# Open Innovation in clusters: The Portuguese case

Santos, Antonio Bob

ISCTE-IUL

2015

# Open Innovation in Clusters: The Portuguese Case

António Bob Santos[1]

[1] ISCTE-IUL (University Institute of Lisbon)
abmsantos@netcabo.pt
m18020@iscte-iul.pt

**Abstract.** Given the lack of academic research linking open innovation with the clusters literature, this paper analyze the determinants of open innovation adoption in clusters, based on the Portuguese case. This paper is structured as follows: 1) introduction; 2) methodology; 3) theoretical analysis of clusters and open innovation; 4) cluster policy evolution in Portugal; 5) results of an online questionnaire launched to the Portuguese clusters members, identifying the main constraints for the development of open innovation activities; 6) conclusions and implications. The factors that hinder the use of open innovation by clusters members are related to internal problems (e.g., management skills) and external factors (e.g., funding access). This paper also allows the understanding of the importance of belonging to a cluster for the usage of open innovation activities, contributing to the discussion of the necessity of having a more open innovation policy approach in Portugal.

**Keywords.** open innovation, clusters, cluster policy, innovation policy.
**JEL codes:** O25 Industrial Policy; O31 Innovation and Invention; O32 Management of Technological Innovation and R&D; O38 Government Policy

## 1. Introduction

Most part of open innovation research has been developed at the firm level (Chesbrough and Bogers, 2014), with the need for future research on other levels of analysis (West *et al*., 2014). For example, the research that relates open innovation with the cluster theory is still scarce, although open innovation literature have been putting a great focus in the organizational and interorganizational networks (particularly in the inbound and outbound activities), which are important components in the cluster approach (Chesbrough, 2003; Chiaroni *et al*., 2011; Malecki, 2011; West and Bogers, 2014).

The emergence of the importance of clusters in the innovation process and competitiveness is mainly due to Michael Porter (1990, 1998). The cluster definition of Porter is the most mentioned in academic literature, stressing the importance of geographical proximity of firms with other entities, which compete and cooperate with

each other in an interdependent relationship, with both formal and informal links (see European Commission, 2008).

Terstriep and Lüthje (2011) mentioned that the cluster definition of Porter (1998, p. 78) - "*…geographic concentrations of interconnected companies and institutions* .." - is an important ecosystem for open innovation, where issues such as international networks or collaboration between companies and between them and other entities (important practices in open innovation literature) are regular routines in clusters. In fact, those routines are essential in the knowledge flows across organizations in the open innovation approach:

> "…we define open innovation as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model." (Chesbrough and Bogers, 2014, p. 12).

Also Halbert (2010) reinforces this issue, concluding that the organization in cluster can stimulate open innovation, contributing to the creation and searching for partnerships between different actors. Thus, by their nature, clusters appear to be privileged ecosystems to analyze open innovation practices in the real world, especially what concerns to areas that influence firms in the adoption of open innovation.

Given the lack of academic research linking clusters and open innovation, this paper attempts to analyze the determinants for the adoption of open innovation in clusters, based on existing clusters in Portugal[2]. Since clusters are conducive to innovation processes, this analysis intends to understand how open innovation can help to improve the dynamics of clusters. We also intend to have a deeper understanding of open innovation out of the firm level (clusters), in a country that is not in the technological frontier (Portugal).

To do this, we built and launched a survey to all members of the clusters recognized by the Portuguese Government[3]. If the findings point to the low utilization of open innovation activities by the responding entities, we can infer that open innovation is not an approach

[2] In 2009, the Portuguese Government recognized 19 clusters. In 2014, 16 of that clusters created the association "Portugal Clusters".
[3] Survey launched to the members of the 16 clusters of the "Portugal Clusters" association.

considered a priority by the Portuguese clusters. After the introduction Chapter, we discuss the methodological considerations about the survey (Chapter 2). The article continues with an overview of the emergence of clusters policy (Chapter 3) and with the evolution of the cluster policy in Portugal (Chapter 4). In Chapter 5 we analyze the results of the survey launched to the clusters, about open innovation activities (Chapter 5). In Chapter 6, we present the main conclusions, including limitations of this research, implications for public policy and suggestions for further research.

## 2. Methodology

For the identification of open innovation activities, we used the survey method, by building a structured questionnaire, appropriated for situations where the interviewer is not present or when is necessary to put more precise questions (Hill and Hill, 2000). Given that the questionnaire method should use, preferably, questions already tested (Almeida and Pinto, 1997; Hill and Hill, 2000), we looked at other questionnaires where open innovation was analyzed in the context of companies and / or clusters, namely Chesbrough and Brunswicker (2013), Cosh and Zhang (2011), Marques *et al*. (2010), Rahman and Ramos (2013) and Teixeira and Lopes (2012). In the case of international questionnaires, the questions were adapted to the Portuguese reality. The distribution and collection methods of these questionnaires were analyzed - the electronic mail (email) was the preferred communication channel used. In this sense, we also used the email in the current research, given the low costs associated and given that all the members of the clusters have an email address.

The questionnaire included closed questions, mostly[4], speeding up the response process and enabling better uniformity and simplification in the analysis of the responses (Almeida e Pinto, 1997). The few open questions introduced in the questionnaire were designed to enable a more diverse gathering of information and identify other issues not covered by the closed questions. Before the questionnaire was released, we conducted a pre-test (Hill and Hill, 2000), testing the

[4] The respondents selected the questions among those who were presented.

type of questions, their relevance, explicitness, the order of the questions and the size of the questionnaire. This pre-test was conducted among similar entities that belong to the clusters (i.e., firm, R&D entity, technological intermediary, higher education entity and public institution). The suggestions have been analyzed and improvements introduced in the final version of the questionnaire.

The questionnaire had seven blocks of questions (Table 1.1): 1) characterization of the entity, 2) management of R&D and innovation activities, 3) participation in informal networks, 4) formal collaborations, 5) management of internal ideas, 6) management of intellectual property and 7) access to public funding. These seven areas intended to understand how entities organize open innovation activities, namely in the inbound and outbound process (see Jong *et al*. 2008, 2010). The seven areas of the questionnaire included 40 questions (Table 1.1).

**Table 1.1 -** Structure of the questionnaire

| Area | Main questions |
|---|---|
| Characterization of the entity | 1. Type of institution (enterprise, higher education, other entity)<br>2. Number of employees<br>3. Years of activity<br>4. Qualification of human resources<br>5. Expenditures on R&D<br>6. Exports as a percentage of total sales<br>7. Cluster where it belongs |
| Management of R&D and innovation activities | 8. R&D management (organized by project; single department, outsourcing / process R & D projects, in part or in full)<br>9. Type of innovation developed (product, process, organizational, marketing)<br>10. Innovation process management (internal development / with external partners) |
| Participation in informal networks | 11. Participation in informal networks (user groups, participation in community / open source projects, research, collection or sharing of ideas and experiences via social networks, participation in networks of innovation and knowledge; sharing common workspaces with entrepreneurs, inventors, researchers, companies, R&D institutions, etc.)<br>12. Impact of the cluster in informal networks participation |
| Formal collaborations | 13. Type of formal collaboration<br>14. Partners of formal collaborations<br>15. Reasons for collaboration with other entities<br>16. Impact of the cluster in formal networks participation<br>17. Absorption capacity - existing capacity in the institution to use the knowledge and technology generated externally<br>18. Barriers - factors hampering the use of knowledge and technology generated by external entities<br>19. Objectives of the transfer of knowledge and technology to other entities |

| | |
|---|---|
| Management of internal ideas (intrapreneurship) | 20. Incentives to support employees to set up their own businesses (creation of spin-offs)<br>21. If there are no incentives, what the main reasons are?<br>22. If there are, what kind of support is provided?<br>23. Is there any support for the development of the ideas proposed by employees?<br>24. If there is no support, what the main reasons are?<br>25. If there are, what kind of support is given?<br>26. Impact of the cluster in the support to the development of ideas from the employees? |
| Management of intellectual property | 27. What is the IP protection strategy?<br>28. Is there external acquisition or IP licensing from other entities?<br>29. If there is not, why not?<br>30. If so, what kind of IP is acquired externally?<br>31. Is there IP sale or licensing to third parties?<br>32. If there is not, why not?<br>33. If so, what kind of IP is licensed to third parties / sold?<br>34. What are the main IP problems related to collaboration with other entities?<br>35. Impact of the cluster in the IP strategy? |
| Access to public funding | 36. Was there use of public funding for the development of projects?<br>37. What kind of R&D / innovation projects were funded?<br>38. Main objectives related to the participation in funded projects<br>39. Main problems resulting from collaborations with external partners in funded projects<br>40. Main public funding programs used in the last 5 years |

We proceed to the construction of the questionnaire between February and March 2014, having been placed on the Internet in May 2014, using the Qualtrics Online Survey Software platform. In addition to the questionnaire, in this platform was placed background information on the concept of open innovation, purpose of the questionnaire and confidentiality of available data. It was also mentioned the number of questions (40) and the blocks constituting the questionnaire (seven), as well as the average expected filling time (8 minutes). For dissemination and distribution of the questionnaire, we contacted (by telephone and email) the management structures of each Cluster, describing the nature of the questionnaire, requesting their cooperation to disseminate the questionnaire to all its members. The questionnaire was available to the members of the clusters through email, which included the characterization and objectives of the research as well as an electronic link that gave access to the questionnaire.

The questionnaire was launched to all the 905 members of the clusters (ie, the population is equal to the sample). We received 46 unique responses through the

Qualtrics Online Software platform. This means that the responses covered 5.1% of the sample, a similar response rate of others online surveys that analyze open innovation activities in firms (e.g., Chesbrough and Brunswicker, 2013; Cosh and Zhang, 2011).

In this research we intend to develop an exploratory analysis. Thus, the objective was not to test hypotheses, but to respond to the issues contained in Table 1.1, in order to better understand a reality not yet explored in Portugal (open innovation in clusters)[5]. We also seek to ascertain the existing perception of the clusters members about the impact of their cluster in the adoption of open innovation practices.

## 3. The emergence of the cluster policy

Research relating open innovation and clusters is still scarce, although there are deep analysis about organizational and inter-organizational networks, which are important component of the clusters approach (Buchmann and Pyka, 2015; Jarvenpaa and Wernick, 2011; Malecki, 2011; West and Bogers, 2014; Simard and West, 2006). Clusters are also ecosystems favorable to the innovation process and to open innovation activities, although the effects depend on the type of sector, the stage of development and the characteristics of firms and actors of each cluster (Uyarra and Ram Logan, 2012).

The importance of cluster analysis and its impact on the competitiveness of companies and nations is due to Michael Porter (1990, 1998) as well as the work of the geography of innovation and knowledge spillovers (Audretsch and Feldman, 1996; Baptista 2000; Baptista and Swan, 1998; Feldman, 1999; Langlois and Robertson, 1996), the

[5] If there is a participation of most respondents in the seven areas of the Table 1.1, we can say that in such cases, the approach of open innovation is predominant (otherwise, closed innovation will be the dominant approach).

agglomeration economy (Krugman, 1991; Malmberg *et al*., 2000; Ottaviano and Thisse, 2004), or the work of Marshall (1890) on the geographical proximity. The cluster definition of Porter (1990, 1998) is the most mentioned in academic literature, stressing the importance of geographical proximity of firms with other entities (suppliers, R&D and education entities, other firms, etc.), which compete and cooperate with each other in an interdependent relationship, with both formal and informal links (see European Commission, 2008, for an analysis about the definitions of clusters).

The benefits of participation in a cluster have been linked to the positive externalities (Ketels and Memedovic, 2008; Porter, 1998), namely: access to specialized assets and resources - such as human resources - increasing productivity; learning economies, resulting from the interaction with customers and suppliers; reduction of transaction costs, given the proximity between the cluster members; effects of diffusion of knowledge - spillovers - impacting the generation of ideas and creation of new businesses (Maercke, 2013). The awareness of those benefits has led to the development of public policies (cluster policy), in order to maximize these benefits (European Commission, 2008; OECD, 2007; Oxford Research, 2008). Cluster policy can be defined as public policy directed to: 1) create, mobilize and strengthen a given cluster; 2) increase the impact of certain instruments (eg, R&D incentives); 3) eliminate barriers and promote competition in order to facilitate the emergence of new clusters (Oxford Research, 2008). Thus, cluster policies are essentially motivated by systemic failures and market failures (see Ketels, 2013).

The growing attention that clusters have been on the part of policy makers in recent decades (Ketels and Memedovic, 2008) is due not only to its impact on the innovation process, but also of its importance to the organization and implementation of public policies and investments aimed at economic growth (Christensen *et al*., 2012; Ketels *et*

*al*., 2006). Therefore, clusters are an additional way to influence and achieve economic policy objectives by policy makers, stimulating innovation and growth through the development of policies directed at them. However, the degree of intervention and influence of public policies in the development of clusters is not consensual, being relevant the context factors (including institutions) and the maturity of the clusters in the definition of public instruments and incentives (Vicente, 2014).

The development of cluster initiatives had more expression since the 1990s, and especially in the 2000s, particularly in Europe, USA, Australia and New Zealand, having been identified around 1,400 cluster initiatives around the world in 2005 (Ketels *et al*., 2006). To this end, it has been important the development of clusters policy, with greater emphasis in the 2000s, with public support being important in terms of financing instruments, but also at technical and organizational support (Sölvell *et al*., 2003). In the EU, cluster policy is recent (about 50% of countries have started the support to clusters after 1999), with about 60 national cluster programs (with government support) under development in 26 countries, over the decade 2000 (Oxford Research, 2008). The development of clusters policy has not been the same in all countries, and may vary with regard to policy coordination (Ministry or Agency / Institute), public support grants (financial and / or institutional, management and / or projects), the level of development (national, regional or local) or the development focus, which could be firms or other entities, including R&D entities (European Commission, 2008; Sölvell, 2009).

At the level of international institutions such as the OECD or the European Commission (EC), clusters are seen as a major instrument of the innovation policy. The OECD has given a significant importance to the cluster policy, with emphasis on the relationship established between clusters and the innovation process, but also for the role that public policies have on creating the framework conditions and active policies for the development / creating

clusters (OECD, 1999; OECD, 2001; OECD, 2007; OECD, 2009). Within the EC, the importance given to the cluster policy is reflected in various initiatives and communications within the Lisbon Strategy and the Europe 2020 Strategy. The importance of clusters at EU level has recently been strengthened by the European "Smart Specialisation - RIS3" strategy (European Commission, 2012), where the clusters are considered as important structures for the definition and implementation of the priorities of this strategy, given its role in promoting cross-collaborative networks and activities to the territorial / regional level:

> "Clusters can be used at both the design and the implementation phase of smart specialization strategies. In the design phase, they can be used to identify the industrial strength and assets in a region, to contribute to set strategic priorities and to make the right political decisions. In the implementation phase, clusters can be used as efficient platforms that can focus on and quickly contribute to the objectives of smart specialisation…in particular, by fostering cross-sectoral cooperation…". (European Commission, 2012, p. 67)

This analysis of the emergence of clusters policy at international level allows us to better understand the evolution of cluster policy in Portugal (Chapter 4).

## 4. Cluster policy evolution in Portugal (1994-2014)

The first approach to cluster policy in terms of political discourse in Portugal, has origins in the study ordered by the Portuguese Government to Michael Porter`s Monitor Company, in 1992. This study put forward a set of recommendations on clusters that Portugal should develop in order to make its economy more competitive. The "Porter Report" was presented in 1994[6], suggesting that the Portuguese economy should specialize in areas where it already had comparative advantages, giving as an example the textile, wine, cork, footwear, forest products or molds (Monitor Company, 1994). It

[6] The report was entitled "Porter Report: Building Competitive Advantage in Portugal".

was a sectorial and static view, since the study presented made no reference to the evolution of these areas over time, nor had considered other emerging areas where Portugal could in the future be competitive (eg., renewable energy or in information and communication technologies). To Michael Porter, Portugal should bet only on so-called "traditional sectors", ignoring the possibility that Portugal be able to develop skills in higher value-added areas or technological intensity sectors[7].

After the Porter Report, in the period 1995-2001 there were no references to the cluster policy at political discourse level. Only in 2001, the cluster approach was included again in Governmental policy documents, based in a study elaborated by the Portuguese Government, with the mapping of existing and emerging clusters in Portugal, but in a final demand perspective and not on a sectorial / industrial perspective (Cardim and Santos, 2003). This study identified cross competitive factors for the development of the cluster policy, and put forward a proposal to develop "mega-clusters" in Portugal (aggregators of multiple clusters), namely in the fashion area, agro-food, habitat, leisure, mobility, health/personal services and entertainment (Gabinete do Proinov, 2002a). In other words, the proposed clusters were based on the articulation and cooperation between related and complementary areas, oriented according to global markets final demand and needs. In the period 2003-2005 this approach was abandoned, although there were some Government initiatives to support the creation of business cooperation networks and link between business and science and technology institutions.

In 2005, cluster policy was taken up by the Governmental Technological Plan, where it was proposed the creation of "Poles of Competitiveness and Clusters". This new orientation had correspondence in the orientation of funding instruments for this

[7] The "Porter Report" indicated eight recommendations to improve the competitiveness of Portuguese companies: "Concentration on sophisticated customers," "formulate competitive strategies", "Increase productivity", "Cooperate with customers and suppliers", "Creating networks" "Building a home base of competitiveness", "Developing civil society", "Investing in human capital".

purpose, particularly in terms of EU funds managed by the Portuguese authorities (CSF / NSRF)[8]. In this sequence, the public support to clusters was formalized in 2009, with the recognition by the Portuguese Government of 11 poles of competitiveness and eight clusters[9], as well as the respective management structures (Table 1.2)[10]. This recognition had the expected duration of three years (2009-2012).

**Table 1.2** – List of Poles of Competitiveness and Clusters recognized by the Portuguese Government, in 2009

| Poles of Competitiveness | Clusters |
|---|---|
| Health Cluster Portugal | Furniture Cluster |
| Portugal Fashion | Sustainable Habitat Cluster |
| Agroindustrial Technologies | Agroindustrial Cluster in the Centre Region |
| Energy | Natural Stone Cluster |
| Forest-Based Industries | Creative Industries in the North Region |
| Engineering & Tooling | Agroindustrial Cluster in the Ribatejo Region |
| Refining Industries, Petrochemical and Industrial Chemicals | Douro Wine Region Cluster |
| Mobility Industries | Sea Economy Cluster |
| Manufacturing Technologies - PRODUTECH | |
| Information Technology, Communications and Electronics - TICE.PT | |
| Tourism | |

**Source:** Own elaboration, based on http://www.pofc.qren.pt/areas-do-compete/polos-e-clusters

In 2012 it was started the evaluation process of the cluster policy (the clusters recognized in 2009), through an international tender, a process followed by a steering group, composed of national and international experts (advisory Comittee)[11]. The results of that evaluation was presented in April 2013[12], with the study's findings to mention that "are recognized as positive the efforts made and called for the continuity of the cluster approach" (SPI and innoTSD, 2013, pp. Xi), pointing as aspects to improve in the cluster Policy a greater robustness in the i) coordination and management model (governance), ii) financing and sustainability, iii) professionalism in the management of

[8] Community Support Program (QCA III) and National Strategic Reference Program (QREN 2007-2013).
[9] The poles of competitiveness were more orientated to global markets, while clusters had the national market as their "natural market".
[10] The members of the managing structures consisted of five members, elected by the members of each cluster.
[11] The advisory committee included a set of recognized experts at national and international level in the area of clusters. See composition in SPI and innoTSD (2013, pp. Xiii and ix).
[12] Report available at http://tinyurl.com/bo2bzfu.

clusters, iv) setting ambitious and targeted strategies for internationalization and v) a better integration with entities public (SPI and innoTSD, 2013).

This cluster evaluation process pointed to weaknesses in cooperation between the entities belonging to clusters, with the existence of few collaborative projects between companies (both within and between different clusters), the lack of partnerships or projects with international organizations, the tiny participation in technology platforms or in international R&D projects, as well as the small number of formal collaborations between entities belonging to the cluster or between clusters themselves (SPI and innoTSD, 2013, pp. 55-59). Being the collaborative processes essential for the development of open innovation activities, these facts can mean the existence of less favorable conditions for open innovation development. Thus, in Chapter 5 we analyze how open innovation practices are developed in the Portuguese clusters, exploring the results of a questionnaire built and launched for this purpose.

## 5. Open innovation in clusters in Portugal (main results of the survey)

About two-thirds of the responding entities of the survey are companies - a similar structure that exists in the Portuguese clusters (SPI and InnoTSD, 2013) - are not recent (70% have 10 or more years of activity) are essentially micro, small or medium-sized (78%), 44% did not have export activities, 44% of their employees have no more than 12 years of schooling, and nearly a quarter do not have R&D activities. Given these characteristics, we will analyze what the adhesion of open innovation in the entities that belong to clusters, according to the areas identified in Table 1.1 (management of R&D and innovation activities, participation in informal networks, formal collaborations, management of internal ideas, management of intellectual property and access to public funding).

*R&D and innovation management*

In more than half of respondent entities (57%), there is no R&D activity or, when there is, is not frequent and is developed through unique projects. In the entities where R&D is frequent, the most common situation is the existence of own departments with internal teams dedicated to R&D (32%), while separate departments of R&D present in 7% of the entities (Figure 1.1). R&D activities are fundamentally developed internally, as the outsourcing of some or all of the activities being common in only 9% of organizations (including universities, R&D centers or other companies).

(**Figure 1.1** – R&D management)

The hiring of skilled personnel for R&D, especially in terms of PhDs, masters and graduates, is a reality in only 14% of the entities (Figure 1.1). These data show us that, in the management of R&D activities, the closed innovation model is still dominant in the entities belonging to clusters, not only because R&D is non-existent or is sporadic in a large number of entities[13], but also by the small percentage of entities with external relations in the R&D activities (outsourcing of R&D activities or external hiring).

(**Figure 1.2** – Type of innovation, by source of development (in percentage of all entities))

Regarding the type of innovation (Figure 1.2), product innovation is the most frequent, followed by the innovation process, with organizational and marketing innovation to be less frequent. Most innovations are carried internally, although the development with external partners is also common (it's even more common in product innovation, being mentioned by 48% of the organizations). In organizational and marketing innovation, external collaboration is less frequent (mentioned by 21% and 32% of entities,

[13] The existence of internal competences in R&D is essential for the absorption of external knowledge (Laursen and Salter, 2005).

respectively), indicating that in this type of innovation still predominates the closed innovation model. There are entities that, at the same time, developed innovation internally and also involved external partners in the development of some of these innovations. However, if we consider the total of the innovations developed (product, process, organizational and marketing) and the source of that development (internal or with partners), we found that 65% of responding organizations still operating in the closed innovation model – 23% do not have innovations and 42% developed innovation internally. This percentage is higher than in the R&D management, indicating that open innovation practices seem to be less frequent in the innovation development.

*Participation in informal networks*

Participation in informal networks is reported by 84% of the respondent entities, with various forms of participation (Figure 1.3). The participation in networks of knowledge and innovation are mentioned by almost half of organizations (49%), including participations in working groups or discussion forums. Also relevant is the collaboration with potential customers or end users (44%), and less frequent the research and the sharing of ideas via social networks and the Internet (35%). Of the entities participating in informal networks, 23% say that they share common spaces with other entities, including R&D, companies or entrepreneurs.

**(Figure 1.3 and Figure 1.4)**

When asked about the importance of being associated with a cluster for their participation in informal networks, the vast majority of organizations (74%) said they had a positive impact and contributed to the increase in informal relationships with external entities (Figure 1.4). In 26% of cases, the inclusion in a cluster has had no

positive impact on their participation in informal networks. The open innovation approach, thus, seems to be present in most of the responding entities of clusters, with regard to informal relationships with third parties.

*Participation in formal networks*

Participation in formal networks is a reality for most of the clusters respondent entities, with only 13% who say they do not have formal external relations. The most common form of external collaboration is the development of R&D projects with national R&D entities (54% of respondents) and with national companies (51%). However, when questioned about collaboration involving companies and international organizations, this percentage drops to about half (Figure 1.5). The collaborative projects in terms of raw materials, materials, products or services are the most common (41%), followed by projects that focus on marketing, exports or internationalization (36%). About a fifth of these collaborations involve technology licensing to external entities, while only 3% of the entities mentioned the use of technology developed by others (via licensing agreements).

**(Figure 1.5 and Figure 1.6)**

It is also mentioned the collaboration through joint ventures or participation in the capital of other entities (15%), as well as the foreign outsourcing of R&D projects (10%). As was the case in the analysis of informal networks, it is mentioned by a large majority of organizations (72%) that participation in clusters has been important to increase their participation in formal networks (Figure 1.6). When questioned about the preferred partners in formal relations (regardless of project type), higher education entities and R&D centers appear in the top positions (Figure 1.7). Public authorities and

consulting firms are chosen by 42% of the entities, while companies (competitors, suppliers and distributors) are mentioned as preferred partners for a smaller set of entities.

**(Figure 1.7 and Figure 1.8)**

The main reasons for collaboration with external partners relate to access to new ideas, knowledge, equipment and technology (to 91% of organizations), improvement of internal skills (64%) and the reduction of costs related to R&D and innovation activities (61%). Also reason relevant to a significant number of organizations (55%) is the ability to improve their reputation in the market (Figure 1.8).

With regard to an important component of formal collaborations - the absorption capacity and the transfer of technology and knowledge - we tried to know what forms are most used by the entities of the clusters and the main constraints associated. In Figure 1.9 we see that the vast majority of entities considered having internally the ability to identify new ideas and external technologies (71%), to analyze and discuss them with external partners (61%) and applying them in the production process (45%). Only 11% of the entities mentioned that they do not incorporate any ideas and technologies from outside, which means that the vast majority of entities operate according to the open innovation approach in this field.

**(Figure 1.9 and 1.10)**

The main reasons for the existence of difficulties in incorporating external ideas and technologies relate to the lack of financial resources (53%), time constraints (31%) and differences in organizational culture with external partners (31%). Also referred as constraints (for a greater absorption of external ideas and technologies) are the problems

with IP management, the lack of internal skills (in areas such as management and technological capacity), the geographical distance with partners and the lack of confidence with external partners (Figure 1.11). The acquisition of technology / knowledge through the acquisition of companies is not a common practice in the clusters members, with 86% of the responding entities referring that they did not acquired any company in the previous five years.

**(Figure 1.11 and Figure 1.12)**

Regarding the transfer of knowledge and technology to external entities (through formal relations), 34% say it is not a current practice (Figure 1.12). In organizations where there is technology transfer, the external IP licensing (32%), the creation of joint ventures with other entities (26%) and the creation of spin-offs are cited as the main forms in which that transfer occurs. The free availability of technology on the market, without any kind of license, is used by 24% of the entities. The sale of IP rights is a reality in only 13% of the entities (Figure 1.12).

The main objectives associated with the transfer of knowledge / technology to external entities are associated with a potential higher reputation in the market, a higher innovative capacity in the future (63% of the entities, in both cases) and a leadership technology strategy on the market (half of the entities). It is also mentioned, although by a smaller percentage of entities, the access to foreign markets, the prospect of generating revenue from the sale / licensing of IP and the expectation of having influence in the definition of new standards in the market (Figure 1.13).

**(Figure 1.13 and Figure 1.14)**

The association with a cluster influenced positively the capacity of the institution to absorb technology and knowledge from external sources (Figure 1.10), and increased

the transfer capability of the technology and knowledge developed internally to other entities (Figure 1.14). However, it is mentioned that this influence is greater in the first case, given that in the second case 41% of the entities states that the cluster had no positive impact (37% in the absorptive capacity).

*Intrapreneurship: incentives for the development of new ideas and spin-offs*

The vast majority of respondents (73%) have no incentives for the creation of new firms by their employees - spin-offs (which is a possible way of exploitation in the market of ideas and technologies developed internally) (Figure 1.15). When asked about the reasons for that are mentioned the lack of financial resources (44% of responses) and the lack of information regarding the potential benefits and the ways in which this support can be given. The fear that the new spin-offs may pose a threat in terms of competition is identified as a negative reason in 11% of the entities (Figure 1.16). There are also other reasons pointed, such as the lack of initiative on the part of their employees, the existence of potential conflicts of interest or the high degree of specialization of labor, which means that human resources are of high importance for the company's business, discouraging any incentive to exit.

**(Figure 1.15 and Figure 1.16)**

In organizations where there is support for the creation of new companies, 70% of organizations provide technical support or advice, logistical support / facilities and liaison with potential business partners or future customers (60%). Financial support is not a relevant incentive and is only available in 20% of the entities (Figure 1.17). Other forms of support, such as pre-incubation, incubation, networking or disclosure are mentioned as existing in 30% of the entities.

**(Figure 1.17 and Figure 1.18)**

If most part of the entities do not support the creation of new businesses (ie, is predominant the closed innovation model), the opposite is true concerning the incentives for the development of new ideas, with 78% of the entities supporting their workers in the presentation and development of new ideas (Figure 1.18). This support is materialized mainly in terms of technical support and consulting (57% of organizations) and in the provision of working time (46%). The development of contests of ideas or the existence of ideas and suggestions boxes is a reality in 25% of the responding entities. There is also the recourse to collaborations with external entities for the development of these ideas that, potentially, can lead to the creation of new companies (Figure 1.20).

**(Figure 1.20 and Figure 1.21)**

As in supporting the creation of spin-offs, it is reduced the number of entities that provides financial support for the development of new ideas (only present in 4% of entities). As regards the impact of the cluster, most respondent entities (60%) said that there was no positive impact on creating incentives for the development of ideas / spin-offs from their employees (Figure 1.21).

*IP management*

The registration of trademarks is the IP protection form most used, present in about half of respondents (49%). Confidentiality agreements are referred by 34% of the entities, as that patenting is the third most frequent mode (Figure 1.22). It is also mentioned the copyright (23%) and, to a lesser extent, the confidentiality agreements and designs registry.

**(Figure 1.22 and Figure 1.23)**

About a quarter of the entities have not defined a strategy in IP management. The main reasons given are the lack of awareness about the advantages and the various existing protection possibilities and the difficulties in demonstrating the novelty of invention (Figure 1.23). These reasons are given by about a third of the entities, and are also mentioned the costs related to the registration and maintenance of IP as well as the fear that the invention could be copied (by 22% of the entities). For most entities, IP strategy of the entity seems not to be influenced by the fact that they belong to a cluster (Figure 1.24).

**(Figure 1.24 and Figure 1.25)**

Only 14% of organizations admit that acquires externally some kind of IP or that use licensed IP developed by other entities (Figure 1.25). This means that the majority of entities use the closed innovation model in IP management, with 79% admitting that they feel no need to acquire IP externally. The costs related to IP acquisition and the lack of informations about legal procedures are also appointed reasons (Figure 1.26). With regard to entities that acquire IP externally, software licenses (60%), copyright (40%) and patents (20%) are the most frequently mentioned (Figure 1.27).

**(Figure 1.26 and Figure 1.27)**

The analysis of the reverse situation - sales and / or licensing IP to others - shows us a greater involvement of the members of the clusters in the open innovation process. About 34% of the entities sell or license their IP to external entities (Figure 1.28) and patents (58%) and copyright (50%) are the most common form, followed by trademarks and designs (Figure 1.29).

**(Figure 1.28 and Figure 1.29)**

However, in 66% of the entities there is no sale or licensing of IP externally, with most of them stating as the main reason for that the lack of information about the advantages and associated mechanisms. As a second reason, it appears the fear that the sale / licensing might pose a competitive threat from third parties (Figure 1.30). Were also identified problems related to the management of IP with other entities, including the detention of IP rights, the costs of acquisition and the integration of acquired IP in internal processes, but also the undervaluation of IP by external partners and disagreements related to the way of using the IP (Fig 1.30-a).

**(Figure 1.30 and Figure 1.30-a)**

When asked about the impact of cluster which they are in into the IP management strategy with external partners, 63% of organizations said that there was no positive impact (Figure 1.31) - the same percentage found when it was questioned the impact of the cluster on the internal management IP strategy.

**(Figure 1.31)**

*Access to public funding*

The analysis of another perspective for the stimulus of open innovation - the use of public incentives - is held ascertaining four questions, including the type of funded projects, the objectives of access to such funding, the problems identified in the development of projects financed (when they involve external collaborations) and public programs used to obtain such funding.

Of the entities that belong to the clusters and that responded to the survey, 71% assumes that used (in the previous five years) public funding for R&D and / or innovation

projects, showing its importance for the development of such projects (Figure 1.32). Financial support for projects aligned with open innovation approach seems to be common, given that nearly 80% of financed entities states that this funding served to the development of joint projects with higher education or R&D institutions, while 67% obtained funding for joint projects with companies (Figure 1.33). However, in 50% of the entities the funding was also used in projects developed exclusively internally. The use of public funding for R&D outsourcing was mentioned by a small percentage of entities (8%).

**(Figure 1.32 and Figure 1.33)**

The reasons for the access to public funding for R&D / innovation projects are the technology modernization and / or the acquisition of new equipment (67%), also being relevant the opportunity to access to new knowledge, new skills (for the internal development of R&D / innovation activities) as well as external financing (Figure 1.34). Access to public funding to recruit skilled workers or improve the company's reputation externally are referred to by one third of the entities.

**(Figure 1.34 and Figure 1.35)**

In projects financed by public funds involving external partners, coordination between partners and the time management are seen as the main problem for the development of these projects (64% and 59%, respectively). There are also mentioned difficulties in management activities (at the project level) and in the sharing of results between the various partners (41%), with only 23% of the entities referred complications related to intellectual property (Figure 1.35).

Concerning the funding sources, national programs[14] are the most used by clusters, particularly those supporting R&D projects (SI R&D program, with 71% of organizations). The support for business modernization projects (SI Qualification program), qualification of R&D entities (SAESCTN program) or the clusters activities management (EEC / SIAC) are mentioned by about one-third of the entities that use public funding (Figure 1.36). The projects submitted to QREN by the entities that belong to clusters have evaluation benefits relative to non-member entities, ensuring a competitive advantage over projects submitted by entities that do not belong to any cluster. This situation has not been analyzed here (it was not in the scope of this survey).

**(Figure 1.36)**

Also relevant are the international funding programs, specifically the ones targeted to promote R&D (7th Framework Program of the European Union, that is used by 38% of the entities of the clusters), innovation in SMEs (CIP 2007-2013) or the international partnerships in science and technology (MIT / CMU / Austin-Texas / Fraunhofer / Harvard Medical School)[15], both mentioned by 25% of the entities. On the opposite side, the public instruments of venture capital were not mentioned by any entity, while the financial instruments to innovation were only mentioned by 4% of the entities.

## 6. Conclusions and discussion

The responses to the survey allow the identification of the more developed open innovation areas (and their activities), the main constraints and the impact of the cluster

[14] European funds managed by national authorities.
[15] Programs supported by the Portuguese Government since 2006.

in the adoption of open innovation by its members. In order to get a better perception of the adoption of open innovation, we proceeded to the classification of the responses, regarding open innovation areas as well as the impact of the cluster in open innovation adoption, proposing the following typology of classification (Table 1.3):

**Table 1.3** – Typology of classification of open innovation areas developed by the clusters members

| Open innovation areas | Impact of the cluster in open innovation adoption |
|---|---|
| ▪ > 60% positive responses: open innovation model is dominant<br>▪ < 40% positive responses: closed innovation model is dominant<br>▪ Between 40%-60%: in transition from the closed to the open innovation model | ▪ > 60% positive responses: a high impact<br>▪ < 40% positive responses: a low impact<br>▪ Between 40%-60%: a moderate impact |

Source: own ellaboration

Based on this classification, and combining these two dimensions, one can view i) how open innovation is being developed in the clusters in Portugal and if ii) being part of a cluster is favorable or not for the development of open innovation practices.

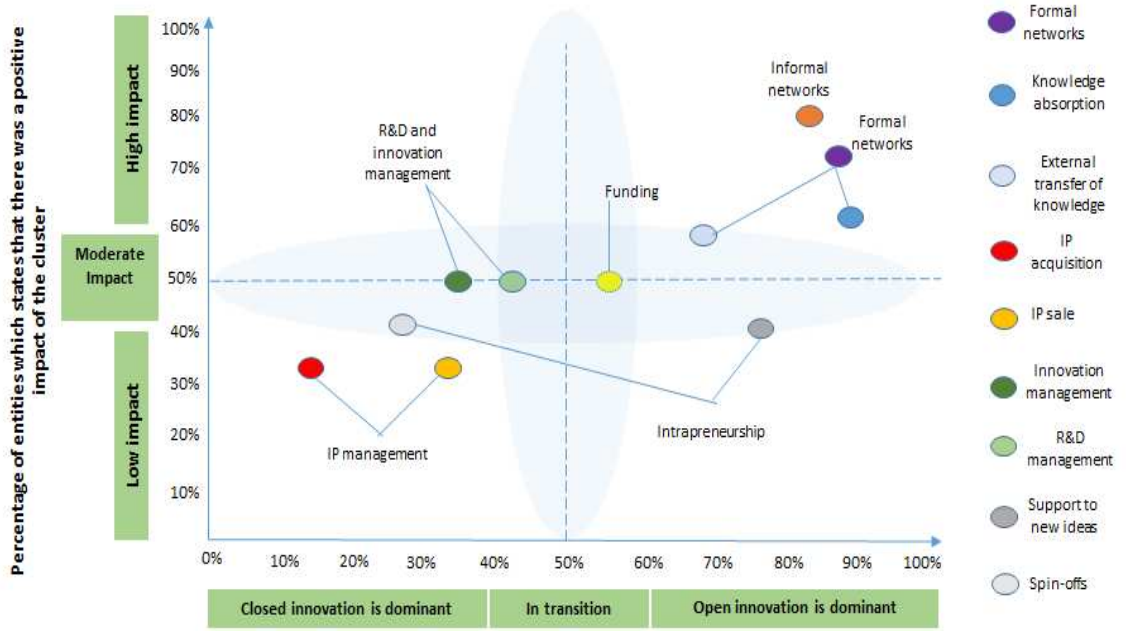
*i) Open innovation activities in clusters*

Through the survey responses one can say that there is a group of activities where the open innovation approach is already a reality in the clusters members (namely in informal and in formal collaborations, and in the ideas development), another group of activities dominated by closed innovation (IP management, innovation management and in the support to the creation of start-ups / spin-offs) and activities that appear to be in transition from the closed to the open innovation model – R&D management and use of public funding (Figure 1.37).

It is in the formal and informal collaborations with external parties (whether in inbound or outbound process) that open innovation is felt most, as these are common and are developed by more than 80% of the members of the clusters that responded to the survey (upper quadrant right, Figure 1.37). Internet usage is the main mean for the

development of informal relationships, while collaborative R&D projects (with businesses and national R&D entities, but also international) are the most frequent form of formal relations. The entities that belong to clusters also adopt open innovation in the identification, selection analysis of the technology and knowledge generated externally, and in their integration in the production process (absorption of knowledge / inbound). Regarding the transfer of knowledge and technology activities (internally developed) to other entities (outbound), although less frequent than absorbing activities, are mentioned by most part of the respondents, namely through licensing agreements and the creation of joint ventures.

**Figure 1.37** – Open innovation in clusters




Source: own elaboration, based in the survey results.

When we look to the intrapreneurship development, the respondents follow the open innovation approach in relation to supporting the development of ideas, but have an opposite attitude in supporting the creation of new businesses by their workers, ie., the closed innovation model is dominant here (lower left quadrant, Figure 1.37). Open

innovation is still not a reality for most of the responding entities at the level of IP management (acquisition, sale and licensing), R&D and innovation management, where prevail closed innovation practices. The acquisition and / or licensing of IP developed externally is a reality for few entities (14%), while the sale / IP licensing to other entities occurs in a higher percentage of entities, although that do not happen in the majority of the entities (66%). In innovation management, the percentage of entities that operate in the closed innovation model is still high - 65% of organizations do not develop innovation of the development is made only indoors (product / process / marketing / organizational). Both in R&D management and in financing instruments there is a higher balance between the percentage of entities operating in the closed innovation and in the open innovation model, ie., these two areas are in transition to a more open innovation approach.

*ii) Belonging to a cluster supports the development of open innovation practices*

The data collected through the survey allowed to verify the impact of the cluster in the adoption of open innovation in each of the areas analyzed, based on the perception of its members. The areas where the cluster has contributed more to the adoption of open innovation was at the level of informal networks and formal collaborations, including absorption and external transfer of technology and knowledge, these also being the most used areas by the respondents, ie., where open innovation predominates (upper right quadrant, Figure 1.37). On the contrary, the areas where the most part of the responding entities considered to have been a minor impact of the cluster in open innovation adoption are also those where open innovation is felt less, ie., where the closed innovation mode is dominant (lower left quadrant, Figure 1.37). The only exception lies in supporting the development of ideas, where most of the respondents said that the cluster had little influence on the development of initiatives in this direction, although it

is an activity present in 78% of entities (lower right quadrant, Figure 1.37). In terms of financing instruments, belonging to is a cluster has advantages in terms of positive discrimination in the project analysis (under the COMPETE / QREN program), and a financial support to promotion and networking activities inherent to the management of each cluster. However, we found that there are a high percentage of entities that does not use public funding (29%), while those who use mention that about 80% of the funding was intended to support collaborative projects.

To answer more clearly if the clusters in Portugal are favorable to the adoption of open innovation, it is necessary to summarize the main barriers that are hindering its adoption. Through the analysis of the survey is possible to identify six major barriers (Table 1.4): 1) the lack of financial resources and / or budget constraints (to seek and incorporate ideas and external knowledge, support the development of ideas and the creation of spin offs); 2) the lack of information (on how to develop new ideas); 3) the deficit of internal skills (to absorb external knowledge, take advantage of the internal ideas, to manage the IP or in the relationships with external partners); 4) time management problems, which hinders the activities related to the absorption of knowledge, the development of ideas or the management of collaborative projects; 5) the competitive threat of fear at the level of IP protection (copy fear) or in the support of workers to set up their businesses (potential competitors); 6) the implementation or the advantages associated with certain activities (particularly in the protection, acquisition and licensing of IP or in the support issues related to the management and coordination in general, the level of IP management of external networks and involvement in collaborative projects. There were also mentioned other constraints, such as the costs associated with registration, maintenance, acquisition / licensing of IP, the differences in organizational culture with external entities or the trust deficit with external partners.

**Table 1.4** – Main factors that constrains the adoption of open innovation, in clusters

| Areas | Identified constraints (in order of importance) |
|---|---|
| Barriers to absorption of knowledge (inbound) | Lack of financial resources<br>Time constraints<br>Lack of internal skills<br>Differences in organizational culture with external partners<br>IP management problems<br>Distant location of external partners<br>Lack of trust in external partners |
| No support for spin-offs development (outbound) | Lack of financial resources or logistical conditions<br>High degree of specialization / lack initiative of workers<br>Unawareness of the advantages associated with the creation of spin-offs<br>Lack of information about the kind of support that can be given<br>Fear of competitive threat |
| No support for ideas development *(outbound)* | Lack of financial and / or logistical resources to support ideas<br>Limitation of working hours<br>Preference for collaboration with external entities to capture new ideas / suggestions for improvement<br>Lack of internal skills to take advantage of the ideas proposed |
| Lack of IP strategy *(inbound/outbound)* | Unawareness of the advantages and / or forms of protection<br>Difficulty in demonstrating the novelty of the invention<br>Costs associated with the registration / application for IP protection<br>Costs associated with maintenance of IP rights<br>Copy fear (by competitors)<br>Costs associated with IP litigation |
| No acquisition / IP licensing from others *(inbound)* | There is no necessity<br>High cost of acquisition of external IP<br>Lack information about the mechanisms for the acquisition of external IP |
| No selling / IP licensing to others *(outbound)* | Lack of information on the forms of IP sale to other entities and licensing advantages<br>Fear of competitive threat |
| Gestão da PI com entidades externas *(inbound/outbound)* | Problems with the ownership of IP rights<br>Underestimation (by external partners) of the value of the IP<br>IP acquisition costs<br>Internal difficulties in the integration and management of the IP acquired externally<br>Disagreement with external partners in the form of use of IP |
| Funded projects developed with external entities *(inbound/outbound)* | Coordination problems (many partners involved)<br>Time management problems<br>Difficulty in project management and sharing results with partners<br>IP protection conflicts<br>Skills gap between the partners involved |

Source: own elaboration, based in the survey results.

If the constraints refers mostly to existing deficits at the level of entities (internal skills, time management, network management, budgetary constraints), others may be associated with contextual factors - external entities - such as those related with IP costs - while others may derive from an incorrect functioning of the market (lack of information about the advantages and the ways of open innovation implementation). These deficits anticipate the need for developed mechanisms to encourage the adoption of open innovation, either through the entities that belong to the clusters (via greater

awareness about the importance of open innovation or the acquisition of new skills) or through external entities, such as the public entities acting on market failures (via dissemination of information, a more friendly intellectual property framework of financing instruments, for example).

Thus, despite these constraints identified, the analysis seems to suggest that being in a cluster favors the adoption of a more open approach to innovation - with greater intensity in the formal and informal networks, to a lesser intensity in the IP management and with moderate intensity in the intrapreneurship activities and in the transfer of technology and knowledge to external entities (Figure 1.37).

**References**


Almeida, J. and J. Pinto (1995), *A Investigação nas Ciências Sociais*. Lisboa: Editorial Presença.

Audretsch, D. B. and M.P. Feldman (1996), R&D spillovers and the geography of innovation and production, *American Economic Review*, 86(4), 253-273.

Baptista, R. (2000), Do innovations diffuse faster within geographical clusters?, *International Journal of Industrial Organization*, Vol. 18 No. 3, pp. 515–535.

Baptista, R. and Swann, P. (1998), Do firms in clusters innovate more?, *Research Policy*, Vol. 27 No. 5, pp. 525–540.

Buchmann, T. e A. Pyka (2015), The evolution of innovation networks: the case of a publicly funded German automotive network, *Economics of Innovation and New Technology* 24(1-2), 114-139.

Cardim, José Casqueiro and Santos, António Bob (2003), O apoio ao desenvolvimento de clusters – a metodologia do Proinov, in Rodrigues, M.J., Godinho, M.M. e Neves, A. (2003), *Para uma política de inovação em Portugal*, Edições Dom Quixote.

Chesbrough, H. (2003), *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston, MA: Harvard Business School Press.

Chesbrough, H. and M. Bogers (2014), Explicating open innovation: clarifying an emerging paradigm for understanding innovation, in Chesbrough, H., W. Vanhaverbeke

e J. West (Eds.), *New Frontiers in Open Innovation*, Oxford: Oxford University Press, 3-28.

Chesbrough, H. and S. Brunswicker (2013), *Managing Open Innovation in Large Firms - Survey Report*. Fraunhofer Verlag.

Chiaroni, D., V. Chiesa e F. Frattini (2011), The open innovation journey: how firms dynamically implement the emerging innovation management paradigma, *Technovation* 31(1), 34-43.

Christensen, T.A., Lämmer-Gamp, T. and zu Köcker, G.M. (2012), *Let's Make a Perfect Cluster Policy and Cluster Programme - Smart Recommendations For Policy Makers*, VDI/VDE.

Cosh, A. and J. Zhang (2011), *Open Innovation Choices - What is British Enterprise doing?*, London: Imperial College London, Centre for Business Research, University of Cambridge.

Dong-Sung, C., Hwy-Chang, M. and Moon, H.-C. (2000), *From Adam Smith to Michael Porter - Evolution of Competitiveness Theory*, World Scientific, Singapore.

European Commission (2008), *The Concept of Clusters and Cluster Policies and their role for competitiveness and Innovation: Main statistical results and lessons learned*, Luxembourg.

European Commission (2012): *Guide to Research and Innovation Strategies for Smart Specialisation (RIS3)*, Comissão Europeia.

Feldman, M. (1999), The new economics of innovation, spillovers and agglomeration: a review of empirical studies, *Economics of Innovation and New Technology*, 8(1-2), 5-25.

Gabinete do Proinov (2002a), *Clusters e políticas de inovação***,** Presidência do Conselho de Ministros.

Gabinete do Proinov (2002b), *O cluster do software em Portugal,* Presidência do Conselho de Ministros.

Gabinete do Proinov (2002c), *O cluster do calçado em Portugal***,** Presidência do Conselho de Ministros.

Gabinete do Proinov (2002d), *Prioridades para os recursos humanos em Portugal***,** Presidência do Conselho de Ministros.

Halbert, L. (2010), Collaborative and collective! Reflexive coordination and the dynamics of open innovation in clusters, *Working Paper, LATTS* (Laboratoire Techniques, Territoires et Sociétés), Université Paris-Est.

Hill, A. and M.M. Hill (2000), *Investigação por Questionário*. Lisboa: Edições Sílabo.

Jarvenpaa, S.L. and A. Wernick (2011), Paradoxical tensions in open innovation networks, *European Journal of Innovation Management* 14(4), 521-548.

Ketels, C., Lindqvist, G. and Sölvell, Ö. (2006), *Cluster Initiatives in Developing and Transition Economies*, Stockholm: Center for Strategy and Competitiveness.

Ketels, C. (2013), Cluster Policy: A Guide to the State of the Debate, in Meusburger, P., Glückler, J. e Meskioui, M. (eds), *Knowledge and the Economy*, Springer Netherlands, 2013, 249-269.

Ketels, C. and Memedovic, O. (2008), From clusters to cluster-based economic development, *International Journal of Technological Learning, Innovation and Development*, Vol. 1, No. 3, 2008.

Krugman, P. (1990), "Increasing returns and economic geography", Journal of Political Economy, Vol. 99 No. 3, pp. 483–499.

Lains, P. (2007), *O economista suave – Ensaios*, Edições Cosmos.

Langlois, R. N. e P. Robertson (1996), Stop crying over spilt knowledge: a critical look at the theory of spillovers and technical change, *Economics Working Papers no 199606,* Connecticut: University of Connecticut, Department of Economics, http://tinyurl.com/otx62nl.

Maercke, A.V. (2013), *Clusters and entrepreneurship in support of emerging industries*, Comissão Europeia. Disponível em http://tinyurl.com/kw8ylgx

Malecki, E.J. (2011), Connecting local entrepreneurial ecosystems to global innovation networks: open innovation, double networks and knowledge integration, *International Journal of Entrepreneurship and Innovation Management* 14(1), 36-59.

Malmberg, A., Sölvell, Ö. and Zander, I. (1996), "Spatial Clustering, Local Accumulation of Knowledge and Firm Competitiveness", Geografiska Annaler, Vol. 78 No. 2, pp. 85–97.

Malmberg, A., Malmberg, B. e Lundequist, P. (2000), Agglomeration and firm performance: economies of scale, localisation , and urbanisation among Swedish export firms, *Environmental and Planning* A, Vol. 32 No. 1, pp. 305–322.

Marques, J.P.C., J.M.G. Caraça and H. Diz (2010), Do business incubators function as a transfer technology mechanism from University to Industry? Evidence from Portugal, *The Open Business Journal* 3, 15-29.

Marshall, A. (1920), *Principles of Economics*, (8th ed.), Macmillan and Co., London, 8thed.

Ministério da Indústria e Energia - Gabinete de Estudos e Planeamento. (1995), O Projecto Porter. A aplicação a Portugal - 1993/94, (Ministério da Indústria e Energia - Gabinete de Estudos e Planeamento,Ed.), Lisbon, 1sted.

Monitor Company (1994), *Construir as Vantagens Competitivas de Portugal*, Forum para a Competitividade (Ed.), Cedintec, Lisboa.

Observatório do QCA III (2007), *Quadro de Referência Estratégico Nacional – Portugal 2007-2013*, Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional http://tinyurl.com/mwhao5a.

OCDE (2007), *Competitive Regional Clusters: National Policy Approaches*, OECD Observer, doi:10.1177/0022146512469014.

Ottaviano, G. and Thisse, J. (2004), *Agglomeration and economic geography*, Handbook of Regional and Urban Economics.

Oxford Research (2008), *Cluster policy in Europe. A brief summary of cluster policies in 31 European countries*, Oxford Research AS.2008.´

Porter, M.E. (1990), The Competitive Advantage of Nations, Harvard Business Review, Macmillan and Co., London, Vol. 69, pp. 73–91.

Porter, M.E. (1998), Clusters and the new economics of competition", Harvard Business Review, No. November - December, pp. 77–90.

Porter, M.E. (2000), Location, Competition, and Economic Development: Local Clusters in a Global Economy, Economic Development Quarterly, Vol. 14 No. 1, pp. 15–34.

Rahman, H. and I. Ramos (2013), Challenges in adopting open innovation strategies in SMEs: an exploratory study in Portugal, *Proceedings of the Informing Science and Information Technology Education Conference 2013*, Cohen, E. e E. Boyd (Eds.), Informing Science Institute, 431-448.

Rosenfeld, S. (2005), Industry clusters: business choice, policy outcome, or branding strategy?, *Journal of New Business Ideas and Trends* 3.2 (2005): 4-13.

Simard, C. e J. West (2006), Knowledge networks and the geographic locus of innovation, in Chesbrough, H., W. Vanhaverbeke e J. West (Eds.), *Open Innovation: Researching a New Paradigm*, Oxford: Oxford University Press, 220-240.

Smit, A. (2012), The competitive advantage of nations: is Porter's Diamond Framework a new theory that explains the international competitiveness of countries?, *Southern African Business Review*, Vol. 14 No. 1, pp. 105–130.

Sölvell, Ö. (2009), *Clusters: Balancing evolutionary and constructive forces*, Ivory Tower Publishers, Stockholm, 2nded.

Sölvell Ö., Lindqvist G. and Ketels C. (2003) *The Cluster Initiative Greenbook*, Stockholm: Bromma Tryck AB.

Sölvell, Ö., Ketels, C. and Lindqvist, G. (2008), Industrial specialization and regional clusters in the ten new EU member states, (Druid,Ed.), Competitiveness Review: An International Business Journal incorporating *Journal of Global Competitiveness*, Copenhagen, Vol. 18 No. 1/2, pp. 104–130.

SPI and innoTSD (2013), *Estudo de Avaliação da Estratégia e do Processo de Implementação das Estratégias de Eficiência Coletiva – Tipologia Clusters*, Secretaria-Geral do Ministério das Finanças e Observatório do QREN.

Teixeira, A. and M. Lopes (2012), Open innovation in Portugal, *Acta Oeconomica* 62(4), 435-458.

Terstriep, J. and C. Lüthje (2011), Do clusters as open innovation systems enhance firm`s innovation performance?, *19th International Product Development Management Conference: "Transformative Research in Product and Service Innovation"*, Manchester, UK: Manchester Business School, University of Manchester, 1-36.

Uyarra, E. and R. Ramlogan (2012), The effects of cluster policy on innovation, *Nesta Working Paper* 12/05.

West, J., A. Salter, W. Vanhaverbeke and H. Chesbrough (2014), Open innovation: the next decade, *Research Policy* 43(5), 805-811.

West, J. and M. Bogers (2014), Leveraging external sources of innovation: a review of research on open innovation, *Journal of Product Innovation Management* 31(4), 814-831.