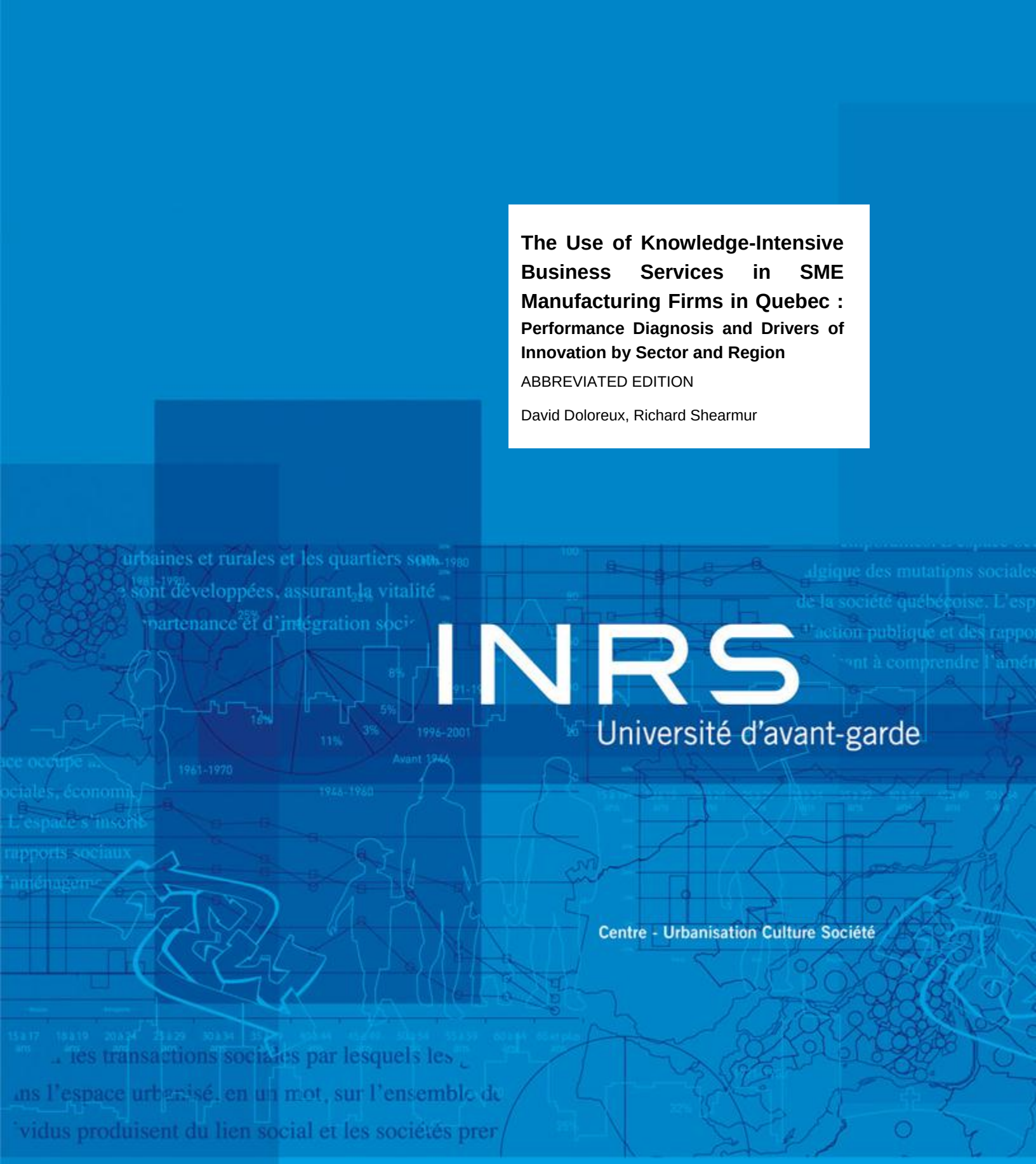
The Use of Knowledge-Intensive Business Services in SME Manufacturing Firms in Quebec : Performance Diagnosis and Drivers of Innovation by Sector and Region

ABBREVIATED EDITION

David Doloreux, Richard Shearmur



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    - Réjean Landry, Professor, University of Laval

Executive summary

Goal of the report

This report, which has benefited from a financial contribution from Canada Economic Development's Regional Development Study program, aims to explore the following questions:

- To what extent does the use of knowledge-intensive business services (KIBS) contribute to innovation in manufacturing firms?
- Do these services act alone or do they interact with each other? Are some services more associated with innovative activities than others?
- Do services used differ according to the location of the manufacturing firms in relation to urban areas and major cities?
- Are establishments that are located far from their service providers less innovative?

Method

A survey of 804 manufacturing establishments was carried out from April to June 2011 in the province of Quebec. The sample is representative of economic sectors (classified in four large manufacturing sectors) and of central and peripheral locations (classified by presence in urban or rural zones and by distance from major cities). The results of this survey have been compiled, geo-referenced, and analyzed with exploratory techniques (two-way tables, chi-squared distribution) and more advanced techniques (factorial analysis, classification analysis, simple regression analysis, multi-level analysis).

Results

A. Innovation and service utilization

1. *There is a clear link between the use of external KIBS and innovation within manufacturing establishments.* This link applies to all kinds of innovations (technological innovations involving new products or processes; or management innovations involving new approaches to management or marketing). However, the link is stronger when it comes to technological innovations. In addition, it appears that management innovations often come after technological innovations.

2. *Technological innovations are strongly associated with the use of external services at each stage of the value chain,* and, more specifically, with knowledge identification services (information on technology and patents) and knowledge validation (patent preparation).

3. *Management innovations are strongly associated with management consulting and human resource services.* Marketing innovations are strongly associated with the use of commercialization services.

4. *In addition, technological innovations are associated with a wide range of services*: For this type of innovation, the effect of one service seems to depend on the use of other services.

B. Geography of service utilization

1. *There is no spatial variability in service utilization (nor in terms of innovation within the manufacturing establishments).* This means that service utilization is as intensive in rural and peripheral regions as it is in metropolitan regions. This result supports MacPherson's findings (2008), and most likely reflects the use of Internet and other forms of electronic communication.

2. *On average, the distance between service providers and users is greater for the most strategic services* (that is, those most strongly associated with innovation, and also the least frequently used). This is consistent with central place theory, which posits that the most strategic services tend to be located in central areas, and that clients will travel great distances to reach them when necessary.

3. *Users who travel the farthest to receive their services are not necessarily the most innovative, nor are the users of local services.* In other words, there is no link between innovation and distance to service providers.

4. This last point leads us to the conclusion that *users identify the best service providers, regardless of their geographic location within the province of Quebec*. They then travel the necessary distance to reach the providers. The greater the distance between users and providers, the greater the importance of electronic communications.

5. In accordance with our previous findings, it is also necessary to highlight that *face-to-face contacts with service providers does not increase the propensity to innovate.* This leads to the conclusion that once a relation of trust and understanding has been

established between service users and providers (generally through initial face-to-face meetings at the users' site), electronic communications become effective substitutes to routine face-to-face meetings.

C. Conclusions and implications

1. External services are strongly associated with innovation within manufacturing establishments, especially when it comes to technological innovations, and, to a lesser extent, with innovations related to management and marketing.

2. Regarding technological innovations, the use of different services throughout the value chain is strongly linked to innovation.

3. Even if manufacturing establishments in remote regions perceive that barriers inhibit their access to services (distance in particular), this does not appear to have an impact on their effective use of services.

4. Some establishments, especially in remote regions, but also in major cities like Quebec City, are located very far from their service providers. Mobility and physical accessibility between provider and user (in order to allow the first face-to-face meetings) is important.

5. KIBS *are not part of territorial innovation systems.* The distance between providers and users has no effect on the propensity to innovate. *The challenge for innovation policy is to encourage the best possible matching between the needs of service users and the capacity of service providers. The goal is not to ensure a presence of local services.*

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Introduction

Background and mandate

This exploratory research project aims at understanding the supporting role of knowledge-intensive business services (KIBS) in the innovation activities of manufacturing firms. The project has three objectives:

- To present a synthesis of knowledge on the use of services targeting the development and innovation capacity of manufacturing establishments;
- To measure the extent of service utilization by manufacturing SMEs, the strengths of the links between service utilization and innovation, as well as the characteristics (notably business type, sector, intensity of utilization) explaining the variations of KIBS utilization;
- To understand the regional variations of service utilization by manufacturing SMEs and to examine to what extent establishments located farther away from service providers are more or less innovative.

KIBS designate the activities of intermediary services that businesses integrate to their production activities (of either material goods or services), or that they integrate as autonomous services (OCDE, 2011). It should be noted, as we will emphasize later, that the core of our empirical analysis is based on *the services received by the companies*, and not on the nature or the sector of the service provider (Landry and Amara, 2010).

The originality of this research, which combines theoretical reflections and empirical analyses, is its focus on the role of KIBS as knowledge vectors influencing the innovation capacity of manufacturing firms and regions. This project offers a major contribution because, until now, statistical or national surveys have not targeted this topic from the perspective of service users in the innovation process and have not explored the links between service utilization and the territorial dimensions of service utilization.

Research method

This study is based on a survey made with manufacturing establishments in Quebec on KIBS services supporting the manufacturing process. The survey was developed within the frame of this research project, and was funded by Canada Economic Development

(2010-2012) to 66%, with the balance (34%) payed by the research funds of this research team. The survey questionnaire was developed by Professors David Doloreux and Richard Shearmur, in collaboration with Professor Réjean Landry. The questionnaire is inspired by questionnaires on innovation used by the OECD, the European Union (Community Innovation Surveys), Statistic Canada (Surveys of Innovation), and the scientific literature on innovation and services. The methodology used in this research to capture the geographical dimension of service utilization is unique and surpasses common approaches often based on a more imprecise categorization of location (for example: local, regional, national, global).

A long version of this report is available on the website of INRS (www.inrs.ca). It includes a more exhaustive literature review, a description of the analysis methodology, as well as a set of preliminary analyses. It also includes the mid-term report, which provides descriptive tables, and an annex containing the questionnaire. This final report presents the main analyses and conclusions of the study. We invite readers to consult the other reports online for further information.

Report outline

This report is divided into three sections. The first is a literature review of major research on KIBS. It provides a definition and a description of KIBS' role in the economy and their contribution to the innovation process. We will also highlight certain geographic dimensions relevant to KIBS analysis.

The second section presents the empirical findings. After having given a basic description of the results, we present the main empirical results more thoroughly (which constitute the core of the document); with a focus on the characteristics of manufacturing establishments using KIBS, the service types used, and the regional variations of service utilization in manufacturing SMEs. We also explore the links between the use of different types of services and innovation.

The third section presents the main findings and highlights the implications for innovation policy, in particular regarding the use of innovation-support services.

Section I : Literature review

1. SERVICES, INNOVATION, AND REGIONAL DEVELOPMENT

1.1 Knowledge-intensive business services (KIBS)

1.1.1 DEFINITION AND CHARACTERISTICS

The KIBS sector constitutes a service subsector and includes establishments whose primary activities depend on human capital, knowledge, and skills. KIBS' final product is a consulting service and/or knowledge transfer. Other than being knowledge intensive, these services have the particularity of being intermediary services (i.e., services intended for businesses). According to the North American Industry Classification System (NAICS), the definition includes professional, scientific and technical services (NAICS 541). The main components of this subsector are: legal services (NAICS 5411); accounting and related services (NAICS 5412); architectural, engineering and related services (NAICS 5413); specialized design services (NAICS 5414); management, scientific and technical consulting services (NAICS 5416); scientific research and development services (NAICS 5417); advertising, public relations, and related services (NAICS 5418); and other professional, scientific and technical services (NAICS 5419).

Another way of defining KIBS is by looking at the functions of the services and see how they integrate into value chains (Landry and Amara, 2010; OECD, 2007). With this approach, services are not classified according to the service provider's main sector of activity (in which some services might not correspond to the main activity identified by the NAICS code). They are rather classified according to the actual service received by the client, regardless of the provider's main sector of activity. For example, an accounting service provided by a management consulting company will be identified as an accounting service (the function of the service) and not as a management consulting service (the main activity of the service provider). The industrial classification method is the most widely used for the different definitions of KIBS (Table 1.A). For this reason, we have chosen to use this system in our literature review.

Table 1.A : Definitions of KIBS

Source	*Definition of KIBS*
Miles et al. (1995)	"Services that involve economic activities which are intended to result in the creation, accumulation or dissemination of knowledge." (p.18)
Den Hertog (2000)	"Private companies or organisations who rely heavily on professional knowledge, i.e., knowledge or expertise related to a specific (technical) discipline or (technical) functional-domain to supply intermediate products and services that are knowledge based." (p.505)
Bettencourt et al. (2002)	"Enterprises whose primary value-added activities consist of the accumulation, creation or dissemination of knowledge for the purpose of developing a customised service or product solution to satisfy the client's needs." (p.100–101)
Toivenen (2006)	"Expert companies that provide services to other companies and organisations." (p.2)
Muller and Doloreux (2009)	"Service firms that are characterised by high knowledge intensity and services to other firms and organisations, services that are predominantly non-routine." (p.65)

In general, experts agree that certain characteristics distinguish KIBS from other economic sectors:

- Knowledge is the primary asset of KIBS (Schreyögg and Geiger, 2007);
- The role of KIBS is to transfer knowledge and skills to user organizations (Leiponen, 2006);
- KIBS combine various types of highly specialized knowledge, including codified and tacit knowledge, in order to create solutions for specific problems (Miles, 2008);
- The production of KIBS requires frequent interactions and close cooperation between KIBS establishments and user organizations (Koch and Stahlecker, 2006);
- The services KIBS provide are client-specific (Muller and Doloreux, 2009);
- KIBS create value when they transform and convert knowledge at higher levels in order to increase their clients' problem-solving capacity (Allee, 2008);
- KIBS act as intermediaries between their clients' tacit knowledge base and their pool of codified knowledge, which leads to exchanges of different types of knowledge (Toivenen, 2006);

- The exchange of knowledge creates problem-solving processes in which KIBS transform information and knowledge into personalized solutions tailored to users' needs (Tether and Hipp, 2002). It is often said that the final service is coproduced with clients because it emerges when the service providers and the service users interact (Daniels, 1985).

1.1.2 THE LINKS BETWEEN KIBS ACTIVITIES AND INNOVATION

Since the 1970s, the utilization of KIBS has been growing due to the increasingly complex situation that businesses confront in their production processes (Bryson et al, 2004). As Miles (2008) points out, KIBS play an important role both in the initial stages of development of new products and services, i.e., in R&D processes, and in the subsequent stages of the innovation life-cycle and commercialization. Indeed, confronted to a flurry of new production needs, businesses increasingly need to mobilize a wide range of skills and knowledge often exceeding their internal capacity. Access to KIBS is especially important, as businesses need to innovate and compete in international and even global markets.

Another factor that has been contributing to the growth of services is firms' increasing specialization (Daniels, 1985). Since the 1970s, firms have been reducing their internal service departments and shifting their focus on production and on efforts to increase competitiveness. At the same time, the quality of external services has been improving as larger and more experienced service providers have emerged to respond to the new demand. Consequently, a symbiosis has developed between service users and providers attributable to the specialization possibilities opening up for both parties. Although this reasoning portrays manufacturing businesses as users, and service businesses as providers, these distinctions are becoming less relevant. Indeed, service businesses themselves can be important service users; and manufacturing businesses, for example IBM and Apple, can be important service providers. (Bryson et al, 2004).

Given this increasingly complex economic environment and the specialization opportunities it engenders, the business service sector is becoming particularly important for the economy as a whole and for innovation in particular. Innovation in itself can be strongly dependent on service utilization, which is what this report focuses on. The literature suggests – sometimes without providing empirical evidence – that KIBS play a major role in the innovation process (den Hertog, 2000; Muller et Zenker, 2001; Miles, 2008; Muller et Doloreux, 2009). KIBS have been portrayed as: *sources* of innovation when they intervene in the launching and development of the new innovation activities of organizations; as *facilitators* of innovation when they help

organizations at different stages of innovation; and as *vectors* of innovation when they contribute to the transfer of knowledge between or within organizations, industries, innovation networks, and clusters to apply knowledge in new contexts.

According to OECD's description (2007; 18), KIBS offer the following services: i) renewal services that are directly related to innovation such as R&D and strategic management consulting; ii) routine services, such as accounting and taxation that help improve the maintenance and management of different business' subsystems; iii) compliance services, such as legal services that help businesses deal with legal and regulatory issues; and iv) network services, such as production networks that facilitate knowledge exchange and resource distribution.

These different functions vary according to the needs of user organizations and to the logics by which businesses choose to internalize or externalize different functions. This testifies to the interactive nature of the relations between KIBS providers and users.

1.2 Innovation systems and KIBS

The innovation process within a business is influenced by factors internal to the firm as well as by external ones, the latter being shaped both by actors and activities taking place in proximity to the business, and by those located further away (Shearmur, 2011; Uyarra, 2010). The importance given to the external environment derives from the idea that innovation is an interactive and social process in which several economic actors collaborate in order to achieve an objective (Asheim and Gertler, 2005; Cooke et al., 2004). In this context, the external business environment can be seen as supporting businesses' innovation activities.

Innovation is also conceptualized as a process grounded in proximity relations, in favourable conditions for interaction and in learning focussed on the exploration of new knowledge combinations and opportunities (Torre 2009; Boschma 2005). In other words, the nearby economic actors constitute a business' environment. But this proximity is not necessarily *spatial*: in fact, the nature of this proximity is often social or organizational. Economic actors that know each other or work in similar structures will interact (thanks to this non-spatial proximity) even if they are not in physical proximity. However, authors (ex: Cooke et al, 2004; Wolfe, 2009) often argue that geographic proximity and spatial concentration stimulate interactive learning capacities by facilitating the relations between innovating businesses and the external factors needed for the innovation process.

There are numerous studies describing the spatial dimensions of innovation activities in different countries. These have generated important theoretical insights on the forms of regional development through innovation (Doloreux, 2004; Moulaert et Sekia, 2003). Among the different approaches to innovation processes and their spatial dimensions[1], the regional innovation system is a privileged approach. Many governments and political bodies, such as OECD and the European Union, chose this analytical framework to develop policies in order to stimulate regional economic development through innovation. However, the problem with the concept of territorial innovation systems is that it portrays geographic proximity as a factor stimulating innovation, while research on proximity increasingly questions this idea. (Boschma, 2005; Shearmur, 2011).

An innovation system is defined – in non-spatial terms – by the relations between constitutive elements that generate, disseminate, and utilize knowledge (Lundvall, 2007). At the regional level, this approach highlights the role of geographic proximity between the innovative actors, as well as the importance of knowledge and locally generated learning processes. A regional innovation system is ideally comprised of a productive system, composed of businesses and clusters; and of a support system, composed of intermediate education and research organizations that generate, disseminate, exploit, and utilize knowledge. The interactions between local actors generate fluxes of knowledge that draw in external knowledge, which then becomes available locally. The concept of regional innovation system has frequently been used in innovation analysis within a territorial framework in spite of the doubts over this approach (Asheim and Gertler, 2005; Cooke et al., 2004; Doloreux, 2004).

The literature on innovation and regional development contains three perspectives that address the role of KIBS in regional innovation systems: i) KIBS as innovative organizations, i.e., when they function as innovative agents within the system; ii) KIBS as sources of external information among other sources, and iii) KIBS as knowledge facilitators and vectors supporting their users' innovation processes and the knowledge transfers between organizations, industries, networks, and innovation systems and their clusters.

i) KIBS as innovative organizations: KIBS, like manufacturing firms, can be internally innovative and introduce innovative strategies (Doloreux et al, 2010; Camacho et Rodriguez, 2008). In this context, the firm itself has to introduce the conditions and

[1] For example, industrial districts, innovative milieus, learning regions, or clusters.

elements that will help it develop the capacity to introduce or significantly improve a service, a new organizational practice or marketing method, or an already existing process.

***ii) KIBS as sources of external information (among other sources)*:** A firms' innovation capacity depends on its sources of internal information (R&D capacity, use of advanced technologies, use of high value-added manufacturing practices) and its sources of external information (Amara and Landry, 2005). The *internal sources* include R&D employees, sales and marketing employees, and management employees; the *market sources* include clients, suppliers, competitors, and service firms, which include KIBS; the *institutional sources* include education and research establishments, and public and private research laboratories and institutes; finally, the *other sources* include conferences, trade fairs, scientific journals, trade or technical publications, and professional and industrial associations.

***iii) KIBS as knowledge facilitators and vectors*:** Some KIBS activities have the particularity of having knowledge as their main input *and* output (Toivenen, 2006; Gallouj, 2002). As we have seen, they perform multiple service activities such as consulting, engineering, and R&D; but also other activities such as legal services or accounting. However, one of their main contributions is to provide their clients with innovation support. In this context, KIBS act as innovation *facilitators*.

The empirical analyses presented in this paper focus on the roles of KIBS as ii) sources of external information and iii) facilitators.

1.3 Regional economic development and KIBS

The role of the service sector in national economies is gaining importance. It accounts for more than 70% of employment and value added in OECD economies (OECD, 2011). It is increasingly recognized that these services are "the engine of growth and job creation in all industrialized countries" (*Conseil de la science et de la technologie*, 2003: 2). Since the 1960s, we note a remarkable growth in the service sector in OECD countries. Within the service sector, employment levels and production in KIBS have well exceeded those of other services or less technology-intensive manufacturing activities (Shearmur, 2010).

What is the relation between regional economic development and KIBS? The KIBS phenomenon is in many ways connected to metropolitan areas where we observe high employment rates in the KIBS sector. Studies have also shown that, in spite of their footloose character, KIBS concentrate in urban areas and their number increases with

the size of the city (Chadwick et Glasson, 2008; Simmie et Strambach, 2006). Furthermore, we observe an important interregional disparity of KIBS concentration between metropolitan and non-metropolitan regions. This observation applies to the Europe (Chadwick et Glasson, 2008; Simmie et Strambach, 2006) and to North America (Shearmur et Doloreux, 2008).

From a theoretical perspective, and based on the literature on regional innovation, Simmie and Strambach (2006) describe three types of advantages related to the spatial concentration of KIBS in metropolitan areas. The first is linked to the production and distribution of knowledge and to individual and collective learning processes. To begin, geographic concentration would facilitate access to information and knowledge. Knowledge exchange, especially if implicit, could not take place without face-to-face encounters. In the service sector, local relations between service users and providers would, therefore, be necessary. In addition, Cooke and Leydesdorff (2006) suggest that business services are key components in local innovation systems; these services would contribute to local innovation system through the integration and dissemination of knowledge or specialized technological know-how.

The second advantage is linked to the opportunities found in metropolitan areas. These areas act as nodes of national and international knowledge transfer and sharing. In a metropolitan context, KIBS have various opportunities to use information and knowledge generated within the region and in remote regions. This is the reason why KIBS in metropolitan areas integrate more easily into the channels of national and international information and knowledge exchange (Bathelt. et al. 2004).

The third advantage of metropolitan areas is linked to the presence of economies of agglomeration. According to Malmberg (1997), access to markets and suppliers, to a qualified and diverse labour force, to specialized business services, and to a developed technological infrastructure is crucial for businesses, particularly for KIBS. This is because KIBS need to collect and process knowledge and input from the other organizations of their environment to be able to respond to their clients' needs rapidly.

Many studies have attempted to describe empirically the regional distribution and concentration of KIBS in national economies. For example, Chadwick and Glasson (2008) have analyzed the geographic distribution of KIBS in Great Britain. They have revealed the presence of a strong concentration of KIBS employment in the regions of London and Southeast England, which accounts for more than 30% of KIBS employment in Great Britain. In other regions, employment in the KIBS sector is less important than in other sectors, varying between 5 and 7%. However, it should be noted

that, between 1991-2001[2], job growth was higher in small municipalities (with less than 50 000 inhabitants) and in rural regions located within London's sphere of influence. In the same period, job growth in KIBS in areas outside Greater London remained marginal.

In a comparative analysis, Simmie and Strambach (2006) have observed a concentration of KIBS in European metropolitan areas. However, they also highlight interregional differences in the distribution of KIBS in these urban economies: The most successful areas are the ones where KIBS have created interactions between different users in different institutional contexts (regional and national).

Shearmur and Doloreux (2008) have analyzed the distribution and regional concentration of KIBS in Canada. In past research, we provide a more nuanced picture of the geographic distribution of KIBS than the above-mentioned studies, and present three phenomena explaining the geographic distribution and growth of KIBS in Canada. Firstly, in tune with the above-mentioned studies, we show that KIBS are strongly concentrated in the main metropolitan regions, with eight agglomerations accounting for 61.5% of KIBS employment. KIBS are found there because of their need to access qualified (but not necessarily specialized) labour, and to benefit from being in proximity to diverse economic sectors. There are also KIBS that concentrate near their regional markets. These KIBS are located in the same region as their clients but not necessarily in, or near, the same locality. These KIBS look for specialized labour and interact regionally but not necessarily locally. Finally, some KIBS are present in the same localities as their clients. These KIBS are very specialized and support specialized sectors such as forestry, oil, and the maritime sector.

Very few studies examine the interactions between service users and providers. To our knowledge, only Alan MacPherson (1997; 2008) has addressed this question from a geographic perspective. Three key observations stem from his studies on KIBS users in the state of New York:

1) Service utilization is strongly associated with innovation. However, in the agglomeration of New York, innovative businesses draw their information from different places, and move towards service providers *in order to* innovate (after having acquired the need and the opportunity to innovate). In the rest of the state, the causality is inversed: the use of services *brings* innovation to the manufacturing firms (service providers present innovation opportunities to their clients).

[2] In relative terms, not in absolute terms.

2) The use of services, which in the beginning of the 1990s was strongly associated with urban areas (particularly in the proximity of New York), has been democratized to the extent that, by the mid-2010s, there was hardly any difference between the state's peripheral regions and large urban centers. According to MacPherson (2008), this results from a higher awareness of the virtues of KIBS utilization and from the spread of electronic communication.

3) Consistent with the two first observations, innovations related to service utilization was mainly a metropolitan phenomenon in the beginning of the 1990s, but it had spread to the whole state of New York by the end of the study, in 2005.

These geographic dimensions are important since KIBS are almost always studied in a metropolitan context, with the exceptions of Shearmur and Doloreux (2008), Cooke and Leydesdorff (2006), and MacPherson (1997; 2008). Because of their relative scarcity in small cities and regions outside metropolitan areas, and based on the common assumptions found in the literature on regional innovation, the lack of access to services may constitute a considerable obstacle for the manufacturing firms that wish to use KIBS to support their innovation activities. This brings us back to the issue of accessibility, to the effects of geography on service utilization, and to the role of KIBS in local and regional economies. Our study also aims to verify MacPherson's (2008) static observations.

1.4 KIBS utilization and innovation

Relatively little is known about the impact of KIBS utilization on innovation performance. To our knowledge, other than a few sectoral studies (Martinez-Fernandez and Miles, 2011; Mas-Verdu et al., 2011; Martinez-Fernandez, 2010; Aslesen and Isaksen 2007; OCDE, 2007) and the above-mentioned contribution of MacPherson (1997; 2008), there are no comprehensive assessments or empirical surveys available. However, experts agree on the importance of KIBS as facilitators of innovation in the production system.

1.4.1 THE CHARACTERISTICS OF BUSINESSES

In this study, we emphasize the relation between the characteristics of businesses and service utilization. Until now, this important aspect has not been addressed in the scientific literature (Garcia-Quevado et Mas-Verdi, 2008). However, it is possible to make general observations. It is known that the internal characteristics of businesses play an important role in innovation. The hypothesis is that certain characteristics

influence businesses' capacity to innovate and generate related spin-offs of technology utilization. For example, the size of the business (approximate indicator of the internal resources), group affiliation, years in operation, export activities (indicator of capacity to handle exportation and international contacts), R&D expenditure, and the modes and strategies used to organize innovation and the circulation of knowledge (Becheikh *et al.*, 2005).

In this context, services can play two distinct roles:

1. Compensate for the internal capacity missing in a business. In other words, a business would seek external services in the absence of internal capacity. For example, a business without an internal R&D capacity would call for external R&D services in order to carry out R&D.

2. Complement or strengthen the existing internal capacity. For example, a business with internal R&D capacity would call for external services in order to validate their R&D activities.

1.4.2 THE STAGES OF THE INNOVATION PROCESS: THE VALUE CHAIN

Given the increasing complexity that businesses confront in the innovation process and in the innovation environment, KIBS provide crucial information and knowledge that businesses will use in the different stages of the innovation process.

From an innovation perspective, the stages of the innovation process and value chain are the following:

1. *Research on potential innovations and on innovation methods.* This stage covers the acquisition of information and knowledge. In this context, KIBS: "can help businesses differentiate the knowledge-based opportunities that have better potential from the ones with lower potential. This aid can be particularly significant for businesses that are averse to radical innovation (behavioural deficiency), that face information asymmetry (poor market information), and who have limited contacts with producers of knowledge (poor governance)" (Landry et Amara, 2010: 35).

2. *Validation of new knowledge prior to entering markets and/or prior to making major process modifications*. This stage corresponds to knowledge validation. In this context, KIBS can help businesses "decide whether they should invest based on evidence that investments will bring returns. At the knowledge-validation stage, businesses need to produce several types of concept proofs, some of

which are complementary." KIBS can help businesses produce these proofs of concept because … "the businesses can be lacking expertise, equipment, and information about the requirements of different types of proofs of concepts" (Landry and Amara, 2010: 36).

3. *Applying this new knowledge.* This entails modifying the business' operations, or beginning the production of a new product. This stage corresponds to implementation. In this context, KIBS can "help businesses exploit validated knowledge in order to develop or improve their products and processes" (Landry and Amara, 2010: 39).

Marketing the product and/or making it known on the market that the business produces better products at lower costs or in larger quantities. This stage corresponds to the marketing of new products. In this context, KIBS can help "businesses access often and very often capital, but they are less likely to help them often and very often with the scaling of innovation production, or to improve the management process, or to help businesses with marketing" (Landry et Amara, 2010: 40).

1.4.3 MANUFACTURING INDUSTRIES AND TECHNOLOGICAL REGIMES

From a sectoral perspective, each sector is characterized by different types of innovations (Malerba, 2007). In order to understand the interdependencies between sectoral dynamics and innovation, it is crucial to refer to the notion of technological regime.

The notion of technological regime describes businesses' cognitive environment and tries to account for specific sectoral and technological conditions that influence the intensity and the quality of the innovation process. Breschi et al. (2000) characterize it with the combination of four fundamental factors:

1. *The nature of the knowledge base* relates to the type of knowledge mobilized in the businesses' innovation activities.

2. *The degree of innovation opportunity* reflects the probability of innovation in a business based on the amount of money invested in R&D.

3. *The appropriability of innovation* takes into account the capacity of businesses to protect their innovations from imitation and of maximizing the profitability of their innovation activities.

4. *The cumulativeness of innovation* describes the probability linked to innovations in successive periods, the probability of innovating in time t+1 being dependent on the innovations of previous periods (or on all innovations accumulated in previous periods).

Keeping these basic notions in mind, each firm has its own way of using its knowledge base through the mobilization of codified, but also tacit, knowledge. In this way, firms create their technological trajectories based on knowledge that can be mobilized, on economic opportunities and constraints, and on the market conditions for innovation.

As for the manufacturing sector, Pavitt (1984) applies a notion very similar to technological regimes in order to identify sectors that share similar innovation processes and conditions. We will use these notions to classify our observations in sectoral categories. This could be useful since we can assume that certain services are linked to certain trajectories. Indeed, each technological trajectory corresponds to a different innovation type, and each trajectory could, therefore, reflect a different way of using knowledge. (Malerba, 2007).

1.4.4 INNOVATION, SERVICES, AND REGIONS

The local innovation system approach suggests that innovation and service utilization is more frequent in metropolitan areas because of the physical proximity between service users and providers who are highly concentrated in these areas. However, the proximity approach (Torre, 2009, Boschma, 2005) and the empirical results of Shearmur (2011, 2012), Doloreux and Shearmur (2011), Shearmur and Doloreux (2008), and MacPherson (2008) call for caution. Indeed, the proximity approach shows that the collaboration and interaction needed for innovation does not necessarily have to be local. Nothing indicates that the absence of local service providers (or other elements of innovation) slows down innovation in local businesses. In addition, the empirical analyses cited above show that regional differences in terms of innovation probability are weak or non-existent. In certain sectors, and for certain innovation types, we can even observe an *increased* propensity to innovate outside metropolitan areas.

In short, even if there are more patent registrations in metropolitan areas, the capacity to introduce innovations, in general, is not stronger there than in other areas. This could be explained by the high level of specialization of businesses in metropolitan areas (where integrating businesses innovate by recombining standard input from less innovative businesses), and, concomitantly, by the increasing internalization of innovation

processes outside metropolitan areas. Moreover, MacPherson (2008) shows that there is no variation in service utilization between urban and peripheral businesses in the state of New York due to the latter's increasing use of electronic communications.

We thus have two rather different conceptualizations of innovation and services. According to the local innovation system approach (Cooke et Leydesdorff, 2006), the presence of local services is important; and since accessible services are rare in peripheral areas, one could expect less service utilization, and, consequently, less innovation. According to the proximity approach (Boschma, 2005, Shearmur, 2011), innovation systems are not territorialized, at least not at the intra-provincial level. There is no a priori reason to believe that businesses in peripheral areas should not be as innovative as those in metropolitan areas since they use innovation factors (notably services) outside of their locality when necessary.

2. METHODOLOGY

2.1 Population and sample

In order to identify the population, we purchased the database from the *Centre de Recherche Industrielle du Québec* (CRIQ). The population targeted in this survey consists of all manufacturing establishments in the province of Quebec with five or more employees when CRIQ conducted its survey. The database generated a list of 8809 manufacturing establishments. These businesses were divided into four industrial subcategories (resource-intensive sectors, labour-intensive sectors, scale-intensive sectors, and science and specialized sectors) and five geographical regions (Montreal region, Quebec region, central regions, rural central regions, and peripheral regions)[3] that could reveal differences and similarities in service utilization. These five regions upon which the sampling was based and for which representatively has been verified have been further subdivided in the analysis.

Following this, a representative sample of 2000 establishments was created from the list according to industrial group and region. The telephone interviews with the manufacturing firms were carried out by the polling firm *INFRAS International*. In all, 804 interviews were completed, with a response rate of 40.2% (804/2000).

2.2 Service types

We have identified different business services after consulting the scientific literature on innovation and services, and, particularly, a report by Landry and Amara (2010). We have compiled a list of fifteen services classified according to their role in the value chain (Table 2.A) (these are defined by the service *received by the user*, and not by the sector to which the provider belongs):

i) accounting services; ii) human resource management services; iii) consulting services for business plan preparation; iv) identification of technological and equipment requirements; v) identification of R&D needs; vi) consulting services for access to technology, patents, etc.; vii) assistance with prototype design or technological feasibility tests ; viii) consulting services for patent preparation; ix) certification of product or process safety; x) consulting services for implementing a process or bringing a product on line; xi) consulting services for accessing capital or financing; xii)

[3] Section 2.3 and 2.4 provide a detailed explanation of the industrial and regional typologies used in this report.

consulting services for improving management processes; xiii) consulting services for commercialization or marketing; xiv) services offered by lawyer or notary; xv) fiscal services.

Table 2.A : Service types according to their role in the value chain

Category	Service type
Identification of high-value knowledge	Identification of technological and equipment requirements Identification of R&D needs Consulting services for access to technology, patents, etc.
Knowledge validation	Consulting services for business plan preparation Assistance with prototype design or technological feasibility tests Consulting services for patent preparation Certification of product or process safety
Implementation	Consulting services for improving management processes Consulting services for implementing a process or bringing a product on line Consulting services for accessing capital or financing Fiscal services
Commercialization	Consulting services for commercialization or marketing
Support services/implementation	Human resource management services Services offered by lawyer or notary Accounting services

2.3 Pavitt's sectoral classification

As with technological regimes (see 1.4.3), there are different sectoral typologies. For example, Lee and Has (1996) divide sectors based on knowledge intensity, R&D efforts, and proportion of qualified employees. The OECD (2005), on the other hand, uses a classification based on the intensity of R&D spending. In this report, we use the sectoral classification established by Pavitt (1984; Archibugi, 2001). Pavitt provides a typology of technological development trajectories in the manufacturing sectors. These are classified in five categories based on the conditions influencing the intensity and quality of the innovation process, on user profiles and demands, and on the appropriability of generated knowledge.

Pavitt's sectoral classification distinguishes the following types of industries: i) traditional and resource intensive, ii) labour intensive, iii) scale intensive, iv) specialized, and v) science based.

Sectors characterized by firms that are either resource based or labour intensive include manufacturing firms in traditional sectors (wood, food, paper, textile and clothing). According to Pavitt, these are dependent on external sources to innovate. In the scale-

intensive sector, we find firms that manufacture primary and assembly materials as well as durable consumer goods. These firms, for example in the chemical or motor vehicle sectors, innovate using both internal and external resources. Sectors characterized by specialized suppliers and/or science-based firms include specialized firms that produce technologies sold to other firms (specialized suppliers); as well as hi-technology firms involved with R&D, patents, and tacit knowledge of new products and/or process development (science-based firms).

2.4 Regional classification

The regional classification used in this research is based on the works of Coffey, Polèse and Shearmur (see Shearmur and Polèse, 2007) and reflects similar approaches used by other researchers who analyze large countries (Desmet and Fafchamps, 2005). In the center of this breakdown, we have the *main metropolitan areas* of the province of Quebec: the agglomerations of Montreal, Quebec City, and Ottawa-Gatineau. By agglomeration we mean the employment area, as defined by Statistics Canada, which centers in the main municipality of each major city.

We also identify *central areas* that are fixed based on the distance one covers by driving outwards from the major cities for one, or one and a half hour (the limit is approximate given the spatial breakdown). These zones interact strongly[4] with the major cities named above and have particular economic profiles: They are composed of many light-manufacturing industries (textile, plastic, machinery, furniture), of businesses in the tourism industry, and also firms in the primary sector, mostly agriculture or mining (for construction materials) (Shearmur et Hutton, 2011; Polèse et Shearmur, 2002; 2007). Within these central areas, we have identified *central-urban agglomerations* with populations of more than 10 000 as well as *central-rural areas*.

Finally, we identify *peripheral regions*, located more than one hour away from major cities. These correspond largely to regions known in the province of Quebec as ‘resource regions’. Their remoteness makes regular interactions with major cities costly and less frequent; but, as is the case for the central regions, this assumption has to be verified empirically. These areas are also sub-divided in *peripheral urban* and *peripheral rural* areas. Finalement, on distingue aussi les régions périphériques, celles situées à plus d’une heure ou une heure et demie d’une métropole. Celles-ci correspondent en gros à ce qu’on appelle les régions ressources au Québec. Leur éloignement rend l’interaction régulière avec la métropole plus onéreuse et moins

[4] It should be noted that, to our knowledge, this strong interaction is presumed but not empirically verified. This study will allow us to empirically measure the interactions of service utilization in central areas and major cities.

fréquente, mais, tout comme pour les zones centrales, ce constat reste à être vérifié et qualifié empiriquement. Ces zones sont aussi, bien évidemment, subdivisées en zones rurales et en zones urbaines.

2.5 Methods of analysis

Various methods of analysis have been used in this report. A detailed description of the sampling methods can be found in the midterm-report (which also includes the questionnaire). Details of the methods and techniques are included in the long version of the report and will, therefore, not be repeated here. Likewise, a set of preliminary analyses that classifies innovations and services and creates profiles, is not included in this report. The complete set of analyses that were used to create these composite variables can be found in the long report. Some of the variables created from these analyses, however, are used in the regression analyses presented below.

Section II : Empirical results

3. INNOVATION AND SERVICES

3.1 Are there links between utilization and innovation?

One of the first questions we asked was whether special relationships exist between different types of innovations or between different types of service utilization. For example, if an establishment introduces a new type of innovation such as a new process, will it necessarily lead it to introduce another innovation such as a new management practice? Similarly, will the use of a service to develop a prototype lead to the use of patent services?

In general, even though there are different innovation profiles, we have not identified very systematic relations. Introducing an innovation of type A does not necessarily result in the introduction of an innovation of type B. What is most striking is that many businesses introduce technological innovations (products or processes) without introducing other types of innovations, whereas management innovations (management or marketing) are almost always associated with at least one technological innovation. This is why we say that management innovations are often a consequence of technological innovations.

There are also different service utilization profiles. We observe that the vast majority of businesses use support services and that only 57 (7% of the sample) do not use any services at all. There are 213 establishments classified as having a high service utilization (which means that they use services throughout the value chain).

Juxtaposing these two classification systems (service use and innovation profile) sheds light on innovation and service use. A relatively large number of service users do not innovate, but almost no businesses that do not use service are innovators. It is therefore important to keep in mind throughout this analysis that service utilization is a necessary, but not a sufficient, factor of innovation.

3.2 Links between service utilization and manufacturing innovations

In this section, we ask to what extent service utilization explains innovation. However, we will also consider the classic factors presented in the literature as being associated with innovation: 1) distance to major and medium-sized cities; 2) Pavitt's sectors; 3) a

firm's number of employees; 4) R&D activities (percentage of employees assigned to R&D); 4) number of years in operation; and 5) the percentage of the turnover yielded by exportations.

We thus formulate the following question: While taking these classic explanatory factors into account, to what extent does the service utilization factor *further contribute* to the statistical explanation[5] of innovation? We can consider three hypotheses:

1. Service utilization helps us better understand innovation within businesses. Service utilization is, therefore, an independent factor of innovation, even if the direction of the causality is not established (MacPherson, 2008).

2. Service utilization does not help us better understand innovation, but it clarifies how the classic factors act. In this case, service utilization is an element contributing to innovation, but it is not independent of other factors.

3. Service utilization does not help us better understand innovation, nor does it clarify the role of the classic factors. Therefore, we can say that there is no association between service utilization and innovation.

In order to verify these hypotheses, we propose four ways of measuring service utilization.

1. Based on the number of services used: We test the idea that the greater the variety of services used, the more businesses innovate.

2. Based on composite variables representing services that are often used together (see long report, Table 3.C): We test the idea that services do not act alone, but that there are 'cocktails' of services associated with innovation.

3. Based on variables representing nine profiles of businesses using services (see Long report, Table 3.D): This is another way of testing the idea of 'cocktails' of services associated with innovation.

[5] We use the word "explanation" in the statistical sense: it should not be confused with causality. In fact, based on these analyses, were are not able to assert if it is the firms that already have the inclination to innovate who use services in the first place; or if it is service utilization that creates the inclination to innovate. Based on the literature review and on our understanding of the innovation process, even if there is a certain circularity in this association, we consider that the use of services – which brings expertise and new knowledge to businesses – is a causal factor of innovation; that is, of the introduction of a product or a new process on the market, or of the implementation of new marketing or management practices. However, MacPherson (2008) suggests that the nature of the causality could vary according to the geographic context.

4. Based on the fifteen service utilization variables representing the fifteen sectors: The underlying assumption of this approach is that each service acts independently of other services.

3.2.1 DOES THE USE OF MANY DIFFERENT SERVICES LEAD TO MORE INNOVATION?

The use of many different services has a moderate effect on the probability of introducing a *minor* innovation, except when it comes to management innovations, where the impact is more significant.

By contrast, the use of four services or more strongly increases the probability of introducing a *major* innovation. In addition, for all four types of innovations, we see that innovations increase when a larger the number of services is used.

3.2.2 DOES THE USE OF DIFFERENT SERVICE COMBINATIONS LEAD TO MORE INNOVATION?

The use of different service combinations is not strongly associated with minor process innovations or marketing innovations, but it has a significant impact on minor production and management innovations. The more businesses introduce minor production innovations without introducing major ones, *the less* frequently they use patent preparation services or technological feasibility services, and the more frequently they use fiscal services. When it comes to minor management innovations, they are strongly associated with the use of a range of services covering the whole value chain, and to the use of management services and support services.

As for major innovations, they are strongly associated with the use of different combinations of services, notably technological innovations. All service combinations increase technological innovations other than combinations of fiscal and accounting services. We also observe that the introduction of radically new products is particularly associated with the use of a complete range of services, and with the use of patent registration services and technological feasibility services.

Unsurprisingly, major management innovations are tightly associated with management, finance, legal, and human resources services; whereas marketing innovations are strongly associated with the use of a complete range of services.

3.2.3 DO PARTICULAR UTILIZATION PROFILES LEAD TO MORE INNOVATION?

Service utilization profiles also have an important impact on innovation. Profiles with high service utilization (use of services on the *entire value chain*, or, on the *entire value chain except support services*) are the most strongly associated with innovation,

particularly with major innovations. The *knowledge acquisition, implementation, and support services* utilization profile is more associated with management innovations; while the *validation, support and knowledge acquisition* profile is associated with major innovations, except for product innovation.

3.2.4 DOES THE UTILIZATION OF CERTAIN INDIVIDUAL SERVICES LEAD TO INNOVATION?

As for individual service utilization, we observe that major innovations are mostly associated with individual service utilization, although minor management and marketing innovations are also associated with individual utilization, but to a lesser extent. Only major innovations call for knowledge acquisition and validation services: Indeed, if an association exists at all between minor innovations and validation services, it is a *negative* association (Table 3.A).

Table 3.A : Individual services (added to the classic explanatory model)

Innovation:	Minor				Major			
	product	process	manag.	market.	product	process	manag.	market.
Adjusted pseudo r2	0.097	0.098	0.159	0.081	0.258	0.211	0.184	0.160
Non innovators	688	669	675	715	523	592	704	712
Innovators	116	135	129	89	281	212	100	92
Acquisition of knowledge								
Tech. and production equip.						++	+++	
R&D								
Patent information, research					+	+++		
Validation								
Business plan								
Conception of prototypes					+++			++
Patent preparation	- -				+++	+		
Safety certification	-	- -			+++			
Implementation								
Product/process implementation		++	+		+			++
Financing consultation					++		+++	
Management consultation	+		+++	+++			++	
Fiscal services	+++	+++						+
Commercialization								
Commercialization				++	++		+	+++
Support								
Accounting								
Human resources				-			+++	
Legal (lawyer or notary)			+++	+				

Note: This table illustrates the link between each type of innovation and the utilization of the fifteen service types. '+' indicates that the service is associated with more innovation, '-' indicates that it is associated with less innovation.

Implementation services are associated with major and minor innovations, but in different ways. While major innovations are associated with implementation and financing services, minor product innovations are associated with management consultation services and fiscal services. Major process innovations do not systematically require implementation services, while minor innovations require implementation and management consultation services. This implies that minor process innovations are imported from outside (hence, the need for consultation) while major process innovations are carried out internally (hence, the need for information, and the low use of validation, implementation, and support services).

Major management innovations are strongly associated with patent and technology services; and, less surprisingly, with management, human resources, and financial services. Likewise, marketing innovations are created jointly with commercialization consulting, but also with consulting on implementation of products or processes and prototype-design services. This opens the possibility that certain management and marketing innovations would be associated with, or follow, more technological innovations.

It thus appears that, within manufacturing firms, organizational innovations accompany (or are encouraged by) the introduction of technological innovations. This means that the apparent association between services of a more technological nature (patent information, conception of prototypes, etc.) and organizational innovations does not necessarily involve a causal relation (in either direction). Rather, the association entails that establishments use services to introduce new products or processes, which, in turn, creates the need for management and marketing innovations.Les innovations majeures de gestion sont fortement associées aux services d’acquisition de connaissances sur les brevets et les technologies, et, de manière moins surprenante, aux conseils en gestion, en ressources humaines et en finances. De même, les innovations en marketing se font, certes, de concert avec des conseils en commercialisation, mais aussi de concert avec des conseils sur la mise en œuvre de produits ou de procédés et d’aide à la conception de prototypes. Ceci laisse de nouveau entrevoir la possibilité que certaines innovations en gestion et en marketing soient associées à – ou se fassent à la suite – des innovations de nature plus technologique.

3.3 Do services work alone or in concert?

We have just seen that, regardless of how they are introduced in the classic model, services contribute independently to the explanation of innovation, especially major innovations. However, in order to understand the interaction between innovation and service utilization, it is necessary to question why it would be necessary to introduce services.

Three hypotheses are thus possible:

1. *The contribution of each innovation service is essentially independent*. Every service makes a specific contribution that is not influenced by the utilization of other services. If this were the case, innovations could be linked to individual services.

2. *The contribution of services occurs through combinations of services*. Services do not have an impact on innovation unless they are combined with other services. The impact of each individual service is, therefore, not independent, but directly dependent on its inclusion in a 'cocktail' of services (two types of cocktail are tested, see Table 3.B).

3. *The contribution of services to innovation occurs through diversity*. Regardless of the type of service, the utilization of a large number of services brings a diversity of external contributions throughout the value chain.

In order to divide these three hypotheses, we propose, in the table below (Table 3.B), a comparison of the explanatory power (adjusted pseudo r2) of the four different approaches.

Table 3.B : Comparison of the explanatory power of the different approaches

Innovations	Minor				Major			
	product.	process.	manag.	market.	product.	process.	manag.	market.
Models								
Control	0.055	0.073	0.089	0.027	0.169	0.119	0.066	0.074
Diversity of services	0.069	0.073	**0.123**	**0.056**	0.241	0.195	0.120	0.122
Cocktails of services (type 1)	**0.099**	0.067	**0.123**	0.027	**0.262**	**0.212**	**0.152**	0.135
Cocktails of services (type 2)	0.057	**0.087**	0.120	0.051	0.247	0.184	0.123	**0.144**
Individual services	**0.097**	**0.098**	**0.159**	**0.081**	**0.258**	**0.211**	**0.184**	**0.160**

Note : Bold red shows the strongest explanation, bold shows the second strongest. Type 1 'cocktails' correspond to factor scores derived from correlations between service usage. Type 2 'cocktails' correspond to a discrete classification of establishment according to their service use profile.

Although services sometimes appear to act in combination (the explanatory power of the model with components (Type 1 cocktail) is the strongest in three cases out of eight), they generally act independently. In addition, individual services always explain innovation very well, while, in some cases, components do not explain it well.

This comparison serves two purposes:

1. It allows us to understand that services tend to act in concert for minor technological innovations and, more particularly, for major innovations; but not individually.

2. To inform analytical choices for the continuation of this research. Based on Table 3.B, we will continue to introduce services individually, without forgetting the importance of service combinations, especially for technological innovations.

3.4 Do the new observations on the links between services and innovation really teach us something new?

Regarding the previous analysis, one could object that services might be nothing but an indicator of a business' information sources. However, it is well known that firms that are more aware of the external environment and that draw information from different sources are more innovative. Therefore, in this section, we verify if service utilization increases our understanding of innovation, or whether it merely reveals what we already know about the role of external information sources.

Our analyses clearly show that, within our sample of establishments, the use of external information sources explains innovation. On the other hand, if we look at the combined effects of external information sources and service utilization, we can observe the following:

1- There is no important correlation between service utilization and general information sources.

2- Two hypotheses thus emerge:

- The addition of information sources does not contribute to the model that already includes service utilization (which is the case for management and marketing innovations, except minor marketing). In this case, innovation is clearly associated with *service utilization*, and general information sources hardly contribute with any additional explanation.

- The addition of information sources improves the model that already includes services, while only slightly modifying the impact of services as described in Table 3.B. This is the case for technological innovations: Service utilization is an *additional* explanatory factor, which adds to what we already know about the importance of information drawn from outside a business.

3.5 Summary

In this chapter, we have described the impact of service utilization on innovation within manufacturing firms in Quebec. We have shown that major technological innovations (products and processes) are based on the use of certain service combinations, especially those covering the whole value chain, and the more specific ones covering patent preparation and acquisition of knowledge. Major management and marketing innovations, even if associated with these service combinations, are more strongly linked to specific services, notably to consulting services on commercialization and marketing.

We have also established that, despite the importance of service combinations, individual services can play an equally important role for technological innovations. Our analyses will, therefore, focus on individual services, while keeping in mind that this methodology is not the only one applicable to technological innovations.

An important result of this analysis shows the contribution of services at different stages of the value chain: Only establishments that introduce major innovations (systematically) use research and validation services. Businesses that only introduce minor innovations use these services less.

Major management innovations are associated with the use of human resource services, management consulting, and consulting services for access to financing; but also with services more closely related to technology (notably acquisition of technological information). This might reflect the derived nature of these innovations (which, we have suggested, are sometimes the result of product and process innovations). For their part, marketing innovations are strongly associated with consultation on commercialization.

Finally, the contribution of services to innovation – or, more precisely, the strong association observed between service utilization and innovation – is independent of general information sources. General information sources either contribute with a supplementary explanation that is distinct from the services' explanation, or their contribution to the explanation of innovation is almost negligible (as is the case with management and marketing innovations).

4. GEOGRAPHY OF SERVICE UTILIZATION

In the previous chapters, we have seen that services contribute significantly to innovation in manufacturing firms, that this contribution is not captured by the "classical" explanations of innovation, and that it is independent from the explanation brought by general information sources. In the current chapter, we focus on the distance between service users and service providers.

The local development theory, also known as the endogenous theory, has had a major influence on analysts and policy makers since the 1990s. It posits that regions or territories will develop internally the institutions and dynamics needed to innovate. However, research on the geography of superior services (Shearmur and Doloreux, 2008) reveals that these institutions and dynamics are more concentrated in larger metropolitan areas than in medium-sized agglomerations, while they are almost absent from the rest of the territory.

If, as we have seen above, services were important for innovation, we would face two possibilities:

1. To the extent that innovation dynamics are local, firms located far away from urban centers would have no access to services and, consequently, innovate less.
2. If firms located far from urban centers travel farther to access services, then we have to acknowledge that innovation dynamics are not exclusively local.

We already know that firms located far away from urban centers are no less innovative than those located closer (see the mid-term report and long report): this analysis, as well as other research that is more spatially representative, confirm that innovation is not more likely in Quebec's large urban centers than elsewhere (Shearmur, 2011). We therefore expect that the second hypothesis is valid.

Table 4.A shows clearly that the average distance between service users and providers increases as we move from metropolitan areas and urban centers to rural, and, especially, peripheral areas. In the periphery, the average distance between service users and providers is almost always over 100 km and over 200 km in many cases. In these regions, 25 to 50% of users utilize local services while at least 25% travel very far to access services (thereby increasing the average distance for these regions substantially).

On the other hand, we observe that nearly all service users located in Montreal find service providers (whatever the service) within 100 km and that 75% find them do so within 30 km. Only commercialization services encourage a small number of users to travel beyond metropolitan areas.

We also note that knowledge-acquisition services are those located the farthest away from users. Manufacturing firms are ready to travel far to receive the advice they need. The same observation applies to validation services, and, to a lesser extent, to marketing services. Implementation services are more local, except for users in peripheral areas and for a minority of urban users.

Finally, support services are nearly always found locally, except in peripheral areas. In these areas, there is a stark contrast between the majority of users who access support services locally, and a small minority that travels very far for these services.

Table 4.A : Distance to service providers according to service type and user location

Service type according to value chain	User location	n	Distance to service providers					
			average	10%	25%	50%	75%	90%
Knowledge	Montreal	146	39	5	11	18	33	72
Knowledge	Quebec City	70	89	7	9	21	237	250
Knowledge	Urban centers	99	76	4	14	63	114	151
Knowledge	Rural central	148	89	23	40	66	113	202
Knowledge	Periph. cities	46	243	5	11	79	448	800
Knowledge	Rural periph.	36	302	32	82	248	470	705
Implementation	Montreal	159	29	4	9	16	25	39
Implementation	Quebec City	71	39	7	8	13	22	101
Implementation	Urban centers	119	41	2	5	10	58	106
Implementation	Rural central	129	63	13	23	42	71	122
Implementation	Periph. cities	62	163	2	6	20	154	618
Implementation	Rural periph.	45	118	11	29	63	140	299
Validation	Montreal	88	49	5	14	19	34	93
Validation	Quebec City	40	91	9	12	22	207	246
Validation	Urban centers	63	70	4	9	54	127	153
Validation	Rural central	68	97	13	42	73	110	248
Validation	Periph. cities	26	294	7	9	111	618	970
Validation	Rural periph.	13	238	21	59	111	572	605
Commercialization	Montreal	29	45	2	5	15	27	239
Commercialization	Quebec City	11	34	4	8	11	17	20
Commercialization	Urban centers	20	64	2	7	60	104	160
Commercialization	Rural central	28	91	10	36	64	123	215
Commercialization	Periph. cities	10	277	7	27	145	450	869
Commercialization	Rural periph.	8	256	51	67	149	390	787
Support services	Montreal	310	26	4	8	15	25	38
Support services	Quebec City	126	21	7	8	11	22	29
Support services	Urban centers	230	33	2	4	7	40	103
Support services	Rural central	271	56	8	17	38	68	110
Support services	Periph. cities	99	60	3	5	11	28	202
Support services	Rural periph.	79	119	4	21	35	100	372

Note: This table indicates average distance to service providers, and the distances that correspond to the 10%, 25%, 50%, 75% and 90% of closest service providers. For example, the table indicates that the average distance between providers of knowledge acquisition services and Montreal users is 39 km, and that 75% of Montreal users are within 33 km of these providers. The column does not indicate the number of users on which the calculations were based. To facilitate reading, we put distances of less than 20 km in green, those between 20 and 50 km in blue, those between 50 and 100 km in black, those between 100 and 200 km in orange, and those over 200 km in red.

These descriptive results do not take into account other explanatory factors. In the following section, we will attempt to answer two questions: Firstly, are variations in the distances separating service users and providers attributable to the type of service, the location of users, or to other factors such as business size or number of years in operation? Secondly, are users utilizing remote services more innovative than those using local services?

4.1 Factors explaining distance between service users and providers

This section provides an overview of the factors explaining the distance between service providers and users.

4.1.1 The effects of user location

The distance between users and providers increases as one moves away from metropolitan areas (namely, Montreal, Quebec City, or Ottawa-Gatineau) and mid-sized cities (cities with a population of more than 40 000 and located more than 100 km from a metropolitan area).

Taking into account the effects of distance to major and mid-sized cities, users in Quebec City and rural areas are farther away from their providers than users in Montreal are.

4.1.2 Effects of users' size

Firms employing less than 50 employees are closer to their providers than larger firms are.

4.1.3 Other effects

The business sector, number of years in operation, R&D activities, exportations, group affiliation, and the use of at least one service outside the province of Quebec have no effect on the distance between users and providers.

4.1.4 Different services

Once the effects mentioned above are taken into consideration, we can observe important distance variations between users and providers according to the type of service used (Table 4.B).

The services most often used locally are routine support services as well as fiscal, financial, and business plan services. Followed by management, marketing, implementation and production, technological, and R&D support services. Finally, the services located farthest away are technological feasibility services as well as those related to knowledge validation (except for business plan preparation).

Table 4.C takes the results of Table 4.B on distance to services and classifies them in four groups, from closest to farthest.

We also use the results of Table 3.A on the links between service utilization and major innovation. We observe that the farther away businesses travel to receive a service, the more this service will be closely linked to innovation, especially technological innovation. The only exception concerns management innovations, which depend equally on near and distant providers.

This result does not imply that businesses that travel far to receive services are more innovative. What it does indicate is that businesses travel far to access services having the *potential* to contribute to innovation (this potential is evident from the fact that these services are strongly connected with innovation: of course, this does not mean that their use automatically brings about innovation). Firms are thus willing to go beyond their local environment. In fact, the more services will (potentially) contribute to innovation, the further firms travel (this is what is suggested in the literature; and it corresponds to what we have shown in Chapter 4). Therefore, it is clear that the business environment is not local or even regional: it spreads throughout the province of Quebec over vast distances that often separate users and providers by hundreds of kilometers.

Table 4.B : Average distance between users and providers according to service type

Knowledge	
Support for production technologies	0.33***
R&D support	0.35***
Information on patents, research	0.41***
Validation	
Business plans	0.07
Prototype conception	0.38***
Patent preparation	0.37***
Safety certification	0.44***
Implementation	
Process or product implementation	0.34***
Consultation on finances	0.01
Consultation on management	0.23***
Fiscal services	0.07
Commercialization	
Commercialization	0.30***
Support	
Accounting (reference)	0.00
Human resources	0.03
Legal services (lawyers)	0.06**

Note: This table presents indicators on the average distance between service users and providers after subtracting the effects of the factors described in 4.1. The distance between accountants and users is set at 0 arbitrarily. As the distances increase, the color moves through blue, green and orange to red.

Table 4.C : Links between contribution to innovation and distance to services

		Major innovations			
		Prod.	Process	Management	Market
Business plan	Near				
Consultation on access to capital	Near	++		+++	
Fiscal services	Near				+
Accounting (reference)	Near				
Human resources	Near			+++	
Legal services (lawyers)	Near				
Consultation on management	Quite near			++	
Support for production technologies	Quite far		++	+++	
R&D support	Quite far				
Process or product implementation	Quite far	+			++
Commercialization	Quite far	++		+	+++
Information on patents, research	Very far	+	+++		
Prototype conception	Very far	+++			++
Patent preparation	Very far	+++	+		
Safety certification	Very far	+++			

4.2 Do firms located far from service providers innovate more?

We have just seen that the nature of a service, and, more precisely, its potential contribution to innovation is a factor explaining the distance between service users and providers. In this section, we will see whether firms traveling far to receive their services are more innovative.

The various tests that we have conducted have not revealed relationships between innovation and distance to service providers. We have found the same results in the separate analyses of users in central and peripheral areas (with or without the users in metropolitan areas).

This negative result is important for two reasons. One the one hand, it shows that the most innovative users are not necessarily those located closest to their providers. On the other hand, it shows that users located the farthest away, or even at intermediary distances, are not necessarily more innovative either. This means that neither proximity nor closeness enable exchanges between users and providers that lead to innovation.

In sum, what matters is whether firms use services or not, rather than the distance travelled to access them. Once firms decide to use a service, they will choose the provider that best matches their needs, regardless of distance. In the following chapter, we will focus on the factors influencing the decision to use services and those influencing contact frequency and contact mode between users and providers.

5. DETERMINANTS OF SERVICE UTILIZATION

In this section, we will explore the determinants of service utilization, and evaluate what determines the frequency of utilization and the contact modes used between providers and users.

5.1 Determinants of service utilization

We observe that innovating firms use the most services (i.e. the largest number of different services), especially firms that introduce major innovations. This result has already been presented in earlier sections, but in this formulation, the implicit hypothesis is that innovation brings about service utilization.

The distance separating a firm from a major or mid-sized city does not influence linearly the probability of service utilization. But we do notice that firms located outside metropolitan areas, but within a 100 km radius, (either in central cities with a population of more than 50 000 or in rural areas) use services most often.

Service utilization does not vary according to the firms' sector. However, all things being equal, the larger the firm (in number of employees), the younger it is, and the more it has employees assigned to R&D, the higher the probability that it will use external services. Belonging to an industrial group (i.e. being a subsidiary or part of a wider corporation), however, diminishes this probability.

In sum, larger, younger, and R&D-active firms use services most often – regardless of their innovative activity (because we already take their innovations into account). On the other hand, it seems that firms belonging to groups obtain some of their services from the group, because, all things being equal, firms with group affiliation use external services less.

By changing the level of analysis, this regression allows us to see what services are used most frequently. Process and production implementation services and patent services are those used the least often. On the other hand, accounting, legal, R&D, and financial consulting services are used most frequently.

5.2 Determinants of frequency of service utilization

Not only do innovators use more external services, they also tend to use each service more frequently. This information adds to our knowledge because we have already established that innovators use a larger number of services than non-innovators, and that

that they use certain types of services (Chapter 4). Here, we show that the contacts between innovators and providers are more frequent than those of non-innovators.

It is interesting, however, to observe that establishments that have introduced only one minor innovation are the ones most frequently in contact with their service providers, perhaps because they consult a smaller variety of providers. This means that the total number of contacts might be similar for minor and major innovators, even if minor innovators consult a smaller range of providers (they consult each provider more frequently), while major innovators consult a larger range of providers (but each provider is consulted less frequently). In any case, innovators consult their providers more frequently than non-innovators.

The frequency of contacts with providers *is not dependent on the distance between providers and users.* Contact frequency does not change whether one is located in a major city, or in rural or peripheral areas. The geographic location, which has almost no influence on the probability of service utilization, has no influence at all on the frequency. These findings, which corroborate in a more robust way the simple tables presented in the mid-term report, are important. They emphasize that the geographic location of a manufacturing firm does not have an effect on its propensity to use external services and does not affect the frequency of contacts when services are used. It appears that businesses identify their service needs and do what is necessary to access them, regardless of geographic location or distance.

We also observe a sectoral effect. The most labour-intensive firms are the ones that least frequently consult their service providers. Not only do the largest establishments consult the widest range of services, they also consult their providers most frequently. However, if the size of a business is an indicator of its internal resources, there seems to be a complementary (not a substitution) between internal resources and the use of external services.

The services most frequently used are management, commercialization, conception of prototypes and identification of technological needs, and, to a slightly lesser extent, implementation and accounting services. We identify two different patterns:

- High frequency utilization by a large number of establishments (technological needs, accounting).
- High frequency utilization by a small number of establishments (prototypes, implementation, and commercialization).

5.3 Determinants of the importance assigned to contact modes

In this section, we address the importance that users assign to the three contact modes used with providers. We have asked the respondents to rank them on a scale from 1 to 3. We need to keep in mind that we are no longer talking about frequency, but about the opinions of the users regarding the importance of these different modes of communication.

5.3.1 ELECTRONIC COMMUNICATION

While service utilization and frequency of contacts with providers are not structured by geography, the importance assigned to electronic communication is greatly affected by geography. *The farther away users are from providers, the more importance given to electronic contacts*. Users located in larger cities (central or peripheral cities with a population of more than 50 000) find them less important than those located in rural areas or small cities.Le seul autre facteur qui semble jouer sur l'importance que revêtent les contacts par voie électronique est la R-D : ce sont les établissements qui ont une activité de R-D moyenne (autrement dit, ceux qui font de la R-D, mais dont moins de 35% des effectifs y sont consacrés) qui assignent le plus d'importance aux contacts par voie électronique.

However, there is an anomaly in these findings: Users located in the metropolitan areas of Montreal and Quebec City give as much importance to electronic communication as those in rural areas and small cities. Two things could explain this. On the one hand, service users in Montreal and Quebec City are on average closer to their providers (Table 4.A) (the effect of major cities has perhaps already been captured by the distance variable). On the other hand, traffic congestion in major cities increases the importance assigned to electronic communication for metropolitan users.

The only other determinant that influences the importance assigned to electronic communication is R&D. Businesses with average R&D activities (those with less than 35% of the workforce assigned to R&D) are those assigning most importance to electronic communication.

There is very little variation between types of services when it comes to the importance assigned to electronic communication. Only the users of management consultation services assign a little less importance to electronic communication than users of other services.

The central conclusion of this sub-section is that the *importance assigned to electronic communication is essentially determined by geography*, by the location of the user, and by the distance between users and providers. Electronic contacts facilitate service utilization when large distances separate users and providers and when the environment (traffic in urban areas, or isolation in rural areas) makes face-to-face contacts difficult

5.3.2 FACE-TO-FACE CONTACTS AT THE USERS' AND PROVIDERS' SITES

As opposed to electronic contacts, face-to-face contacts are more frequent when users and providers are in proximity of each other. There are no indications, however, that these contacts are more valued by innovators than non-innovators. This relates to our previous demonstration that the distance between users and providers has no impact on innovation. The reason we could have anticipated a positive relation between proximity and innovation, based on the literature on local innovation systems, is the common idea that proximity engenders more frequent and intimate contacts. Here, we demonstrate that, in reality, proximity does not increase frequency nor does it stimulate innovation.

With these conclusions, we re-emphasize the idea that users identify their needs and do what is necessary to access their services. Service *utilization* is the factor of innovation – not geography or milieus or local systems.

In the same vein, we see that users in small cities and rural areas (whether central or peripheral) give more importance to face-to-face meetings. This seems to indicate that people travel to access services because of their scarcity in these areas (Shearmur and Doloreux, 2008). On the other hand, traveling to meet providers is less important in larger cities and urban areas.

For all services other than legal services, users consider that visits by providers to their sites are especially important, or that their own visits to the providers' sites are not important, or both. In other words, there is a clear bias towards assigning importance towards on-site visits by the service provider.

If we compare services, we note that visits from providers to the clients' offices are especially important for management, business plan preparation, identification of technological needs, R&D, marketing, and implementation services. Face-to-face contacts are less important for legal services, human resources, safety certification, patent preparation and related research. In sum, as we have just seen, the importance of face-to-face contacts at the providers' sites is the opposite of the importance given to visits from the providers to the clients' offices.

Finally, in absolute terms, electronic contacts are most important regardless of the sector. On average, 56% of users find them very important. Face-to-face visits at the client's sites are also very important: 45% of users see them as important, but this varies according to the sector. Meetings at the providers' sites are seen as less important than the others, with only 24% attributing value to them.

6. BARRIERS TO SERVICE UTILIZATION

For each of the fifteen service types, we have asked potential users to identify barriers to service utilization. Four types of barriers were examined:

1. Difficulty identifying an appropriate service provider
2. The cost of the service
3. The distance between the potential provider and the user
4. The time needed to get in contact with the provider

These findings cause interpretation problems since we cannot distinguish the respondents who do not identify barriers because they did not need the service, from those who do not identify barriers because of their easy access to the service. In the same way, when a barrier to access is identified, it can either indicate that the barrier has been overcome, or that it has hindered access to the service.

There is an association between service utilization, and perceived barriers to utilization. Users identify barriers for the services that are used the most often. We also observe that barriers are identified by the actual users, not by those who do not use them: Between 66 and 77% of barriers are identified by users.

We have performed a basic analysis of the factors explaining the identification of barriers. This analysis was not made service by service because the low number of cases would invalidate such an exercise. On the other hand, we have identified establishments that evoke each type of barrier at least once. We see that, depending on the barrier, between 8.9 and 24.9% of the establishments are concerned.

We cannot identify many explanatory factors. Neither size, distance to a major city, exportations, nor the proximity to a subsidiary is associated with barriers. In addition, even if years in operation or R&D activities seem to make a difference, these links are not clear since they are not monotonous, (the probability neither increases nor diminishes systematically with years in operation or intensity of R&D). We can also observe some associations between some types of utilization and barriers to access, but, again, no general pattern is observed.

In fact, the only lesson drawn from these analyses is that access problems associated with distance are evoked most often by establishments located in rural areas, either central-rural areas (close to major cities) or peripheral-rural areas. This may be

expected, but this finding highlights that being located in a low-density environment increases the perception of barriers more than being located far from a major city. It is thus a question of *perception* since we have not identified any similar findings for service *utilization.* In fact, we have seen that service utilization is not systematically lower in rural environments. We can conclude that service utilization requires an additional effort for firms in rural environments because of the remoteness of providers (an effort acknowledged by the users, and which is reflected in the longer distances between providers and users). This additional effort, however, does not in any way hinder the access to services when these are deemed necessary.

Conclusions et discussion

Services and innovation

The most important conclusion of this report is also the easiest to forget: There is a close connection between innovation and service utilization within the manufacturing firms in Quebec. This conclusion seems obvious because it has often been theorized; but it has, however, rarely been demonstrated.

The link between utilization and innovation is more important for technological innovations (products and processes) than for management innovation (management and marketing). Regarding technological innovations, there are indications that services do not act alone: Product and process innovators tend to use a multitude of services throughout the value chain. Management innovations, on the other hand, are mostly influenced by marketing, management, and human resource services. Moreover, not only do innovators use more varied services than non-innovators, they also use them more frequently.

In spite of these observations, the causal mechanisms of those links must be approached with caution. The value chain approach, which we have adopted, presupposes a linear process of innovation; beginning with information collection, moving on to implementation, validation, and, finally, to the commercialization of the product. Services contribute to innovation at each of these stages. MacPherson (2008), however, suggests that the causality is not so straightforward. According to him, in the state of New York, the decision to innovate is taken prior to consultations with service providers. Firms identify innovation opportunities, and then call upon external services to help them develop their ideas. However, in remote areas, the service providers are the ones that point out innovation opportunities to the firms. In this case, the firms initially use services to receive management or technical advice; innovation possibilities then emerge from these consultations.

These two processes, however, lead to the same statistical observation. We do not have the data needed to identify the origin of the initial idea. Our conclusion thus focuses on the *links* between utilization and innovation; but we cannot demonstrate that the innovations are *caused* by service utilization. On the other hand, it is possible to confidently affirm that services are crucial elements of the innovation process, and that without external services, firms would innovate less, or with greater difficulty.

This last statement is even more plausible given the confirmation that service utilization, rather than information obtained from general sources, is associated with innovation. Even if general sources are important factors for technological innovations, the use of external services is an *additional* innovation factor that complements general information.

Access to services

The services most closely linked to innovation, and, especially, those linked to technological innovations, are those that involve the longest distance between users and providers. If we concede that these services are the most strategic, then this is commensurate with central place theory. This theory, which is fundamental to the theory of localization of service activities, states that strategic (high-order) services will be used less than routine (low-order) ones. Consequently, in order to access a sufficiently large market, service providers will concentrate in urban areas. This implies that users living outside metropolitan areas will have to travel to access these services. Our results, which demonstrate that the distance separating users and providers is greater for the most strategic services (those linked to innovation), are thus consistent with this theory.

It may seem paradoxical that the firms willing to travel the farthest to access services are *not* the most innovative, whether these firms are located in metropolitan regions or in periphery. This paradox, however, is not substantial because service utilization, not distance traveled, is what is associated with innovation. This result suggests that innovative firms identify their needs and their providers without concern for distance: Chosen providers are neither systematically close nor far. However, on average, strategic service providers are located farther than non-strategic ones.

Distance (i.e. localization in a rural area and the distance from metropolitan areas) does not reduce service utilization (that is, the decision to use them) or utilization frequency (that is, contact regularity once a decision has been taken to use them). However, distance has two effects on service utilization:

1- Electronic communications increase with the distance between users and providers.

2- The farther users are from providers (especially in low-density areas), the more they will perceive barriers to access (especially, distance-wise). This is only a perception, as we have just seen, because the frequency of utilization is not affected by distance or rurality.

These important results support the claims of MacPherson (2008). He has noted an important transformation in the patterns of service utilization in the state of New York between 1995 and 2005. In 1995, service utilization was less frequent in rural areas than in New York City; by 2005 hardly any differences remained in terms of utilization and of actual innovation activities – largely due to the spread of the Internet.

Local innovation systems

The above-mentioned results bring us back to the notion of local innovation systems, according to which the most important elements and institutions needed for a firm's innovation are found in its immediate environment. It is obvious that local culture and institutions are important external elements. Our results, however, demonstrate that while KIBS are evidently part of firms' innovation system, they are not local. Because KIBS are such important elements of innovation systems that are not necessarily local, we can suggest in more general terms that the innovation systems are not localized at the provincial level in Quebec.

This does not mean that certain elements of the innovation system are not more concentrated in certain areas. What it means is that firms do not limit themselves to their local environment when it comes to seeking information, resources, and external services. Our results show, however, that users focus on local providers only in Montreal. But this does not entail that a local metropolitan innovation system exists. Rather, it shows that Montreal functions like a large agglomeration (Gaschet and Lacour, 2007). Agglomeration economies are well theorized, as is the localization of superior services in urban areas. There is no need to refer to the notion of innovation systems to understand why the distances between users and providers are smaller. We can take the example of Quebec city, where many firms commonly interact with providers located as far as Montreal, over two hundred kilometers away.

What is more, the very small number of users seeking services outside the province of Quebec (we have not analyzed them given their small number) points to the existence of an innovation system at the provincial scale – structured by Quebec's geography (anchored in Montreal), language, culture, and public policy environment. This relates to Lundvall (2007) who introduced in the early 1990s the notion of *national* innovation systems, and who later criticized the attempts to apply this model to smaller scales.

Also related to this idea is the apparent substitution of face-to-face contacts with electronic communications. Even though face-to-face contacts are still favoured when proximity allows it, and even if electronic communications are more frequent in rural areas, there seems to be no link between innovation and face-to-face communication.

This does not mean that face-to-face contacts are not important to create social ties and share tacit information. But it recalls Torre's argument (2008) that face-to-face meetings are not that frequent and can be easily replaced by routine, long-distance communications once the initial contact has been made.

In sum, it appears that territorial co-localization with service providers (whose advantage would be to favour face-to-face contacts) does not constitute an innovation advantage for manufacturing firms.

Implications of the study

The first implication of our results is that KIBS utilization is important for firms, throughout the value chain. The use of external services is important for firms wanting to innovate, and this, independently of their other sources of information, size, or internal capacity. Close to a quarter of our sample respondents use very few services, and another quarter use them throughout the value chain. Therefore, it is possible to intensify service utilization in 75% of establishments (though intensification would not be appropriate in all cases).

However, we observe that larger firms, firms with active R&D, and younger firms are those using services the most. For these firms, there appears to be a complementarity of internal and external resources. The task would therefore be to look at firms with less internal capacity to evaluate the possibility of:

- Increasing their internal capacity in order to enable them to use external services.

- Exploring a mode of service utilization that does not use the internal resources of manufacturing firms but rather completes them.

The second implication is that there are no geographic barriers to service utilization, even if firms in peripheral areas perceive some. The spread of the Internet to the whole territory seems to account for this (MacPherson, 2008). However, we should realize that policies aiming at increasing service utilization would have to be tailored according to the localization of users. In more rural areas, facilitating means of electronic communication should be emphasized, although we must remain aware of costs and of the importance of face-to-face contacts. Regardless of the area, making firms aware of the importance of service utilization is what matters most. In this regard, one must be realistic: Our results show well that there are no automatic links between service

utilization and innovation. Indeed, many service users did not innovate during the period of this study. However, very few innovators do not use external services. The use of external services, therefore, seems to be necessary but not sufficient for innovation.

The third implication concerns local innovation systems. Nothing suggests that innovation services should be local. On the contrary, manufacturing firms should be able to choose the most appropriate providers without being limited by distance. This means that there is no reason to develop local services, or to discourage them. Policy interventions should rather aim to increase the matching between users and providers instead of focusing on localization. This matching entails good communication infrastructures (high-speed internet), and, more importantly, means of transportation that enable face-to-face contacts at reasonable costs. Face-to-face contacts do not need to be frequent – but their role is crucial. The idea is, therefore, to work on the connections between firms and their external environment rather than to develop a local system of services in each region of Quebec.

Finally, many areas remain unexplored, notably, the nature of the causality between services and innovation. Even though services are clearly associated with innovation (in general, innovation would not occur without external services), we have little information on the nature of the relation between users and providers, and, in particular, on the source of the original idea of innovation. It is therefore not clear if firms that have innovative ideas call upon service providers to help them develop these, or whether these ideas originate in those very services. Both scenarios probably occur, but it would be important to understand if one scenario is more prevalent than the other, and to understand the determinants in these dynamics.

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