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Portuguese SME Innovation Sources: Trends of the last Decade

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Abstract

The study aims to explain the changes in the sources of information for innovation used by Portuguese small and medium-sized enterprises (SME) comparing two 3-years periods: 2002-2004 and 2010-2012. For this purpose, it was used the data from the Community Innovation Survey (CIS) published in 2004 (CIS 4) and 2014 (CIS 2012). Comparative analysis reveals that there was a greater incidence of innovation activities in SME, mainly due to the use of their own knowledge resources and of their customers. The interaction with the scientific and technological system showed to be modest, although it has been detected in the medium-sized enterprises an appreciable increase on related sources – including higher education institutions, Government and research centres. Despite being a strictly descriptive analysis, evidence gathered through graphical analysis suggests a slight change along the last decade towards to organizational and technological innovations within Portuguese SME, based on knowledge networking.

Keywords: Open innovation; digital technologies; knowledge networking

1. INTRODUCTION

There is nowadays a broad consensus among scholars and researchers about the decisive role that knowledge and innovation play in economic growth. Whatever the type of innovation this plays a key role in increasing productivity and improving wellbeing (Schumpeter, 1934. OECD, 1996; Hall & Rosenberg, 2010). Growth, business success and resilience, all depend on firms' ability to innovate on a systematic basis. However, innovation activities require a favorable environment and the adequate allocation of highly skilled people and financial resources that can generate new products and processes, as well as new approaches to the market or value creation (Porter, 1985; Fagerberg, Mowery, & Nelson, 2005; European Commission, 2016).

Sources of innovation are considered the trigger for companies to carry out innovation activities. These sources determine a company's ability to develop and apply innovations, being as such critical to achieve market success. Following Skibiński & Sipa (2015), it can be admitted the following typology: (1) internal scientific research of the company (basic, applied, and development); (2) the activities of rationalization-invention; (3) external sources of technological knowledge.

Concerning the incentive mechanism for innovation, the literature distinguishes between supply-side and demand-side sources of innovation. On the supply-side, innovations result of scientific and technological development; on the demand-side, they emerge to meet both market needs and environmental protection requirements. In detail, it should be taken into consideration: (1) customer needs and/or technological development that contribute to the creation of new resource combinations meaning this technological

innovation (Dodgson & Rothwell, 1994); (2) functional sources of innovation, including knowledge recipients, suppliers, co-workers; consultants and other business partners, and competitors (Von Hippel, 1988).

Using the terminology of Eurostat's Community Innovation Surveys (CIS 4 to CIS 2012) the main sources of information that encourage innovation can be classified as: (1) internal to the company (including R&D activities or innovative ideas proposed by employees); (2) business (suppliers, customers, and competitors); institutional (institutions of higher education, R&D, and state laboratories); (3) other sources (conferences, meetings and publications, fairs and exhibitions, etc.).

Small and medium-sized enterprises (SME) are the backbone of the EU-28 economy, sustaining two-thirds of employment in 2015 and close to three-fifths of the value added in the non-financial sector (Muller et al., 2016). Further strengthening its relevance in the European Community economy, SME account for around 99% of the European Community business fabric (European Commission, 2016).

Notwithstanding, researchers, consultants and policy makers keep mentioning the existence of barriers in SME to carry on activities of innovation, such as the incipient endowment of internal resources. In the case of small firms – and even more in micro firms - the versatility of cognitive, human and operational skills of entrepreneurs and managers are crucial to take advantage of the respective human capital (Hemert, Nijkamp, & Masurel, 2013). It is therefore imperative to analyse the sources of innovation in such important business segment and what changes have occurred in these along the first decade of the new millennium.

As such, the research question is: what changes have occurred in sources of innovation, either of formal or informal nature, used by SME between 2002-2004 and 2010-2012?

Evidence is gathered through a descriptive analysis of data collected in Community Innovation Survey for both 3-years periods, supported by graphs intentionally produced to show the most frequent sources in each period. These allow to make inference about significant changes in what concerns to increasing participation of SME in knowledge networks, confirming what is suggested by open innovation literature.

The main contribution of this paper is the enrichment of the current academic discussion, supported on an empirical basis, about how Regional Innovation Systems can enhance the implementation of Open Innovation in SME. The paper is structured as it follows: after a brief literature review about the main sources to innovate, it follows a descriptive analysis of the main trends in the last decade. The paper ends with a conclusive reading about the main evidence taken out from the data, with a special focus on the paradigm shift that slightly seems to be featured in the knowledge management model as a sustainability factor of Portuguese SME.

2. LITERATURE REVIEW

2.1. Sources of innovation

There is, since a long time ago, a huge consensus in the academic community that innovation is conceived

through a systemic, non-linear and interactive process in which the prevailing actors are several types of producers and users of knowledge (tacit/implicit or codified/explicit) categorized in the following subsystems: education and vocational training system, science and technology system, and productive system (Teece, 1996; Etzkowitz & Leydesdorff, 2000; Edquist, 2005; Chesbrough, Vanhaverbeke, & West, 2008).

This systemic view is the touchstone of innovation systems approach, introduced by Lundvall (1992), based on the evolutionist principles of interactive learning, bounded rationality and uncertainty of economic agents, and technology path dependence as drivers of technological change and economic growth (Dosi et al., 1988). Its main contribution was to include the use of external resources to enhance technological innovation, including knowledge interchange and development of prototypes in partnership with other companies, research institutions, and university research units (Tsai & Chang, 2016). Cooke (1992, 2008) introduced the concept of regional innovation systems (RIS) considering these as systems that promoted interactive learning between organizations embedded in an ‘innovative milieu’.

The RIS is essential to ensure that localized ‘synthetic’ and ‘symbolic’ knowledge bases, developed and exploited on an ongoing basis through Doing-Using-Interacting (DUI) type processes, are enriched by ‘analytical’ knowledge and more explorative efforts that reflect the Science-Technology-Innovation (STI) mode of innovation (Herstad & Sandven, 2017).

Innovation is taken as the result of an organizational learning process depending on the “absorptive capacity” of the company to recognize the economic value of new information, to assimilate it, and to apply it for commercial purposes (Cohen & Levinthal, 1990). According to these authors, the development of such exploitation capacity is subject to a historical contingency referring to the importance of prior related knowledge (i.e. basic competencies, shared language or even mindfulness of the latest scientific and technological developments in a given field of knowledge).

Therefore, although innovativeness in high-tech sectors depend on internal R&D resources they gradually tend to be the result of an integrated process of knowledge generation, diffusion and application. Such process takes place within a complex network of formal and informal relations. In this network an active role is played by the set of stakeholders involved in firms’ chain value - other companies linked to the same sector of activity (competitors, suppliers, and distributors), institutions of higher education, R&D laboratories, certification centres, financial institutions, professional associations, trade unions and representatives of the political system (Tödtling, Lehner, & Kaufmann, 2009).

The generation and use of knowledge among firms depends on cognitive proximity (Boschma, 2005) and on the frequency and density of interactions with external sources of innovation (Chesbrough et al., 2008). But it also depends on their ability to overcome organizational barriers to access networks and poles of knowledge (Hemert et al., 2013). In this line of thought has emerged recently literature proposing a model of open innovation (Brunswick & Vanhaverbeke, 2015; Henttonen & Lehtimäki, 2017; Bogers et al.,

2017) which assumes that companies seek to open their knowledge creation process to the outside, compensating for the inadequate endowment of professionals in R&D activities proactively, in order to get a competitive advantage. Legenvre & Gualandris (2018), for example, consider a purchasing perspective essential for innovation sourcing capabilities. Thus, the authors reflect about three situations: (1) Purchasing needs to explore the unmet ones and anticipate future competitive advantages by working closely with other functions and clients; (2) It needs to explore external opportunities beyond first-tier suppliers; and (3) It needs to involve suppliers in innovation projects that consistently deliver results over time.

Even large companies tend to adopt this model of open innovation when it comes to explore new fields of their own knowledge domain (exploration) in search of new products or new technological processes through, for example, joint ventures with partners in projects of fundamental and/or applied R&D (Chesbrough & Brunswicker, 2013). These partnerships therefore function as an organizational learning channel and are economically advantageous in diluting the risk inherent to the innovation process of scientific and technological bases, which is more demanding in terms of knowledge resources than incremental innovation.

To trigger innovation activities in firms, information sources are crucial because they influence the ability of companies to innovate (particularly in the case of SME) and the success of innovations in the market. According to the “traditional perspective” (Skibiński & Sipa 2015), those sources can be categorized as: (1) internal (basic research, applied research and development); (2) invention; (3) external (technological know-how). In addition, considering the mechanisms that encourage innovation, it is possible to differentiate between sources of innovation on the supply side and the demand side. In the first case, the innovations result directly from scientific and technological developments, while on the demand side the relevant sources are market and production needs (including environmental protection).

In sum, the literature suggests that a categorization of sources of innovation may be established, distinguishing between internal and external according to the following constructs. The internal sources allude to both the research carried out within the company (i.e., “inside doors”), including inventions, and the empowerment actions of the collaborators (Fernandez & Moldogaziev, 2013). External sources applies to a vast range of knowledge transfer, such as researches conducted in higher education institutions (HEI) and independent R&D units, licenses, hired specialists, technology transferred through new equipment’s acquisition, knowledge facilitated by other companies (competitors, suppliers or customers), professional publications, exhibitions, and demonstrations (Clausen, Pohjola, & Verspagen, 2011; Brunswicker & Vanhaverbeke, 2015; Silva et al., 2016).

2.2. Innovation in SME

In the last four decades, coinciding with the crisis of the Fordist production model in the late 1970s (Boyer, 1994), in overall literature have recognized the existence of different innovation patterns depending on the characteristics of the companies (size, sector of activity, location).

In fact, there is a remarkable group of academics who highlight large companies as the engine of innovation, thanks to economies of scale and productive flexibility. Such prominence arises in a context of increasing uncertainty associated with the reduction of the product life cycle, vertical disintegration of globalized production supply chains, and rapid technological change (Piore & Sabel, 1984). Another advantage attributed to large companies is that they are better endowed with R&D resources, either internally or collaboratively with research units and technology hubs (Acs & Audretsch, 1988; Teece, 1988; Gray, 2006).

However, several empirical studies demonstrate that innovation is not necessarily an output of R&D activities (Muller et al., 2016). Moreover, SME are broadly recognized as global drivers of technological innovation and economic development in both industrialized and developing countries (Tont & Tont, 2016). This innovativeness lays on learning mechanisms referring these to agents' actions through which a process of understanding the information received is triggered implying knowledge dissemination to new users (Lundvall, 1992). So, the innovative performance in SME will depend potentially on the entrepreneurial capacity to adopt collaborative strategies to commercially exploit either new products created in-house or those already existent in the market (by voluntary imitation or pressure from business partners).

Bearing in mind that firms are basic elements of any socioeconomic system (shown in RIS literature), it should be taken as priorities by policymakers, stakeholders and managers to enhance human capital side by side with educational progress in ICT and professional qualifications. Such priorities are aligned with the finding that emerging digital technologies disrupts traditional forms of work - rising risks of labor market fragmentation such as income (in)equality, income security and social stability (World Economic Forum, 2016).

Given the increasing requirements of quality and regulations at international markets (particularly in the European Union), SME are called upon to deeply redefine respective business models by: (1) fostering competition in relation to similar companies, either in terms of the main activity or dimension (Ghobadi & D'Ambra, 2012); (2) establishing strategic alliances with public and private promoters, suppliers, consultants and clients (Todeva & Knoke, 2005); (3) implementing quality management systems (Tsai & Chou, 2009); and (4) getting involved in internationalization processes (Kuivalainen et al., 2012).

In short, innovation in SME critically depends on access to a broad base of external knowledge resources, with geographical expression at different scales (from local to international), according to the literature mentioned in the previous section. So, smaller firms may reveal a better innovation performance by being less subject to bureaucratic processes in R&D management compared to large firms - often due to managing conflicts of interest between managers and shareholders (Eisenhardt, 1989; Hill & Jones, 1992). These tend to create spin-offs (branches of small size) to develop innovative projects with more flexibility and probability of commercial success.

However, the literature recognizes typical weaknesses in SME regarding to innovativeness capacity.

Brunswicker & Vanhaverbeke (2015) state that, because of their small size, they are unable to embrace all innovation activities in order to autonomously deliver a successful innovation.

Thus, the authors suggest there will be a tendency to intentionally take advantage of the non-pecuniary external sources of knowledge, namely through "social and personal ties". Such type of sources remit to the sociological perspective of Polany (1956), Granovetter (1985), and Putman (1993) about social and territorial "embeddedness" of business activities as determinants of the transference of tacit and codified knowledge. Additionally, the absence of such activities can be explained by the high financial risk associated with the R&D process, as it becomes unlikely to have an incorporation of laboratory units in business structure - clearly a manifest risk aversion, moreover when entrepreneur's family is rather dependent on his business (Hausman, 2005).

Furthermore, innovation processes requires a team of skilled people with individual knowledge necessary to interact with the various producers and users of knowledge outside the organization. In this respect, Hausman (2005) and Varis & Littunen (2010) point out difficulties, especially in small firms, due to a certain conservatism typical of their owners/managers. Such behavior results, on the one hand, in self-centered leadership, i.e. not being receptive to employees' advices, and even less likely delegate to them the decision-making process. On the other hand, smaller firms often show a lack of adequate training to understand the contextual changes (of socio-cultural, political-institutional, economic, and/or technological nature) to respond effectively with innovations to customers' needs.

3. METHODOLOGY

The aim of this study is to analyze the changes in the sources of information used for innovation by SME in Portugal in last decade and to detect trends in companies regarding the use of sources of innovation as reported in CIS. For this purpose, the results of CIS in Portugal for two periods (2002–2004 and 2010–2012, published in CIS 4 and CIS 2012, respectively) are used. Such results can be found in databases provided by the Portuguese Directorate General of Statistics for Education and Science (Direção-Geral de Estatísticas da Educação e Ciência, 2006; 2014).

In Portugal, CIS4 was distributed to a sample of 7,370 companies, representing a population of 27,797 companies in the Industry, Construction and Services Sections of the Economic Activity Classification (CAE) - Rev. 2.1. These were randomly selected by the Statistics Portugal (INE). After corrected, the sample analyzed consisted of 4,815 valid responses corresponding to a 65% of the main sample. CIS 2012 was carried out from the companies of CAE - Rev. 3. Following the guidelines and recommendations of the Eurostat, INE has constructed a composite sample by 9,423 companies, based on a combination census (for companies with 250 people service or more) and random sampling for other companies. They considered as valid 6,840 responses, corresponding to a response rate of 73%.

The indicators used were the diverse sources of information for innovation activities carried out by companies depending on their size (number of employees). We opted for those with a number of workers

in the intervals of 10 to 49 and 50 to 249, classified respectively as small and medium enterprises according to the CIS classification, in order to analyze the behavior and trends of SME regarding to sources of innovation.

The sources of information for innovation used in the CIS are categorized into: a) "Other enterprises within your enterprise group"; b) "suppliers of equipment, materials, components or software"; c) "customers or consumers", d) "competitors or other companies in the same sector of activity"; e) "consultants and commercial laboratories"; f) "universities or other institutions of higher education"; g) "Government, public or private research institutes"; h) "conferences, trade fairs, exhibitions; i) "scientific journals and trade/technical publications "; and j) "professional or business associations".

Despite the conceptualization discussed in section 2.1 and the importance of human resources' qualification - one of the most central determinants for the absorptive capacity (Cohen and Levinthal, 1990) - as well as the networking between several stakeholders at various territorial scales of geographical proximity, the first CIS does not include information as source of innovation.

For the relationships the information is available at CIS but separated from innovation source group. Besides that the methodology used relatively the cooperation has changed from CIS 4 to CIS 2012 making impossible to compare this dimension correctly. The CIS 2012 considers only the cooperation for innovation in product and process and not for all innovation as the CIS 4. Nevertheless, the CIS information about sources of innovation still provides a useful exercise for identify trends in the behavior of enterprises.

In the next section, we will focus on the Portuguese SME panorama of innovation sources, analyzing the extent to which the considerations and findings invoked in the literature review manifest themselves.

4. RECENT TRENDS ON INNOVATION SOURCES: RESULTS

In the first place it should be noticed that *Oslo Manual* (OCDE/Eurostat, 2005) defines 4 types of innovations: product, process, organizational and marketing innovations.

Product innovations involve significant changes in the capabilities of goods or services. Both entirely new goods and services and significant improvements to existing products are included.

Process innovations represent significant changes in production and/or delivery methods.

Organizational innovations refer to the implementation of new organizational methods. These can be changes in business practices, in organization's workplace or in the firm's external relations (such as new partnerships).

Marketing innovations involve the implementation of new marketing methods. These can include changes in product design and packaging, promotion and placement, and in methods for pricing goods and services. (OCDE/Eurostat, 2005, pp.16-17).

According to data collected over the chosen periods, there was an increase of 15 percentage points (p.p.) in small companies developing innovation activities and about 11 p.p. in the medium enterprises (Table 1).

Global Results for Portugal	Innovation Activities		Product Innovations	Process Innovations	Organizational innovations	Marketing innovations
	2002-04	2010-12	2010-12	2010-12	2010-12	2010-12
Size (number of persons employed)						
10-49	36	51,0	22,4	29,6	29,9	30,7
50-249	56	66,8	37,3	46,5	42,7	38,9
250 or +	63	84,6	62,2	68,8	65,5	51,0
TOTAL	41	54,5	25,9	33,5	33,0	32,6

Table 1 - Activities and types of innovation in Portuguese enterprises (% in total surveyed).

Source: Own elaboration based in data of CIS 4 and CIS 2012.

Data displayed in Table 1 show that the type of innovation most adopted by small companies in 2010-12 was Marketing Innovation, but in companies with 50 or more employees the type of innovation most adopted was process innovation. In 2002-2004, as illustrated in Figure 1, the sources of information for innovation considered of "high importance" by SME with innovation activities were (in descending order):

1. within the company or group to which it belongs;
2. customers or consumers;
3. suppliers of equipment, materials, components, or software; and
4. conferences, fairs, exhibitions.

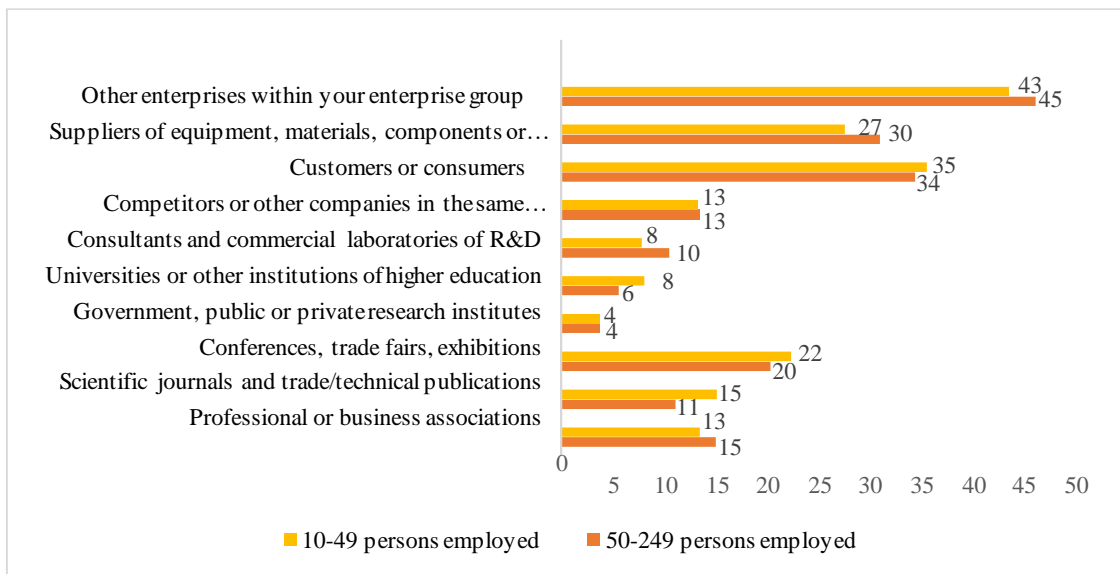


Figure 1 - Sources of innovation during 2002-2004 (% of surveyed enterprises).

Source: Own elaboration based in data of CIS 4.

Then, we found scientific journals and technical/professional/trade publications, with greater relevance in small businesses (15% against 11% in medium-sized firms); professional or business associations, more frequent in medium-sized enterprises (15% against 13% in small firms); and competitors or other companies

in the same sector of activity (13% in both size categories). The remaining sources of information for innovation - consultants and commercial laboratories; universities or other institutions of higher education; and Government, public or private research institutes - were used by lower percentages of innovating companies.

In the 2010–2012 period, as Figure 2 illustrates, the main sources of information classified with the "degree of high importance" for innovation activities developed by innovating companies continued to be internal sources (the own company or group to which this belongs; customers or consumers; and suppliers of equipment, materials, components or software. However, there have been changes in the other sources.

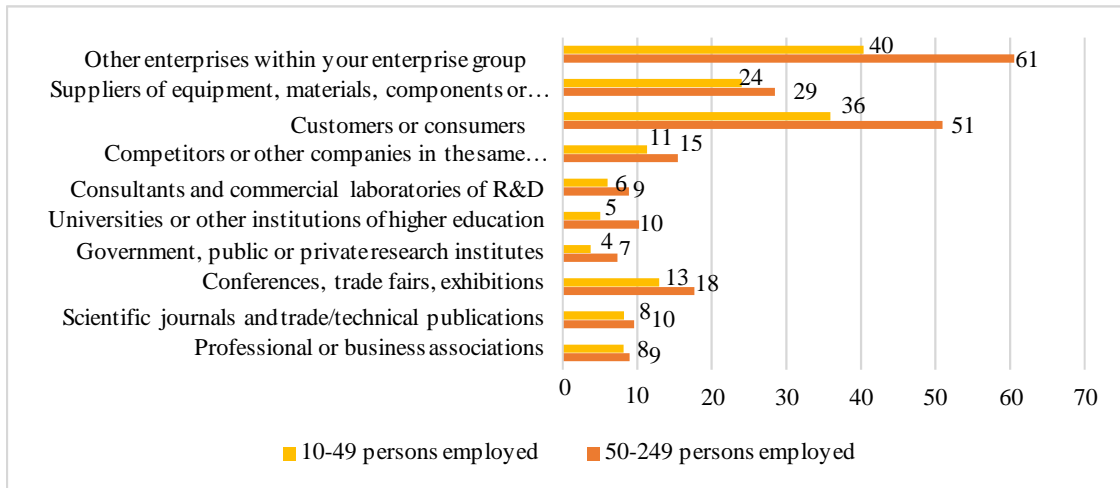


Figure 2 - Sources of innovation during 2010-2012 (% of surveyed enterprises).

Source: Own elaboration based in data of CIS 2012.

In small businesses, the major reductions were in the use of conferences, fairs, exhibitions (-9 p.p.); scientific journals and technical/professional/trade publications (-6,6 p.p.), and also trade associations or business (-5,0 p.p.). There was a slight increase in the use of information from the customers or consumers and the Government, public or private research institutes was practically the same – see Figure 3.

In medium-sized enterprises (Figure 4), as sources of information to innovate it is worth of notice the reducing use of conferences, fairs, exhibitions; scientific journals and trade/technical publications; professional or business associations; suppliers of equipment, materials, components, or software; and universities or other institutions of higher education.

On the contrary, there was a significant increase in the use of customers or consumers (+17,2 p.p.); Government, public or private research institutes (+15,3 p.p.); consultants and commercial labs or R&D (+4,7 p.p); competitors and other companies in the same sector of activity; and, for last, the company or firms belonging to the same group. In medium-sized enterprises (Figure 4), as sources of information to innovate it is worth of notice the reducing use of conferences, fairs, exhibitions; scientific journals and trade/technical publications; professional or business associations; suppliers of equipment, materials,

components, or software; and universities or other institutions of higher education. On the contrary, there was a significant increase in the use of customers or consumers (+17,2 p.p.); Government, public or private research institutes (+15,3 p.p.); consultants and commercial labs or R&D (+4,7 p.p.); competitors and other companies in the same sector of activity; and, for last, the company or firms belonging to the same group.

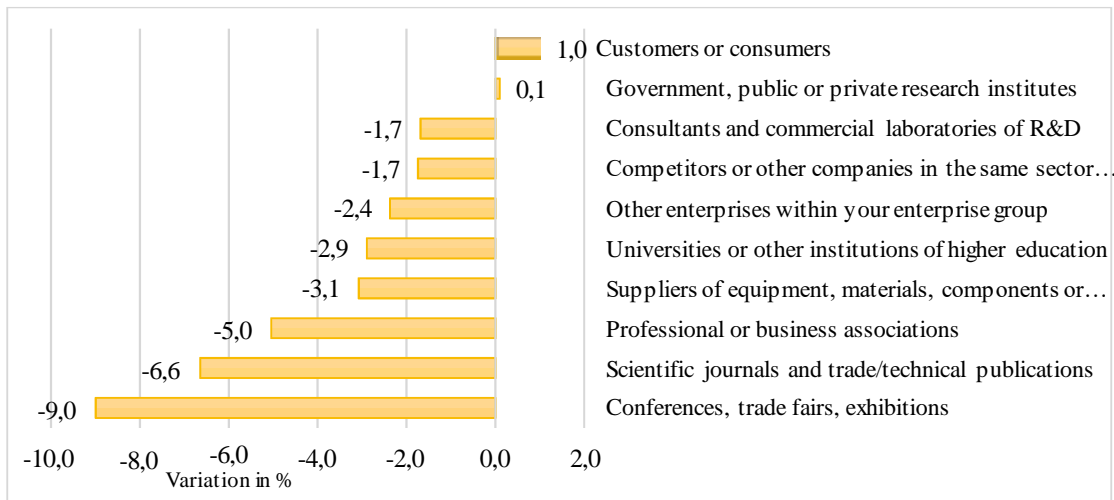


Figure 3 - Trends in innovation sources of small business since 2002 - 2004 till 2010 - 2012.
Source: Own elaboration based in data of CIS 4 and CIS 2012.

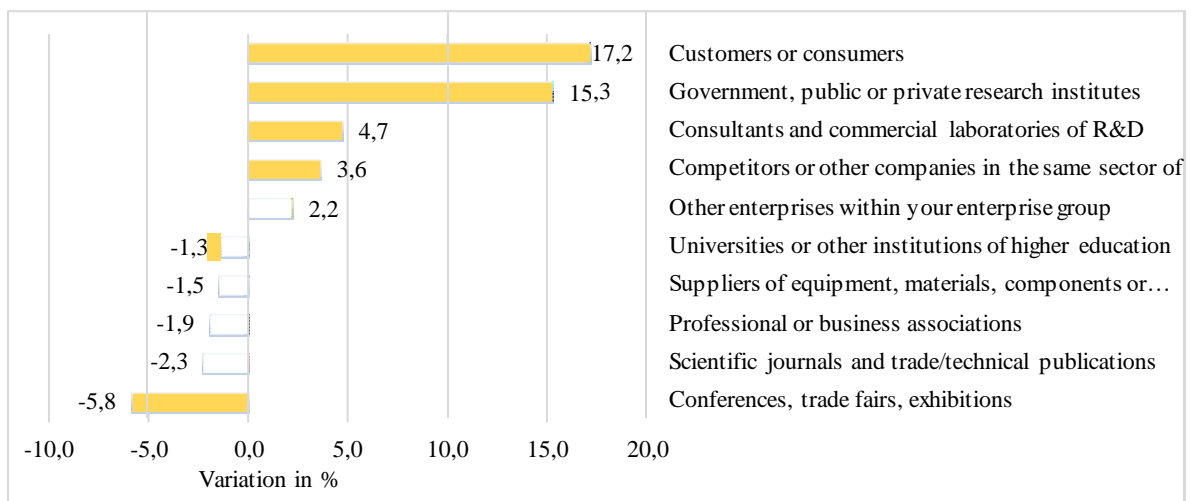


Figure 4. Trends in Innovation Sources of Median Enterprises since 2002 - 2004 till 2010 - 2012.
Source: Own elaboration based in data of CIS 4 and CIS 2012

So, there was a clear change in the use of information sources to innovate with a tendency towards the use of internal and institutional sources (especially in medium firms) to the detriment of the informal sources (as illustrated by the smaller weight of professional or business associations, scientific journals and trade/technical publications, and conferences, trade fairs and exhibitions, in Figures 3 and 4).

Concerning cooperation as a source of innovation, although with the constraints previously referred in the methodology, there were also changes in the categories of partners chosen by the companies to cooperate. For small firms (Figure 5) there has been an increase in cooperation with education and research institutes

(universities and other higher education institutions, and Government/public research institutes) and clients (or customers); as opposed to suppliers, competitors and consultancy firms.

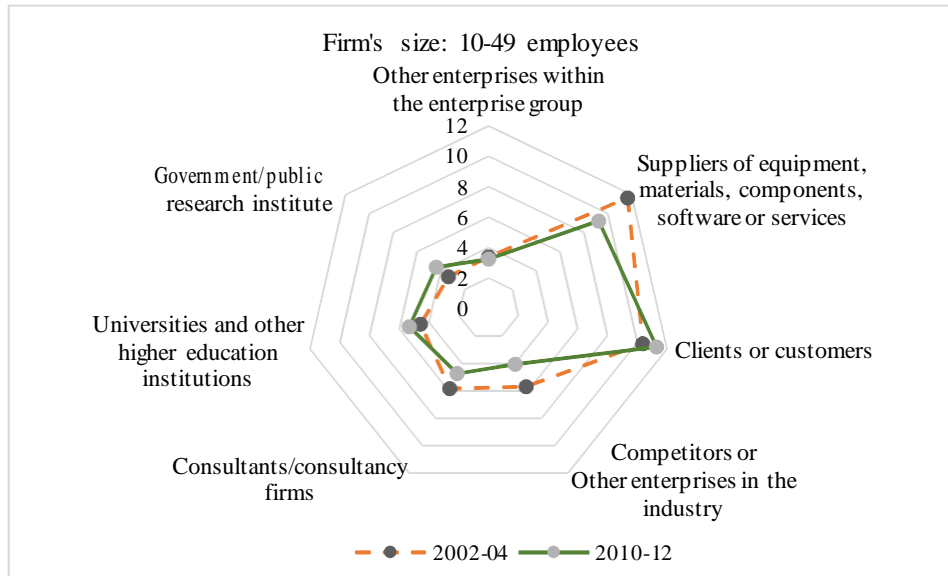


Figure 5 - Partners for innovation (of product and/or process types) in small enterprises, since 2002 - 2004 till 2010 - 2012 (in % of surveyed enterprises).

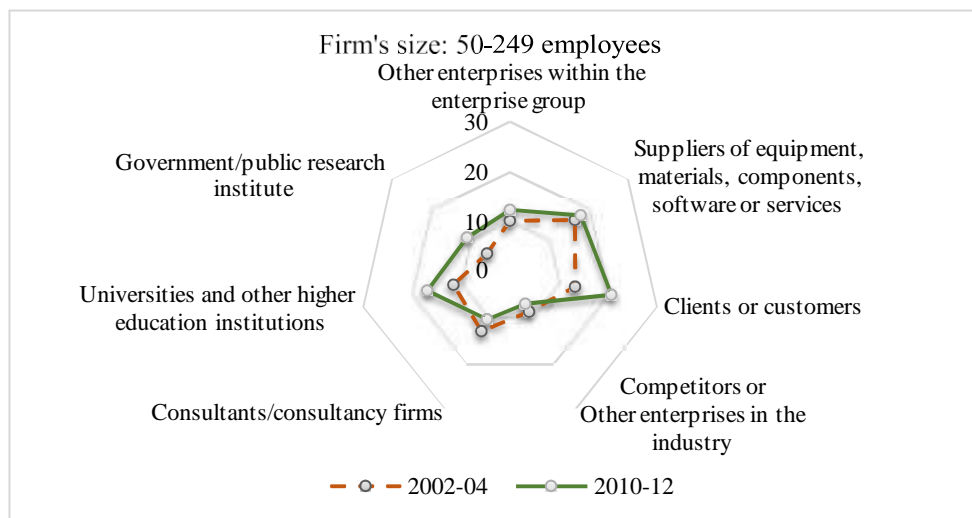


Figure 6 - Partners for innovation (of product and/or process types) in medium enterprises, since 2002 – 2004 till 2010 - 2012 (in % of surveyed enterprises).

For medium-sized enterprises the situation is similar: Figure 6 shows there was an intensification of cooperation with the institutional sources in of external consultants/consultancy firms. It is worth of notice that clients (or customers) showed a remarkable increment.

5. DISCUSSION

During the first decade of the new millennium there was a change of paradigm for Portuguese companies regarding to the information sources for product and process innovation. Both small firms and medium-

sized firms have reduced their search for external sources, whether formal or informal (conferences, trade fairs, exhibitions; scientific journals and trade/technical publications; and professional or business associations). In counterpart, they have reinforced the trend for external market sources (customers or consumers) and institutional sources (from State and institutes of public or private research).

The medium-sized enterprises also intensified the use of information from higher education institutions (HEI) in order to support new innovation projects or to assure the completion of existing projects. This paradigm shift follows the recommended in systems of innovation approaches, open innovation and triple helix which highlight the role of institutions in promoting innovation (Edquist, 1997; Leydesdorff & Etzkowitz, 1996; Ranga et al. 2016; Natário et al. 2017).

In this institutional framework also interaction and cooperation relations, recognizably important to the development of innovation, have changed. SME have stepped up cooperation partnerships with institutional sources to the detriment of the market and commercial sources.

These results show an apparent contradiction: Portuguese SME tend to be more inclined to select internal sources instead of institutional external sources (HEI and research centers, as well). But, at the same time, there is evidence of a greater interaction (cooperation) with such.

Our interpretation is that such firms, microenterprises markedly, have become more autonomous in the innovation process by interacting more with customers and depending less on informal sources as the "most important" to get information needed to support innovation activities. Nevertheless, they still cooperate with suppliers, competitors/companies in the same market and business associations.

This development may reflect a greater focus on the client and, given the limited enterprise resources to innovate, the consolidation of an open innovation model within Portuguese SME. Both trends are linked to business internationalization based on partnerships with customers (including intermediary agents and final consumers/customers), what explains the recognized relevance of such sources.

In the case of medium-sized firms – with greater volume of internal resources to undertake innovation activities and more focused in the certification of their products, in compliance with national and international markets standards – they tend to be more inclined to adopt quality management systems (thus reinforcing the process approach and continuous improvement). Meanwhile it is noticeable their positioning to effectively take advantage of the financial support made available by the Portuguese Government, with the sponsorship of the European Union, through R&D projects in partnership with research centers (public and/or private).

In overall, a key feature suggested by such empirical results is the collective awareness that cooperation in order to innovate is a strategic tool for business sustainability, whatever the economic activity and/or company's size. This surges as an expected consequence of the Industry 4.0 model's dissemination across Europe, which impulses joint ventures between companies and consortiums with HEI to exploit new digital processes and devices (Brettel et al., 2014).

6. CONCLUSIONS

Our purpose is to find out the main trends regarding to sources of innovation used by SME in 2002-2004 and 2010-2012. The data analysis reveals that in the decade of 2002–2012 there was a greater incidence of innovation activities in SME, mainly due to the use of the company's own knowledge resources and that of its customers. The interaction with the scientific and technological system was shown to be modest, although between the two periods examined, medium-sized enterprises showed an appreciable increase on related sources, including HEI, government and research centers. Such suggests that the model of open innovation has come to consolidate itself, with a growing competition because of the increasing relevance of competitors or other companies belonging to the same sector of activity as the external source of innovation.

From the results presented it should be stressed that the highest relative frequency of companies performing innovation activities were supported by clients, employees (including also those belonging to the group to which company belongs) and suppliers. This shows the central role of the market (both on the demand side and on the supply side) as a driver of innovation in SME. In small companies, the dependence of knowledge networks is evident, demonstrating the relevance of organizational proximity to entities within the same value chain.

At the level of strategic management, these results generally suggest a greater awareness of SME management for the relevant role of access to knowledge through intentional cooperation with various stakeholders, focused on interactive learning and innovation in their various types. Such evolution, in our perspective, is a consequence of the growing professionalization of managers and entrepreneurs, which symbolizes the reinforcement of human capital mainly in small enterprises, typically more fragile in this respect as shown in literature and empirical studies.

In terms of public policies for competitiveness and innovation, the greater weight of the State, research institutes (public or private), and HEI shows that an effective and efficient strategy for the Portuguese economy, strongly built on SME, will depend critically on collaborative networking in order to consolidate an effective regional ecosystem of innovation – especially in less developed regions.

The incipient results of Portuguese SME suggest that the current decade is likely to be based on the reinforcement of open innovation as driver of technological innovation in SME, in coherence with the pressure of switching to new Industry 4.0 technologies and moving forward with the integration of the various IT systems.

As limitations it is pointed out the strict use of secondary databases used which inhibit more sophisticated analyzes. Thus for future research we think it would be valuable to analyse directly the companies through application of inquiry and proceed the comparison with results already tested by other studies as, for example, Natário (2005) and Oliveira (2013).

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