Innovative Behaviour and the Performance of Technology-based Knowledge-Intensive Business Services: An empirical study

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Abstract: The aim of this paper is to learn more about how technology-based knowledge-intensive business service firms (t-KIBS) innovate. To do so, we examine the range of innovation practices employed by a sample of 50 t-KIBS in Catalonia, Spain and the impact these practices have on innovation and business results. We distinguish between practices widely used among manufacturing and services firms and practices that are more typically used by services. Our results reveal that, on the one hand, practices common to manufacturing and services are significant in explaining improvements in both innovation and financial performance, while on the other hand, innovation patterns and practices that are more often used in services are not significant in explaining either innovative outputs or increases in operational profits and returns. These results are important for refining the design of innovation policies at a regional level in Catalonia, as well as abroad. Further research is needed to establish whether the innovative behaviour of t-KIBS is more akin to that of manufacturing firms than to that of service firms.

Keywords: innovation, performance, service firms, service business, technology, knowledge-intensive, KIBS, t-KIBS.

1. Introduction

At the Lisbon Summit 2000, EU member states declared their desire for Europe to become the 'most competitive knowledge-based economy in the world' by 2010. According to Howells and Tether (2004) and the findings of the different rounds of the Community Innovation Survey (EUROSTAT, 2014), amongst the 'hallmarks of the knowledge-based economy' and 'the most innovative service sectors' Knowledge-Intensive Business Services (KIBS) can be found. Generally, KIBS are services that 'rely heavily upon professional knowledge, are either themselves primary sources of information and knowledge or they use their knowledge to produce intermediary services for their clients' production processes, which are of competitive importance and supplied primarily to business' (Miles et al.,1995:2).

In the almost two decades since they first appeared, in addition to attracting the attention of innovation researchers and innovation policy makers (see, for example, the European Monitoring Centre on Change, 2005, Muller & Doloreux, 2009, Madeira et al. 2014, Gallouj et al. 2014), KIBS have also outperformed most other sectors of the economy and been highly innovative. Moreover, they have played an important role in diffusing innovations and helping their clients innovate (Asikainen, 2015, Muller & Zenker, 2001, Schrike *et al.*, 2012).

Most researchers distinguish between t-KIBS (services with a high use of scientific and technological knowledge, including R&D, engineering and computer services, among others), and p-KIBS, which are more traditional professional services - legal, accountancy, management consultancy and marketing. The heterogeneity among KIBS suggests the importance of studying them separately (see, for example, Amara *et al.*, 2009; Corrocher *et al.*, 2009; Consoli & Elche-Hortelano, 2010; Hipp et al. 2015).

Despite all the research that KIBS have generated, Schricke *et al.* (2012) point out the dearth of data and difficulties in measuring innovation activities in knowledge-intensive service firms at a regional level. Together with cities, regions have become the spatial units where knowledge is transferred and innovation systems are built (European Commission, 2012).

This paper contributes to filling this gap in the research literature. We use original data from t-KIBS in Catalonia to learn more about how t-KIBS innovate. More specifically, this study examines i) the innovation practices used by t-KIBS, ii) the impact of the use of these practices on their innovation and business results and iii) the effects of the different innovation practices typically used in manufacturing and service firms on the innovation and business results of t-KIBS.

The paper is structured in five main sections. Following the introduction, Section 2 provides a review of the literature, Section 3 the methodology and Section 4 the results. Section 5 draws the conclusions.

2. Literature review

Despite the wide acknowledgement of just how important KIBS, and t-KIBS in particular, are to innovation in an economic system (Bilderbeek *et al*., 1998; Hertog, 2000; Miles *et al.* 1995; Muller & Zenker, 2001; Kuusisto & Meyer, 2003; Gallouj et al. 2014; Hipp et al. 2015), the details and precise definitions of how they innovate are more difficult to grasp. Table 1 attempts to map the state of knowledge represented in scientific publications.

Insert Table 1 about here

As Coombs (2003) argues, innovation in KIBS is in many instances a transfer of knowledge that lies in a category somewhere between basic 'inventions' and 'practical innovations'; in other words, it occupies an intermediary position in the innovation processes of others. The challenge of managing and evaluating this new concept of innovation can also be grasped from Dankbaar (2003), who explains that the traditional concept of innovation originated in a stable environment where repetition was the norm. Today (as is the case of t-KIBS, for instance) there are firms where innovation activities are regular, day-to-day activities that are constantly adapting to market changes and the needs of clients.

Traditionally, measuring innovation in services has been approached from two different angles: the first is the 'assimilation approach', which considers that innovation in services is similar to innovation in manufacturing, and the second is the 'demarcation approach', which views innovation in services as highly distinctive from innovation in manufacturing. A third and more modern approach, the 'synthesis' approach, considers that services and manufacturing share many innovation activities and that the study of innovation in services has brought to light aspects of innovation that are prominent in services but are also increasingly relevant to manufacturing sectors (Coombs & Miles, 2000).

In attempting to characterise innovation management in t-KIBS, a broad spectrum of the literature has taken the approach of looking for similarities and differences between innovation processes in manufacturing and service firms.

Some studies (Tether & Hipp, 2002; Miles et al., 1995:4) observe that innovations in t-KIBS share many traits that are characteristic of services: 'rarely organised through R&D departments, very frequently conducted on a project-specific basis, liable to involve close collaboration with clients or other services, and highly influenced by issues such as regulation and appropriability'. Others (Howells, 2000; Freel, 2006; Miles 2003, 2008) point to the similarities in innovation management between KIBS, and t-KIBS in particular, and high-tech manufacturing firms (with an emphasis on the role of R&D departments). Finally, others (e.g. Miles, 2005) identify patterns characteristic of manufacturing, such as the pre-eminence of the R&D department and production engineering, and patterns characteristic of services, such as project-based innovation.

Having a better knowledge of how t-KIBS innovate and which of their innovation practices are more fruitful in promoting innovation and business results is important if we are going to enhance the contribution of t-KIBS to innovation in the economy.

3. Methodology

This paper analyses some data on management practices from 50 firms in the Catalan autonomous region of Spain from a sample universe of 140 t-KIBS with NACE codes 5829, 6201, 6202, 6203, 6209, 6311, 7112, 7120, 7219, 9511 (OECD, 1999). Only firms

with over 20 employees were selected. The data were obtained from face-to-face interviews with the firms' managers, all conducted by the same interviewer and a control observer to enhance consistency across the interviewees' responses. The sample data and the accounting results were extracted from the SABI (*the Iberian Balance sheet Analysis System*) database, which contains records of more than 550,000 Spanish firms. The complete methodological details can be found in Table 2.

Insert Table 2 about here

The questionnaire, used as a guide for semi-structured interviews, was the one developed and previously used by the local regional development agency's guide (CIDEM *et al*, 2007) and based on previous relevant studies (Chiesa et al., 1996, Bilderbeerk et al., 1998, Hertog et al., 2000, Cooper & Edgett, 1999, Tidd & Hull, 2006). It contains a total of 52 items organised in 4 main sections: i) practices referred to as *practices in innovation management* (Questions 1 to 12), ii) *practices in innovation processes* (Questions 13 to 33), iii) *practices in strategy, innovation culture and environment* (Questions 34 to 42) and iv) a specific block of *practices and patterns of innovation in services* (Questions 43 to 52). A final set of questions refer to general innovation indicators and innovation impact-related aspects of firms (Questions 53 to 58). Respondents were asked to express their degree of agreement using a 7-point Likert scale with linguistic values ranging from never (1) to always (7), through very rarely (2), rarely (3), sometimes (4), often (5) and very often (6). With simplification in

mind, results are presented using 5 categories (never, very rarely/rarely, sometimes, often/very often, and always).

Insert Table 3 about here

We specified one hierarchical mixed model for each of the three dependent variables (innovation outputs, profit and return). The innovation outputs variable was computed as the sum of eleven items, each of which scored from 1 to 7. Profit and return were measured as the average annual variations in the last three years. As these variables were continuous, we in fact specified a linear mixed model. As explanatory variables of the three dependent variables we included: i) Best practices related to four concepts: *1) innovation management, 2) innovation process, 3) strategy, innovation, culture and environment, 4) innovation in services*; ii) number of employees; iii) R&D spending; iv) innovation spending; and v) number of people specifically employed in innovation. These variables were introduced non-linearly in the models and categorical variables were used. Beyond these explanatory variables, we controlled for the existence of 'individual' heterogeneity, i.e. effects (on the dependent variable not captured by the explanatory variables) specific to each 'individual' unit and invariant over time. We captured this heterogeneity by means of a random effect (hence the term 'mixed'), the intercept. This random effect varied within each NACE sector. That is, we considered that firms belonging to the same NACE sector (with respect to the three dependent variables considered) behave in much the same way, while this behavior is different to

that of other firms in different NACE sectors (which is why the model is hierarchical). Finally, we allowed the disturbance term to be heteroskedastic.

The models were built as Bayesian hierarchical models with two stages (Schrödle & Held, 2011). The first stage was the observational model and the second stage was given by the hyperparameters and their respective prior distribution. The posterior marginal of the hyperparameters was approached by using a Laplace approximation (Tierney & Kadane, 1986). More specifically, a simplified Laplace approximation (less expensive from a computational point of view with only a slight loss of accuracy) was used (Rue & Held, 2005; Martino & Rue, 2010; Schrödle & Held, 2011). All computations were carried out using the INLA interface, running directly in R (version R 2.15).

The analytical framework of the present research is depicted in Figure 1. The results, described in the following section, are presented following the same sequence.

Insert Figure 1 about here

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4. Results

According to the information given in Table 4, the descriptive measures of t-KIBS show that these companies spend approximately 3% of their turnover on R&D activities. Madeira et al. 2014 find that service firms classified as KIBS (t-KIBS) have a higher

propensity to innovate than other service firms, while Asikainen (2015) states that engagement in intra and extra-mural R&D is more frequent in KIBS as compared to manufacturing firms, while as compared to service firms, KIBS stand out to some extent, as their innovation strategies resemble those of manufacturing (Hipp et al., 2015).

Our results show that compared to the habitual behaviour of manufacturing businesses, where a strong and positive correlation exists between R&D budgets and firm size, a different behaviour can be observed in t-KIBS. Smaller size companies make the most effort in R&D, which may be a sign of a strong commitment to this, followed by large firms, while at the lower end middle size t-KIBS spend just 2.5% of turnover. A slight increment can be observed when the innovation budget is declared in relative terms as a percentage of turnover. Figures are above the mean of 3.6% for smaller size t-KIBS, while medium-size and large firms are below this figure. It is interesting to observe that compared to the strict R&D budget, the difference in spending for innovation is considerably higher - 1 perceptual point - for medium-sized companies compared with others (0.6 and 0.2). Another indicator characterising companies' degree of involvement in innovative activities is the human effort they devote to such processes. Overall, the figure is 6.5 for smaller size companies, almost tripling for medium size companies (17.1) and almost quadrupling for large establishments (23.2). In the case of this particular indicator, we observe a linear trend and a positive relationship between larger firm size and more human resources devoted to innovation.

Insert Table 4 about here

Having analysed R&D and innovation inputs, the main outputs are now shown in Table 4, which contains the results of the descriptive analysis of the greatest impacts made by companies with their innovative projects. In the case of smaller size t-KIBS, the main achievements are related to i) increased turnover or profits (4.9), ii) reduced process costs and more efficiency (4.4) and iii) access to new clients/market segments (4.3), while improved service quality, increasing speed or flexibility of service provision and internationalisation receive on average the lowest scores. For middle size t-KIBS the situation is rather different. On the one hand, highly ranked impact areas are i) greater client satisfaction (5.1), ii) improved company productivity (5.1) and iii) reduced process costs and more efficiency (4.8), while on the other hand, at the lower end of the scale we find increasing knowledge/mastery of new technologies, access to new clients/market segments and internationalisation. Large size t-KIBS rate the most frequent impact areas as follows: i) increased turnover or profits (6.0), ii) greater client satisfaction (5.2) and iii) improved brand image/company reputation. Areas that are less important are access to new clients/market segments, internationalisation and improved service quality.

Insert Table 5 about here

Overall it is interesting to observe that the innovative projects of SME t-KIBSs result in a variety of impacts. All their items considered for evaluation achieve a minimum rating of 3.4 (between 'rarely occurring' and 'average') and a maximum rating of 5.1 (slightly above 'often'), while large firms show a wider range of scores at both ends of the scale. For large companies, innovative projects often result in an increased turnover or more profits, while three or more other possible areas of impact occur only 'very rarely'. These results lead us to conclude that in the case of t-KIBS it is important to consider a wide range of possible impact areas, including both financial and non-financial aspects. Moreover, there is no unique pattern of impact, with considerable variations in terms of firm size, meaning that impact is different for different types of firms. Finally, it is interesting to observe that ultimate or 'hard' business performance aspects (profitability, efficiency, productivity) do not dominate the important areas of impact, but rather it is 'soft' facets that do so.

After describing innovation inputs and outputs we now present and comment on the different innovation practices and their occurrence in t-KIBS.

Insert Figure 2 about here

Figure 2 shows 12 innovation management practices arranged from the most affirmative responses to the least. Different departments actively participate in the innovative process, company management regularly participates in innovation processes, heads of innovation projects have the capacity to take decisions on project

resources, time and objectives, multidisciplinary teams draw on different departments and systematic management of innovation as a key business process are the most frequently used practices. In contrast, it is interesting to note the practices that do not occur at all: heads of innovation projects are hierarchically above department heads and answer directly to top management or an innovation committee, the company carries out audits of innovation activities to increase its systematisation, there is an innovation committee or team in charge of managing innovation projects carried out within the company, a system of indicators is in place which allows the suitability and results of the innovation process to be measured and assessed and, finally, the company has a budget for innovation activities and reviews the results obtained. Our results regarding innovation management point to a general lack of formalisation and systematisation of innovation management in t-KIBS. Most measures associated with the practices that were not employed (budgets, indicators, audits, etc.) are rarely used, meaning that innovation is normally managed in a flat organisational structure, through multidisciplinary teams lead by managers who have a lot of autonomy in their decision making.

Insert Figure 3 about here

Figure 3 shows the results obtained for 20 concepts related to innovation processes, in decreasing order of occurrence from high to low. The most frequently occurring items are that innovation projects are always carried through to completion, the company systematises innovation project resources and time planning prior to their

implementation, the company systematizes innovation project development, the company systematises technology management and that the company has its clients segmented and systematically monitors the most demanding and innovative clients. Again, concepts that are not used at all can be identified and they are: i) systematised IP management; ii) ideas for innovations come mainly from a single department (marketing or R&D); iii) universities, centres of technology and other agents external to the company are the main idea provider for innovations; and iv) advanced technological surveillance systems are employed.

Insert Figure 4 about here

Figure 4 shows the practices related to strategy, innovation culture and environment. Items with above average scores are the most frequently used, and in this study they were found to be: i) company management communicates the company's identity, vision, mission, values and aims to the organisation as a whole; ii) the company promotes the entrepreneurial spirit of its employees; and iii) the company implements a strategic business plan with flexible medium and long-term aims. Conversely, the items that do not occur in the responses of the t-KIBS are: the company sells to other companies the ideas it cannot implement itself due to a lack of resources, the company participates in cluster activities and the company internalises external ideas, patents or pre-projects to turn them into innovation projects.

Insert Figure 5 about here

Regarding practices and patterns of innovations in the specific area of services (a core activity of the analysed companies), 10 concepts were selected. Figure 5 shows the scores obtained by each, arranged from high to low. Those with above average scores were: i) new ways of providing services are actively sought in order to reduce costs or response times and increase quality, reliability and flexibility; ii) the company's innovation takes the form of combinations of existing services or packaging concepts for existing services which, when combined, become innovative, or the addition of peripheral, complementary services to the main service; and iii) opportunities for innovation are systematically looked for in material infrastructures associated with the service provision process. Practices that are not referred to are: the company's innovation takes the form of innovations in management or business management, the company's innovation takes the form of innovation in the company's sales or marketing processes and the company analyses the impact of introducing innovations in order to adjust the extent of client participation as co-producer of the service, considering the advantages and disadvantages this generates for the company and the client.

Table 6 contains the main results of the statistical analysis conducted. We ran three models with 'Innovation outputs', 'Profit' and 'Return' as the dependent variables. 'Innovation practices in management' and 'Innovation practices in strategy, innovation culture and environment' were found to be statistically significant in all three models, at a 95% confidence level. 'Innovation practices in strategy, innovation culture and

environment' increased both 'Innovation outputs' and 'Business results' from 3% to 5%. The effect of 'Innovation practices in management' varied for different dependent variables: there was a change of a little over 3% in 'Innovation products', nearly 6% in 'Profit' and a little over 18% in 'Return'. 'Innovation process practices' were found to be statistically significant in the 'Innovation outputs' and 'Return' models, at a 95% confidence level. The effects of 'Innovation process practices' were close to 60% for 'Innovation outputs' and 12% for 'Return'. The group 'Practices and patterns of innovation in services' was found not to be statistically significant in any of the three models.

Insert Table 6 about here

We introduced control variables into the models to better account for the effects of the dependent variables identified above. 'Number of employees' (as a proxy for the size of the firm) was found to be significant in all three models. 'R&D spending as share of turnover (% of turnover)', 'Innovation spending as share of turnover, including R&D (%)' and 'Number of people specifically employed in innovation activities' were all significant for 'Innovation output'. These were predictable results. However, only 'Innovation as share of turnover, including R&D (%)' was found to be significant in the 'Business results' model. This might suggest two issues: first, that innovation activities in a broad sense are more relevant than R&D activities in t-KIBS; and second, that the 'Number of people specifically employed in innovation activities' might not be

sufficiently well-defined and it would be pertinent to study the characteristics of these personnel, including their level of education, in future studies.

5. Conclusions

Over the past decade, innovation policies across Europe have been adapted in recognition of the crucial role t-KIBS play as diffusers of innovation. Among these policies is the dissemination of information about the management practices that best fit t-KIBS. In this paper, we test a model that includes i) practices designed for general use in manufacturing and ii) services, practices and innovation patterns that are designed specifically for services. We find that practices common to manufacturing and services are significant in explaining improvements in innovation outputs and accounting for operational profits and returns. On the other hand, innovation patterns and practices specific to services are found not to be significant in explaining innovation outputs and increases in operational profits or returns. These findings should contribute to refining the design of innovation policies both at a regional level in Catalonia and abroad.

Although all three models passed misspecification and goodness-of-fit tests, (Gaussian) variation (measured as the residual standard error) was much greater than heterogeneity (measured as the standard deviation of the random effect capturing heterogeneity). That is, the behaviour of firms within the same NACE group was much more similar than had they been in different groups. Gallouj et al. (2014) and Hipp et al. (2015) also stress that KIBS are a heterogeneous sector.

The limitations of this study are related to the variables used in the analysis. The questionnaire was designed with the aim of including all the relevant variables

identified in the literature on best practice in t-KIBS innovation, which is naturally conditioned by the still limited knowledge available about how these firms innovate. Best practices are general in nature and do not relate to very specific details of how firms work, although they are important because they have been shown to be effective and are widely used in innovation policies. The practices are heterogeneous and some of them can be described as 'soft', having fuzzy conceptual boundaries.

We also call for a cautious interpretation of the results. The small sample size (50 firms) led to a modest statistical significance that was overcome by using statistical techniques typical of small samples. However, we believe that this limitation is not accompanied by lack of internal validity. In fact, there were no differences (in the variables of interest) between the 50 firms' responders and the 140 firms initially contacted.

As futures lines of research, further investigation is required to understand the idiosyncrasy of this typology of firms. More studies comparing KIBS and t-KIBS and t-KIBS and manufacturing firms would further enlighten the black box of this type of firm, whose contribution to the economy is incontestable.

Acknowledgements

The authors are grateful for the financial support from the University of Girona (Spain) MPCUdG2016/093.

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Table 1: Main search strings on t-KIBS and their results

Word	Location	Word	Location	Word	Location	Word	Location	Word	Location	Results	Articles	Main subject area
Product	Title	Innovation	Title							1857	1046	Bus., Man.&Acc. (812) Eng. (700) Comp. Sci. (264) Eco., Fin. (220)
Service	Title	Innovation	Title							1755	906	Bus., Man.&Acc. (692) Eng. (397) Comp. Sci. (387) Soc. Sci. (303) Med. (213)
Knowledge	Title	Intensive	Title	Business	Title	Service	Title			131	83	Bus., Man.&Acc. (73) Soc. Sci. (29) Eco., Fin. (28) Comp. Sci. (19) Eng. (17)
Knowledge	Title	Intensive	Title	Business	Title	Sector	Title	Innovation	Keywords	1	1	
Knowledge	Title	Intensive	Title	Business	Title	Innovation	Title			42	27	Bus., Man.&Acc. (28) Eco., Fin. (13) Soc. Sci. (9) Comp. Sci. (3) Dec. Sci. (3)
KIBS	Title									63	40	Bus., Man.&Acc. (39) Eng. (21) Comp. Sci. (16) Soc. Sci. (13) Eco., Fin. (9)
Technological	Title	Knowledge	Title	Intensive	Title	Business	Title	Service	Title	2	1	Bus., Man.&Acc. (1) Soc. Sci. (1)
t-KIBS	Title									0	0	

Abbreviations: Bus., Man.& Acc. · Business, Management and Accounting; Soc. Sci. · Social Sciences; Comp. Sci. · Computer Science; Eng. · Engineering; Eco., Fin. · Economics, Econometrics and Finance; Dec. Sci. · Decision Sciences

Table 2: Methodological summary

Geographical coverage	Catalonia, autonomous region of Spain
Economic activity concept	Technology-based Knowledge-Intensive Business Services
Selected NACE codes	5829, 6201, 6202, 6203, 6209, 6311, 7112, 7120, 7219, 9511
Cut-off criterion	More than 20 employees
Reference period	2008-2010
Population	139
Contacted firms	139
Number of valid answers	50
Return rate	35%
Documentation	Presentation letter, interview guidelines (paper)
Follow-up	E-mail and telephone reminder
Interviewed	CEO and general manager (SME), production manager (others)
Interviewers	The same interviewer and a control observer for all the interviews
Duration of the interview	Between 1 and 1 ½ hours
Questionnaire	Replication of a validated questionnaire (CIDEM at al., 2007)
Interview treatment	Records and transcript
Start of field work	2010
End of field work end	2011
Software used for data treatment	INLA, R

Table 3: Operationalization of variables

	Concept	**No. items**	**Relevant aspects**	**Previously used in**
Dep. Var.	Innovation performance	5	Expenditure and personnel	
	Financial performance (productivity)	1	Operational profits per employee	
	Financial performance (investment)	1	Return on total assets	
Explanatory variables	Practices in innovation management	12	Extent of implementation of a practice Importance attached to a practice	Roberts (2001), Chiesa et al (1996), Brown (1997), Tidd (2006), CIDEM (1999), Hamel and Breen (2007)
	Practices in innovation processes	21	Portfolio management, stage gate, knowledge management, protection of innovation	CIDEM (1999), Van de Ven (2000), Cooper (1999) and (2001), Cho et al. (2012), AT Kearney (2006), OECD (2005)
	Practices in strategy, innovation culture and	9	Open innovation, R&D collaboration and public funding incentives for innovation	Burgelmann (2004), Chesbrough (2003), AT Kearney (2006) and Hamel (2000)

	environment			
	Practices and patterns of innovation in services	10	Dimensions of innovation in services and specific features of the innovation process in services	Amara et al. (2009), Galende et al (2003), Bilderbeek et al. (1998), Cooper and Edgett (1999), Hertog (2000), Hollenstein (2003), Martín et al. (2009), Sundbo and Gallouj (1998), Tidd (2001), Howells and Tether (2004), Kussisto and Meuyer (2003), OECD (2005), de Jong (2003), Soete and Miozzo (2001), Miles (2008), Hertog et al. (2010), Leiponen (2006), Janssen et al. (2015), CIDEM et al. (2007)
Control variables	Firm size	1	Number of employees	
	R&D expenditure as % of turnover	1	% of turnover	
	Innovation expenditure as % of turnover	1	% of turnover	
	Innovation personnel	1	Number of employees	
Random effects	NACE	1	Captures individual heterogeneity	

Figure 1: Analytical framework of the research

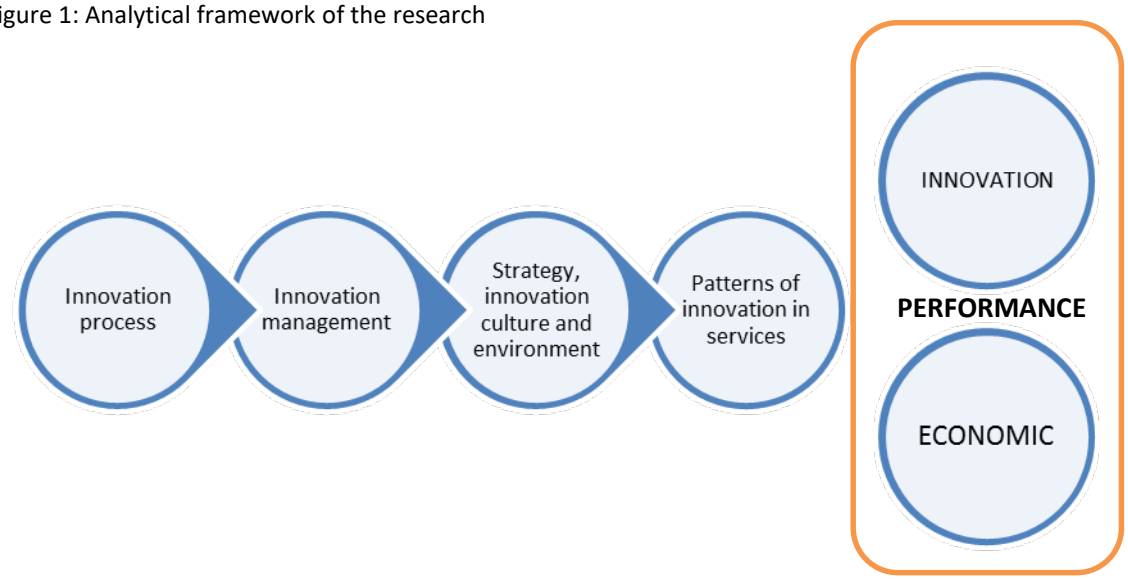

Table 4: Descriptive statistics for control variables for each category of employees

	employee_cat			
	<100	**100>= empl <250**	**>=250**	**TOTAL**
N	32	16	4	52
R&D spending as share of turnover (%)	3.125	2.563	3.000	2.942
Innovation spending as a share of turnover, including R&D (%)	3.719	3.563	3.250	3.635
Number of people employed in innovation activities (%)	6.531	17.156	23.250	11.087

Note: values showed in the table correspond to *means*

Table 5: Descriptive statistics - Innovation results (Innovation has contributed to …) (means

	employee_cat			
	<100	100>= empl <250	>=250	TOTAL
Increasing turnover or profits	4.938	4.625	6.000	4.923
Reducing process costs and more efficiency	4.438	4.875	3.000	4.462
Accessing new clients and market segments	4.355	4.500	2.750	4.275
Increasing internationalisation or new market segments	3.469	3.750	2.750	3.500
Improving quality of service	3.906	4.625	2.750	4.038
Increasing client satisfaction	4.219	5.188	5.250	4.596
Increasing speed or flexibility of service provision	3.750	4.750	3.250	4.019
Increasing knowledge or mastery of new technologies	4.000	4.625	3.250	4.137
Improving company productivity	4.094	4.813	3.000	4.231
Improving brand image and company reputation	4.219	5.188	4.000	4.500
Innovations for client's market	3.719	4.375	4.250	3.962

Note: values showed in the table correspond to *means*

Figure 2: Innovation management practices (Implementation of innovation practices by the firm through

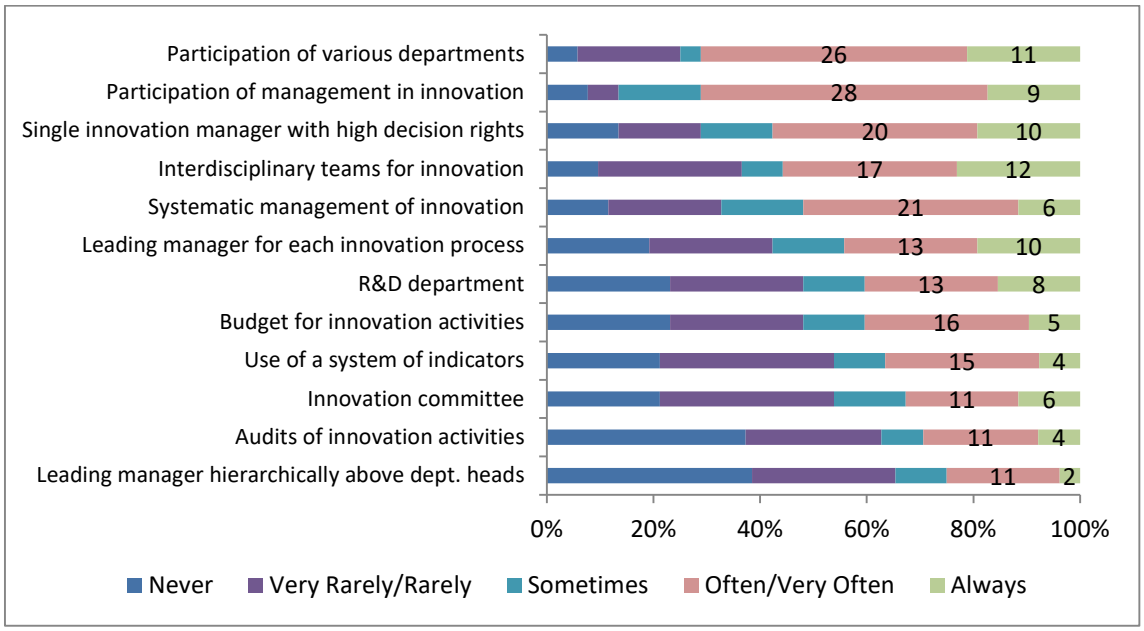

Figure 3: Innovation process practices (Regarding innovation processes the firm has/conducts…)

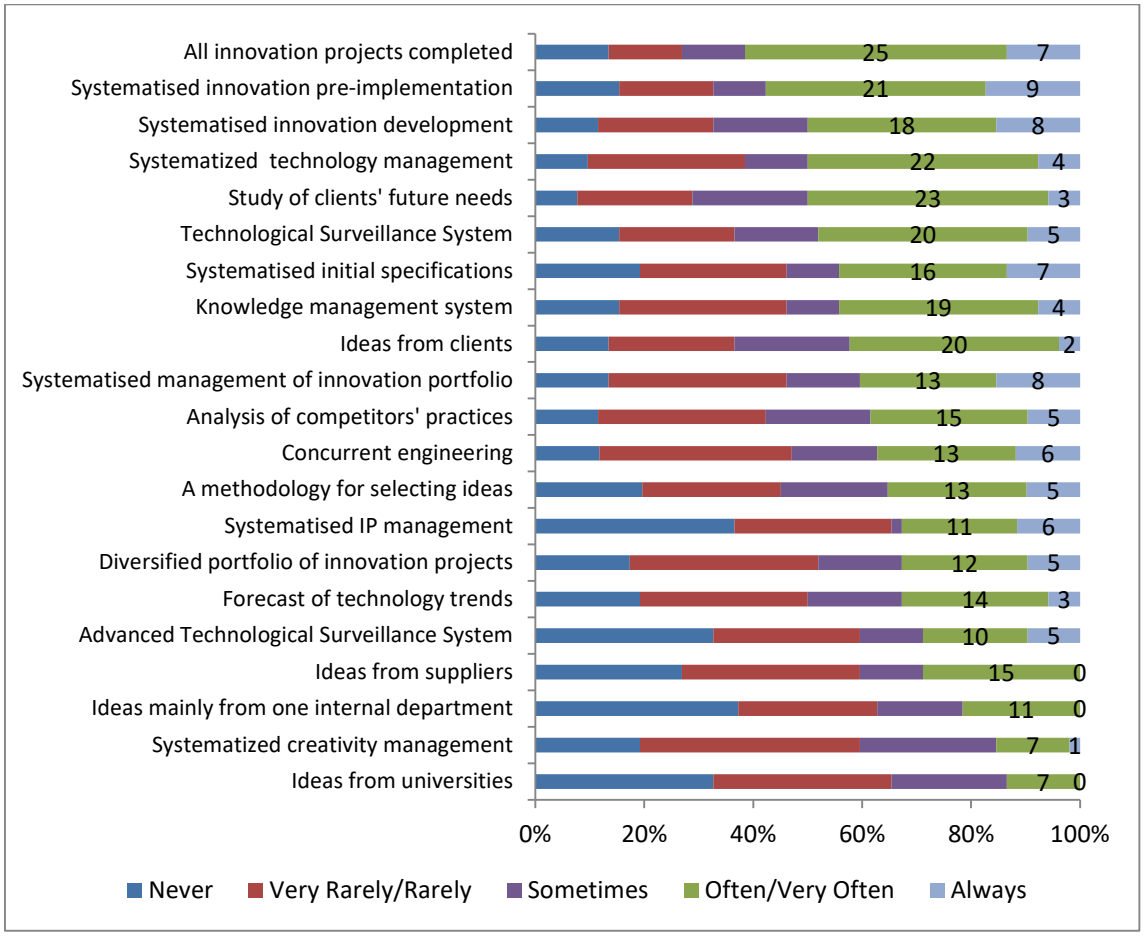

Figure 4: Practices in strategy, innovation culture and innovation (Regarding strategy and innovation the firm…)

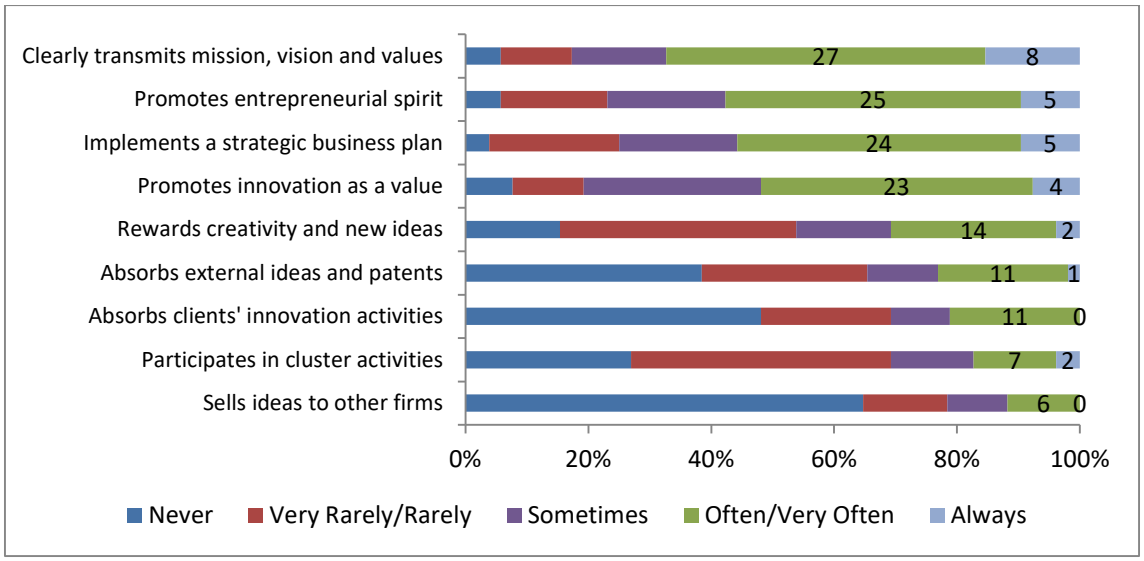

Figure 5: Practices and patterns of innovation in services (Regarding non-technological innovations, the firm introduced …)

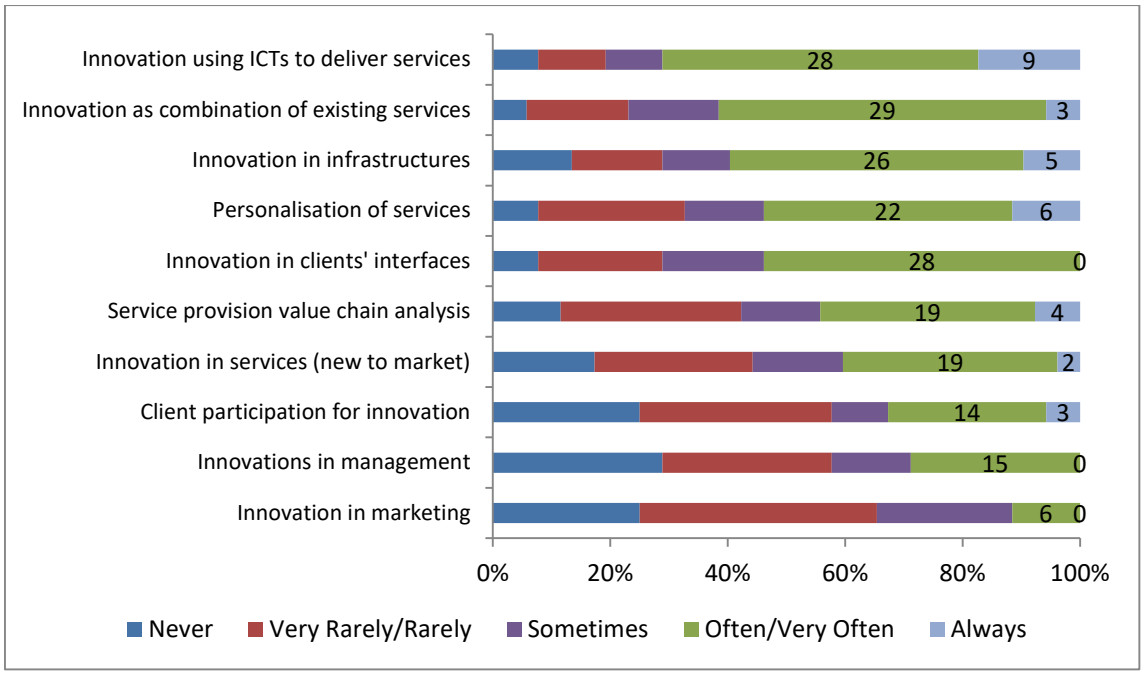

Table 6: Results of the estimation of the linear mixed models

	Innovation outputs [a]	**Business results**	
		Profit [b]	**Return** [c]
Best practices in innovation management [d]	0.03183 (0.01487)	**0.05787** **(0.01777)**	**0.18380** **(0.08290)**
Best practices in innovation process [e]	0.57728 (0.17668)	0.03179 (0.11930)	**0.11676** **(0.05897)**
Best practices in strategy, innovation culture and environment [f]	0.03301 (0.01370)	**0.03965** **(0.01301)**	**0.04742** **(0.00828)**
Best practices and patterns of innovation in services [g]	0.12096 (0.18910)	0.05336 (0.12342)	0.01781 (0.09746)
Number of employees	**0.02153** **(0.00957)**	**0.02646** **(0.00419)**	**0.023894** **(0.00029)**
R&D spending as share of turnover (% of turnover)	**4.38486** **(1.13408)**	1.38761 (1.78741)	0.248392 (1.45296)
Innovation spending as share of turnover, including R&D (%)	**6.57249** **(2.35155)**	**2.41805** **(0.92696)**	**2.010101** **(0.95841)**
Number of people specifically employed in innovation activities (%)	**0.21975** **(0.62710)**	0.01115 (0.09212)	0.024705 (0.07731)
Residual standard error	11.5256 (1.23251)	7.91197 (0.47916)	6.76007 (0.38733)
Heterogeneity	0.01053 (0.00623)	0.01055 (0.00638)	0.01060 (0.00638)

Significant at p-level < 0.05

[a] Question number 58
[b] Operational profits per employee (average increases of the last three years available)
[c] Return on total assets (average increases of the last three years available)
[d] Questions 1 to 12
[e] Questions 13 to 33
[f] Questions 34 to 42
[g] Questions 43 to 52