competition to be more intense and, thus, will focus on new product development (Baldwin, 1998). Both the uncertainty of the environment and the type of competition would be expected to affect the types of competencies a firm develops. Hence, innovators were asked to indicate the intensity of competition (using a scale of 0 to 5, where 0 was not relevant, 1 was low intensity and 5 was high intensity) in seven different dimensions. The percent of innovators indicating they felt competition was intense (assigned a score of 4 or 5) is presented in Figure 4.2.2. Generally, customer service, price, flexibility, and quality were the most intensely competitive tools. Product customization, product range, and new product introduction were typically less competitive areas.

While innovators in financial industries generally reported greater competition in each area and innovators in the communications sector reported lower competition in each area, the relative intensities in each of the dimensions were quite similar across sectors. The somewhat lower intensity of competition in communications industries may be due to the type of

regulation therein. The only departures in similarity of relative rankings were observed for the competitive aspects regarding “a wide range of products” and “quality”. Offering a wide range of related products is particularly important in financial industries, while quality is more important than product range in the other two groups.

**Figure 4.2.2: Intensity of Competition**



### Functional Competencies

Both the uncertainty of the environment and the type of competition can be expected to affect the competencies a firm develops. Understanding how competitive strategies are translated into competencies in the areas of financing, human resources, marketing, management, production and technology allows the importance given to research and development (R&D) and technology development to be set in the context of the other capacities of a firm.

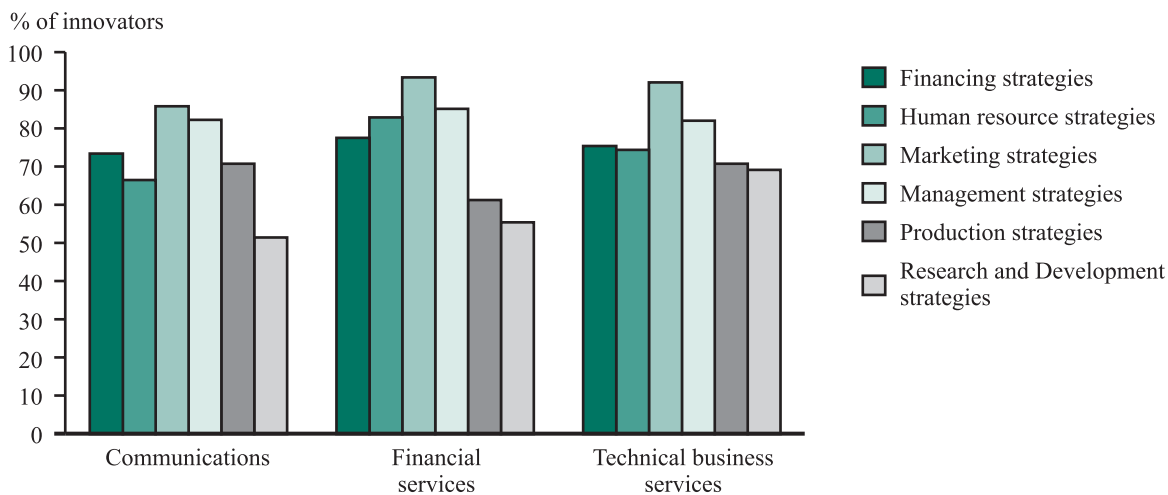
In order to investigate how innovators respond to these competitive pressures, and translate overall strategies into competencies, innovators were asked to indicate the importance they place on a range of business strategies. Specifically, they were asked to rate the importance (on a scale of 0 to 5, 0 corresponding to not applicable, 1 to unimportant and 5 to crucial) of specific strategies grouped into six basic functional areas—marketing, management, financing, human resources, production and research and development. The percentages of innovators giving high importance (assigning a 4 or 5) to at least one strategy within the categories are plotted in Figure 4.2.3. The percentage of innovators attributing high importance to a set of more specific competencies is presented in Table 4.2.1.

In general, marketing and management strategies were found to be among the most important business strategies in each of the three sectors studied (Figure 4.2.3). Strategic development in the areas of financing, human resources, and production was important to more than half of all innovators. Strategies related to R&D were the least valued in each of the three groups. These findings are similar to those of previous surveys (Baldwin et al., 1994; Baldwin and Johnson, 1996a). It is not that R&D is unimportant but rather that the effective

performance of such specialized activities is critically dependent on superior competencies in all other areas.

At the detailed strategy level, there are considerable similarities in the rankings by sector. With respect to managerial strategies, the ranking of the strategies—continuous quality improvement, using information technology, consensus decision making and delegating decision making—is basically the same in each of the industries (Table 4.2.1). The rankings of the human resource strategies were also similar. Recruiting skilled employees was most important, followed by training. Providing incentive compensation plans was least important in each of the three industries, but while it followed training closely in financial services, it was a distant third for the other two groups.

**Figure 4.2.3: Importance of Various Business Strategies**



Marketing strategies are the most important set of strategies, and satisfying existing customers and improving position in existing markets are dominant in each of the three industry groups. Targeting new foreign markets is only important to technical business service innovators. Hence, technical business services innovators are pursuing a diversification strategy that involves satisfying their existing customers and seeking out customers in other foreign or domestic markets.

Within the group of financing capabilities, financial management is the most important competency in each of the three groups, and is deemed to be very important by approximately the same proportion of innovators in each industry. However, finding/maintaining capital was accorded greater importance in communications than in the other industries.

Substantial differences are also evident in the valuation of specific production strategies. Using high quality suppliers is more important in the communications group than in the other two service sectors. This is consistent with the finding that changes in production technology and low liquidation values for machinery and equipment are dominant sources of uncertainty in the industry. Hence, innovators that link up with the wrong suppliers will pay dearly for it. Conversely, using computer-controlled processes is deemed to be most important—relative to other production strategies—in financial services. This is consistent with the high value attributed to using information technology by these innovators. In addition to using high-quality suppliers and computer-controlled processes, technical business services innovators give about the same importance to the remaining strategies: reducing production times and improving the efficiency of input use. This is consistent with the finding that innovators here face uncertainty from a broader range of areas and, thus, employ a broader range of strategies.

**Table 4.2.1: Percentage of Innovators Giving a High Importance to Various Business Strategies**

	Communications	Financial services	Technical business services
	% of innovators		
<b>Financing</b>			
Flexibility in meeting unforeseen circumstances	59	56	58
Financial management	70	74	71
Finding/maintaining capital	62	53	54
<b>Human resources</b>			
Providing incentive compensation plans	39	63	38
Recruiting skilled employees	57	80	67
Training	54	70	58
<b>Marketing</b>			
Using third party distributors	15	43	25
Promoting company or product reputation	60	72	69
Satisfying existing customers	83	84	89
Improving position in existing markets	67	82	74
Targeting new foreign markets	7	16	37
Targeting new domestic markets	45	71	60
<b>Management</b>			
Consensus decision making	53	53	44
Delegating decision making	44	44	32
Using information technology	62	78	70
Continuous quality improvement	73	75	73
<b>Production</b>			
Using high quality suppliers	63	31	50
Using computer controlled processes	50	52	50
Reducing production times	27	43	46
Improving efficiency of input use	40	44	46
<b>Research and Development</b>			
Protecting products/process with intellectual property rights	10	12	25
R&D capabilities	13	22	42
Purchasing other technology	43	35	27
Developing new/refining existing technology	35	43	58

Not surprisingly, technical business service innovators attribute the greatest value—of each of the three groups—to the undertaking of R&D and technological development, and the use of intellectual property rights. The strategy of purchasing technology from others is found to be most important in communications.

In summary, several sources of uncertainty are shared among the industry groups studied. The ability of customers to substitute and the threat of new competitors are important sources of uncertainty throughout. Reacting to this uncertain environment, innovators universally stress the importance of marketing and management strategies.

Despite these similarities, there are substantial differences to be found across sectors. In the financial services sector, competitive pressures, due to the ability of customers to substitute and the threat of new competitors, foster an environment where there is intense competition along numerous dimensions. Innovators in this sector are generally the largest. They attribute their success to using their extensive resources to acquire, train and manage their people and market their products.

Similar to their counterparts in other industries, sound marketing, managing and financing strategies are central to the success of communications firms. They face a high degree of technological uncertainty due to rapid changes in production technology and low liquidation values of machinery and equipment. Innovators respond to these demands by placing greater relative emphasis on using high quality suppliers, purchasing technology and seeking and maintaining sources of financing.

Technical business service providers are generally smaller than innovators in the other groups. They face uncertainty associated with their environment in more ways than do innovators in the other industries. The dominant focus of their business strategy lies in placing greater relative emphasis on both satisfying their existing customers, as well as targeting new foreign markets. As part of this, research and development—designed to reach a highly specific market—is more important here than it is in other industries. In keeping with the wide variety of uncertainties that they face, their business strategy is balanced across many areas. Production and management strategies that emphasize quality, speed and efficiency are crucial here.

### **4.3. Objectives of Innovation**

*In keeping with their emphasis on product innovation, service sector innovators focus more on market-related and product-related than on production-oriented objectives. Innovating firms in all sectors innovate to maintain or increase market share by focusing on existing customers and improving product quality. Innovators in financial services focus on reducing costs more than innovators in the other sectors while their counterparts in technical business services focus on production flexibility.*

Innovation can be introduced to attain different objectives. It may be used to maintain market share or to expand markets. The first approach is defensive; the latter is more aggressive. In order to affect market share, innovation may be directed at creating new products or at improving the quality of existing products. Innovation can also be used to achieve



cost reductions in the production process or changes in the production line that allow greater flexibility in product customization.

What a firm hopes to achieve through innovation is closely aligned with its overall business strategy and to the competitive environment in which it operates. In industries where customer service is crucial to success, a firm might innovate in order to augment its ability to produce more customized products with less lead time. Where customers can easily switch to a competitor's product and price competition is intense, the need to keep the cost of the final product competitive can lead a firm to introduce process innovations to reduce unit costs. Similarly, in industries where there is competition for skilled workers, innovation might be introduced with the goal of improving working conditions and attracting or retaining highly-trained and well-educated employees.

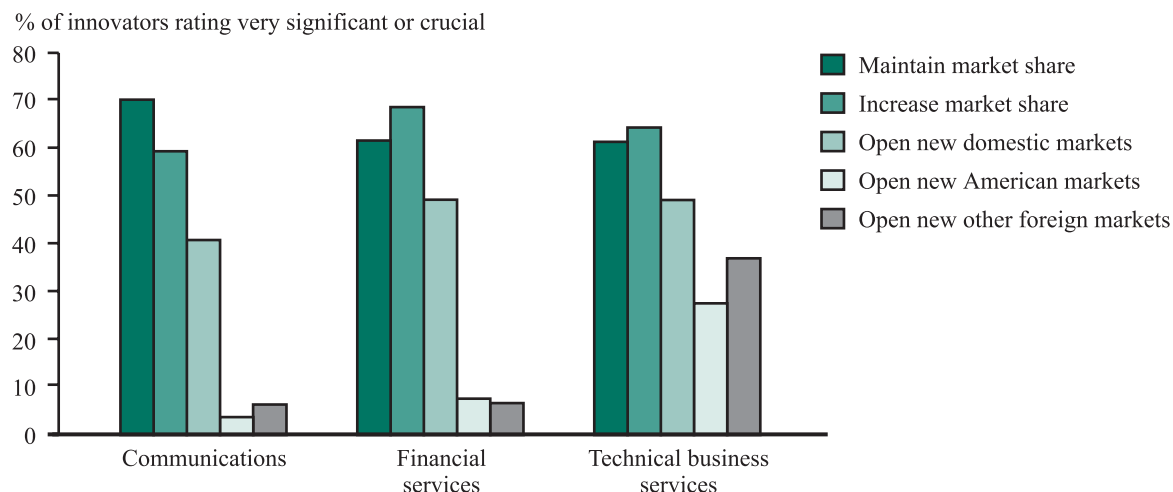
The survey asked firms to report, on a scale of 0 to 5, where 0 is irrelevant, 1 is insignificant and 5 is crucial, the importance of a range of objectives to the firm's innovation activities over the 1994 to 1996 period. The data reported here reflect the proportion of innovative firms in each of our three industry groups that considered a given objective "very significant" or "crucial" (4 or 5) to their innovation activities.

Included in the list were a variety of objectives related to production, product and market strategies. Survey respondents were asked directly about general market-related strategies, such as increasing or maintaining market share and expanding into new geographic or product markets. While many of the product- and production-related objectives, such as improving product quality, reducing production lead times and lowering labour costs are discrete objectives in themselves, they are also part of a firm's market strategy and are thus linked to a firm's market-related objectives.

Among specific market-related objectives, maintaining market share and increasing market share were rated as very important by over half of innovators in all three industry groups (Figure 4.3.1). For innovators in communications services, maintaining market share was more likely to be important than was increasing market share, consistent with the earlier finding that this industry gives the least stress to opening new domestic or foreign markets and faces market fragmentation as a result of new competitors. Conversely, innovators in financial services and technical business services tended to place greater stress on increasing market share.

Opening new domestic markets was an important objective of the innovation activities for innovators in all industries, but was so-rated by larger proportions of innovators in financial services and technical business services than it was by innovators in communications services. Only technical business services innovators indicated that moving into new foreign markets was also an important objective of innovation activity. This undoubtedly reflects the fact that these industries, compared with the other two sectors, operate in a relatively regulation-free environment around the world and thus foreign markets are open to them. It also reflects an aggressive customer diversification strategy that is central to their overall business strategy.

**Figure 4.3.1: Importance of Market-related Objectives**



Product-related objectives, such as improving product quality and extending the product range, were also considered important by innovators in all industry sectors, as would be expected given the high levels of product innovation reported in the previous section. Product-related objectives are the means of achieving market-related objectives. Indeed, of all innovators rating a market-related objective highly, 84% also rated a product-related objective highly. Improving product quality, rated as important by over half of all innovators in each industry sector, was the product-related objective most likely to be considered an important objective of innovative activity.

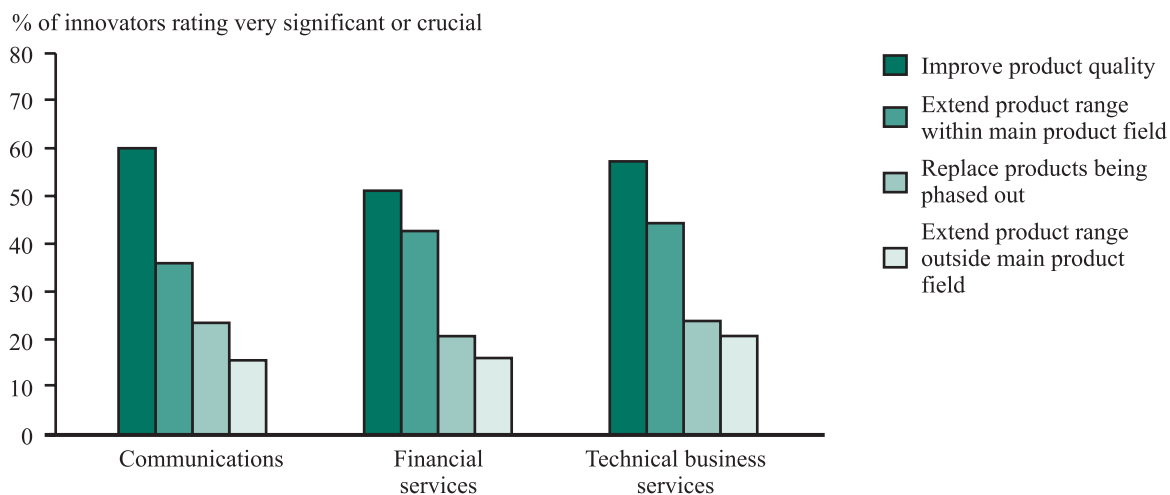
Innovation activity in all three industry groups is more likely to be concerned with solidifying a firm’s existing product range than in moving into new product areas. While a fairly large proportion of innovators in each industry rated extending their product range *within* their main product field as important, less than a quarter of innovators in each industry group gave the same rating to the objective of extending a product line *outside* of the main product field. This approach supports the market-oriented objectives driving innovation noted above: offering existing clients (reflecting current market share) a greater number of improved products while simultaneously using these same products/services to attract new clients.

The need to replace products being phased out was also rated as one of the reasons for innovation activity by a significant proportion of innovators in all three industries. This finding is of importance. Innovation is often equated with the radically new. While firms may devise new products that lead them in completely new directions, the majority of innovators in these service industries are making improvements to, rather than replacements for, their main product lines. It is in technical business services that the greatest stress is given to using innovation to extend the product range, both within and outside the main product field. This complements the greater stress these innovators give to the overall objective of moving into new markets.

A highly price-competitive marketplace, where customers can easily substitute another firm's product/service, can lead a firm to innovate in order to keep production costs down. Where a firm is following a niche-market strategy, innovations leading to improved production flexibility can allow for greater product or service specialization. Production-related objectives are often closely associated with a firm's market-related objectives—indeed 89% of innovators that gave a high rating to a production-related objective also rated highly a market-related objective.

It has been observed that the service industries studied here are more likely to be product rather than process innovators. Consistent with this is the finding that more than 50% of innovators stress product-related objectives (Figure 4.3.2) while a smaller proportion stress production-related objectives (Figure 4.3.3).

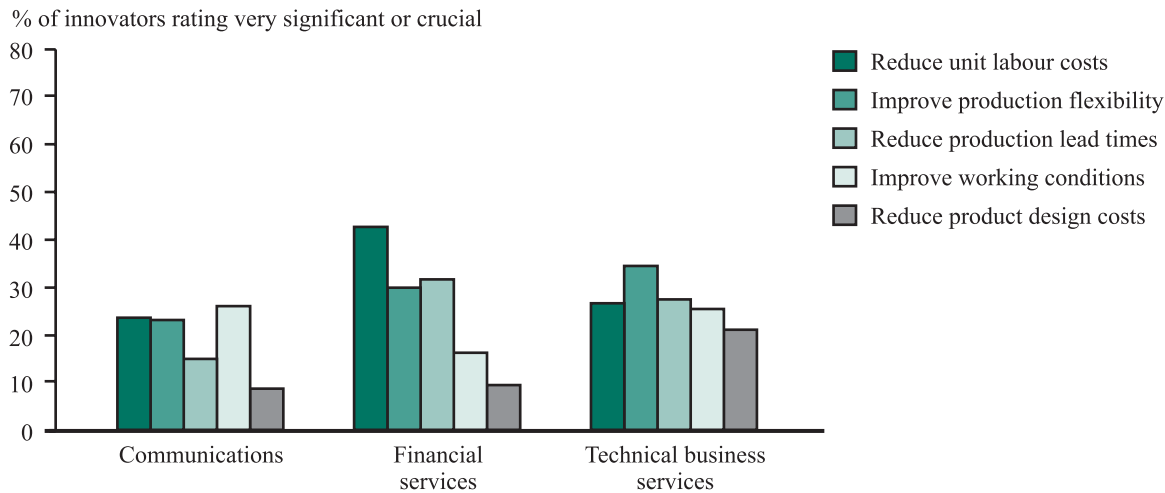
**Figure 4.3.2: Importance of Product-related Objectives**



While the ranking of market-related and product-related objectives was quite similar across industries, the same cannot be said of production-related objectives (Figure 4.3.3). Here, there was considerable variation across industry groups in terms of which production-related objectives were considered important to innovation activities.

The differences in relative importance of each of the production-related objectives across industries is consistent with the variations in the general strategic orientation of the industries. Among innovators in the financial services industries, reducing labour costs was most consistently rated as important, followed by the related objectives of reducing production lead times and improving production flexibility. This indicates that costs and an ability to respond rapidly are of greater importance in financial services where customers can easily substitute a competitor's product and price, and where customer service and flexibility are key competitive tools.

**Figure 4.3.3: Importance of Production-related Objectives**



Firms in technical business services are generally small and pursuing a customer diversification strategy. To do so, they give greater relative emphasis to improving production flexibility—a requirement if the firm is to follow a strategy of varying the main product line slightly to diversify its customer base. Flexibility is central to their innovation strategy. Consequently, reducing design costs and improving production flexibility are key objectives for innovators in these industries.

In communications services industries, where competition tends to focus on customer service areas and firms stress the purchase of technology from suppliers, production-related objectives tended to be considered important by only a relatively small proportion of innovators.

In summary, firms in all three industries innovate to maintain or increase market share and improve product quality. Opening new markets and extending product range are important secondary objectives in all sectors.

Product- and production-related objectives are important complements to, and sometimes even the primary means of, satisfying market-related objectives. Nevertheless, there was more variation in the rankings of specific production-related objectives across industries than there was for market-related objectives. This variation reflects, in part, the differences in industry environment.

Financial services innovators, operating in a price-sensitive environment where new competitors are a threat and consumers can easily switch to a competitor’s product, tend to be motivated more by the desire to keep production costs down than do innovators in the other two groups.

Innovators in technical business services industries, where markets are global and new, and customer diversification strategies are important, are the group most likely to innovate in order to open up foreign markets. This market-related objective is buttressed by related objectives such as improving product quality and production flexibility in the product and production areas.

Communications services innovators tend to give more emphasis to market-related and product-related objectives than they give to production-related objectives, reflecting the fact that they focus more than other industries on buying their technology from others. Communications services industries work to maintain market share through innovations designed to extend product lines and increase product quality. Consistent with the fact that they face rapidly changing production technology and low liquidation values for machinery and equipment, firms in this sector give relatively greater emphasis to using high quality suppliers.

#### **4.4. Impacts of Innovation**

*The primary impact of innovation in the dynamic service sector is on quality of service. The actual methods used to enhance quality vary by industry. In financial services, firms focus on flexibility and speed of delivery. In communications, firms focus on service reliability. In technical business services, where firms are unique in focusing on foreign markets, firms emphasize the broadest range of quality characteristics—reliability, flexibility in adapting to customer requirements, delivery speed, user-friendliness, and accessibility.*

Introducing an innovation, be it a product, process or organizational innovation, changes or alters many aspects of a firm, from what products and services it brings to market, to how these are produced, through to the type and level of service it can offer its clients. Analysis of the impacts of innovation serves to demonstrate whether the results accord with objectives, that is, how innovation serves to maintain customers—whether by focusing more on product reliability, customization, or the speed with which products are delivered to customers, and whether customer productivity is improved.

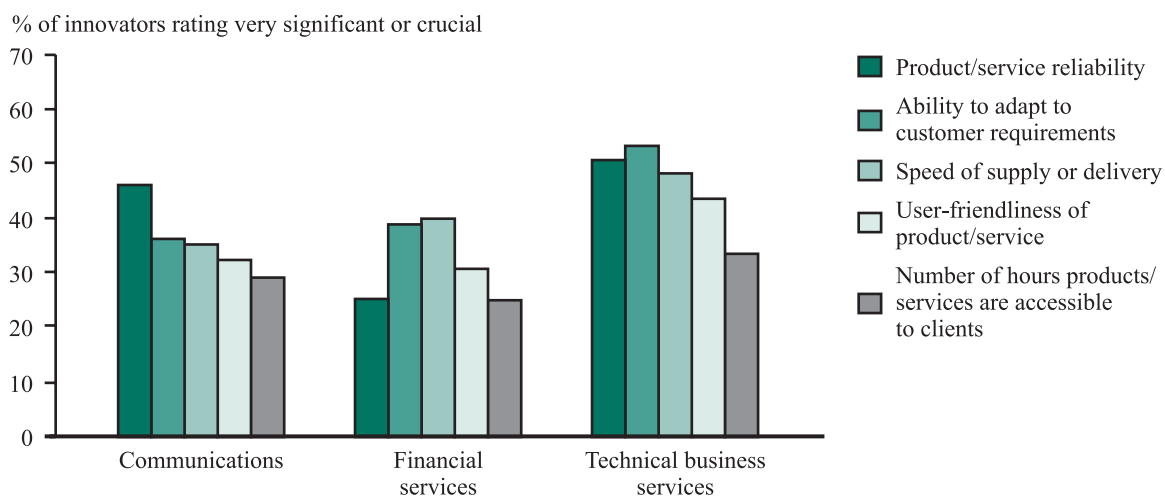
Innovations are often introduced with a specific objective or set of objectives in mind. They frequently have unintended impacts as well. A firm may implement product-development teams with the aim of improving product quality and unexpectedly find that these teams also result in improved employee morale, higher productivity and faster delivery times. A firm may set up an Internet site designed to provide 24-hour technical assistance to its global clients and unexpectedly find that the web site attracts new clients, improves the productivity of existing clients, and increases the motivation of employees.

In order to investigate the realized impacts of innovation, innovators were asked to rate, on a scale of 0 to 5 where 0 is irrelevant, 1 is insignificant and 5 is crucial, how the introduction of innovation had affected their businesses. These impacts were grouped into broad categories: productivity, product or market expansion, and quality of service. Each of these general categories included at least three specific areas. Examples of these specific areas where innovation might have an impact include employee motivation, product range, the

user-friendliness and reliability of a firm's products and services, as well as the firm's ability to comply with safety or ecological requirements. The data presented here refer to the proportion of innovators who indicated that innovation had a very significant or crucial impact on their firm (a score of 4 or 5).

Customer service and product quality are of critical importance to survival in most service industries. This is particularly true for the three target industries where, as noted earlier, competition is intense in the areas of customer service and flexibility. Given this level of competition, the threat of new competitors, and customers' ability to substitute, it is not surprising that relatively large proportions of innovators reported that the impact of innovation on their quality of service was significant (Figure 4.4.1). For each industry, it is a quality of service dimension that is rated as very significant/crucial by the largest proportion of innovators.

**Figure 4.4.1: Impact of Innovation on Quality of Service**



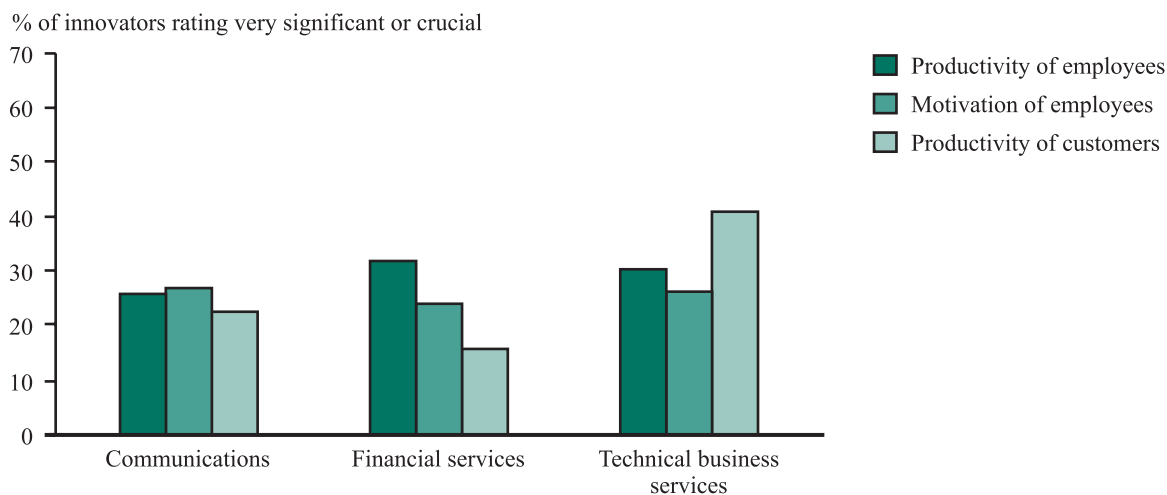
Overall, technical business services innovators were more likely than innovators in the other two industries to consider the impact of innovation on their customer service as very significant or crucial. More than four in ten of innovators in this industry indicated that innovation had affected their ability to respond flexibly to customer requirements, to increase the reliability of their products or services, to increase their speed of product/service delivery as well as the user-friendliness of their products and services. That significant impacts were felt in each of these areas indicates that technical business service innovators follow innovation strategies that allow them to differentiate their product lines from those of others in a number of different dimensions.

Among communications services firms, the impact of innovation on the reliability of products and services was most likely to be considered very significant or crucial, with the other four customer service areas receiving lower levels of support. All service sectors emphasize quality. In communications, the dimension of quality considered to be critical is reliability.

Innovators in financial services were less likely to report that innovation had a significant impact on their quality of service, despite the fact that these firms felt that competition in product quality was intense (Figure 4.2.2). However, over a third of innovators here found that innovation had affected their ability to adapt flexibly to customer requirements and the speed of product/service delivery. These elements of service quality are key competitive tools in the financial services industry.

In comparison with the wide-ranging effects innovation has on quality of service, its impact on productivity is relatively less intense (Figure 4.4.2). Fewer innovators reported very significant or crucial effects on productivity than for quality of service—a result consistent with more innovation being of the product, rather than the process, variety in the service sector. Technical business services innovators were most likely to report that innovation had affected their productivity or the productivity of their clients while their counterparts in financial services reported that their employees’ productivity had been affected. In communications services, each of the three productivity effects (customer’s productivity, employees’ productivity and employees’ motivation) were equally likely to have occurred.

**Figure 4.4.2: Impact of Innovation on Productivity**

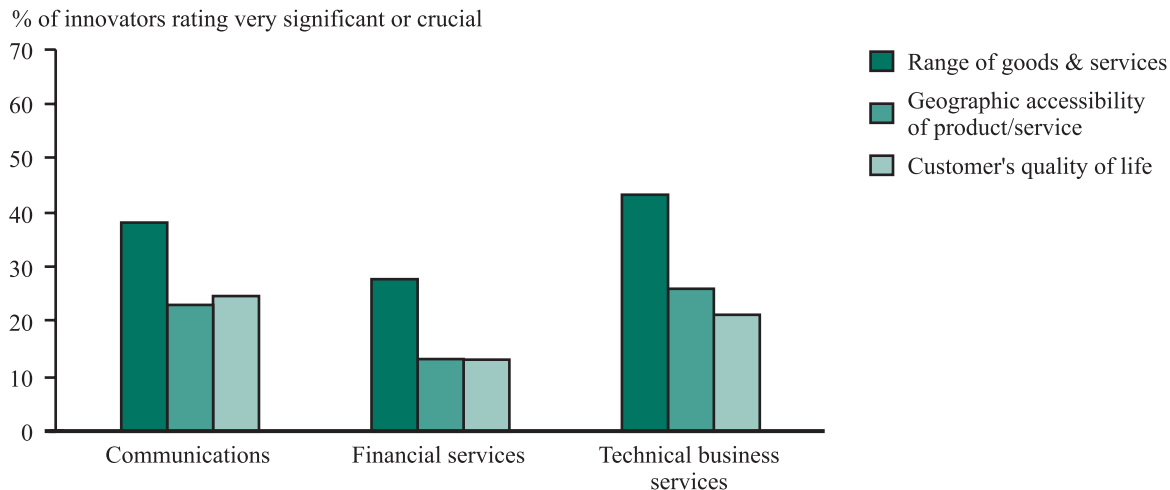


The significance of the impact of innovation on product or market expansion, primary objectives of innovation activity in all three industries, was measured in three areas: the range of goods and services offered by a company, the geographic accessibility of those goods and services, and the customer’s quality of life. The most likely of these three areas to be affected by innovation in each of the industries was the range of products and services brought to market.

Innovation affected the geographic accessibility of products and services more frequently in communications services and technical business services than in financial services (Figure 4.4.3). There are several possible and inter-related explanations for this. First, communications technologies, by definition, involve providing services across regions. Similarly, computer services (part of the technical business services group) enable the physical separation of the provider and the customer. Thus, for both of these industries, growth/

success is defined to a certain extent by increased geographic accessibility. The low proportion of financial services innovators reporting a change in geographic accessibility could be due to the fact that wide access to these firms across Canada existed prior to the survey.

**Figure 4.4.3: Impact of Innovation on Product/Market Expansion**



An important impact of innovation that has been of concern since the Luddite revolution is its effect on workers. This effect occurs both in terms of total demand for labour and in the type of demand, if firms introducing new products experience market share increases and expand their need for employees (Baldwin et al., 1994). Innovations, particularly those of the process variety, can decrease demand if productivity gains cause the demand for labour to fall.

Respondents to the survey described the effect of their most important innovation on labour demand. A large majority of firms in all three sectors indicated that the offsetting effects were neutral (Table 4.4.1). Between 26% and 32% indicated that innovation had increased the demand for labour while under 15% indicated that labour requirements fell. These results are very similar to those derived from manufacturing firms (Baldwin and Da Pont, 1996). Technical business services were most likely to show a net difference in favour of expansion; financial services were least likely to show a net increase.

The effects of innovation on skill levels has also garnered considerable interest. To some, innovation and the knowledge-based economy are synonymous. Innovation would, therefore, be part of the trend to increased demand for more-highly skilled workers. To others, innovation is deskilling, allowing firms to substitute less-skilled for more-skilled workers.

Once again, respondents assessed whether the introduction of their most important innovation had an effect on labour markets—this time on the skill level of its workforce. Firms were asked to assess whether the innovation increased skill requirements, decreased skill requirements or had no effect on skill requirements. A considerably greater proportion of



firms felt that skill requirements had increased, rather than decreased but the majority of innovators reported no change in their skill requirements (Table 4.4.1). Once again, these results broadly reflect those for the manufacturing sector (Baldwin and Da Pont, 1996). Differences across industry sectors are not significant.

**Table 4.4.1: Impact of the Most Important Innovation on Labour and Skill Requirements**

	Communications	Financial services	Technical business services
	% of innovators		
<b>Number of workers:</b>			
Decrease	10	13	4
No change	64	61	63
Increase	26	26	32
<b>Skill requirements:</b>			
Decrease	4	3	2
No change	68	66	62
Increase	28	31	36

In summary, within each of the three groups of innovators, one or another category relating to “quality of service” was found to be the most common of all impacts of innovation. However, the specific aspect of quality of service that was most affected varied across the groups.

For innovators in financial services, the imperative to increase and maintain market share is coupled with innovation strategies designed to improve product quality and reduce labour costs. Like their counterparts in the other industries, financial services innovators have found that their innovation activities have affected the quality of service they can offer their customers. However, innovators in this industry report a narrower range of impacts than do innovators elsewhere—focusing primarily on flexibility and speed of delivery. These innovators have also had some success in translating production-related innovation goals into productivity gains for their employees and flexibility in meeting customer requirements—essential for success in this intensely price-competitive industry.

Communications services innovators, who compete for market share through customer service, product quality, flexibility and price, have found that their innovation activities are most likely to affect product and service reliability—consistent with the emphasis they place on improving product quality as an objective of innovating.

At a general level, innovation has had the broadest impact in the technical business services industries. It is here where the largest proportions of innovators report significant innovation impacts in the greatest number of areas. Technical business services innovators are also motivated to innovate by a broader range of objectives and report effects of innovation on more aspects of their business activities. In addition to affecting the range of products and services offered by these innovators and the productivity of the buyers of these products and services, innovation has had an impact on all areas of the quality of service

provided to clients. Diversification of the client base, achieved by extending the product range, is accompanied by a greater emphasis on a wide range of dimensions of quality and flexibility in order to attract customers.

#### **4.5. Sources of Innovation**

*Innovators in services demonstrate their strong customer orientation by relying heavily upon their customers as sources of ideas for innovation. The value of other sources varies in concert with the general strategic orientation of innovators and the competitive environment within which innovation is undertaken. In the financial sector, innovators look to their competitors for ideas. In the communications group, where changing technology poses a serious threat to firms, linkages with suppliers are crucial. The nature of the service provided by technical business service innovators results in an emphasis on working closely with customers as well as having highly developed research capabilities.*

Innovation is a complex process. An investigation of the sources of innovation reveals whether firms rely just on research and development, or whether they value this source at all, whether networking with other firms in the vertical customer/supplier chain or with competitors is important, and finally how important computer-based technologies have been.

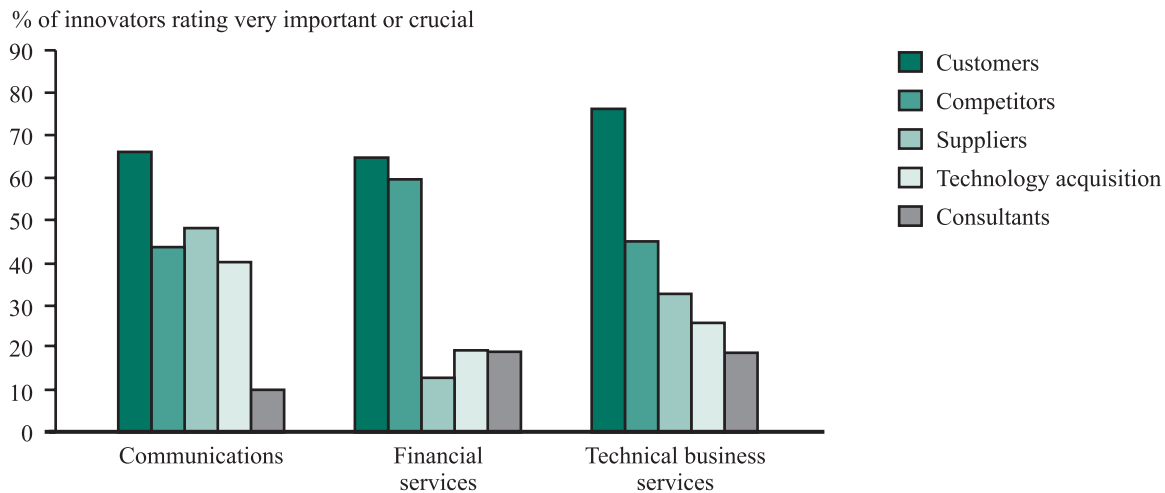
The view of innovation as a linear process, arising out of inventive activity in a research and development unit, and progressing sequentially through various production and marketing stages has long been recognized as insufficient. Mowery and Rosenberg (1989) have emphasized that ideas often originate in production divisions, only to be forwarded to research and development units for development and then returned to the production group for implementation and refinement. More recently, the importance of outside linkages for innovative ideas has been carefully noted (Baldwin et al., 1994; Baldwin, 1997a).

To investigate the means by which innovators acquire their ideas and the necessary complements to such activities, innovators were asked to rate the importance of various sources of information for innovation. Respondents indicated the importance (on a scale of 0 to 5, with 0 indicating irrelevant, 1 indicating insignificant and 5 indicating crucial) they gave to sources of information. These sources included internal sources (e.g., management, R&D), external sources (e.g., customers, suppliers), generally available information (e.g., conferences, patent literature) and education and research institutes. The percentage of firms attributing high importance (4 or 5) to each of these sources is portrayed in Figures 4.5.1 to 4.5.4.

Next, so as to obtain an objective measure of the importance of research and development, innovators were asked to indicate their involvement in R&D activities. Finally, since the importance of computer-based technologies to innovation has been widely reported (Baldwin and Johnson, 1996a), innovators were asked whether various computer-based technologies had been important to their innovation activity. Together, these three sets of questions provide an overview of where innovators obtain their ideas, and how important computer-based technologies are to these activities.

The extent of interaction between firms is clearly borne out by innovators' responses regarding the importance of various sources of information for innovation. Indeed, two phenomena are strikingly apparent (Figure 4.5.1). First, information from external agents is a key factor in the innovation process. Customers and competitors are deemed to be among the most valuable of all sources—external and internal combined—of information. The manufacturing sector follows the same pattern, with customers being slightly more important than suppliers (Baldwin, 1997a). Competitors, however, are seen to be much less important in manufacturing (Baldwin and Da Pont, 1996).

**Figure 4.5.1: Importance of External Sources for Ideas About Innovation**

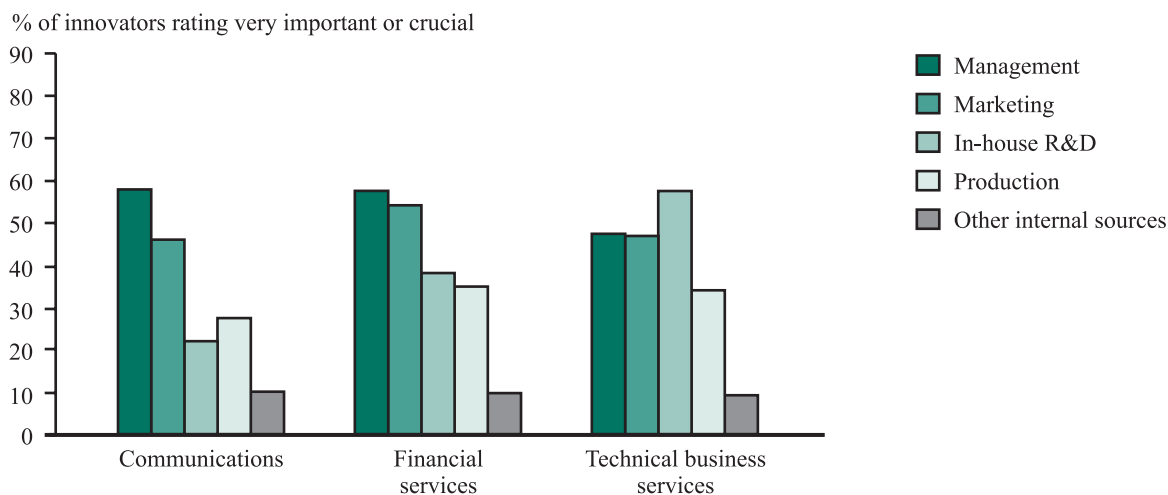


Research, whether internal or external to the firm, is generally accorded less importance than other sources (Figure 4.5.2). This also accords with findings from the manufacturing sector (Baldwin and Da Pont, 1996). In general, in-house R&D is only perceived to be very important in technical business service firms. Conversely, other sources internal to the firm, such as management and marketing, are judged to be very important in each of the three industries. Similarly, among the 13 non-internal sources listed, innovators rated government and private research, and patent literature the least important (Figure 4.5.3). This finding is further supported by a survey in the UK, which found that while firms generally collaborate to expand or deepen their expertise, seek out new markets and maintain position in existing markets, they typically place less importance on sharing research and development (Kitson and Mitchie, 1998).

The relative importance of alternate sources varies across the three industry sectors analysed. In technical business services, customers are the most important source of innovation, consistent with their small size and the fact that the product of these industries usually must be installed at the customer's location. The ability of these firms to offer highly specialized services depends on their capacity to undertake sophisticated specialized research. Hence, as alluded to above, research is more important in technical business services, as indicated by the relatively higher valuation of in-house R&D. Research enables these firms to respond to the risk of rapidly changing technology within their industry.

Firms in the communications sector also indicate that rapidly changing production technology is a common phenomenon in their industry. Unlike technical business service providers, they look to their suppliers when innovating. Indeed, suppliers are ranked the third most important source of innovation, out of the 18 sources listed. Suppliers serve as important sources of information by sharing ideas or research or they may supply information that is embedded in the products they sell. Firms in this sector also look to technology acquisition (including both know-how and equipment) as a specific means by which they acquire information about innovation. It is not surprising, given the volatility in production technology in telecommunications and the importance of suppliers, that innovators in the communications group are particularly sensitive to both their suppliers of equipment and technology.

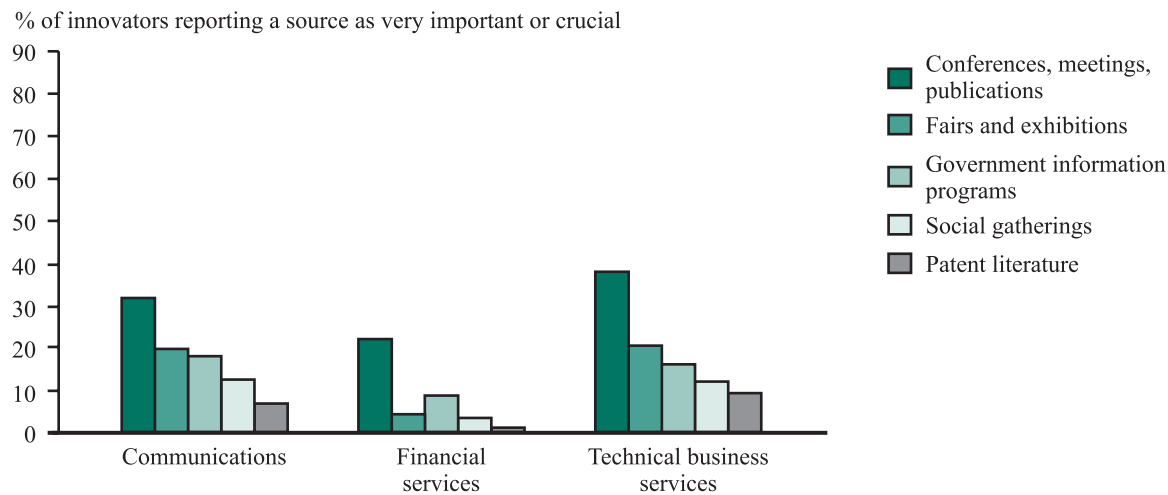
**Figure 4.5.2: Importance of Internal Sources for Ideas About Innovation**



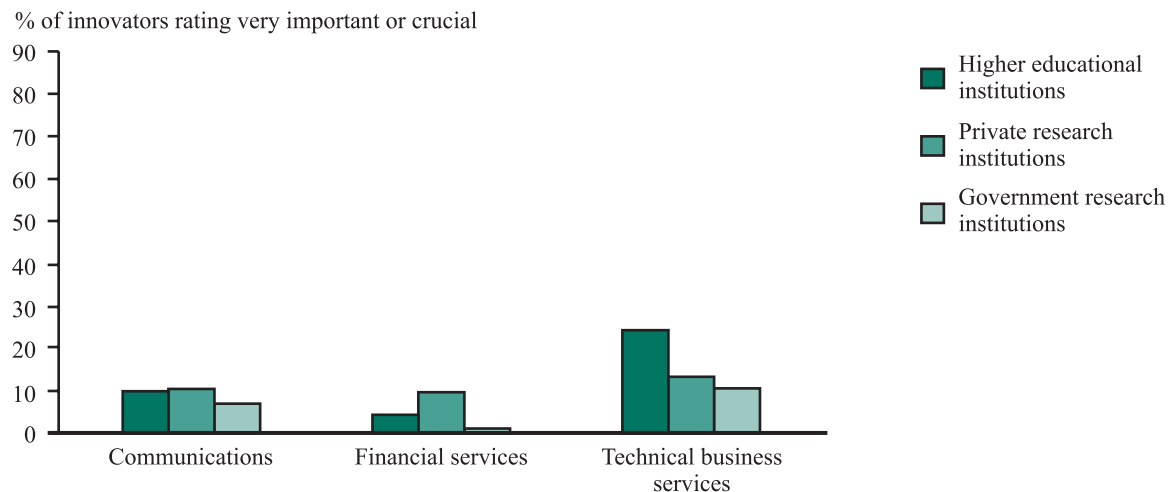
In financial services, customers and internal marketing expertise are more important, whereas suppliers, fairs/exhibitions, and technology acquisition are less important. Once again, the emphasis on customers and marketing as opposed to suppliers, research or technology, is attributable to the finding that the greatest source of risk here is the ability of consumers to substitute and the threat that new competitors will offer more attractive services.

Similar tendencies in the valuation of various sources of information are evident from a survey of German innovators. Customers were among the most important sources of information for innovation in most of the industries (Hipp et al., 1995). However, as is the case in Canada, competitors were more important sources for the financial sector and research was most important for technical consultants.

**Figure 4.5.3: Importance of Generally Available Information for Ideas About Innovation**



**Figure 4.5.4: Importance of Education and Research Institutions for Ideas About Innovation**



The importance of R&D to the innovation process in technical business services is confirmed by its high incidence therein (Table 4.5.1). Indeed, the incidence of research and development in technical business services is higher than that observed in financial services, despite the fact that financial services innovators are much larger than technical business service innovators and research and development is strongly associated with firm size (Baldwin, 1997a). It should also be noted that the technical business services innovators are more likely to perform R&D on a continuous basis, indicating a greater commitment to scientific development. However, it is noteworthy that a smaller percentage of these innovators do joint research than do innovators in either communications services or financial services, though in all cases research linkages with other firms are extensive.

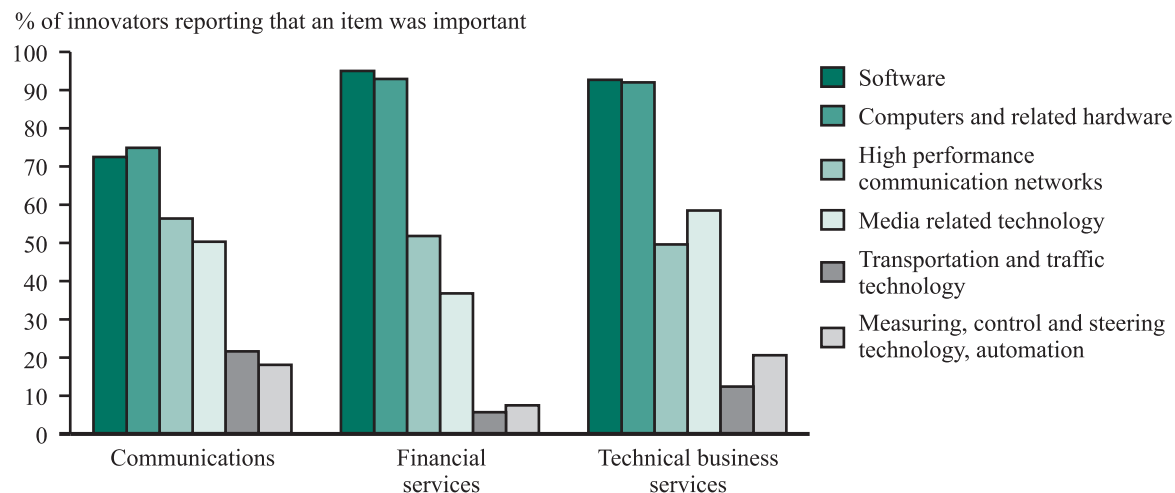
**Table 4.5.1: Research and Development Activity**

	Communications	Financial services	Technical business services
	% of innovators		
Engaging in R&D	24	43	59
Of the firms engaging in R&D:			
those engaged on a continuous basis	42	61	73
those engaged on an occasional basis	58	39	27
R&D co-operation agreements or alliances with other organizations	51	44	38

Since innovation can also be derived from various computer-based technologies, innovators were asked to indicate whether the introduction and/or development of new technologies was important to their innovative activity. Computer software and hardware were important to innovation in all sectors, but particularly so in financial services and technical business services (Figure 4.5.5).

The importance of the remaining technologies varied across the sectors. High performance communications networks and transportation and traffic technology were most important in communications services industries. Media related technology and measuring, control and steering technology were most important in technical business services.

**Figure 4.5.5: Importance of the Introduction or Development of New Technologies to Innovative Activity**



## 4.6. Impediments to Innovation

*High costs proved to be the dominant factor hampering innovation. Among innovators in technical business services, financial restrictions were also important obstacles. Similar to technical business services, innovators in communications consistently cited financial factors as important impediments. Those impediments that are related to market and technical risks, however, were deemed less important. Legislation was also a significant obstacle within communications services, reflecting its regulatory environment. Of the three industries, innovators in financial services generally face the fewest financial barriers.*

There are many factors that hinder the development of innovation. Many reflect the ongoing demands of competition. For instance, innovation projects may expose the firm to high levels of risk, or excessive costs. In a highly competitive environment, these will lead more frequently to bankruptcy, often discouraging innovative behaviour. Other factors relate directly to firm-specific competencies such as labour skills, or the ability to market new products. These are idiosyncratic characteristics that may be more prevalent in some industries than in others.

A study of the impediments to innovation provides information on the problem areas that innovators face—whether it is just costs in general that matter at the margin, or whether there are particular bottlenecks, some of which might be amenable to public policy. It also asks whether firms perceive that they are capital constrained and whether risk is partially at fault. Finally it looks at areas such as lack of skilled labour and legislative and regulatory barriers.

Factors hindering innovation can be organized into three categories: financial impediments, market and technical risk, and non-financial factors. Financial impediments refer directly to the costs of innovation—the monetary requirements of bringing new products to market, or of adopting new processes or organizational forms—or the financing of such costs. Market and technical risks are uncertainties pertaining to the market viability of an innovation: risks that condition both its feasibility and benefits. Lastly, non-financial factors pertain to both firm-specific characteristics and institutional rules that affect the innovation process.

The current section investigates each of these classes of impediments for innovators—respondents that have introduced new products, processes or organizational methods. The choice of innovators for the investigation of the importance of impediments is deliberate. Innovators are more likely to emphasize the importance of impediments than non-innovators in the survey. This finding is consistent with earlier surveys and supports the view that the knowledge gained by introducing an innovation affords the respondent a superior vantage point from which to assess problems associated with innovation. Simply stated, firms learn about the difficulties associated with innovation by introducing innovations (Baldwin, Sabourin and Rafiquzzaman, 1996).

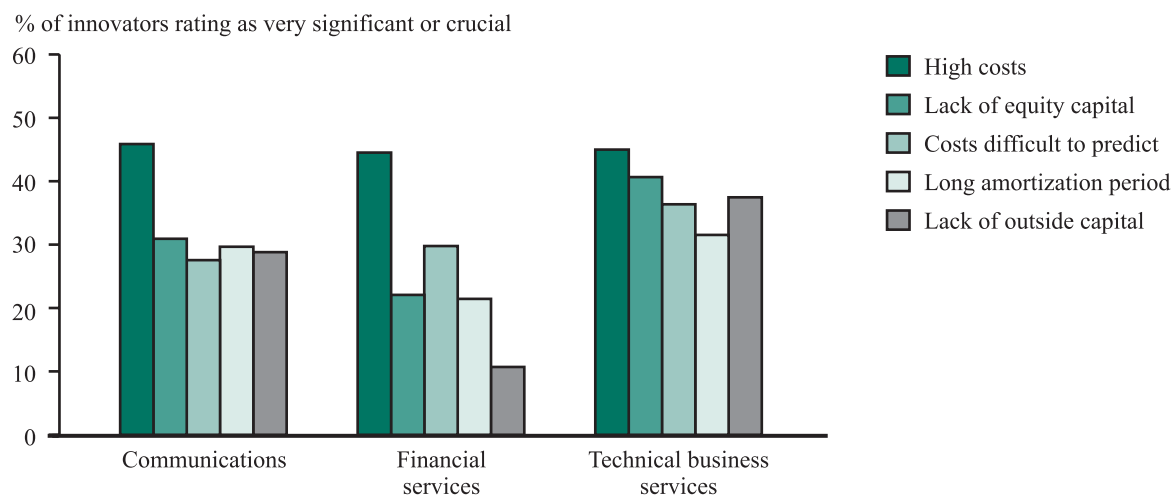
Innovation projects are often costly and financial impediments can take several forms. Substantial investments may be needed in order to bring new products to market, or when implementing new production or organizational techniques. Such activities may require

firms to divert scarce financial resources away from established business activities. This is complicated by the fact that the costs associated with innovation are often unpredictable. Financing requirements often pose additional cost-related challenges. Innovation may require access to specific types of capital, such as equity (e.g., retained earnings) and/or external (e.g., long-term debt). A final financial impediment rests with the amortization of an innovation—the dynamic interplay between costs and revenue. An innovator must compare the benefits an innovation brings, often realized in future periods, with its costs, many of which arise in earlier periods. The longer the time required for revenues to offset costs, the longer the amortization period and the lower the expected rate of return.

The relative intensity of these factors is measured by calculating an extreme score based on innovators' responses within each target industry—that is, the percentage of innovators reporting a score of 4 or 5 on a scale of 0 to 5, where 0 corresponds to 'not relevant', 1 denotes 'insignificant', and 5 denotes 'crucial'.

The cost of pursuing innovation projects is the most important factor hindering the innovation process (Figure 4.6.1). More than four out of every ten innovators in each industry viewed high costs, measured generally, as a significant barrier. This result finds support in previous innovation studies undertaken in Germany (Licht et al., 1995; Hipp et al., 1995) and Italy (Evangelista and Sirilli, 1997).<sup>9</sup>

**Figure 4.6.1: Importance of Financial Impediments to Innovation Activity**



This notwithstanding, the importance of specific cost-related factors was generally more pronounced in technical business services than in either communications or financial services. A greater percentage of innovators within technical business services also cited innovation costs as more difficult to predict. Financing restrictions—either in terms of equity or

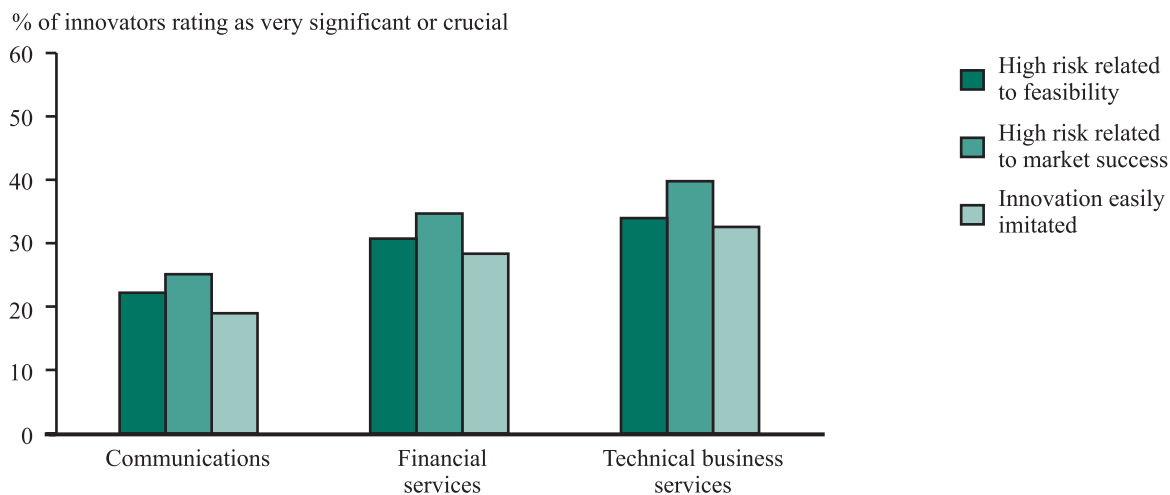
<sup>9</sup> It is perhaps surprising that less than one-in-two innovators were constrained by costs—implying that the other fifty percent would have innovated even if the costs had been higher. However, these percentages are much like those who reported that costs were an impediment to adopting advanced technologies (Baldwin, Sabourin and Rafiquzzaman, 1996).



external capital—were also more pronounced among innovators in technical business services than in other industries. Such restrictions are least prevalent in financial services. The greater financing obstacles evident in technical business services may be related to a combination of firm size and R&D intensity. R&D is an important source of innovation within technical business services. Many of the innovators in this industry are small and other studies suggest that small firms, particularly those involved in R&D-intensive activities, encounter substantial problems in acquiring financing (Evans and Jovanovic, 1989; Hall, 1992; Himmelberg and Peters, 1994).

The market and technical risks associated with innovation relate closely to the issue of market viability. The success of an innovation is often difficult to predict, due to uncertainties associated with both its technical aspects (factors strongly related to feasibility) and its degree of market acceptance (Figure 4.6.2). Moreover, gains from innovation may be ephemeral if competitors are readily able to imitate new products or technologies.

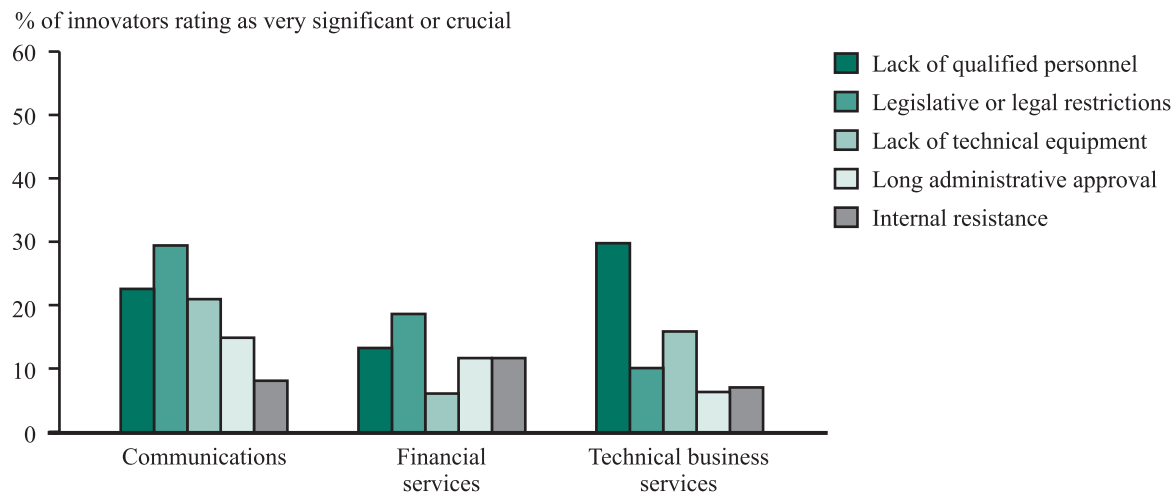
**Figure 4.6.2: Importance of Market and Technical Risks to Innovation Activity**



It is noteworthy that the financing restrictions reported by innovators in technical business services are accompanied by high risks related to the market success of innovation. Other market and technical risks, such as concerns over feasibility and imitation, also represent considerable barriers in this industry, with over three in ten innovators citing these as very important or crucial. A general emphasis on market and technical constraints was also evident among innovators in financial services. Here too risks related to market success, as opposed to technical factors, posed the most significant barrier. The communications industry presents a slightly different view with innovators here generally being less concerned with market and technical risks.

Idiosyncratic and institutional factors also bear directly on the innovation process. In regard to the former, firm-specific competencies, such as employee skills, may be highly conducive to innovation, or alternatively, may constitute a significant obstacle. Corporate mindset is also consequential, following from the principle that "corporate innovation and

**Figure 4.6.3: Importance of Non-financial Impediments to Innovation Activity**



entrepreneurship can be effectively managed (and mismanaged), like every aspect of corporation activity" (Knight, 1985: 89). Hence, internal resistance to innovation, as well as lengthy administrative delays, may hamper innovation projects. The absence of technical equipment, often required for such projects, is an additional barrier. Finally, institutional factors, such as legislation or legal regulations, can also impede the effectiveness of innovation.

Relative to many financial impediments or market and technical risks, idiosyncratic non-financial barriers were less constraining on the innovation process (Figure 4.6.3). One notable exception occurred for innovators in technical business services. In this industry, three in ten innovators deemed the lack of skilled labour a significant obstacle. This is consistent with an emphasis on R&D, an important internal source of innovation within this industry. A previous study (Baldwin and Johnson, 1996b) has shown that R&D intensive firms tend to place greater importance on human resources than other firms. A second exception occurred in communications where three in ten innovators cited legislation as a significant barrier. This may reflect ongoing regulatory constraints that preclude firms in certain markets from offering services in other markets.

#### **4.7. Innovation and Intellectual Property**

*The dynamic service industries studied here give heavy emphasis to the use of two instruments used to protect intellectual property—copyrights and trademarks. This is in marked contrast to the manufacturing sector where patents and trade secrets receive relatively greater emphasis.*

*Communications services generally place the least emphasis on intellectual property in terms of usage rates. Innovators in financial services focus on trademarks. Innovators in technical business services take a more diversified approach, in that they generally make relatively greater use than other sectors of all of the instruments.*

While the creative activities of enterprises are at the core of innovation, these activities require a supporting institutional framework. A key part of this consists of the legal system that establishes the rules protecting property rights in ideas. For the innovation system, intellectual property rights are the supporting framework provided by the state. An imperfect framework provides an impediment to innovation.

Innovation requires substantial investments for the commercialization of new ideas. Innovation will not occur unless that investment is profitable—unless the intellectual property that results from the investment has some private value. Unfortunately, in many cases ideas can be easily copied. Without some form of protection for the knowledge-assets developed through investment in the ideas required for innovations, innovation will be restricted.

Intellectual property rights offer innovators one way to protect their innovations. These rights are legally enforceable over an innovative product or process. They can take the form of patents, trademarks, trade secrets, industrial designs, copyrights or integrated circuit designs.

A patent gives the inventor the exclusive right to produce an original invention for a limited period in return for the public disclosure of information about the innovation. Trademarks are devices or words legally registered as distinguishing a manufacturer's goods. The Industrial Designs Act protects the ornamental aspects of goods. Copyrights give the author of a text or software code the right to print, publish, or sell copies of an original work. Finally, innovations can be protected through secrecy. Trade secrets can be licensed to others with the requirement that the recipient not divulge information about the secret. These agreements are enforced by the courts.

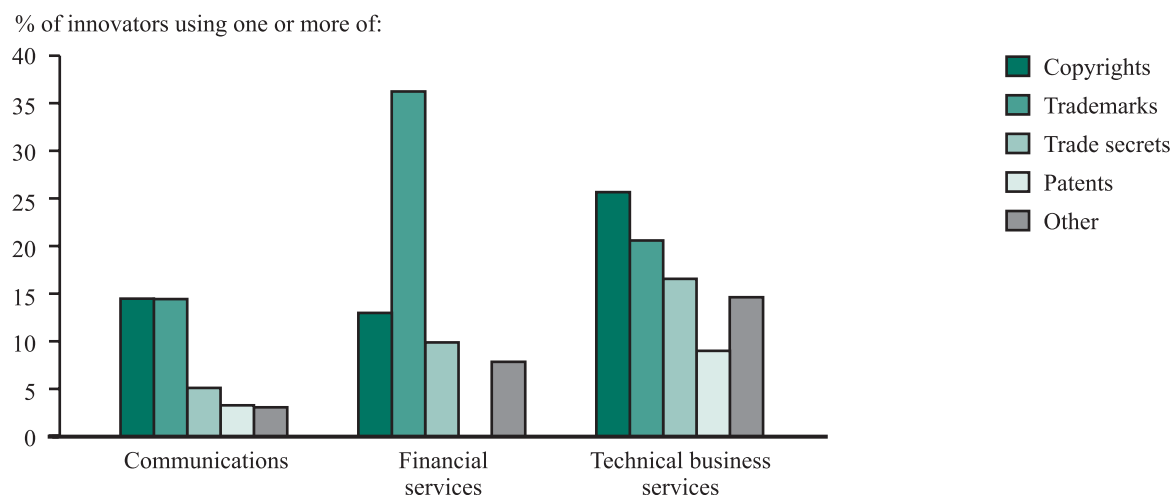
Firms may choose other methods than trademarks or patents (which depend upon regulatory or judicial oversight) as substitutes or complements for the intellectual property rights. Careful design of products may make it difficult for others to copy the innovation. Being first in the market may give a firm a sufficient lead; because of the importance of cumulative learning, imitators cannot hope to produce a similar product at the same cost. Finally, firms can bundle complementary characteristics such as services with their products to reduce the chance that their customers will switch to the products of imitators.

The use that an innovator makes of intellectual property rights will depend on the originality of the innovation, other characteristics of the innovation, and on characteristics of the industry in which a firm operates (Baldwin, 1997a). The more novel an innovation is, the more likely it is to be protected. Small firms are more likely to use trade secrets and large firms are more likely to use patents. Product innovations are more likely to be protected by patents while process innovations are more likely to use trade secrets. Chemical and machinery industries are more likely to be users of patents since patents require clear standards for definition and defence against infringements and products in these industries generally possess the required characteristics. Research by Taylor and Silbertson (1973) and Mansfield (1986) suggest that pharmaceuticals and chemicals, followed by mechanical engineering, benefit most from the patent system.

The importance of the various forms of intellectual property rights is measured here in two ways. The first is the percentage of innovators making use of the various instruments used to protect knowledge capital—since the actions of service firms can be used as a measure of their preferences. The second is provided by evaluations of the efficacy of each mode given by innovators who use intellectual property. Innovators indicated if they felt that the various intellectual property rights provided an effective method of preventing competitors from bringing to market copies of their innovation, scoring this effectiveness on a scale of 1 (not at all effective) to 3 (effective) to 5 (extremely effective).

Generally, fewer than half of the innovators in each industry report using any one of the property rights. The primary instruments used by innovators in these industries are copyrights and trademarks (Figure 4.7.1). Trade secrets come third in each case. There are three differences between these results and those recently reported for the manufacturing sector (Baldwin, 1997a). First the incidence of use of trademarks is considerably higher than in manufacturing; secondly, copyrights are both absolutely and relatively more important. Finally, patents are relatively less important.

**Figure 4.7.1: Use of Intellectual Property Protection by Innovators**



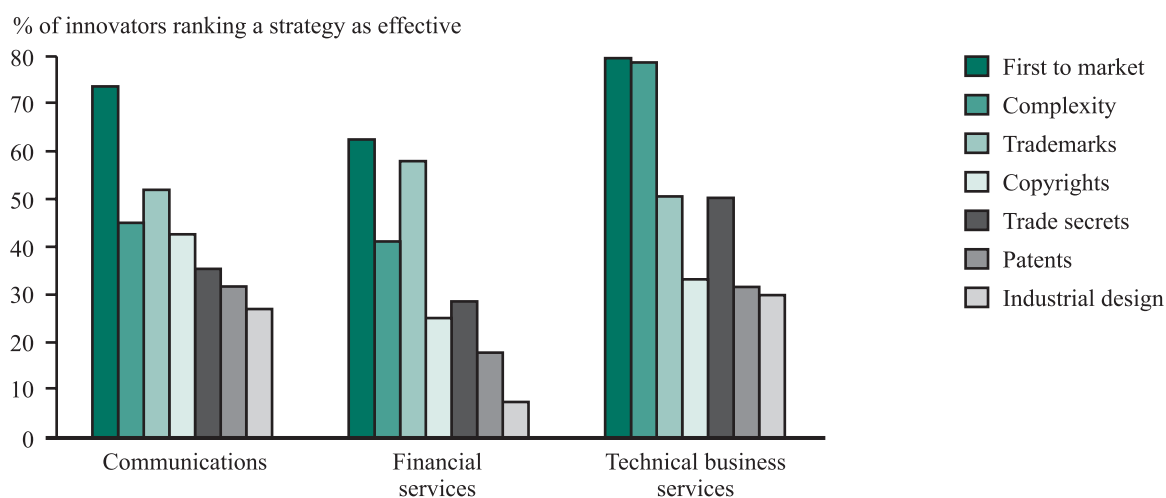
Across the service sectors, there are considerable variations in the use of intellectual property rights. Innovators in communications generally place the least emphasis on the dominant two instruments (copyrights and trademarks). Financial service innovators are relatively heavy users of trademarks. Innovators in technical business services use both copyrights and trademarks equally and are the only innovators who make any use of patents.

The effectiveness of the different instruments can be judged by the percentage of innovators who use intellectual property that rank an intellectual property right as effective or better (Figure 4.7.2). In general, copyrights and trademarks score highly. 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. It is interesting to note that while copyrights are the form of intellectual property used most intensively by innovators in this industry, only a third of those who use intellectual property find them to be effective.

The differences across sectors in the importance given to the various forms of intellectual property protection accord with the differences in innovation regimes reported previously. All sectors focus on retaining customers who can relatively easily switch to competitors. Use of trademarks for brand identification purposes is, therefore, important. On the production side, all sectors concentrate on computer software and software codes where copyright is important. The greater use of patents in technical business services is consistent with a greater emphasis on research and development. Finally, the fact that trade secrets are given greater emphasis in technical services can be explained by the fact that most technical business service firms are small—since small firms tend to give relatively greater emphasis to trade secrets (Baldwin, 1997a).

**Figure 4.7.2: Ratings of the Effectiveness of Intellectual Property Strategies by Innovators who use Intellectual Property**



While many innovators do not consider intellectual property instruments effective, they nonetheless do innovate and they do find ways to protect their intellectual property. This protection is achieved through other means, such as complex product design or being first in the market. Generally, manufacturing firms rank strategies like being first in the market above the use of patents or trade secrets—at least with regards to their ability to protect their market position (Baldwin, 1997a; Cohen et al., 1996). This is also the case for the service firms studied here (Figure 4.7.2). In all industries, a solid majority of innovators using intellectual property rank being first to market as being effective. This is considerably higher than the top ranked formal statutory right—trademarks. Technical business services also rank complexity of product design higher than trademarks.

A final measure of the importance of intellectual property rights is the extent that innovators trade these rights—by either selling or buying them. Here there is evidence that a small group of innovating firms transfer rights among themselves. Between 33% and 40% of innovators in each of the three industries who use intellectual property rights also traded in them over the 1994-1996 period.



## 5. Conclusion

The communications, financial and technical business services industries are at the core of the innovation system. They are undergoing rapid technological changes and increased competition due to regulatory changes. They are highly innovative—just as innovative as the manufacturing industries like computer products and pharmaceuticals that have often been described as the leaders in innovative activity. The dynamic element they contribute to economic progress is further enhanced by the fact that these industries provide core services to all other industries. Hence, innovation here translates into innovation throughout the broader economy. The high incidence of innovation exhibited in these industries is also found in the UK, Germany and Italy.

Many of the challenges that innovators in these industries face, and the tools with which they meet those challenges, are similar. In each of the industries, customers can easily substitute among producers, and there is a high threat of entry of new competitors. These two factors are among the greatest sources of uncertainty faced by innovators in each of the industry groups. Similarly, innovators in each of the industries report that customer service, flexibility in responding to customer needs, price and quality are among the most intensive elements of their competitive environment. Basic marketing and management tools—in addition to technology or innovation strategies—are the crucial tools that innovators possess to combat these risks.

Intense competition implies that a commitment to excelling in their line of business is the central strategy for succeeding. Indeed, two of the most important strategies in each of the three industries are satisfying existing customers and improving positions in existing markets. Hence, innovation activities in all three industries are motivated by attempts to maintain or increase market share. Improving product quality is a key element throughout and improved quality of service is the most common impact of innovation.

The importance of focusing on customer requirements is evident not just in the objectives and impacts of innovation. It is also seen in the information regimes that support the innovation process within these service sectors. Customers are the single most important source of information for innovation in each of the industry groups. This finding mirrors the results of a survey of innovation in German service firms. Moreover, two of the most important internal sources of information are management and marketing, both of which are closely tied to customers. Finally, trademarks are the most common intellectual property right used to retain customers.

While innovation has consistently been found to be positively associated with prosperity, many firms chose not to innovate, or innovate infrequently. There are numerous factors inhibiting firms from undertaking such activity. The primary factor limiting innovative activity in each of the industry groups is the high cost of innovation. Capital shortages and risk are also important barriers in two of the industries. This finding is consistent with that found in Germany.

These similarities notwithstanding, differences in industry structure, competitive environment, level of capital intensity, production processes and demographics across the three groups also translate into differences in innovative activities, strategic emphases, and the goals, realizations, and impediments to innovation.

Firms are generally largest in financial services and, hence, innovation—particularly highly complex innovation involving product, process and organizational innovation—is most common here. Uncertainties in this industry tend to be concentrated in two areas: the ability of customers to substitute and the threat of new entrants. This high vulnerability to loss of customers generates intense competition in all areas. Innovators respond to these pressures by placing greater relative emphasis on both their own human resources and on those of consultants and marketing experts hired to assist them in innovating to expand market share. Consistent with their involvement in the various types of innovative activity, and their need to compete on multiple levels, they emphasize both product and process enhancements. Intense competition not only drives these firms to innovate, but also often provides the very ideas for innovative activities. Impediments to innovation appear to be least common here. This is likely due to two factors. First, financing presents little difficulty for these firms. Second, the extent to which innovative ideas can be borrowed from competitors suggests that proprietary rights offer less protection here than elsewhere.

Firms in the communications sector operate in a different environment. Here production technology changes rapidly and the liquidation value of machinery and equipment is low. Regulation also limits the extent to which firms can innovate. Quality is the most intense area of competition and, thus, innovators tend to focus on improving their product. Innovators form networks with suppliers in order to access high quality inputs and information for innovation. The primary barrier to innovation is the high costs of undertaking such activities. The impediments created by legislative barriers are given the most importance here.

Technical business services consists of small innovators who, in many instances, have to work closely with customers in order to customize their product. These innovators differ from those in the other two sectors in that they face uncertainty from more sources—substitutability, new competitors, rapidly changing production technology, rapid product obsolescence and difficulty in predicting customers' and competitors' actions. Innovators here focus on satisfying their existing customers, and seeking out similar customers with similar specialized needs, in other markets. Emphasis on customer diversification is highest in this sector. It is accomplished by extending the product line both domestically and in foreign markets. In turn, this is achieved by emphasizing a wide range of quality-enhancing characteristics when innovating—product reliability, speed of delivery, user friendliness, accessibility as well as adaptability to customer requirements. While some of these are also emphasized by innovators in the other industries, technical business services innovators stand out for the depth and breadth of the intensity of their effort here.



Research and development is particularly important in technical business services, both as a general business strategy and as a source of information for innovation. While innovators in communications services have concentrated on product/service reliability, and those in financial services have concerned themselves with improving adaptability to customer requirements and speed of delivery, innovators in technical business services experienced greater impacts in each of these, and other, areas. Innovators here also face greater financial barriers from a lack of capital—either equity or outside capital—to fund innovation costs; but then innovation is also perceived to be riskier—costs are more difficult to predict, market success is lower and innovation is perceived as more likely to be imitated. Lack of qualified personnel is a greater problem in technical business services than it is in either of the other two industries.





## 6. Summary Tables

All data presented in the following tables are weighted. Standard errors for the technical business services sample appear in parentheses. Unless otherwise stated, the reference period for all data is 1994-1996.

### ***Innovation Activity***

	Communications	Financial Services	Technical Business Services
	% of respondents		
<b>Introduced an innovation, 1994-1996</b>	45.0	61.8	42.6 (1.3)
<b>Type of innovation introduced:</b>	% of innovators reporting type of innovation		
Product only	25.5	27.3	33.9 (1.9)
Comprehensive	18.1	33.2	19.0 (1.4)
Product and process	23.4	22.1	18.6 (1.4)
Process or organizational	19.8	5.5	14.9 (1.4)
Product and organizational	9.7	7.3	11.2 (1.1)
Process and organizational	3.6	4.6	2.5 (0.6)

### ***Innovation Rates by Size of Firm***

	Communications	Financial Services	Technical Business Services
	% of respondents		
0 to 19 employees	39.4	20.3	38.7 (1.4)
20 to 99 employees	57.3	62.4	62.2 (2.6)
100 to 499 employees	61.6	68.0	68.2 (6.0)
500 and over employees	61.7	100.0	86.4 (4.6)

### ***Frequency of Introducing Innovation***

	Communications	Financial Services	Technical Business Services
	% of innovators		
More than once a year	23.2	44.7	44.4 (1.9)
Once a year	26.2	31.6	25.2 (1.7)
Every second year	13.8	7.4	9.6 (1.1)
Every third year	8.0	3.2	5.2 (0.8)
Less frequently	28.7	13.1	15.5 (1.4)

## ***Novelty of Innovation***

	Communications	Financial Services	Technical Business Services
		% of innovators	
World first	5.3	--	16.8 (1.3)
Canada first	10.4	7.1	11.9 (1.6)
Local-market first	54.9	11.2	27.8 (2.7)

-- amount too small to be expressed

## ***Competitive Environment***

	Communications	Financial Services	Technical Business Services
		% of innovators agreeing with statements about their industry	
High threat of arrivals from new competitors	60.7	69.9	61.9 (1.9)
Consumers can easily substitute	49.2	90.4	50.1 (1.9)
Production technology changes rapidly	60.3	45.0	56.5 (1.9)
Low liquidation values of machinery/equipment	60.8	32.2	58.2 (1.9)
Products quickly become obsolete	32.6	41.3	48.6 (1.9)
Competitors' actions are difficult to predict	33.4	30.5	38.5 (1.9)
Consumer demand is difficult to predict	34.0	24.9	39.9 (1.9)

## ***Intensity of Competition***

	Communications	Financial Services	Technical Business Services
		% of innovators reporting highly intense competition in their industry	
Price	43.5	87.0	59.3 (1.9)
Flexibility in responding to customer needs	47.6	82.7	59.1 (1.9)
Quality	50.0	72.4	66.7 (1.8)
Customer service	48.4	85.1	67.2 (1.8)
Customization of products	37.1	72.3	53.4 (1.9)
Offering a wide range of related products	39.6	77.7	40.8 (1.9)
Frequently introducing new products	33.5	69.8	37.0 (1.8)

## General Business Strategies

	Communications	Financial Services	Technical Business Services
	% of innovators giving a high importance to various business strategies		
Financing strategies	74.8	77.6	76.9 (1.7)
Human resource strategies	67.5	83.0	75.8 (1.8)
Marketing strategies	87.4	93.5	93.8 (0.9)
Management strategies	84.3	85.2	83.5 (1.5)
Production strategies	72.1	61.3	72.1 (1.8)
Research and development strategies	52.3	55.5	70.5 (1.8)

## Importance of Business Strategies

	Communications	Financial Services	Technical Business Services
	% of innovators rating very important or crucial		
Financing			
Flexibility in meeting unforeseen circumstances	59.6	55.7	57.9 (1.9)
Financial management	70.3	74.3	70.8 (1.8)
Finding/maintaining capital	61.5	53.2	54.4 (1.9)
Human resources			
Providing incentive compensation plans	38.6	62.9	37.6 (1.8)
Recruiting skilled employees	57.4	79.9	66.6 (1.9)
Training	54.0	70.0	58.0 (1.9)
Marketing			
Using third party distributors	15.1	42.9	24.7 (1.7)
Promoting company or product reputation	59.6	72.4	68.7 (1.8)
Satisfying existing customers	83.3	84.2	89.3 (1.2)
Improving position in existing markets	67.1	82.2	74.3 (1.8)
Targeting new foreign markets	6.5	16.3	36.5 (1.8)
Targeting new domestic markets	44.9	70.5	60.0 (1.9)
Management			
Consensus decision-making	53.0	53.0	43.6 (1.9)
Delegating decision-making	43.8	43.5	31.7 (1.7)
Using information technology	62.4	78.0	70.2 (1.8)
Continuous quality improvement	72.6	75.4	72.6 (1.8)
Production			
Using high quality suppliers	62.9	31.0	50.4 (1.9)
Using computer controlled processes	50.3	51.9	49.6 (1.9)
Reducing production times	27.1	43.3	46.1 (1.9)
Improving efficiency of input use	40.2	43.6	46.1 (1.9)
Technology and R&D			
Protecting products/processes with IPRs	10.1	11.7	24.9 (1.6)
R&D capabilities	12.6	22.3	41.7 (1.9)
Purchasing other technology	43.1	35.4	27.2 (1.7)
Developing new/refining existing technology	34.8	42.7	57.7 (1.9)

## Objectives of Innovation

	Communications	Financial Services	Technical Business Services
	% of innovators rating very significant or crucial		
Reducing unit labour costs	23.5	42.5	26.5 (1.7)
Cutting consumption of materials	10.6	3.2	10.0 (1.1)
Cutting energy consumption	9.2	--	5.4 (0.8)
Reducing product design costs	8.6	9.4	20.9 (1.6)
Reducing production lead times	14.8	31.5	27.3 (1.7)
Other means of lowering costs	8.6	6.5	8.9 (1.1)
Replace products being phased out	23.4	20.6	23.8 (1.7)
Extend product range within main product field	35.9	42.6	44.3 (1.9)
Extend product range outside main product field	15.6	16.1	20.7 (1.6)
Maintain market share	70.3	61.7	61.4 (1.9)
Increase market share	59.4	68.7	64.4 (1.9)
Open new domestic markets	40.9	49.3	49.2 (1.9)
Open new American markets	3.7	7.6	27.6 (1.0)
Open new European markets	--	--	11.7 (1.0)
Open new Japanese markets	--	--	6.0 (0.8)
Open new other Pacific Rim markets	--	3.3	10.2 (1.0)
Open other new markets	--	--	9.2 (1.0)
Improve production flexibility	23.0	29.8	34.3 (1.8)
Improve product quality	60.0	51.1	57.2 (1.9)
Improve working conditions	25.9	16.1	25.3 (1.7)

-- amount too small to be expressed

## Impacts of Innovation

	Communications	Financial Services	Technical Business Services
	% of innovators rating very significant or crucial		
Productivity of employees	25.8	31.9	30.4 (1.8)
Motivation of employees	26.9	24.0	26.2 (1.7)
Productivity of customers	22.6	15.7	41.0 (1.9)
Range of goods & services	38.3	27.9	43.4 (1.9)
Geographic accessibility of product/service	23.2	13.3	26.2 (1.7)
Customers' quality of life	24.9	13.2	21.4 (1.6)
Ability to adapt to customer requirements	36.2	38.9	53.2 (2.0)
Speed of supply or delivery	35.2	39.9	48.2 (2.0)
Access by hours	29.1	25.0	33.5 (1.9)
User-friendliness of product/service	32.3	30.7	43.6 (1.9)
Product/service reliability	46.1	25.2	50.6 (2.0)
Ability to comply with safety requirements	14.2	11.0	19.9 (1.5)

## Effect of Most Important Innovation

	Communications	Financial Services	Technical Business Services
	% of innovators		
On demand for labour:			
Decrease	10.1	13.2	4.2 (0.8)
No change	64.2	61.3	63.3 (1.8)
Increase	25.7	25.5	32.5 (1.7)
On skill requirements:			
Decrease	3.5	3.2	2.0 (0.6)
No change	68.0	65.8	62.3 (1.8)
Increase	28.5	31.0	35.7 (1.8)

## Sources of Information for Innovation

	Communications	Financial Services	Technical Business Services
	% of innovators rating as very important or crucial		
<b>Internal:</b>			
Management	57.8	57.5	47.3 (1.9)
Marketing	45.9	54.1	46.8 (1.9)
In-house R&D	22.0	38.1	57.4 (1.9)
Production	27.4	34.9	34.0 (1.8)
Other internal sources	10.0	9.7	9.2 (1.2)
<b>External:</b>			
Customers	66.1	64.8	76.2 (1.7)
Competitors	43.7	59.6	45.0 (1.9)
Suppliers	48.1	12.9	32.6 (1.8)
Technology acquisition	40.1	19.3	25.8 (1.7)
Consultants	10.0	19.0	18.8 (1.5)
<b>Generally available information:</b>			
Conferences, meetings, publications	31.7	22.0	37.9 (1.9)
Fairs and exhibitions	19.6	4.2	20.4 (1.6)
Government information programs	17.9	8.6	16.0 (1.4)
Social gatherings	12.4	3.3	11.9 (1.3)
Patent literature	6.7	--	9.2 (1.1)
<b>Education and research:</b>			
Higher educational institutions	10.0	4.4	24.4 (1.7)
Private research institutions	10.5	9.7	13.4 (1.4)
Government research institutions	7.0	--	10.6 (1.1)

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## ***Technologies Important to Innovation***

	Communications	Financial Services	Technical Business Services
	% of innovators reporting that a technology was important to innovation activity		
Software	72.3	94.8	92.5 (1.0)
Computers and related hardware	74.7	92.7	91.8 (1.0)
High performance communication networks	56.2	51.6	49.4 (1.8)
Media-related technology	50.1	36.6	58.3 (1.9)
Transportation and traffic technology	21.4	5.5	12.2 (1.1)
Measuring, automation, control and steering technology	17.9	7.3	20.4 (1.5)

## ***Impediments to Innovation***

	Communications	Financial Services	Technical Business Services
	% of innovators rating as very significant or crucial		
High risk related to feasibility	22.2	30.7	34.0 (1.8)
High risk related to market success	25.1	34.7	39.8 (1.8)
Innovation easily imitated	19.0	28.3	32.6 (1.8)
Costs difficult to predict	27.6	29.8	36.4 (1.8)
High costs	45.9	44.5	45.0 (1.9)
Long amortization period	29.7	21.4	31.5 (1.8)
Lack of equity capital	30.9	22.1	40.6 (1.9)
Lack of outside capital	28.8	10.7	37.5 (1.8)
Lack of qualified personnel	22.7	13.4	29.9 (1.7)
Lack of technical equipment	21.1	6.2	16.0 (1.4)
Internal resistance	8.2	11.8	7.2 (0.9)
Long administrative approval	15.0	11.8	6.4 (0.9)
Legislative or legal restrictions	29.6	18.8	10.2 (1.1)

## ***Use of Intellectual Property***

	Communications	Financial Services	Technical Business Services
	% of innovators using one or more of:		
Copyrights	14.5	13.0	25.7 (1.6)
Patents	3.3	--	9.0 (1.0)
Trade secrets	5.1	9.9	16.6 (1.4)
Trademarks	14.4	36.2	20.6 (1.4)
Other	3.1	7.8	14.6 (1.2)

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## ***Effectiveness of Intellectual Property Strategies***

	Communications	Financial Services	Technical Business Services
	% of innovators using intellectual property who rate a strategy as effective		
First to market	73.5	62.4	79.4 (2.6)
Complexity	45.0	41.1	78.5 (2.8)
Trademarks	51.9	57.9	50.5 (3.6)
Copyrights	42.6	25.1	33.2 (3.0)
Trade secrets	35.4	28.6	50.2 (3.8)
Patents	31.7	17.9	31.6 (3.6)
Industrial design	27.0	7.6	29.9 (4.3)





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## 1. Innovation

### 1A. Innovation Activity

- |  |  |                                       |   |
|--|--|---------------------------------------|---|
| 1. Did your firm offer new or improved <b>products (goods or services)</b> to your customers during 1994-1996?   | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No |   |
| 2. Did your firm introduce new or improved <b>processes</b> in your firm during 1994-1996 for the supply of products (goods or services)?  | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No |   |
| 3. Did your firm introduce any significant improvements in terms of <b>organizational structure or internal business routines</b> in 1994-1996?  | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No |   |
| In answering questions 1 to 3, did you have difficulty distinguishing between:   |  |                                       |   |
| 4. New or improved <b>products</b> (question 1) and new or improved <b>processes</b> (question 2)?   | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No |   |
| 5. <b>New processes</b> (question 2) and <b>organizational changes</b> (question 3)?   | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No |   |
| 6. Did your firm undertake in <b>1996</b> activities (R&D, acquisition of technology, patents, trademarks, etc.) expected to result in the introduction of new or improved products and processes? | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No | <sup>3</sup> <input type="radio"/> don't know |
| 7. Did your firm undertake any innovation activity during 1994-1996 that did not result in the introduction of a new or improved product or process?   | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No | <sup>3</sup> <input type="radio"/> don't know |
| <b>If yes,</b>   |  |                                       |   |
| a) Is it because the innovation activity is ongoing?   | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No | <sup>3</sup> <input type="radio"/> don't know |
| b) Is it because the innovation activity was abandoned?  | <sup>1</sup> <input type="radio"/> Yes | <sup>2</sup> <input type="radio"/> No | <sup>3</sup> <input type="radio"/> don't know |

## 1B. Impact of Innovation Activity

### Qualitative Impact

How did innovations (product, process and others) introduced in 1994-1996 affect your firm? Please assess the following statements based on your experience, and check box using the following scale:

8. The introduced innovations have increased:

	insignificant	slightly insignificant	moderately significant	very significant	crucial	not relevant
<b>A. Productivity</b>						
i) the productivity of your employees	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) the motivation of your employees	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) the productivity of your customers	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>B. Product or market expansion</b>						
i) the range of goods and services provided to your clients	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) the accessibility to your goods and services over a wider geographic area	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) your customers' quality of life	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>C. Quality of service</b>						
i) your ability to adapt flexibly to different customer requirements	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) the speed of supplying and/or delivering your services	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) accessibility of your services/products to your clients in terms of the number of hours	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iv) the user-friendliness of your services/products	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
v) the reliability of your services/products	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>D. Environmental impact</b>						
i) your ability to comply with safety requirements (technical regulations, data security, etc.)	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) your ability to meet ecological, medical or ergonomic requirements	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) the serviceability, durability, or recyclability of your products	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>



## Quantitative Impact

9. Please indicate how often your enterprise, on the average, introduces new products or processes.  
Please check one box below.

More than three times a year	1	<input type="radio"/>
Three times a year	2	<input type="radio"/>
Twice a year	3	<input type="radio"/>
Once a year	4	<input type="radio"/>
Every second year	5	<input type="radio"/>
Every third year	6	<input type="radio"/>
More seldom than every third year	7	<input type="radio"/>

## 1C. Objectives of Innovation

10. Please indicate the importance of the following objectives of your firm's innovation activities during 1994-1996.  
Check one box for each item using the following scale:

	insignificant	slightly insignificant	moderately significant	very significant	crucial	not relevant
A. Lower production costs by:						
i) reducing unit labour costs	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) cutting consumption of materials	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) cutting energy consumption	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iv) reducing product design costs	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
v) reducing production lead times	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
vi) other means	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
B. Replace products being phased out	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
C. Extend product range						
i) within main product field	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) outside main product field	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
D. Maintain market share	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
E. Increase market share	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
F. Open up new markets						
i) new domestic target groups	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) European	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) USA	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

10. Please indicate the importance of the following objectives of your firm's innovation activities during 1994-1996. Check one box for each item using the following scale: – (concluded)

	insignificant	slightly insignificant	moderately significant	very significant	crucial	not relevant
F. Open up new markets – (concluded)						
iv) Japan	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
v) other Pacific Rim (Hong Kong, Indonesia, Malaysia, Singapore, South Korea, Taiwan, Thailand and the Philippines)	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
vi) other	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
G. Improve production flexibility	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
H. Improve product quality	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
I. Improve working conditions	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

### 1D. Sources of Information for Innovation

11. Please indicate the degree of importance attached to various sources. Check one box for each item.

	insignificant	slightly insignificant	moderately significant	very significant	crucial	not relevant
A. Sources internal to the enterprise:						
i) in-house R&D	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) marketing	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) production	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iv) management	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
v) other	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
B. External sources:						
i) competitors in your line of business	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) acquisition of embodied technology equipment	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) clients or customers	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iv) consultancy firms	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
v) suppliers of equipment, material and components	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
C. Generally available information						
i) government information programs	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) fairs, exhibitions	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) professional conferences, meetings, publications	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iv) gatherings of a social nature	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
v) patent literature	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

11. Please indicate the degree of importance attached to various sources. Check one box for each item. – (concluded)

	insignificant	slightly insignificant	moderately significant	very significant	crucial	not relevant
D. Education and research institutions						
i) university and other higher educational institutions	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) government research institutions	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) private research institutions	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

12. Innovation activities in the service sector often go hand-in-hand with the introduction and/or development of new technologies. In terms of the innovation activities undertaken by your firm during 1994-1996, were the following technologies important?

A. Information and communication technologies:

i) software	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know
ii) computers and related hardware	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know
iii) high performance communication networks (e.g., broadband, ISDN)	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know
iv) media related technology, (e.g. CD ROM)	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know

B. New developments in the area of:

i) transportation and traffic technology (e.g., vehicle, transmission technology, logistics)	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know
ii) measuring, control and steering technology, automation	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know
iii) medical technology	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know

### 1E. Barriers to Innovation

13. Please indicate the degree of importance attached to various impediments by using the following scale:

	insignificant	slightly insignificant	moderately significant	very significant	crucial	not relevant
A. Risk						
i) high risk related to the feasibility of innovative projects	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) high risk in terms of the innovation's market success	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) innovation easily copied by other companies	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
B. Cost						
i) innovation cost difficult to predict	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) high cost of innovation projects	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) long amortization period of innovations	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

13. Please indicate the degree of importance attached to various impediments by using the following scale: – (concluded)

	insignificant	slightly insignificant	moderately significant	very significant	crucial	not relevant
<b>C. Availability of inputs</b>						
i) lack of equity capital for implementation of innovative projects	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) lack of outside capital for implementation of innovation projects	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) lack of qualified personnel for innovation projects	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iv) lack of technical equipment for innovation projects	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>D. Corporate style</b>						
i) internal resistance to innovation	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) long administrative/approval process for innovation projects	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>E. Others</b>						
i) innovation technologies not yet sufficiently well developed	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
ii) legislation, legal regulations affecting innovations	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iii) innovations or innovation activities were not required because they were undertaken by associated companies (e.g. parent or subsidiary)	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
iv) innovations or innovation activities were not required because of your company's market position	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

### 1F. Most Important Innovation

14. Was this innovation:

a) a world first?	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know
b) if not, was it a Canadian first?	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know
c) a local market first?	1 <input type="radio"/> Yes	2 <input type="radio"/> No	3 <input type="radio"/> don't know

15. Companies often pursue innovation projects in cooperation with other companies or public institutions. Here, we specifically mean cooperative ventures where both partners, in contrast to pure contract research, actively pursue joint innovative projects. Was your enterprise involved in such cooperative ventures in **1996**?

1  Yes      2  No

16. Please indicate the effect of this innovation on the number of workers in your firm.

	Decrease	Increase	No Change
Overall	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>

17. Please indicate how the skill requirements of your workers were changed as a result of this innovation?

	Decrease	Increase	No Change
Overall	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>

**2. R&D (Research and Development)**

1. Did your firm engage in R&D activities in 1994-1996? 1  Yes      2  No

2. Does your firm engage in R&D on a continuous or occasional basis? 1  continuous      2  occasional

3. Did your firm have any cooperation arrangements on R&D activities with other enterprises or institutions in 1994-1996? 1  Yes      2  No

4. Did your firm engage in alliances for R&D purposes with other firms or organizations in 1994-1996? 1  Yes      2  No

**3. Intellectual Property**

1. Please indicate the extent to which the following methods have been used by your firm to protect its intellectual property in **Canada** over the last three years 1994-1996.

	Number of usages (where relevant)				
	None	1 to 5	6 to 20	21 to 100	100 +
a) Copyrights	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>
b) Patents	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>
c) Industrial design	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>
d) Trade secrets	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>
e) Trademarks	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>
f) Integrated circuit designs (semi conductor chips)	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>
g) Other	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>

2. How effective are the following means of preventing your competitors from bringing to market copies of your new product or process technology. Please use the following scale:

Intellectual property rights associated with:	not at all effective	somewhat effective	effective	very effective	extremely effective	not relevant
a) Copyrights	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) Patents	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) Industrial designs	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
d) Trade secrets	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
e) Trademarks	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
f) Integrated circuit designs	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
Other strategies						
g) Complexity of product design	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
h) Being first in the market	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

3. During the last three years, 1994-1996, has your firm assigned the right to use intellectual property to, or acquired the right to use intellectual property from, another firm?

1  Yes      2  No

#### 4. *Competitive Environment*

1. For the industry in which your firm operates, how strongly do you agree or disagree with each of the following statements? Please indicate your opinion by using the following scale where 1 is strongly disagree and 5 is strongly agree:

	disagree	neutral	agree	not applicable		
a) Consumer demand is easy to predict	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) Consumers can easily substitute among competitive product	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) Competitors' actions are easy to predict	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
d) Competitors can easily substitute among suppliers	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
e) The arrival of new competitors is a constant threat	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
f) Products quickly become obsolete	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
g) Production technology changes rapidly	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
h) Liquidation value of machinery and equipment is well below purchase cost	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

2. For the industry in which your firm operates, rate the intensity of competition among firms in the following areas, using the scale of 1 to 6, with 1 for low and 5 for high, 6 for not applicable:

	competition					
	low				high	not applicable
a) <u>Price</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) <u>Flexibility in responding to customer needs</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) <u>Quality</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
d) <u>Customer service</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
e) <u>Customization of products</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
f) <u>Offering a wide range of related products</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
g) <u>Frequently introducing new/improved products</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

3. Rate the importance of each of the following factors to the ongoing success of your firm, using the scale of 1 to 6, with 1 for low and 5 for high, 6 for not applicable:

	importance					
	low				high	not applicable
<b>Technology and R&amp;D</b>						
a) <u>Protecting products/processes with intellectual property rights (patents, trademarks, etc.)</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) <u>R&amp;D capabilities</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) <u>Purchasing other technology</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
d) <u>Developing new/refining existing technology</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>Management</b>						
a) <u>Consensus decision-making</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) <u>Delegating decision making</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) <u>Using information technology</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
d) <u>Continuous quality improvement</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>Production</b>						
a) <u>Using high quality suppliers</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) <u>Using computer controlled processes</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) <u>Reducing production times</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
d) <u>Improving efficiency of input (materials or services) use</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>Marketing</b>						
a) <u>Using third party distributors</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) <u>Promoting company or product reputation</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) <u>Satisfying existing customers</u>	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

4. Rate the importance of each of the following factors to the ongoing success of your firm, using the scale of 1 to 6, with 1 for low and 5 for high, 6 for not applicable: – (concluded)

	importance					
	low				high	not applicable
<b>Marketing – (concluded)</b>						
d) Improving position in existing markets	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
e) Targeting new foreign markets	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
f) Targeting new domestic markets	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>Financing</b>						
a) Flexibility in meeting unforeseen circumstances	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) Financial management (costs, cashflow)	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) Finding/maintaining capital	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
<b>Human resources</b>						
a) Providing incentive compensation plans	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) Recruiting skilled employees	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) Training	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

5. Rate the importance of each of the following factors to your firm's competitive strategy, using the scale of 1 to 6, with 1 for low and 5 for high, 6 for not applicable:

	importance					
	low				high	not applicable
a) Price	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
b) Flexibility in responding to customer needs	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
c) Quality	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
d) Customer service	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
e) Customization of products	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
f) Offering a wide range of related products	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>
g) Frequently introducing new/improved products	1 <input type="radio"/>	2 <input type="radio"/>	3 <input type="radio"/>	4 <input type="radio"/>	5 <input type="radio"/>	6 <input type="radio"/>

### Note to readers:

For scale-based questions, a 'not applicable' or 'not relevant' response was originally captured as '6'. To improve readability, we have referred to these responses as representing '0' values throughout the text.