

Knowledge exchange strategies between KIBS firms and their clients: the case of Québec City

By

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Outline

- Context
- Aim of the paper
- Contribution of the paper
- Data
- Results
- Tentative conclusion



Context

- Attention is moving from knowledge creation to knowledge exchange with the implication that traded and untraded knowledge may be becoming more important than trading tangible resources in order to create **competitive advantages** (Almeida et al., 2002; Leonard-Barton, 1990; Nonaka, 1991; Spender, 1996; Teece, 1998; Von Krogh, 1998. Zollo and Winter, 2002;...).
- Underlying the debate on how to foster innovation, there is frequently the assumption that the exchange of knowledge with other organizations, in particular between firms and their clients needs to be enhanced (Kogut 1999, Almeida and Kogut, 1999; Lane and Lubatkin, 1998;....).
- According to Wong and He (2005:2), knowledge exchanges between KIBS and their clients generate positive networks externalities “and possibly accelerate knowledge intensification across economy”.



Aim of this study

- This study **explores** the extent and determinants of knowledge exchanges (flows) between KIBS and their clients.
- More specifically, we focus on factors that could facilitate or hamper knowledge exchanges (flows).
- Knowledge exchanges are more important for KIBS than for other types of firms for many reasons:
 - First, the higher level of knowledge embodied in people in the knowledge intensive service industry generates higher needs of knowledge flows between KIBS and their clients (Lindsay et al., 2003).
 - Second, providing knowledge intensive services requires more adaptation than producing tangible goods, and therefore needs more customization and more knowledge exchanges between KIBS and their clients (Lindsay et al., 2003).



KIBS: definition and characteristics

- According to Muller and Doloreux (2007:5), “KIBS are mainly concerned with providing knowledge-intensive inputs to the business processes of other organizations, including private and public sector clients”.
- More specifically, KIBS are associated with the following characteristics:
 - Knowledge is the essential asset of KIBS (Schreyögg and Geiger, 2007);
 - Knowledge intensive business services “almost exclusively consist of transferring knowledge and skills to client organizations” (Leiponen, 2006);
 - Knowledge intensive services combine various types of highly specialized knowledge in order to develop problem-specific solutions (Miles, 1995; Muller and Zenker, 2001, Koschatzky and Staklecker, 2006);
 - The production of knowledge intensive services requires frequent interaction and close cooperation between KIBS and their clients (Koschatzky and Staklecker, 2006);
 - The services provided by KIBS are client-specific (Koschatzky and Staklecker, 2006);
 - KIBS create value when they convert knowledge into increased levels of solving capabilities for their clients (Allee, 2008)



Prior studies

- Prior studies on knowledge focus primarily on knowledge creation (R&D) and knowledge appropriation (patents).
- Although, there is a large and expanding diversity of studies on knowledge and firms, one may differentiate five major perspectives:
 - first, there are studies that focus on valuing intangible assets and corporate knowledge (Sveiby,);
 - second, there are studies that center on initiatives related to greater codification of the corporate knowledge that was tacit and resided in the minds of employees ();
 - third, associated with codification perspective, there has been greater concern with protecting the intellectual property against imitation by other companies and the most appropriate mechanisms to protect knowledge from appropriation by competitors ();
 - fourth, there has been a large number of studies on knowledge exchange between alliance partners () and across organization subunits of multiunit organizations (Hansen, 1999;).



Prior studies and contribution

- Finally, there are studies on innovation that have accorded attention to knowledge exchange between innovative firms and external actors by considering the influence of ideas and information acquired from informal exchange with their clients, suppliers, competitors, consultancy firms, universities, colleges, governmental research laboratories, research institutions, centers for technology transfer, professional conferences, trade fairs and exhibitions, and trade associations.
- Compared to this last group of studies, which consider knowledge exchange as an explanatory variable, this paper contributes to advance knowledge by considering as its dependent variables the types of knowledge exchanged between knowledge-intensive based firms and their clients.



Conceptual framework

- Knowledge exchange depends on how easily it can be transported, interpreted and absorbed (Cohen and Levinthal, 1999; Zahra and George,...).
- One key dimension of knowledge that influences its exchange is recurring constantly in the literature: tacit vs codified knowledge



Three strategies of knowledge exchange between KIBS and their clients

- Exchange of tacit knowledge (personalization strategy),
- Exchange of codified knowledge (commodification strategy),
- Exchange of mixed knowledge, when the transfer of codified knowledge needs to be complemented by the transfer of tacit knowledge (mixed strategy).



The Knowledge-based view

- The knowledge-based view (KBV) of the firm is especially appropriate to investigate differences in the choice of the types of knowledge exchanged between KIBS and their clients because the KBV suggests that KIBS should position themselves strategically based on their unique, valuable and difficult to imitate knowledge resources.
- In the KBV, differences in the choice of the types of knowledge exchanged between KIBS and their clients are driven by the knowledge resources of the KIBS (Barney, 1991; Barney and Arkan, 2001; Grant 1996; Kogut and Zander, 1996; Spender and Grant, 1996; Zack, 1999; Barney and Clark, 2007; ...).



Conceptual framework

Independent variables

Variety of Knowledge Sources

Knowledge Creation

Knowledge Embodied in Employees

Knowledge Embodied in Practices & Technologies

Knowledge Embodied in Clients

Strength of Ties

Control variables:

- Size
- Business Age
- Services Industries
- Regions

Types of knowledge exchanged

Mainly Tacit Knowledge

Mixed Knowledge

Mainly Codified Knowledge



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Categorical variable capturing three alternatives of types of knowledge that firms exchanged with their clients :

Question: Thinking about the last three years, what types of information has your firm exchanged during its contacts and discussions with its main clients?

1. **Mainly Tacit Knowledge:** the assessment by the firms that, over the past three years, they exchanged mainly tacit knowledge with their clients (i.e., almost only or mainly unwritten practical know-how);
2. **Mixed Knowledge:** the assessment by the firms that over the past three years, they exchanged mixed knowledge with their clients (i.e., half unwritten practical know-how and half written reports or documents);
3. **Mainly Codified Knowledge:** the assessment by the firms that, over the past three years, they exchanged mainly codified knowledge with their clients (i.e., almost only or mainly written reports or documents).



Explanatory variables

Variety of Knowledge Sources:

- Market Sources
- Research Sources
- Informational Sources

Knowledge Creation:

R&D

Knowledge embodied in employees

Knowledge employees

Knowledge embodied in managerial practices and technologies:

- Number of advanced technologies used
- Number of value-added practices used

Strength of Ties:

- Very Strong Ties
- Strong Ties
- Weak Ties



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Control Variables

- Size
- Business Age
- Services Industries
 - *Traditional Professional KIBS:*
 - Legal Services
 - Accounting, tax preparation, bookkeeping and payroll services
 - Management, scientific and technical consulting services
 - Advertising and related services
 - Other KIBS
 - *New Technology-Based KIBS:*
 - Architectural, engineering and related services
 - Specialized design services
 - Scientific R&D
- *Regions :*
 - Medium metropolitan regions
 - Central regions
 - Resources regions



Data

- The data used in this study have been collected by a survey firm, which conducted computer-assisted telephone interviews from January 30 to May 17 2007.
- With a focus on the six forms of innovation defined earlier, the survey questionnaire derived from the methodology of the Oslo Manual (1997), CIS and Statistics Canada surveys on innovation, the literature on innovation in services **and the ISRN questionnaires**
- The survey was administered to the population of knowledge intensive-based services firms that operate in the province of Québec in Canada in the following eight industries (NAICS (North American Industry Classification System) 541): Legal Services; Accounting, tax preparation, bookkeeping and payroll services; Management, scientific and technical consulting services; Advertising and related services;; Architectural, engineering and related services; Specialized design services; Scientific R&D; and Computer system designs and related services.
- These industries make up to a population of 5694 firms.
- A random sample of 2291 firms was drawn for this study for the Province of Québec
- **The population was surveyed for the region of La Capitale-Nationale (Québec City)**
 - A total of 669 firms were excluded from the sample for the following reasons: firms no longer in operation (39), duplicate names of firms (10), disconnected phone numbers (100), do not produce services (25), not reachable by phone (138).
 - The resulting sample available for interviews was therefore of 1622 firms.
 - From this sample, 25 respondents did not complete the interviews, 345 refused to participate to the study and 100 respondents with whom appointments were made were not reachable for interviews. At the end, 1152 firms completed the interview questionnaire for a response rate of 71.0 %.
 - Following the Statistics Canada definition for SMEs, we also excluded 28 firms as they had 500 or more employees.
- Consequently, the final sample used for this study includes 1124 firms,
- **Among which 262 are localized in the region of La Capitale-Nationale (Québec City)**



Descriptive statistics of the dependent variables

Over the three years preceding the survey:

- 65 firms or 24.8% of the sample indicated they exchanged mainly tacit knowledge with their clients (i.e., almost only or mainly unwritten practical know-how),
- 152 or 58.1% indicated they exchanged mixed knowledge with their clients (i.e., half unwritten practical know-how and half written reports or documents), and finally,
- 45 firms or 17.1% of the sample indicated they exchanged mainly codified knowledge with their clients (i.e., almost only or mainly written reports or documents).



Descriptive statistics of explanatory variables

- The average firm,
 - had 28.69 employees of which 53.23% had completed a university degree,
 - dedicated 9.47% of its total revenue to R&D activities.



Descriptive statistics of explanatory variables

- On average, 46.17% of the firm's revenue came from the three most important clients.
- Strength of ties weaved by the firms' contacts and work relations with their most important clients,
 - 90.1% were very strong ties, and
 - 9.9% were weak ties.
- Finally, considering the sector of activity, and according to the classification of Miles et al. (1995),
 - 126 or 48.2% of the firms operated in Traditional Professional KIBS,
 - 136 or 51.8% of them operated in New Technology-Based KIBS



Descriptive statistics of explanatory variables

More specifically,

- 3.1% of the firms operated in Legal services,
- 4.2% in Accounting, tax preparation, bookkeeping and payroll services,
- 16.0% in Architectural, engineering and related services,
- 6.5% in Specialized design services,
- 24.3% in Computer system designs and related services,
- 26.0% in Management, scientific and technical consulting services,
- 5.0% in Scientific R&D services,
- 8.8% in Advertising and related services, and
- 6.1% in other KIBS.



Analytical models and regression results

- Three binary logistic regressions were estimated where the dependent variables are respectively measured by the three following dichotomous variables:
 - Dependent 1: Mainly tacit knowledge exchanged relative to Mixed knowledge
 - Dependent 2: Mainly tacit knowledge exchanged relative to Mainly codified knowledge
 - Dependent 3: Mixed knowledge exchanged relative to Mainly codified knowledge



Table 4: Estimated logit models of factors affecting the types of knowledge that firms exchanged with their clients

Dependant variables	PANEL A: Quebec (Province)						PANEL B: Quebec City Region					
	<i>Mainly Tacit Knowledge/ Mixed Knowledge</i>		<i>Mainly Tacit Knowledge/ Mainly Codified Knowledge</i>		<i>Mixed Knowledge/ Mainly Codified Knowledge</i>		<i>Mainly Tacit Knowledge/ Mixed Knowledge</i>		<i>Mainly Tacit Knowledge/ Mainly Codified Knowledge</i>		<i>Mixed Knowledge/ Mainly Codified Knowledge</i>	
Independent variables	<i>Coeff. (β)</i>	<i>Exp (β)</i>	<i>Coeff. (β)</i>	<i>Exp (β)</i>	<i>Coeff. (β)</i>	<i>Exp (β)</i>	<i>Coeff. (β)</i>	<i>Exp (β)</i>	<i>Coeff. (β)</i>	<i>Exp (β)</i>	<i>Coeff. (β)</i>	<i>Exp (β)</i>
<i>Intercept</i>	-1.240	.289	-.523	.593	.353	1.424	-2.978	.051	-2.374	.093	.267	1.306
<i>Variety of External Knowledge sources:</i>												
➤ Market sources of information [MARKET]	.006	1.006	-.034	.966	-.100	.905	.044	1.045	-.003	.997	-.112	.894
➤ Research sources of information [RESEAR]	.074	1.077	.265 ***	1.303	.267 ***	1.306	.298 **	1.348	.418 **	1.519	.049 **	1.050
➤ Generally available sources of information [INFOR]	.174 **	1.191	.136	1.145	-.068	.934	-.010	.990	.174	1.190	.215	1.240
<i>Knowledge Creation:</i>												
➤ Percentage of revenue dedicated to R&D activities [SrR&D] ^a	.003	1.003	-.090 **	.914	-.084 **	.920	.024	1.025	-.090	.914	-.029	.972
<i>Knowledge Embodied in Employees:</i>												
➤ Knowledge employees [LNKEMP] ^b	.059 **	1.060	.023 **	1.024	-.048	.953	.020 **	1.020	-.017	.983	-.023	.977
<i>Knowledge Embodied in Managerial Practices and Technologies:</i>												
➤ Number of advanced technologies used [TECHN]	-.061 **	.941	-.143 ***	.867	-.054 **	.947	-.188 **	.829	-.221 **	.802	-.131 **	.877
➤ Number of value-added practices used [PRACT]	.139 ***	1.149	.123 **	.042	-.048	.953	.281 ***	1.324	.077 **	1.080	-.034	.967
<i>Knowledge Embodied in Clients:</i>												
➤ Percentage of revenue that came from the three most important clients [SrCLIENT] ^a	.070	1.072	-.069 ***	.933	-.028	.972	.180 **	1.197	.107	1.113	-.057	.945
<i>Strength of Ties:</i>												
➤ Strength of ties [TIES]	.853 ***	2.348	-.563 **	.570	-1.338 ***	.262	.612 ***	1.844	-1.877 ***	.153	-2.166 ***	.115

Table 4 (continued): Estimated logit models of factors affecting the types of knowledge that firms exchanged with their clients

<i>Control Variables:</i>												
➔ Number of employees [LNSIZE] ^a	-.088	.916	.019	1.019	.144 ^{**}	1.155	-.212	.809	.063	1.065	.293 ^{**}	1.340
➔ Business age [LNAGE] ^b	.158 ^{**}	1.171	.329 ^{***}	1.389	.194 ^{**}	1.214	.656 ^{***}	1.928	.997 ^{***}	2.710	.284	1.329
<i>Services Industries:</i>												
➔ Industry [BININDUS]	.306 ^{**}	1.358	.180	1.198	-.196	.822	.410	1.508	.382	1.465	.078	1.081
<i>Census Agglomeration:</i>												
➔ Medium metropolitan regions [MEDIUM] ^c	-.137	.872	-.136	.872	-.072	.930	--	--	--	--	--	--
➔ Central regions [CENTRAL] ^c	-.140	.870	-.100	.905	-.043	.958	--	--	--	--	--	--
➔ Resource regions [RESOUR] ^c	.117	1.125	-.136	.873	-.264	.768	--	--	--	--	--	--
<hr/>												
<i>Number of cases: (Total =)</i>	271/570		271/201		570/201		62/127		62/45		127/45	
<i>Chi-square (d.f.):</i>	41.91 (15)		42.62 (15)		55.35 (15)		21.64 (12)		24.18 (12)		22.60 (12)	
<i>Nagelkerke R² (Pseudo R Square):</i>	.268		.297		.270		.151		.272		.180	
<i>Percentage of correct predictions:</i>	72.3%		75.5%		75.1%		75.1%		70.1%		77.9%	

Note: Exp(B) is the factor of change in the odds of the dependent variable, due to one unit increase in the specific independent variable.

^{*}, ^{**} and ^{***} indicate that the coefficient is significant, respectively, at the 10%, 5% and 1% thresholds.

^a Sr indicates a square root transformation.

^b Ln indicates a logarithmic transformation.

^c The reference category is Large metropolitan regions.



Table 5: Summary Table of the Logit regressions' results explaining the types of knowledge that firms exchanged with their clients

	PANEL A: Québec (Province)			PANEL B: Québec City Region		
Independent variables	<i>Mainly Tacit Knowledge/ Mixed Knowledge</i>	<i>Mainly Tacit Knowledge/ Mainly Codified Knowledge</i>	<i>Mixed Knowledge/ Mainly Codified Knowledge</i>	<i>Mainly Tacit Knowledge/ Mixed Knowledge</i>	<i>Mainly Tacit Knowledge/ Mainly Codified Knowledge</i>	<i>Mixed Knowledge/ Mainly Codified Knowledge</i>
<i>Variety of External Knowledge sources:</i>						
↻ Market sources of information	NS	NS	NS	NS	NS	NS
↻ Research sources of information	NS	▲	▲	▲	▲	▲
↻ Generally available sources of information	▲	NS	NS	NS	NS	NS
<i>Knowledge Creation:</i>						
↻ Percentage of revenue dedicated to R&D activities	NS	▼	▼	NS	NS	NS
<i>Knowledge Embodied in Employees:</i>						
↻ Knowledge employees	▲	▲	NS	▲	NS	NS
<i>Knowledge Embodied in Managerial Practices and Technologies:</i>						
↻ Number of advanced technologies used	▼	▼	▼	▼	▼	▼
↻ Number of value-added practices used	▲	▲	NS	▲	▲	NS
<i>Knowledge Embodied in Clients:</i>						
↻ Percentage of revenue that came from the three most important clients	NS	▼	NS	▲	NS	NS
<i>Strength of Ties:</i>						
↻ Strength of ties [TIES]	▲	▼	▼	▲	▼	▼
<i>Control Variables:</i>						
↻ Number of employees	NS	NS	▲	NS	NS	▲
↻ Business age	▲	▲	▲	▲	▲	NS
↻ Industry [BININDUS]	▲	NS	NS	NS	NS	NS
↻ Medium metropolitan regions	NS	NS	NS	---	---	---
↻ Central regions	NS	NS	NS	---	---	---
↻ Resource regions	NS	NS	NS	---	---	---

▲ indicates positive impact; ▼ indicates negative impact; (NS) indicates non-significant impact.

Factors that increase the likelihood of exchange of mainly codified or mixed knowledge rather than mainly tacit knowledge

- Increases in research sources of ideas and information
- Increases in knowledge embodied in organizational practices
- Increases in % of revenue from the three most important clients
- Increases in the number of knowledge employees
- Age of KIBS firms



Factors that increase the likelihood of exchange of mainly tacit knowledge rather than mainly codified or mixed knowledge

- Increases in knowledge embodied in advanced technologies



Influence of strength of ties

- Being a firm that had strong ties with its clients:
- **increases** the likelihood of exchange of
 - mixed knowledge rather than mainly tacit knowledge, and
- **decreases** the likelihood of exchange of
 - mainly codified knowledge rather than mainly tacit or mixed knowledge



Influence of the number of employees

- Increases in the number of employees increase the probability that firms exchanged with their clients:
 - mainly codified knowledge instead of mixed knowledge.



Not significant variables

- The percentage of revenue dedicated to R&D activities,
- the variety of market sources of ideas and information,
- The variety of the generally available sources of information,
- the services industry where firms operate
 - do not explain the likelihood that firms exchanged with their clients one or the other types of knowledge



Not significant variables in the Province of Québec models

- The market sources of ideas and information and
- The type of region (large metro, medium metro, central, resources regions) where KIBS operate:
 - do not explain the likelihood that firms exchanged with their clients one or the other types of knowledge



Conclusion and discussion

- Results of this study are exploratory
- Three knowledge exchange strategies:
 - Commodification
 - Personalization
 - Mixed
- Still limited number of prior empirical and theoretical foundations on this topics



Conclusion and discussion

- Most variables that explain the reliance of the commodification strategy also explain the reliance on the mixed strategy.
- It might suggest that these two strategies are variations where some KIBS adopt a strong commodification strategy where other adopt a weak commodification strategy. The difference between these two variations involve differences in the investments that KIBS make in information technologies and the extent to which they focus on developing information systems that codify, store, disseminate, and the extent of reuse of the codified or mixed knowledge in their exchange with their clients;
- Similarly the results of this study might suggest that the personalization strategy involves very limited investments in information technologies, accompanied by a strong focus on developing networks to link KIBS with their clients in order to complement the dissemination of a limited volume of codified knowledge with the sharing of tacit knowledge



Conclusion and discussion

- How does each strategy create value for the clients of KIBS firms?
 - KIBS that follow a commodification strategy likely provide their clients with standardized products
 - By comparison, KIBS that follow a personalization strategy offer their clients customized solutions based on advice that are rich in tacit knowledge



Limits

- Analyzing knowledge exchange strategies and their determinants is appropriate to provide insights on the extent of use and the determinants of use of different strategies but it **does not address issues related to the impact resulting from the implementation of these strategies on competitiveness and innovation.**
- Second, future research should complement the analysis of knowledge exchange strategies with the study of the challenging question of to **how the exchange of knowledge inputs is converted into knowledge outputs and in innovations.**



Merci pour votre attention
Thank you for your attention
Questions?
Comments?



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Appendix 1 Definitions of Independent Variables

DEPENDENT VARIABLE			
Types of knowledge exchanged with clients [KNOWL]	Categorical variable capturing three alternatives of types of knowledge that firms exchanged with their clients with 1 being the assessment by the firms that, over the past three years, they exchanged mainly tacit knowledge with their clients (i.e., almost only or mainly unwritten practical know-how); 2 the assessment by the firms that over the past three years, they exchanged mixed knowledge with their clients (i.e., half unwritten practical know-how and half written reports or documents); and 3 the assessment by the firms that, over the past three years, they exchanged mainly codified knowledge with their clients (i.e., almost only or mainly written reports or documents).		
INDEPENDENT VARIABLES			
<i>Independent variables</i>	Measure	Sub-items	Method (Range)
Continuous variables			
Market sources index [MARKET]	Measured as an index on a Likert scale of importance ranging from 1 = <i>Not important</i> to 5 = <i>Very important</i> of the role played between 2004 and 2006 by the following four research organizations as sources of information needed for the firm's innovation activities :	<ul style="list-style-type: none"> • Suppliers of software, hardware, materials, or Equipment • Clients • Consultancy firms • Competitors 	Sum (4-20)
Research sources index [RESEAR]	Measured as an index on a Likert scale of importance ranging from 1 = <i>Not important</i> to 5 = <i>Very important</i> of the role played between 2004 and 2006 by the following five markets organizations as sources of information needed for the firm's innovation activities :	<ul style="list-style-type: none"> • Universities • Colleges • Governmental research laboratories • Research institutions • Centers for technology transfer 	Sum (5-25)
Generally available information index [INFOR]	Measured as an index on a Likert scale of importance ranging from 1 = <i>Not important</i> to 5 = <i>Very important</i> of the role played between 2004 and 2006 by the following four generally available sources of information for the firm's innovation activities:	<ul style="list-style-type: none"> • Professional conferences, meetings, journals • Trade fairs and exhibitions • Trade associations • Internet 	Sum (4-20)
Number of advanced technologies used [TECHN]	Measured as a variety index assessing the number of different advanced knowledge management technologies currently used by the firm. Thus, the degree of use of advanced technologies is measured by the sum of the affirmative responses to the 10 following assertions:	<ul style="list-style-type: none"> • LAN: Local Area Network • Intranet • Internet site • Broadband Communications • Groupware software • Software of statistical analysis • Data warehousing/Data mining software • System of management of the documents • Data-processing networks for data bases with the clients • Knowledge bases 	Sum (0-10)
Knowledge Employees [LNKEMP]	<ul style="list-style-type: none"> • Measured as the percentage of employees that have completed a university degree. This variable was matched with the normal distribution using a logarithmic transformation. 		Ratio
Percentage of revenue dedicated to R&D activities [SrR&D]	<ul style="list-style-type: none"> • Measured as the percentage of the total revenues of 2006 that firm dedicated to R&D activities. This variable was matched with the normal distribution using a square root transformation. 		Ratio
Percentage of revenue that came from the three most important clients [SrCLIENT]	<ul style="list-style-type: none"> • Measured as the percentage of the total revenues of 2006 that came from the three most important clients. This variable was matched with the normal distribution using a square root transformation. 		Ratio
Number of employees [LNFSIZE]	<ul style="list-style-type: none"> • Measured by the total number of full-time employees in 2006. This variable was matched with the normal distribution using a logarithmic transformation. 		Ratio
Business age [LNAGE]	<ul style="list-style-type: none"> • Measured as the number of years between 2007 and the year of creation of the firm. This variable was matched with the normal distribution using a logarithmic transformation. 		Ratio

Appendix 1 (Continued) Definitions of Independent Variables

Number of value-added practices used [PRACT]	Measured as a variety index assessing the number of the value-added practices currently used by the firm to manage its knowledge. Thus, the degree of use of knowledge management practices is measured by the sum of the affirmative responses to the 8 following assertions:	<p>My firm...</p> <ul style="list-style-type: none"> • Uses financial incentives to promote knowledge sharing between its employees • Uses non-financial incentives to promote knowledge sharing between its employees • Dedicates resources to knowledge acquisition from other sources and to their diffusion to its employees • Provides formal training related to knowledge management practices • Encourages experienced workers to transfer their knowledge to new or less experienced workers • Regularly updates databases of good work practices, lessons learned or listings of experts • Prepares written documentation such as lessons learned, training manuals, good work practices, articles for publications, etc. • Has a written knowledge management policy or strategy 	Sum (0-8)
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Categorical Variables

Strength of ties [TIES]	<p>Dichotomous variable:</p> <ul style="list-style-type: none"> - coded "1" if the firm described its working relationship with its most important clients as very close, (practically like being in the same work group somewhat close) or somewhat close (like discussing and solving issues together), and 0 otherwise (somewhat distant, like with people that you do not know well; distant, like a working group with which you can only have a quick exchange of information; or very distant, practically like with people that you do not know at all).
Services industries [BININDUS]	<p>Dichotomous variable:</p> <ul style="list-style-type: none"> - coded "1" if the firm is operating in a new technology-based KIBS (Architectural, engineering and related services; Specialized design services; Scientific R&D; and Computer system designs and related services) are considered in this study, and 0 if the firm is operating in a traditional professional KIBS (Legal Services; Accounting, tax preparation, bookkeeping and payroll services; Management, scientific and technical consulting services; Advertising and related services; and Other KIBS).
Census agglomerations	<p>A series of dichotomous variables defined as follows:</p> <ul style="list-style-type: none"> - Large metropolitan region [LARGE] is a binary variable coded 1 if the firm is located in the region of Montreal and neighbouring regions of the Laurentides, Lanaudière, Montérégie and Laval, and coded 0 otherwise. - Medium metropolitan regions [MEDIUM] is a binary variable coded 1 if the firm is located in the regions of La Capitale-Nationale (Québec) or Outaouais, and coded 0 otherwise. - Central regions [CENTRAL] is a binary variable coded 1 if the firm is located in the regions within approximately 1 hour's drive of a large or medium metropolitan area such as the regions of Centre-du-Québec, Chaudière-Appalaches, Estrie and Mauricie, and coded 0 otherwise. - Resource regions [RESOUR] is a binary variable coded 1 if the firm is located in all areas that are not classified as central or metropolitan, including the regions of Abitibi-Témiscamingue, Bas-Saint-Laurent, Côte-Nord, Gaspésie-Îles-de-la-Madeleine and Saguenay-Lac-Saint-Jean., and coded 0 otherwise. <p>The reference category is Large metropolitan regions.</p>