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Abstract

The growing literature on knowledge and information has focused on the impact of information sources on technological innovation. Our objective was to explore the use made by firms of internal and external (market, research and generally available) sources of information for their organizational innovation practices' implementation. Furthermore, we studies whether these sources may vary according to whether the firm operates in the manufacturing or service industry. Multivariate probit models' results on 2008 Community Innovation Survey (CIS) data show notable differences between services and manufacturing, for instance that employees' skill levels are more important for manufacturing than for services. Overall, this paper provides strong evidence of the heterogeneity in firms' sources of information to engage in organizational innovation. On one hand, differences appear in the sources of innovation used for the various types of organizational innovation, indicating the appropriateness to differentiate organizational innovation practices rather than using an aggregated measure of organizational innovation. On the other hand, the sources of information vary according to the type of industry, even though some similarities appear. Managerial and theoretical implications for organizational innovation are provided.

Keywords: CIS, manufacturing/services, organizational innovation, sources of information

1. Introduction

In today's context of globalization and increased competition, firms' innovative capabilities not only depend on technological competencies and Research and Development (R&D) activities, but also on organizational strategies. The resource-based view has highlighted the importance of investing resources in complementary innovation strategies such as those implemented in organizational fields in order to support technological innovation. Furthermore, the role of knowledge in these resources has been the subject of a growing amount of research, giving rise to a number of related theoretical approaches: the knowledge-based view, learning theory, etc.

Despite the crucial role of organizational strategies in the innovation process, studies on innovation have particularly focused on technological aspects. Research on organizational innovation has mainly concentrated on the relationships between organizational innovation and labour productivity (Ichniowski et al., 1997; Caroli and Van Reenen, 2001; Greenan, 2003; Piva and Vivarelli, 2002; Laursen and Foss, 2003; Evangelista and Vezzani, 2010), between organizational innovation and technological innovation (Schubert, 2010; Battisti and Stoneman, 2010), and on synergistic effects that may arise from the simultaneous adoption of complementary organizational practices (Ichniowski et al., 1997; Cappelli and Newmark, 2001).

Surprisingly, there are few empirical works on firms' motives to adopt organizational innovation, and particularly on the link between firms' perception of sources of information and their implementation of innovative organizational practices. While these sources of information have been studied in relation to technological innovation (Brusoni et al., 2005; Yam et al., 2003), to the degree of innovation novelty (Amara and Landry, 2005), or to the whole innovation adoption process in the case of small firms, but without distinguishing the different types of innovation (Hartman et al., 1994), no such study has been carried out in relation to organizational innovation. In order to remedy this lack in the literature, we analyzed the sources of information used by firms for their different organizational innovation practices, as well as whether and how these may differ depending on whether firms operate in the manufacturing or service industries. For this purpose, we adopted a comparative research strategy (Arvanitis, 2008) that takes the "*dissolution of boundaries*" (Drejer, 2004: 561) between manufacturing and services into account (Coombs and Miles, 2000). Embracing a view of innovation that accounts for its different forms (Tatikonda and Montoya-Weiss,

2001), the paper investigates firms' utilization of sources of information to undergo organizational innovation within a unique framework, however, distinguishing manufacturing from service firms.

The remainder of the article is organized as follows: the next section reviews the literature on organizational innovation practices in services and manufacturing, and on sources of information. Section 3 outlines the data set, variables and methods, based on the large-scale 2008 Community Innovation Survey (CIS) carried out in Luxembourg in 2010. Section 4 presents and discusses the results. Finally, Section 5 presents some conclusions, implications for theory and practice, and derived consequences for policy making.

2. Theoretical framework

2.1. The concept of organizational innovation

Innovation is a widely used concept and the term's definition varies to reflect the particular requirements and characteristics of a specific research (Damanpour and Evan, 1984). The word "innovation" frequently refers to "technical innovation", with relatively few studies on organizational innovation (Liao et al., 2008), although both technological and non-technological innovations can lead to competitive advantage (Santos-Vijande and Álvarez-González, 2007). The notion of "organizational innovation" is also subject to various definitions and interpretations (Lam, 2005). Becker and Whisler (1967) suggested that innovation is "the first or early use of an idea by one of a set of organizations with similar goals" (idem: 463). Innovation (or "organizational innovation") has also been defined as the adoption of an idea or behaviour that is new to the organization (Mohr, 1969; Aiken and Hage, 1971; Daft, 1978). Theoretically, organizational innovation is a broad concept that encompasses strategic, structural and behavioural dimensions (Gera and Gu, 2004). Black and Lynch (2005) view organizational innovation as including components such as workforce training, work design (decentralized and flexible allocation of labour in the firm), employee voice (greater autonomy and discretion in their work) and shared rewards (incentives such as profit sharing or stock options).

Damanpour and Evan (1984) distinguish technical and administrative innovations. Technical innovations are innovations that occur in the technical system of an organization and are directly related to the primary work activity of the organization. A technical innovation can be the implementation of an idea for a new product or a new service or the

introduction of new elements in an organization's production process or service operation. Technical innovations are perceived here as a means of changing and improving the performance of the technical system of an organization. Administrative innovations are defined as those that occur in the social system of an organization. The social system here refers to the relationships among people who interact to accomplish a particular goal or task (Cummings and Srivastva, 1977). It also includes those rules, roles, procedures, and structures that are related to the communication and exchange among people and between the environment and people. An administrative innovation comprises innovations in organizational structure and in the management of people. In this investigation, organizational innovations were thus considered to be the administrative innovations as defined by Damanpour and Evan (1984), involving the implementation of a new administrative idea. The adoption of a new idea in an organization is expected to result in an organizational change that might affect the technological innovative performance of that organization.

In this study, we look at the various organizational innovation practices and analyze whether these practices rely on different sources of information. Considering the numerous approaches to organizational innovation practices, we focused on the OECD recommendations published in the Oslo manual (OECD, 2005), which view organizational innovation as encompassing three types of practices: business practices, workplace organization and external relations. The first category refers to the introduction of new business practices, which aims to organize work and procedures. Examples of this practice are supply chain management, business re-engineering, lean production, quality management and knowledge management. The second category refers to work organization. New work practices are related to decentralized decision-making, job rotation, team work and shared rewards (OECD, 2001a). Implementing new work organization could result in substantial improvements in organizational flexibility which in turn leads to improved firm efficiency and performance. The third organizational practice refers to relations with other firms or public institutions, through alliances, partnerships, outsourcing or sub-contracting. The growing role of networking in firms' innovative capabilities is closely linked to the context of the emerging knowledge-based global economy. The tacit and non-transferable character of knowledge and of the evolutionary and continual character of the learning process means that innovative firms should concentrate on their specific capabilities while being involved in cooperative arrangements in order to develop new competencies and extensions of the firm's know-how to new applications. Moreover, firms should be encouraged to engage in external

relations in order to access partners' complementary or synergistic competencies and capitalize on "*incoming spillovers*" (Cassiman and Veugelers, 2006).

2.2. Organizational innovation in manufacturing and services

Here, we analyze whether firms, according to whether they are in the service or in the manufacturing industry, use different kinds of information sources for their organizational innovation. Over the last decade, the literature on service innovation has represented an increasingly important field of research. The ongoing debate on whether services can be treated like manufacturing with respect to innovation has not been resolved yet and three distinct views on service innovation co-exist (Coombs and Miles, 2000): (i) for the *demarcation* approach, service innovation is different from manufacturing and therefore requires specific theories; (ii) the *assimilation* approach considers that services are similar to manufacturing and attaches little importance to non-technological innovation; (iii) the *synthesis* approach is an integrative view that allows for innovation to take place in manufacturing *and* in services (Gallouj and Weinstein, 1997; Love and Mansury, 2007). Motivated by the need to integrate research on manufacturing *and* service innovation, we used a "comparative" research strategy designed to compare results for manufacturing and service firms to assess the adequacy of using conventional models when analyzing innovation in services, and specifically the factors associated to organizational innovation. This view has recently been made possible in Europe where innovation surveys and European CIS in particular have made remarkable progress, taking into account the specific aspects of services, for instance by extending the definition of innovation to include organizational innovation, which is supposed to be key for service industries.

Organizational innovation is viewed as being more prominent in services than in manufacturing (Tether, 2005; Tether and Tajar, 2008; among others). Innovation in services is mainly non-technological (organizational, marketing, management, service delivery, etc.) with "softer" attributes such as workforce skills or cooperation practices (Tether, 2005). The necessary interaction with clients, service delivery and marketing aspects has also been emphasized (Gallouj and Weinstein, 1997; Tether, 2005; Flikkema et al., 2007; among others). It is thus often analyzed in terms of technological, conceptual, client-interface and service delivery innovation (Evangelista, 2000). Literature has therefore put forward that firms in services do more non-technological innovation than manufacturing companies – with the result that, in services, there is a greater share of firms doing these activities.

However, no previous study, to our knowledge, has empirically analyzed the effects that sources of information have on organizational innovation – as well as whether such effects may differ for manufacturing and service firms.

2.3. Sources of information for organizational innovation

The first theory of knowledge-based innovations is the "engineering theory of innovation" (Amara and Landry, 2005), which considers that R&D is the main source for new or improved products and processes. However, innovations may be developed independently of R&D from other (internal or external) sources of information. This is especially true for organizational innovation, which is not supposed to rely on R&D investment and expenses. Apart from R&D, studies of innovation have also long recognized the importance of external sources of information, especially the importance of customers, as determinants of innovation both in the manufacturing sector (Von Hippel, 1988) and in the service sector (Gallouj and Weinstein, 1997; Tether, 2005; Flikkema et al., 2007). Customers and users are seen as essential sources of information to develop innovation as innovations developed in coordination with users are more likely to be successful. In services, the "servuction" approach highlights the involvement of customers in the production process itself, thus making the interaction between firms and their customers even more "natural" in the case of services. Suppliers are sources of information, sharing many of the advantages generated by customers and suppliers, with this information used to develop or improve products or processes.

Besides customers and suppliers, the technological network theories of innovation have been extended to include a larger variety of sources of information (Lundvall, 1992; Edquist, 1997; Edquist and Hommen, 1999). The supporters of these types of theories assume that innovative firms are linked to a highly diversified set of agents through technical networks of collaboration and exchange of information. This view stresses the importance of the sources of information that are external to the firm: clients, suppliers, consultants, government agencies, government laboratories, university research, etc. In line with the above-mentioned studies, especially that of Amara and Landry (2005) – however devoted to technological innovation – and in order to fit to the objective of our research which relates to the sources of information for organizational innovation, we will retain two main categories of sources: internal (from qualified personnel and from the group) and external sources. These external sources may be split into three: market sources (competitors, customers, and

suppliers), institutional sources (universities or other higher education institutions or governments or public research institutes) and publicly available sources (such as patents, databases, trade literature and fairs). Patents are considered a useful source of knowledge on the technical characteristics of protected inventions (Yam et al., 2003). The use of patent databases may provide valuable knowledge on potentially profitable research areas or on how to invent around a patent (Arundel, 2001). While we include it in the sources, we hypothesize that this type of information source, which is of a codified nature (Brusoni et al., 2005), does not lead to organizational innovation. The same type of hypothesis is made for institutional research sources.

3. Data and methodology

3.1. Data and variables

The empirical analysis is based on firm-level data drawn from the Luxembourg CIS 2008 carried out in 2010 by CEPS/INSTEAD[1] in collaboration with STATEC[2]. It provides a set of firms' general information (sector of activities, group belonging, number of employees, sales, geographic market), information about technological and non-technological innovation as well as perceptions of factors hampering innovation activities or the subjective evaluation of the effects of innovation. The data set also has information about sources of information for innovation activities, competition intensity on the market as well as qualified personnel. The final sample contains 615 firms with more than 10 employees (the target population of CIS).

Of the 615 firms, 405 are in services (65.9%) and 210 in manufacturing (34.1%), reflecting the specific nature of the Luxembourg population oriented towards services. Of these firms, 52 have between 10 and 49 employees, 35% between 50 and 249, and 13% more than 249 employees. Table 1 presents the data set structure classified according to industry type and firm size, and provides the percentages of firms that have implemented organizational innovation.

[1] International Network for Studies in Technology, Environment, Alternatives, Development
[2] Central Service of Statistics and Economic Studies

Table 1: Firms' organizational innovation according to size and sector of activity

	Services		Manufacturing	
	Total firms	*% innovative*	*Total firms*	*% innovative*
Size : 10–49	216	44	101	39
Size : 50–149	70	53	82	56
Size : >149	43	77	27	67
Total sample	405	**51**	**210**	**49**

Table 2 provides the descriptive statistics on firms' organizational innovation practices according to whether they are in services or in manufacturing. It should be noted that those firms that mostly adopt organizational innovation services are: (1) for business practices, high and medium technology manufacturing firms (for 52% of them), financial service firms (49%), R&D engineering (48%) and computer activities (46%); (2) for workplace organization, R&D engineering (55%), financial activities (53%), computer activities (49%) and high and medium technology firms (44%); (3) for external relations, R&D engineering (36%) and financial activities (34%).

Table 2: Organizational innovation practices in services and manufacturing (in %)

	Obs.	Business practices	Workplace organization	External relations
Services	405	31	39	24
Wholesale	83	35	37	16
Transport and communication	101	23	32	18
Financial activities	85	49	53	34
Computer activities	92	46	49	30
R&D-engineering activities and consultancy, testing and analysis	44	48	55	36
Manufacturing	210	32	33	16
High and medium-technology industries	48	52	44	25
Medium and low-technology industries	92	39	37	20
Low-technology industries	70	31	39	16

3.1.1. Dependent variables

Appendix A presents the definition of all variables. Armbruster et al. (2008) pointed out the difficulties and challenges of measuring non-technological innovation in large-scale surveys. Here, in this last CIS survey, organizational innovation is measured through three variables (there were four in the CIS 2006): (1) new *business practices*; (2) new methods of *workplace organization*; and (3) new methods of organizing *external relations* are equal to one if the firm has introduced, during the three years 2006 to 2008, such practices. We added a fourth variable, *organizational innovation* as an aggregated measure, which takes the value one if at least one of three above organizational practices is undertaken, and zero otherwise.

3.1.2. Independent variables

Internal sources of information. Two internal sources of information are considered here, that stemming from qualified personnel and that coming from the group (when the firm belongs to a group). In order to control for the importance of employees' skill level, we created a variable *qualified personnel*, defined as the percentage of employees with higher education (thus post-secondary college diplomas and university graduates). We expect that firms with greater skill resources, whether in services or manufacturing, are more likely to invest in organizational innovation (Lynch, 2007). *Internal knowledge* is a dummy variable taking the value one if the group's importance as the source of knowledge for the firm's innovation process is high. We expect a positive impact on organizational innovation as firms that rely on internally generated know-how are more likely to be constrained to introduce new organizational practices for enhancing communication and knowledge exchange within the group.

External sources of information. In the CIS 2008, firms were asked to rate the importance of different external sources of information for their innovation activities. Five dummy variables were included: competitors, customers, suppliers, institutional research (universities, other higher education institutions, government, public research institutes), and publicly-available information (patents, databases, trade literature and fairs). These five variables take the value one when the source of information is crucial for firm innovation activities.

Control variables. Five variables were included: firm size, the belonging to a group, the sector of activity, the intensity of competition, and the speed of technological change. For *firm size*, three dummy variables are used: (1) "small" firms with fewer than 50 employees (reference); (2) "medium" for those between 50 and 249 employees; (3) "large" for those with more than 249 employees. In line with previous literature (Lynch, 2007), our expectation is that organizational innovation is more frequent in large firms. The dummy variable *belonging to a group* is expected to have a positive impact on innovation as far as the group can provide finance and resources (Lynch, 2007). The sector of activity (services/manufacturing) was further refined with a group of *sub-sector dummies* for the manufacturing industry, according to the two-digit NACE classification. For manufacturing, three sub-sectors are divided according to the OECD (2001b) definition: (1) high and medium-technology industries; (2) medium and low-technology industries; and (3) low-technology industries (reference). For services, five sub-sector dummies are included: (1) R&D-engineering activities and consultancy, technical testing and analysis; (2) transport and communication; (3) computer activities; (4) financial activities; and (5) wholesale trade (reference). *Competition intensity* is a dummy variable which takes the value one when it is intense and zero otherwise. Numerous theoretical and empirical studies have investigated the relationship between competition and innovation, delivering, however, contradictory predictions (Dixit and Stiglitz, 1977; Schmutzler, 2007). The differences related to the assumptions on the competition type and technological characteristics partially explain these inconclusive claims. Aghion et al. (2005) showed that innovation initially increases with intense competition but then declines, thus predicting an inverted U relationship between competition and innovation. Here we expect a positive relationship between competition and organizational innovation. Finally, we introduce the *speed of technological change* which is measured as the sum of sales of firms in the two-digit industry that stated that they had introduced new products to the industry (goods or services) divided by the sum of sales of all firms in the industry. In a context of rapid technological change, the technological innovation capacities of the firm increasingly depend on its organizational learning, problem-solving and organizational adaptability which are generated by implementing new methods of organizational practices. Thus, we expect a positive relationship between the speed of technological change and organizational innovation.

3.3. Empirical methods

As the first three independent variables are individual organizational practices with binary choice equations, we used a multivariate probit model which includes three equations estimating the three organizational practices. To explore whether the determinants of organizational innovation vary according to the underlying practice, we included all explanatory variables in all three equations. This also allows us to investigate the correlations between organizational practices that are conditional on a set of explanatory variables. For the fourth dependent variable (i.e. organizational innovation as an aggregated measure) and the correspondent binary choice equation, a standard probit model was used.

4. Results

Results are presented for the whole sample, then for each industry (manufacturing/services). In each set of results, both organizational innovation and individual practices are considered.

4.1. Sources of information for organizational innovation

Table 3 presents the results of the multivariate probit model for the complete sample of 615 observations. It provides an overview of firms' reliance on sources of information to adopt organizational innovation. From this estimation, the conditional pair-wise correlations among the residuals of the three practices are computed (Appendix B). We note that the correlation coefficients, after controlling for firm-specific effects, are positive and highly significant.

Table 3: Multivariate probit model for organizational innovation (all firms)

	Organizational innovation	Business practices	Workplace organization	External relations
Qualified personnel	0.572***	0.599***	0.634***	0.651***
	(0.004)	(0.000)	(0.000)	(0.000)
Internal knowledge (group)	0.383**	0.346**	0.251*	0.001
	(0.023)	(0.017)	(0.088)	(0.993)
Competitors	0.244	0.119	0.184	0.279
	(0.368)	(0.530)	(0.314)	(0.151)
Customers	0.205	0.232	0.180	0.323**
	(0.296)	(0.145)	(0.241)	(0.049)
Suppliers	-0.035	0.246	-0.024	0.034
	(0.866)	(0.121)	(0.880)	(0.845)
Institutional sources	0.173	0.267	0.209	0.686***
	(0.528)	(0.226)	(0.343)	(0.001)
Publicly available sources	0.603***	0.334**	0.455***	0.190
	(0.002)	(0.035)	(0.005)	(0.274)
Medium size	0.211*	0.397***	0.107	0.114
	(0.091)	(0.002)	(0.387)	(0.392)
Large size	0.504***	0.660***	0.207	-0.051
	(0.001)	(0.001)	(0.231)	(0.794)
Services	-0.041	-0.142	-0.040	-0.006
	(0.758)	(0.278)	(0.754)	(0.965)
Group	0.191	0.115	0.294**	0.191
	(0.163)	(0.370)	(0.0143)	(0.146)
Competition intensity	0.136*	0.184**	0.107	0.117
	(0.056)	(0.010)	(0.120)	(0.147)
Speed of technological change	2.798*	2.227	1.847	0.001
	(0.091)	(0.141)	(0.200)	(0.999)
Constant	-1.386***	-1.814***	-1.795***	-1.781***
	(0.008)	(0.007)	(0.002)	(0.004)
Observations		615		
Wald χ^2 (39)		184.77		
Log likelihood		-935.45		

Notes: *, ** and *** denote significance at the level of 10%, 5% and 1%. P-values are in parentheses

As expected, internal sources have a positive and significant impact on organizational innovation, either *internal knowledge* from the group and *qualified personnel*. Differences can be found between organizational practices. *Internal knowledge* for firms belonging to groups has a significant and positive impact for business practices and workplace organization. This may be explained by the fact that these organizational innovation practices often stem from group requirements and adaptation to the overall group organization and structure. Not surprisingly, employees' skill level is also an important determinant of both types of organizational practice, confirming the hypothesis that organizational implementations are directly related to the qualification and expertise of employees.

As far as external sources of information are concerned, *publicly-available sources* (patents, databases, trade literature and fairs) have the most important positive impact on organizational innovation as a whole, and more specifically on business practices and workplace organization, confirming their crucial role for the production of new knowledge

that will be used by firms in various ways. These sources are also essential to identify potential partners. *Institutional sources* (universities, other higher education institutions, governments or public research institutes) do have a major impact on external relations, which can be explained by the fact that access to these sources may enhance a firm's information on potential partners, recent R&D activities developed by R&D institutes or universities, which could in turn lead firms to introduce new methods of organizing external relations with those institutes. Thus, all the above sources of information, which are considered to be crucial for technological innovation, are also important for organizational innovation as they lead firms to adopt new business practices, organizations and external relationships to collect and absorb information coming from outside, and to better use or exchange the underlying knowledge. Information stemming from *customers* and *competitors* do not have any significant impact on organizational innovation.

When considering firms' internal characteristics and the other control variables, *firm size*, as expected, has a significant impact, large and medium-sized firms being more likely to adopt organizational innovation than smaller firms. When splitting organizational innovation into the three individual practices, this positive relationship is confirmed only for business practices, showing that the larger the firm, the greater the propensity to adopt new business practices. *Belonging to a group* has an impact on workplace organization. *Competition intensity* is likely to induce firms to introduce organizational innovation, especially business practices. On highly competitive markets, firms are more likely to adopt new organizational practices that help them to better use external information and internal skills, probably in order to reinforce their flexibility and adaptability and allow them to better face competition. This result is in line with Nickell et al. (2001) and Pil and MacDuffie (1996) who indicate that firms are motivated to invest more in organizational innovation when the real output price or performance is declining – which can be due to increased competition, both domestically and internationally.

4.2. Differences in sources of information between services and manufacturing

Table 4 presents estimation results of the multivariate probit estimation for the four dependent variables, distinguishing between services and manufacturing. As already stated for the full sample, we observe that there is evidence of the heterogeneity in the impact of sources of information on a firm's engagement in organizational innovation in services and

manufacturing. This is in line with our expectations and confirms the need to separate services from manufacturing.

Regarding organizational innovation at the aggregated level, estimation results show that, for services, the most important information sources come from firms belonging to the same group (*internal knowledge*) while, for manufacturing, the most crucial sources are *qualified personal* and *publicly-available* ones, stemming from patents, software, databases, the trade literature or fairs. Information from competitors, customers and suppliers do not have any impact on organizational innovation in both industries. Theoretically, suppliers, customers and competitors are seen as crucial sources of information for technological innovation (Tether, 2003). Our findings suggest that, the sources of information do not have the same influence according to the types of innovation, i.e. technological versus non-technological innovation.

At the organizational practices level, results show that *qualified personnel* matters for manufacturing, especially for workplace organization and external relations while no evidence was carried out for services. Among external information sources, *institutional sources* are positively associated with the firm's propensity to implement business practices and external relations in services. On the contrary, *publicly available sources* considerably spurs organizational innovation (with the exception of external relations) in manufacturing industries, while this type of source has only a small impact in motivating firms to introduce organizational innovation in services. Information from *customers* and *suppliers* do not carry any impact either in services or in manufacturing. Overall, these results support the hypothesis that information sources used by firms for their organizational innovation practices vary considerably according to whether they are in the manufacturing or service industry. They are also very different from those sources used for technological innovation, for which customers and suppliers play a crucial role (Tether, 2003).

Table 4: Multivariate probit model for organizational innovation in services and manufacturing

	Services				**Manufacturing**			
	Organizational innovation	*Business practices*	*Workplace organization*	*External relations*	*Organizational innovation*	*Business practices*	*Workplace organization*	*External relations*
Qualified personnel	0.286	0.0766	0.353	0.324	1.552*	0.425	1.153**	1.268**
	(0.321)	(0.807)	(0.289)	(0.353)	(0.079)	(0.422)	(0.0244)	(0.0155)
Internal knowledge	0.579***	0.254	0.380	0.0558	0.189	0.234	-0.147	-0.158
	(0.007)	(0.299)	(0.123)	(0.815)	(0.438)	(0.394)	(0.590)	(0.581)
Competitors	0.252	0.155	0.289	0.260	0.097	0.003	0.136	0.331
	(0.461)	(0.613)	(0.291)	(0.350)	(0.827)	(0.991)	(0.671)	(0.375)
Customers	0.377	0.442	0.273	0.434*	0.256	0.332	0.111	0.0786
	(0.120)	(0.109)	(0.287)	(0.0942)	(0.480)	(0.307)	(0.653)	(0.768)
Suppliers	-0.0805	0.267	0.0466	0.187	-0.011	0.060	0.0735	-0.138
	(0.750)	(0.286)	(0.853)	(0.459)	(0.971)	(0.817)	(0.819)	(0.723)
Institutional sources	0.454	0.941***	0.0165	0.924***	-0.181	-0.194	0.238	0.489
	(0.302)	(0.007)	(0.956)	(0.00310)	(0.707)	(0.606)	(0.487)	(0.171)
Publicly available sources	0.472*	0.0591	0.311	0.153	0.834**	0.787***	0.829**	0.444
	(0.079)	(0.824)	(0.222)	(0.544)	(0.0107)	(0.008)	(0.0136)	(0.245)
Medium size	0.163	0.502***	0.108	0.172	0.335	0.418*	0.509**	0.389*
	(0.311)	(0.006)	(0.545)	(0.356)	(0.256)	(0.090)	(0.0216)	(0.0844)
Large size	0.584**	1.007***	0.460**	-0.209	0.464	0.678*	0.417	0.473
	(0.024)	(0.000)	(0.048)	(0.443)	(0.316)	(0.056)	(0.232)	(0.159)
Transport and communication	-0.325	-0.463*	-0.274	0.0685				
	(0.214)	(0.0614)	(0.219)	(0.790)				
Financial activities	-0.193	-0.138	-0.186	0.433				
	(0.468)	(0.643)	(0.535)	(0.130)				
Computer activities	-0.227	0.153	-0.204	0.105				
	(0.472)	(0.610)	(0.501)	(0.725)				
R&D-engineering	0.502	0.399	0.402	0.577*				
	(0.115)	(0.195)	(0.207)	(0.087)				
High and medium high-technology industries					-0.589*	0.199	-0.0688	0.191
					(0.053)	(0.549)	(0.811)	(0.561)
Medium and low-technology industries					-0.308	0.080	0.104	0.194
					(0.179)	(0.748)	(0.640)	(0.439)
Group	0.352**	0.300	0.232	0.196	0.059	0.044	0.131	-0.124
	(0.037)	(0.119)	(0.192)	(0.299)	(0.790)	(0.853)	(0.568)	(0.584)
Competition intensity	0.135	0.159	0.0553	0.216	0.243*	0.221*	0.198	0.0457
	(0.148)	(0.192)	(0.653)	(0.121)	(0.063)	(0.086)	(0.113)	(0.714)
Speed of technological change	4.146*	5.544**	2.671	-0.613	0.904	-1.967	0.892	-0.284
	(0.069)	(0.014)	(0.194)	(0.784)	(0.735)	(0.407)	(0.702)	(0.915)
Constant	-1.435***	-2.059***	-1.139**	-2.244***	-1.221**	-1.627***	-1.767***	-1.656***
	(0.000)	(0.003)	(0.021)	(0.007)	9.088	(0.006)	(0.000	(0.000)
Observations		405			210			
Wald χ^2 (48)		148.89			86.02			
Log likelihood		-1452.236			-564.90			

Notes: *, ** and *** denote significance at the level of 10%, 5% and 1%. P-values are in parentheses

As for control variables, *firm size* is found to have a positive impact. In services, large firms are likely to engage more in organizational innovation, in particular in business practices and workplace organization while, in manufacturing, medium-sized firms appear to be more likely than other firms to engage in new methods of workplace organization and external relations. *Being part of a group* is positively associated with the propensity of organizational innovation in services, in line with Lynch (2007), while this variable has no impact for manufacturing. *Competition intensity* plays a positive role for organizational innovation in manufacturing industries while this variable has no impact in services. *Speed of technological change* has a positive impact on organizational innovation in services, in particular on the implementation of business practices. This is probably due to the underlying use these firms have of different types of technologies, such as information and communication technologies.

5. Conclusion

The objective of this paper was to highlight the sources of information that influence the firm's implementation of organizational innovation, and to determine whether these sources of information differ according to whether the firm operates in the manufacturing or service industry. We used a systemic approach integrating services and manufacturing in the same model and the firm-level dataset from the Luxembourg CIS (2008). We estimated a multivariate probit estimation model with two main groups of explanatory variables, internal and external sources of information. Overall, relationships between information sources and organizational innovation, while statistically significant, account for a small percentage of variance in non-technological innovative activities. This result is in line with Hartman et al.'s results (1994) for small service and manufacturing firms. Thus, Brusoni et al. (2005, 229) stated that "*the current evidence suggests that David and Foray [1995] may have been somewhat too optimistic in ascribing a key role to these forms [i.e. codified sources] of information in the innovation process".* Our results suggest that codified sources such as patents, software, databases, the trade literature or fairs play a more significant role than informal sources (from customers, suppliers, competitors, qualified personnel), especially for manufacturing firms. On the contrary, sources stemming from universities, other education institutions or public research institutes matter for service firms.

We could obtain a general profile of the firms adopting organizational innovation: they are of a medium and large size and use internal information from the group and publicly available sources. When distinguishing between service and manufacturing firms, the hypothesis that medium and large firms are more likely to invest in organizational innovation is confirmed for both sectors, is in line with the literature on organizational innovation. Surprisingly, the skill level of employees does play an important role in stimulating the implementation of organizational innovation only in manufacturing. This result can easily be explained by the fact that qualified personnel account for 48% of total personnel in services while it reaches only 17% in manufacturing. Thus, as qualified personnel are relatively rare in manufacturing, statistically, they stimulate organizational innovation more than in services.

Information sources coming from internal sources (the group), R&D institutions and, to a smaller extent, customers matter for services while publicly available sources and qualified personnel are key for manufacturing firms. The lack of evidence on the impact of market sources of information on organizational innovation, such as those coming from customers, suppliers or competitors is in line with previous studies on sources of information for technological innovation. For instance, Amara and Landry (2005, 256) suggested that their results bring "a word of caution regarding the impact of market sources on innovation". Information from customers was not found to be highly related to the various practices of organizational innovation, in line with Hartman et al.'s (1994) results for the various steps of the innovative process.

These results entail important implications for theory in two directions. First, this paper provides strong evidence of the heterogeneity in the sources of information for firms' organizational innovation. Differentiating the various practices of organizational innovation also appears to be more appropriate than using an aggregated measure. Second, the sources of information underlying organizational innovation vary according to the type of industry, even though some similarities appear. This result suggests that theoretical and empirical works on the determinants of innovation and on the impact of innovation on a firm's performance should use a systemic approach integrating services and manufacturing in the same model.

Our paper is not exempt from some limitations, the main one being the fact that we analyze only some of the determinants of organizational innovation, and without considering their impact on performance measures. Future research could include other determinants such as strategic, organizational and managerial firms' aspects, and analyze the relationship between these organizational innovation practices and other innovation types and, more generally speaking, organizational performance. Taking into account the potential

complementarities between the different organizational practices also appears to be crucial, as in some practices they may act as complements while others may reveal they are substitutes. There remains a lot to be done to understand organizational innovation, taking into account the distinction between service and manufacturing industries.

Appendix A: Definition of variables

Variables	**Description**
Organizational innovation	
Business practices	Equal to 1 if introduced new business practices for organizing work or procedures (i.e. supply chain, business re-engineering, lean production, quality management) during the three years 2006 to 2008, 0 otherwise.
Workplace organization	Equal to 1 if introduced new methods of workplace organization for distributing responsibilities and decision making (team work, decentralization, integration or de-integration of departments), 0 otherwise.
External relations	Equal to 1 if introduced new methods of organizing external relations with other firms or public institutions (partnerships, outsourcing, sub-contracting), 0 otherwise.
Organizational innovation	Equal to 1 if introduced at least one of above three organizational practices during the three years 2006 to 2008, 0 otherwise.
Sources of information	
External sources of information	
Competitors	Equal to 1 if the score of importance of competitors as sources of information is "crucial" for the firm's innovation process, 0 otherwise.
Customers	Equal to 1 if the score of importance of customers as sources of information is "crucial" for the firm's innovation process, 0 otherwise.
Suppliers	Equal to 1 if the score of importance of suppliers as sources of information is "crucial" for the firm's innovation process, 0 otherwise.
Institutional research	Equal to 1 if the score of importance of universities or other higher education institutions or governments or public research institutes as sources of information is "crucial" for the firm's innovation process, 0 otherwise.
Publicly-available	Equal to 1 if the score of importance of patents, databases, trade literature and fairs as sources of information is "crucial" for the firm's innovation process, 0 otherwise.
Internal sources	
Qualified personnel	Percentage of employees with higher education (include post-secondary college diplomas and university graduates, i.e. diplomas over baccalauréat, abitur, etc.).
Group knowledge	Importance of other group firms as source of knowledge for the firm's innovation

	process (scores from 0: unimportant to 3: crucial).
Control variables	
Size	(1) small firms with less than 50 employees (reference), (2) medium for those between 50 and 249 employees, (3) large for more than 249 employees.
Competition intensity	Nature of the market in which firm is operating: No effective competition, not very intense, quite intense, very intense.
Group belonging	Equal to 1 if not part of group, 0 otherwise.
Speed of technological change	Measured as sum of sales of firms in the two-digit industry that stated that they had introduced products (goods or services) new to the industry, divided by sum of sales of all firms in the industry.
Sector of activity	Manufacturing (high and medium-high-technology industries; medium-low-technology industries and low-technology industries) and services (transport and communication; financial activities; computer activities; R&D – engineering activities and consultancy, technical testing and analysis and wholesale trade).

Appendix B: Conditional correlation between organizational practices

	Business practices	Workplace organization	External relations
Business practices	1.000		
Workplace organization	0.810***	1.000	
External relations	0.669***	0.754***	1.000

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