The relationship between knowledge management, innovation and revenues: a survey of incubated firms in Brazil

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Keywords: Knowledge Management Practices; Investments in innovation; revenues; Graduate companies.

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Abstract

Incubators of technology-based firms (TBFs) graduate companies through processes based on innovation and Knowledge Management (KM). The relationship between the efficiency of KM practices, investments in innovation, and revenues of TBFs graduated from incubators was investigated. The study was carried out with 52 graduated TBFs in Brazil. The results show that companies that exhibited higher revenues also perceived more efficacy in KM practices and invested more in innovation. Companies with the lowest revenues display a lower perceived efficacy of KM practices. The data also indicate that micro and medium enterprises invest proportionally more in innovation than small ones.

Keywords: Knowledge Management Practices; Investments in innovation; revenues; Graduate companies.

Introduction

The development of a sustainable regional economic and social environment requires mechanisms to support micro and small businesses - especially technology-based ones, due to their innovative nature (Bengtsson and Wang, 2011, pp. 1370-1371, Muñoz-Bullón and Cueto, 2011, p. 78). Among such mechanisms, business incubators (Bruneel, Ratinho, Clarysse and Groen, 2012, p.112) are an important source of institutional support and physical infrastructure for promising enterprises.

Part of the responsibilities of an incubator is to develop the technical and organizational know-how demanded by the entrepreneurs (Bøllingtoft, 2012, p.304; Qian, Haynes and Riggle, 2011, p.80). In this sense, the required organizational context for the creation of knowledge that arises from material or virtual interaction among the actors involved is made possible by a shared structure of physical, technological and corporate resources. This corresponds precisely to the definition of business incubators (Ahmad and Ingle, 2011, p.635; Schwartz, 2011, pp.493-494; Al-Mubaraki and Busler, 2010, p.2) as long as the elements that allow entrepreneurs to effectively build knowledge are adequately managed (Fang, Tsai and Lin, 2010, p.92; Eshun Jr, 2009, p.158). The incubation process results in the graduation of companies that are able to remain competitive in the market. For technology-based firms (TBFs), this ability is presumably linked to a disposition towards continuous investments in factors that sustain innovation (Borgh, Cloodt and Romme, 2012, p.150, Brettel and Cleven, 2011, p.253).

The extant literature has pointed to the existence of relationships between the incubation process and knowledge management practices (Somsuk, Wonglimpiyarat and Laosirihongthong, 2011, p.246; Ratinho and Henriques, 2010, p.279), as well as the disposition of graduate companies to invest in innovation (Schwartz, 2011, p.508). However, there is no consensus among studies on the financial performance of graduate companies (Kilcrease, 2011, p.81). In addition, few studies deal with the application of knowledge resources in TBFs (West III and Noel, 2009, p.2).

Hence this study was motivated by the dearth of studies about KM and TBF performance after the incubation process (Schwartz, 2011, p.465). It aims to verify the existence of a relationship between perceived efficacy of knowledge management practices, investments in innovative activities and the revenues of TBFs that graduated from incubators. The field research was undertaken with graduated companies from incubators in the state of Paraná, Brazil. Quantitative, multivariate and bivariate methods, which are also not prevalent in KM studies (Choi, Poon and Davis, 2008, p.237; Zack, McKeen and Singh, 2009, p.392) were used to achieve the proposed objective.

Business incubation

Historically, the genesis of business incubators is attributed to Joseph Mancuso, in 1959, from the Batavia Industrial Complex, as well as to the University City Science Center at Pennsylvania University, which developed a structure for the commercialization of research results (Ahmad and Ingle, 2011, p.628). Since then, the number of incubators in the United States has experienced a sharp increase, from 12 recorded incubators in 1980 to over 1100 in 2006 (Qian, Haynes and Riggle, 2011, p.79). In Europe, business incubators can be traced back to 1975 in the UK, originating from British Steel Industry initiatives; in Germany, in 1983, the Technische Universität Berlin created the first German incubator, in order to facilitate the transfer of research results to the industry; in 1985, France created their first incubator inside Sofia Antipolis Technology Park. By 2010, Germany held approximately 33% of the European Union's incubators, while France had 21% and the United Kingdom 16% (Al-Mubaraki and Busler, 2010b, pp.329-330). In China, the first incubation program was developed in the late 1980s, sponsored by the Chinese government and backed by the United Nations. Its quick development resulted in 127 Chinese incubators by 1999. (Al-Mubaraki and Busler, 2010, p.5). In Brazil, the first incubators began to appear in 1982. However, they were only consolidated in 1987, when the National Association for Promotion of Innovative Ventures (Anprotec) was created at the International Seminar on Technology Parks. By 2006, Brazil was the leading country in the southern hemisphere in that regard, with 359 incubators (Engelman, Fracasso and Brasil, 2011, p.806).

Conceptually, a business incubator can be defined as a mechanism that creates a supportive environment for entrepreneurship, with the objective of raising business survival rates (Somsuk, Wonglimpiyarat and Laosirihongthong, 2012,

p.246). This mechanism involves, at a basic level, three components: (1) subsidized physical space, including offices, laboratories and small production lines, (2) shared services, such as communications infrastructure, offices, support services for incubated companies and (3) networking (Schwartz, 2011, pp.493-494). Several studies have demonstrated the importance of both structural support (physical spaces and shared services) and relationship networks (in the form of access to financing, venture capital, universities and research centers) for incubated companies (Bøllingtoft, 2012, p.305; Bruneel, Ratinho, Clarysse and Groen, 2012, p.111; Ahmed and Ingle, 2011, p.629; Kilcrease, 2011, p.80).

In addition to these factors, the consulting services that are provided for incubated companies are an important mechanism for knowledge sharing. In this context, knowledge can be seen as a source of entrepreneurial activities (Qian, Haynes and Riggle, p.80, 2011), which add value to the incubator approach (Bruneel, Ratinho, Clarysse and Groen, p.112, 2012), to the point that incubators play a major role in bridging the knowledge gap from the early stages of enterprises until they become viable businesses (Somsuk, Wonglimpiyarat and Laosirihongthong, p.246, 2012).

Practices that are related to the incubation process are commonly found in knowledge management studies, such as: coaching and mentoring activities (Bøllingtoft, 2012, p.306), formal learning and training programs (Qian, Haynes and Riggle, p.79, 2011), clustering and interaction between people associated with the process (Eshun Jr, 2009, p.157) and benchmarking systems (Gstraunthaler, 2010, p.411).

Knowledge Management

As Nonaka (1991, p.162) points out, there is no consensus on the definition nor a perfect concept of "knowledge". However, the term can be understood as a set of contextualized information and the understanding of how to use it (Christopher and Tanwar, 2012, p.62; Goel, Rana and Rastogi, 2010, p.106). It is distinctive from information alone since it requires a combination of experience, context, interpretation and reflection (Pfaff and Hasan, 2010, p.73). Within an organization, it is associated with managerial functions and responsibilities, business practices and organizational design (Nonaka, 1991, p.164). Once knowledge began to be widely discussed as an essential organizational resource in the early 1990s, the notion of knowledge management (KM) has achieved remarkable popularity in business and academic spheres (Pastor, Santana and Sierra, 2010, p.2452). In a general sense, KM can be defined as a continuous and deliberate series of strategies, practices, techniques, and formal and informal processes used in organizations to identify, create, represent, process, analyze, store and distribute knowledge (Saini, 2013, p.47).

Academic approaches of KM are very diverse, with a prevailing focus on its underlying processes (Goel, Rana and Rastogi, 2010, p.107; Linderman, Schroeder and Sanders, 2010, pp.690-691), as well as on its practices (Saini, 2013, p.47;

Vashisth and Mehta, 2013, p.40). The processes of KM may be classified and grouped in several forms, such as in the continuous cycle composed by (1) creation and capture, (2) distribution and dissemination and (3) acquisition and application, as in the integrated model proposed by Dalkir (2005, p.xiv).

KM practices have been classified into categories such as human resources, organizational policy and information and communication technology (ICT) practices (Batista, Quandt, Pacheco and Terra, 2005, p.12; Christopher and Tanwar, 2012, p.65). The diverse range of studies is justified by common argument that the effective management of organizational knowledge leads to competitive advantage (Aktharsha, Anisa and Ali, 2012, p.23; Alvesson, 2011, p.1643), which is a source of corporate success (Rodger, 2012, p.11) and decisive in shaping the future of the company (Fibuch and Way III, 2011, p.34), and even play an important role in regional sustainable development (Nandita, 2013, p.56).

On the other hand, the notion of KM is not free from criticism. Some of it refers to the lack of broadly accepted common definitions (Ibrahim and Reid, 2010, p.25), while others see KM as a mere business fad (Grant and Grant, 2008, pp.578-579). A common argument is that, at best, it is possible to manage the conditions for the creation, formalization and exchange of knowledge, but not to manage knowledge itself (Pesqueux, 2008, p.6). Criticism aside, studies on GC have often shown an association with innovation. A ranking based on keywords from papers published between 2003 and 2012 in *Knowledge Management Research & Practice* shows that the term 'innovation' is the twelfth most commonly used term (Ribière and Walter, 2013, p.5).

Some studies cite the fact that KM is responsible for leveraging corporate wisdom in such a way as to raise the capacity to respond to the demands of innovation (Christopher and Tanwar, 2012, p.61), to instigate change and innovation (Krogh, Nonaka and Rechsteiner, 2012, p.255), and even associate KM and innovation as complementary and, in a way, inseparable (Camelo-Ordaz, García-Cruz, Sousa-Ginel and Valle-Cabrera, 2011, pp.1442-1443).

Innovation

Innovation has been seen as change and improvement in organizational tasks, products or services with the intention of maintaining or gaining competitive positions in a market (Charterina and Landeta, 2013, p.197), as well as a key component to the very survival of companies (Oke, Walumbwa and Myers, 2012, p.273). The Oslo Manual defines 'innovation' as the implementation of a product, service, process or marketing method which is new or significantly improved or a new organizational method in business practices, within the organization or in external relations (Oslo Manual, 2005, p.46). When pertaining to products and services, innovation can be classified as incremental (continuous improvements and

modifications) or radical (when it breaks a technological trajectory); in processes, when there are changes in production systems; and as organizational, when it alters communication and reward systems or tasks (Prester and Bozac, 2012, p.2).

An innovative company exhibits at least two broad sets of competencies (European Commission, 1995, p.1): a) Strategic competencies, which reflect its capacity to identify and anticipate market trends, as well as to assimilate economic and technological information and b) Organizational competencies, reflected in its capacity to assume and manage risk, as well as in its internal and external cooperation policies, in addition to constant investment in human resources.

The association between a company's ability to innovate and KM aspects is present in many studies. Some exhibit parallels between innovativeness and business performance in a context of extensive exchange of knowledge (Charterina and Landeta, 2013, pp.208-209). Others argue that, especially in smaller companies, limitations in internal R&D are compensated by knowledge generated through interaction with external actors (Colombo, Laursen, Magnusson and Rossi-Lamastra, 2012, p.182).

The discarding of obsolete knowledge is a subject of research that shows its relation to the promotion of innovation and the development of organizational attitudes that are vital to the company's long-term survival (Mieres, Sánchez and Vijande, 2012, p.417). The results of a study carried out in Thailand indicate that both the acquisition of external knowledge and the development of internal knowledge are considered essential to organizational innovation (Liao, Chang, Hu and Yueh, 2012, p.65). Another study indicates that time gained from experimentation for the launch of radically new products is directly related to coordinated KM mechanisms (Prester and Bozac, 2012, p.19).

On the other hand, the literature has shown a wide variety of innovation metrics: there are studies that approach, among others, indirect action - named by the Oslo Manual as 'innovation activities' - such as investments in internal and external R&D, training; acquisition of external knowledge, machinery and equipment, software (IBGE, 2010, pp.20-21); there are those that adopt patent numbers, licenses and published works regarding products/services/processes (Nelson, 2009, p.994); others still employ human resource practices (De Winne and Sels, 2010, pp.1872-1873) and even the final customer's satisfaction with the level of service the company offers (Dotzel, Shankar and Berry, 2013, p.265). Notwithstanding the variety of approaches to the innovation process, it is adequately illustrated by the business incubation process, thus determining the focus of this study.

Methodology

This study uses multivariate and bivariate analysis to investigate characteristics in regard to the efficacy with which firms adopt KM practices, their relationship to investments in innovative activities and the impact on revenues. The

instrument for data collection instrument was a questionnaire based on the KM practices studied in Brazilian government agencies by Batista, Quandt, Pacheco and Terra (2005, pp.12-26). The practices are grouped into three categories:

1) *Human resources management:* reward for staff initiatives, encouragement of informal staff grouping (virtual or otherwise) to solve organizational problems, coaching and mentoring, formal business education programs, and maintenance of a network of knowledge specialists.

2) *Organizational policies:* reward for developing individual abilities, internal and external benchmarking, record-keeping of learned lessons and better practices, formal identification of individual and organizational skills and establishment of formal KM strategies and policies.

3) *ICT-related practices:* corporate portals, electronic communication and collaboration tools, business intelligence systems, electronic document management and integrated management systems.

The respondents offered their perception of the efficacy of those practices on a scale of 1 to 5, where 1 indicated a complete lack of efficacy and 5 indicated total efficacy. The option of 0 was also available to indicate that said practice is not adopted in the company at all. The investments in innovative activities were measured on the basis of expenditures related to the acquisition of external knowledge (consultancies), software, machinery and equipment, training, and internal and external R&D (IBGE, 2010, p.20-21).

Firm size was measured according to yearly revenue ranges, as follows (ANVISA, 2012): Micro-enterprise – under R$ 360,000; Small enterprise – between R$ 360,000 and R$ 3,600,000; Medium enterprise group IV – up to R$ 6,000,000; Medium enterprise group III – between R$ 6,000,000 and R$ 20,000,000; Large enterprise group II – between R$ 20,000,000 and R$ 50,000,000; Large enterprise group I – above R$ 50,000,000.

The questionnaire was submitted to the owners of the graduate TBFs, or, in their absence, someone appointed by them or the person responsible for human resources. At the time of the survey, the state of Paraná had 21 incubators, of which only 12 had graduated companies. 95 TBFs were identified as graduated. Among those, 24 no longer existed or could not be located, or had been incorporated by larger organizations, so they were discarded from the study. That corresponds to 25.3% of the total number of graduate companies. Of the 71 that remained, 52 answered the study. It represents a sizable portion of the study populations, even though the results cannot be generalized. The protocol of analysis is presented in Table 1.

Table 1: Analysis Protocol

Step	Objective	Procedure
1	Evaluate the internal reliability of the sets of questions	Cronbach's Alpha

	submitted to the respondents	
2	Provide a general vision of the characteristics of respondent companies	Descriptive statistics (averages, standard deviations, frequencies)
3	Categorize the variables that represent graduate companies in relation to their investments in innovative elements and perceived efficacy of KM practices.	Percentage frequency.
4	Determine the number of dimensions to be analyzed	Eigenvalues, inertia and scree plot
5	Verify the existence of associations between variables	Multiple correspondence analysis
6	Evaluate the reliability of the set of variables chosen to be represented in the dimensions	Cronbach's Alpha
7	Evaluate the intensity of the association between grouped variables	Pearson's correlation coefficient (r)

Presentation and analysis of results

For the initial step – reliability analysis – the Cronbach's Alpha test was used, which showed values of 0.755 for practices relating to personnel management, 0.754 for corporate policies, 0.803 for ICTs and 0.664 for questions involving investments in innovative elements. These values are acceptable, in social science research, as long as the results are evaluated with precautions showing that the questions submitted to the respondents did not present significant disparities between how they were interpreted and understood.

The first characteristic of the TBFs relates to revenues and the corresponding classification of firm sizes. Fourteen of them (26.9%) were classified as micro companies; twenty-three (44.2%) as small; eleven (21.2%) as group IV medium, and four (7.7%) as group III medium. The investments in innovative activities as a percentage of revenues are shown in Table 2.

Table 2 : Investments in innovative activities (% of revenues)

Statistic	Consultancies	Software	Equipment	Training	Internal R&D	External R&D
Average	0.14	0.4	0.92	0.91	2.54	0.19
Standard Deviation	0.29	0.43	0.92	0.79	1.54	0.36

The average total investment by each company was 5.12% (with a standard deviation of 3.08). The highest rate of investment was 12% and the lowest was 0.5%. The response percentages associated with each option regarding the efficacy of KM practices are displayed in Table 3.

Table 3: Perceived efficacy of KM practices

Practice	0	1	2	3	4	5
Initiative rewarding	0.0	0.0	11.5	46.5	36.5	5.8
Informal grouping	11.5	9.6	19.2	19.2	32.7	7.7
Coaching and mentoring	5.8	15.4	15.4	19.2	32.7	11.5
Corporate education	17.3	40.4	19.2	9.6	9.6	3.9
Knowledge specialists	15.4	11.5	11.5	17.3	26.9	17.3
Best practices	17.3	7.7	17.3	11.5	28.9	17.3
Benchmarking	0.0	5.8	9.6	30.8	36.5	17.3
Skill identification	7.7	11.5	17.3	21.2	28.9	13.5
Skill rewarding	9.6	7.7	11.5	36.5	28.9	5.8
KM Strategies	19.2	42.3	5.8	23.1	7.7	1.9
Corporate portals	13.5	15.4	15.4	21.2	23.1	11.5
Communication tools	0.0	0.0	1.9	21.2	53.9	23.1
Business intelligence	34.6	25.0	19.2	9.6	7.7	3.9
Electronic document management	38.5	23.1	19.2	9.6	5.8	3.9
Management systems	11.5	11.5	15.4	17.3	30.8	13.5

Excluding the companies that do not adopt some of the studied practices, an average perceived efficacy of 42.5% is observed in the group of practices related to personnel management, 43.4% in those related to organizational policies, and 35.8% in the ICT category of practices.

In order to evaluate the existence of groups formed by the variables that characterize the companies through multiple correspondence analysis, the numerical variables were first converted into categorical ones. For investments in innovative activities (ia), the percentages were added up and divided into four classes, "ia <= 1.5", identifying companies that invested an amount equal to or lower than 1.5% of their earnings; "1.5 < ia <=3", characterizing organizations that spent over 1.5% and less than 3% of their earnings; "3 < ia <= 4.5" and; "ia > 4.5".

For the perceived efficacy of KM practices, the percentage frequency of each group was obtained. This result was divided in five parts, identified as "Not efficient" (grouping responses whose achieved percentage was under 20%), "Little efficient", over 20% and under or equal to 40%, "Not little nor very efficient", between 40% and 60%, "Very efficient", between 60% and 80% and; "Totally efficient", for percentages over 80%.

The next step determined the number of dimensions to be analyzed without compromising the interpretation of the results. Initially, the maximum amount was determined to be 18 dimensions - chosen among the largest number of variables and categories. Aiming to reduce this to an interpretable amount, the inertia of each dimension was obtained, calculated by dividing the explained variance of each (eigenvalue) by the number of variables. Inertia relatively quantifies the explained variance for each dimension. Because it is a percentage relationship, one of the criteria employed to reduce the number of dimensions is the evaluation of the cumulative percentage of explanation of the inertia. Figure 1 shows these values.

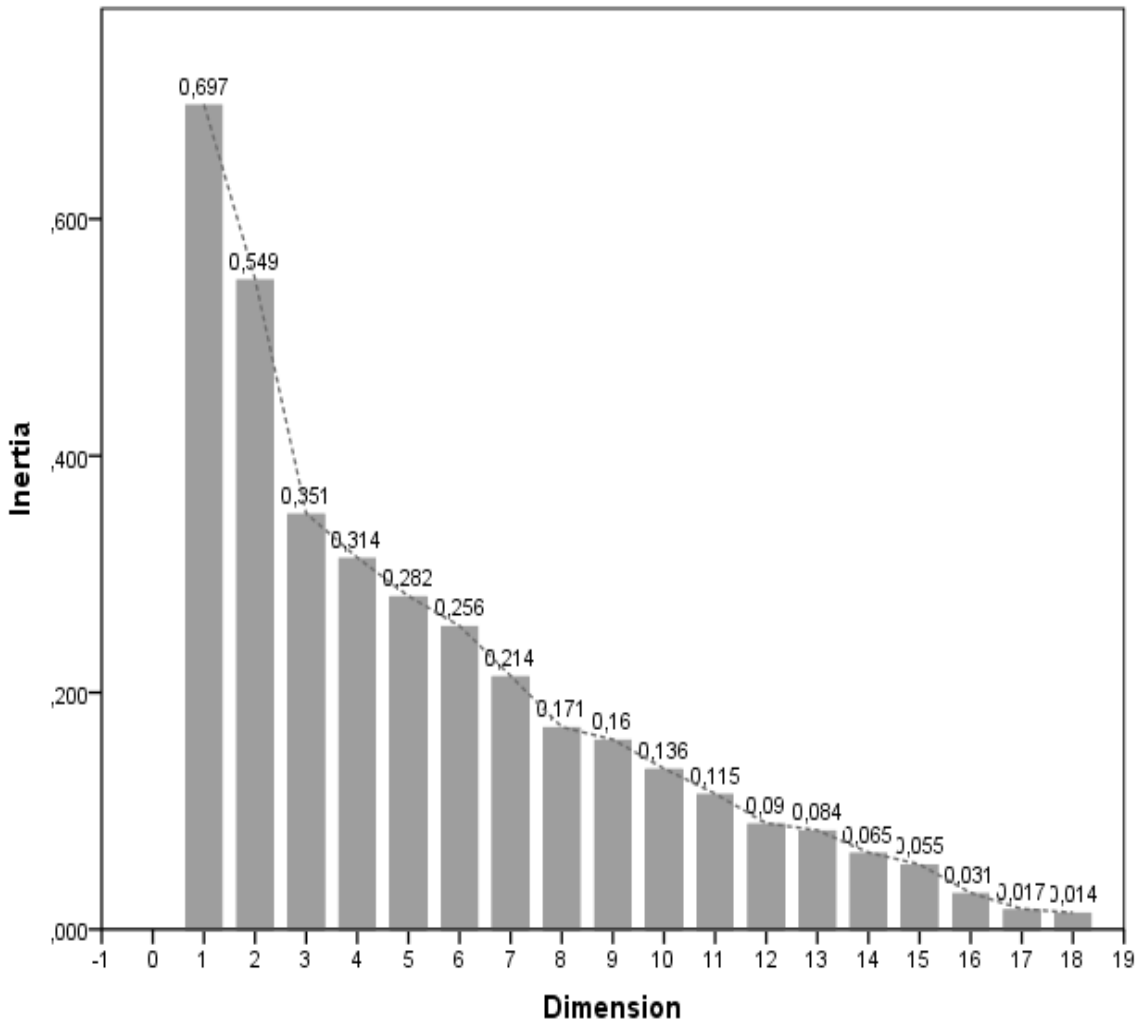

Figure 1: Scree plot

It can be seen that the first two dimensions explain over a third (34.6%) of the total inertia of all 18 dimensions - this is indicative of the expressiveness of both dimensions. This number can also visualized by the curve formed by the inertia values in the scree plot, defined by the previous point in which it ceases to show steep declinations. Hence, the quantified categories are distributed in a two-dimensional plane as shown in Figure 2.

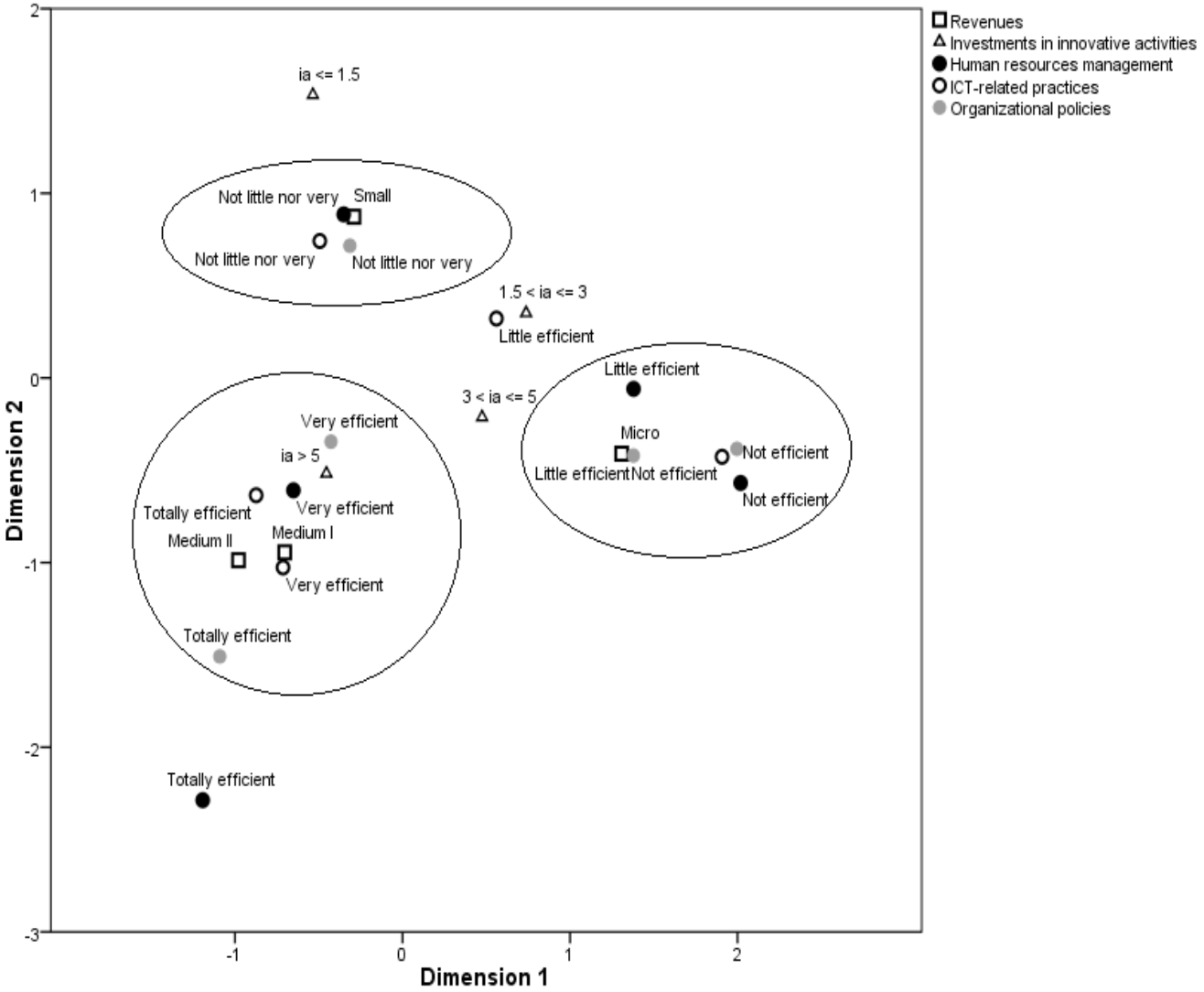

Figure 2: Categories

Even though a high Cronbach's alpha of 0.891 was obtained, indicating reliability of the set of involved transformed variables distributed in two dimensions, it should be noted that out of the three distinct groupings, in only one does the percentage invested in innovative activities is associated: the one in which KM practices are perceived as at least very efficient, the investment in innovation is bigger than 4.5% a year and also in which the companies with the most earnings are

concentrated. The other groupings are formed by small companies that perceive their KM practices as neither very nor little efficient, and by micro companies, whose KM practices are considered little efficient at most.

The lack of an association between the formed groups and the categories that indicate percent investments in innovative activities is confirmed by the discriminant measures. These measures express the variance of each variable, thus informing which contribute the most towards defining each dimension. Values close to zero for a given variable indicate that it does not adequately discriminate the objects. For the analyzed data set, it can be seen that investments in innovative activities are less determinant than other variables by plotting the variables' discriminant measures in two dimensions, as shown in Figure 3.

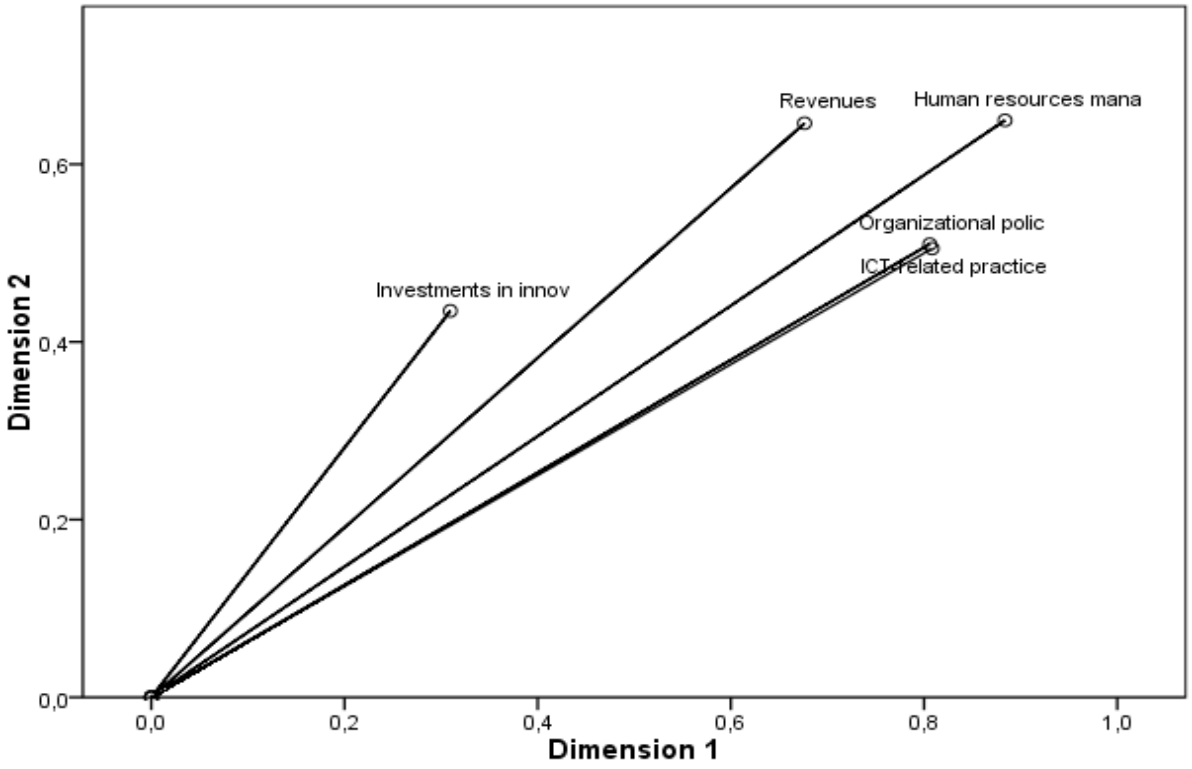

Figure 3: Discriminant measures

In addition, the Pearson correlation coefficients (r) between the transformed variables indicate that investments in innovation elements presents the smallest results as shown in Table 4. This confirms that the variation of these values is weakly associated to the variation in others.

Table 4: Correlations

	Statistic	Revenues	Investment in innovation	HR management	Organizational policies	Information technology
Revenues	r	1.000	0.247	0.685	0.736	0.668
	p-value	0.000	0.779	0.000	0.000	0.000
Investment in innovation	r	0.247	1.000	0.495	0.378	0.417
	p-value	0.779	0.000	0.000	0.006	0.002
Human Resources management	r	0.685	0.495	1.000	0.813	0.853
	p-value	0.000	0.000	0.000	0.000	0.000
Organizational policies	r	0.736	0.378	0.813	1.000	0.724
	p-value	0.000	0.006	0.000	0.000	0.000
Information Technology	r	0.668	0.417	0.853	0.724	1.000
	p-value	0.000	0.002	0.000	0.000	0.000

The results, as shown, do not seem to support the association between innovation and KM that is often found in the literature (Camelo-Ordaz, García-Cruz, Sousa-Ginel and Valle-Cabrera, 2011, p.1442; Aktharsha, Anisa and Ali, 2012, p.22; Krogh, Nonaka and Rechsteiner, 2012, p.258), nor the evidence that investments in innovation elements promote better financial performance (Oke, Walumbwa and Myers, 2012, p.294). In order to address this apparent contradiction, bivariate analysis was applied to the data. Regarding the first aspect, the investments in innovation are not unrelated to KM, especially when observing the group formed by HR practices, where a directly proportional relationship between these elements can be found, even if moderate ($r = 0.495$, p-value < 0.000). This supports the argument that well-developed HR management practices are related to the disposition towards investing in innovation (De Winne and Sels, 2010, p.1878; Bornay-Barrachina, Rosa-Navarro, López-Cabrales and Valle-Cabrera, 2012, pp.236-237). On the other hand, the relation with innovation activities was not as intense in other practices.

Regarding the second aspect – investments in innovation activities and business earnings, Figure 4 shows how this relationship occurs in this case.

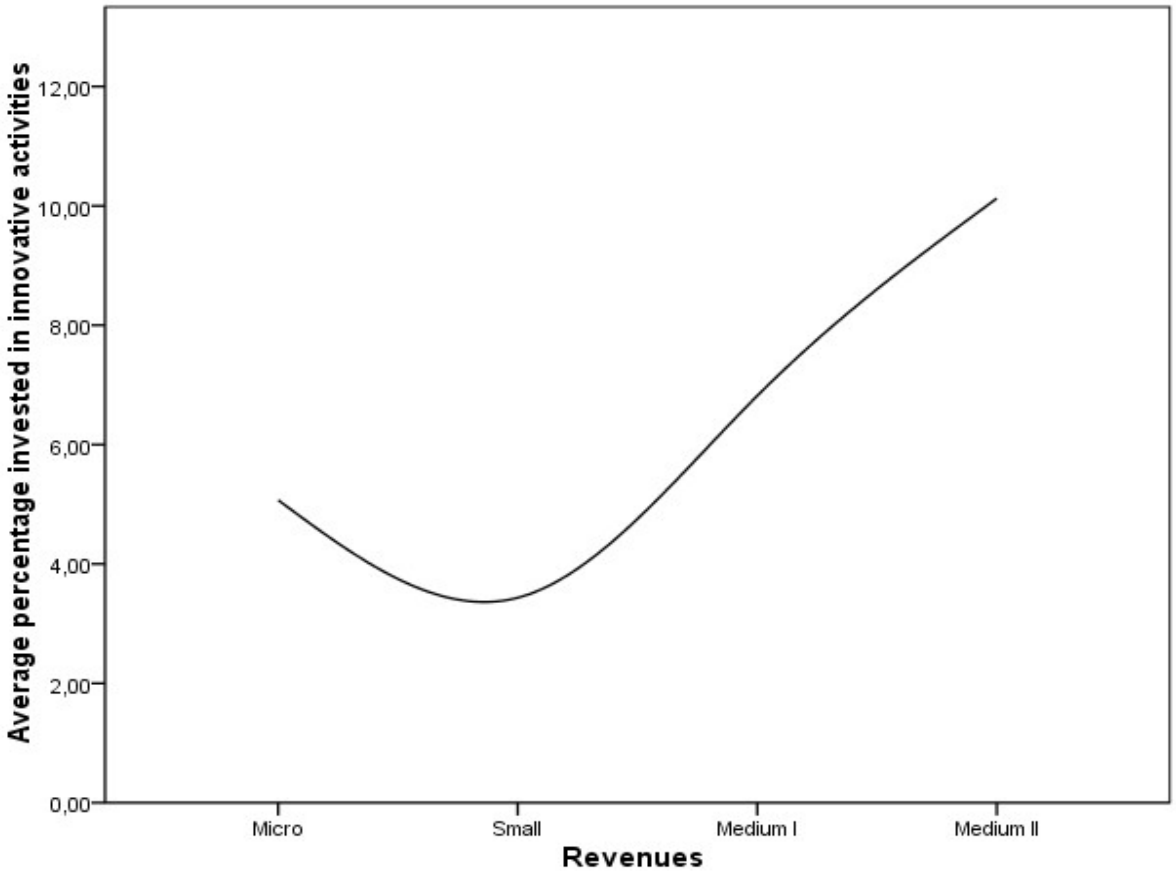

Figure 4 - Investment in innovation and Revenues

The "U" shape supports the proposition that companies with lower earnings have a higher disposition towards investing in innovation activities and, as they leave the "micro" status and go into "small", there is less investment in innovation (perhaps redirected to other areas). As soon as the curve of product/service acceptance starts to descend, the company once more begins to invest financial resources in innovative activities, generates new products/services and, consequently, improves its earnings – therefore moving the company up into another class. After a certain position in the market is reached, a given company, now in the presence of stronger competition, must invest increasingly and continuously in innovation. Table 3 also shows results that detail the groupings formed in Figure 2.

There is a significant relationship between revenue groups and perceived efficacy of KM practices, showing that companies that see their KM practices as more efficient also have higher revenues - especially when relating to organizational policies, in which the variation of perceived efficacy explains 54.2% of the variation in revenues. Among the KM practices, it should be noted that, besides the considerable relationships between other practice groups, HR management practices are very closely associated with the ICT group (explaining 72.8% of its variance).

Final considerations

In general terms, the results indicate that the set of characteristics involving the efficacy of KM practices is related to revenues. Also, the graduate companies that perceive higher efficacy in these practices are also those that invest more in innovation - coincidentally or not, they are also the ones with the highest revenues. The other groups were not categorized by their spending in innovative activities, which indicates that a propensity towards this kind of investment only occurs beyond a certain threshold of revenues or KM practice efficacy.

On the other hand, when controlling for KM practices, it was verified that micro companies tend to invest more in innovative activities than small ones, and the analysis suggests that as soon as they find themselves in higher earning brackets, the rate of investments in innovation also goes up.

The analysis does not allow conclusions about a causal relationship between the variables, although it is possible to raise some hypotheses. Since KM practices are more efficient in companies that earn more, this could indicate that efforts in knowledge management in those companies allow mobility toward higher revenue classes, or even that organizations that earn more require more efficient KM practices. This hypothesis stems mainly from the explanatory power of the variance of efficacy in corporate policy practices as it relates to revenues. Due to the high explanatory power of the human resources management group compared to the organizational policy and ICT group, the human factor is likely to have a significant effect, both in the policies and the results obtained with ICT.

Among the limitations of this study, it should be noted that the results are based on investments in innovative activities during a period of one year. Usually, in other studies that use the Oslo Manual as a basis for research on innovation, a reference period of three years is used. Nevertheless, the manual does recommend an observation period of no less than one year and no more than three (Oslo Manual, 2005, p.61). The choice of a short time period is justified by the fact that a number of the companies had graduated less than a year prior to the survey. Another limitation is that the perceived efficacy of KM practices did not take the time when they were implemented into account. Thus the possibility that the perceived efficacy could be affected by the lack of time for such practices to take effect should not be discarded.

The results of this study lead to consideration of several possibilities for further studies. Firstly, it would be necessary to study a larger number of companies, so that some of these conclusions may be verified or rejected. Secondly, since this type of study does not delve into further explanation of the reasons behind its results, more detailed qualitative studies on companies representing each segment are necessary. The similarities and differences between how graduated and non-incubated companies invest in innovation and perceive the efficacy of KM practices should also be verified.

More generally, more studies in this area should contribute to a better understanding of the impact of the business incubation process. Be that as it may, the disposition of graduate companies towards investing in innovation is undeniable. Studies that, while using different methodology, approach the same elements of innovation, show that, in Brazil, companies tend to invest 2% of their earnings on average (Salum, 2012, p.7; IBGE, 2010, p.43), while in this study this percentage was over 5%. As far as KM practices are concerned, it is not possible to compare the results with other research, since evaluation criteria vary widely. Nevertheless, awareness of the importance of KM in incubated companies should be raised, considering its importance as an input to their innovativeness.

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