A Delphi Approach to Boost an Open Innovation Policy

Santos, Antonio Bob and Mendonca, Sandro

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António Bob Santos

PhD researcher at ISCTE-IUL, University Institute of Lisbon

Sandro Mendonça

Auxiliary Professor at ISCTE-IUL, University Institute of Lisbon

Abstract.

In this research paper we intend to find out whether open innovation approach may be a valid approach to the definition of innovation policy. To that, we use a method applied in various fields of study, including public policy and open innovation studies: the Delphi method. After the introduction (Section 1), we describe the Delphi method (Section 2) and the methodology used in this research (Section 3). The results of the application of the Delphi method are presented in Section 4, where we identify public policy priorities in an open innovation perspective. Then, we propose measures of public policy through which these priorities could be achieved (Section 5). Section 6 presents the main findings, concluding that the approach of open innovation may be considered for prioritization of innovation policy and policy measures.

Keywords. open innovation, innovation policy, public policy, Delphi.

JEL Classification: O25 Industrial Policy, O32 Management of Technological Innovation and R&D, O38 Government Policy

1. Introduction

The “open innovation" concept, which appeared in 2003, is one of the most studied by academic literature. The initial definition of open innovation is due to Chesbrough (see Chesbrough, 2003), having evolved over time and been enriched with the results of research carried out since then (see Chesbrough and Bogers, 2014).

Open innovation research has seen an increasing trend over time concerning published papers, being subject of study not only in economics and management (original areas of open innovation), as well as in areas such as medicine, biotechnology, food industry or public policies (Santos, 2015). As the innovation process is influenced largely by the active role of public policy (Mazzucatto, 2013), the relationship between open innovation and public policy - in particular its influence on the design and implementation of policies — has not been much analyzed, except for some exceptions (eg., de Jong et al., 2010).

The purpose of this research paper[1] is to analyze how innovation policy can be designed according to an open innovation perspective. For this we used a method applied in several

[1] This research paper is based in part of the PhD research of Antonio Bob Santos, at ISCTE-IUL.

research areas, including in public policy and in open innovation — the Delphi method (eg., Brown et al., 2010; Tornjanski et al., 2015).

With the Delphi method we identified the existence (or not) of consensus concerning the priorities of innovation policy, in particular those oriented to boost open innovation activities. These consensuses shed the thought of those who had responsibilities (at the political and executive level) in this area in Portugal. The identification of such consensus had as time horizon the period 2015-2025, for two reasons: there may be different priorities for innovation policy in different time periods; the results of innovation policy require verification in the medium and long term.

Therefore, we discuss in Section 2 the Delphi method and its relevance to the identification of guidelines for public policy. Then, in Section 3, we describe the methodology used in the application of the Delphi method in this research. The presentation of the results is made in Section 4, while in Section 5 we propose example of measures designed in an open innovation perspective. The conclusion is reserved for Section 6.

2. The Delphi method

The Delphi method has origins in the 50s of XX century and was developed by the Rand Corporation, aiming to make predictions in the military field. By gathering opinions of experts on a particular issue, the intention was to reach a global set of answers that reflect these opinions (Stitt-Gohdes and Crews, 2004). This is a qualitative method, and can be described as a process of structured and interactive communication collection and summary of views and knowledge on a particular topic / problem, from a group of specialists / experts (Adler and Ziglio, 1996; Szpilko, 2014). As a process of overcoming the initial assumptions and creative synthesis of opinions, this method can be described as "social technology" (Mendonça, 2001; Nelson and Sampat, 2001).

The Delphi method allows the convergence of views and consensus building (if possible) by experts on a given topic, with no contact between them (anonymity), avoiding face-to-face biases associated to group discussions ("group thinking"), including the reciprocal influences:

> "The Delphi method was designed as a tool to overcome the biasing effects of face-to-face discussion in a group. Its goal is to reach, without such psychological interference, a summary, which expresses common opinions of the group. This summary should be achieved as a result of convergence of opinions (when

achieved), which are the expression of consensus of the interrogated group of experts." (Scapolo e Miles 2004: 13)

The application of the Delphi method follows four principles, according to Wright and Giovinazzo (2000: 54-56): i) anonymity (respondents do not know who participated in the study); ii) the use of experts to answer the questions (ensuring greater reliability of responses on a particular topic); iii) applying the questionnaire in rounds, with interaction between the inquirer and the respondents (reducing deviations from the topic and the correction of the answers) and iv) search for consensus (search for common views and differences). The confidentiality of responses is facilitated by the possibility of respondents can be located in different geographical areas - the communication can be electronic (e-mail) or mail (Hsu and Sandford 2007: 2).

The Delphi method is used in various fields of knowledge due to their reliability and flexibility, and is also a method used in exploratory and normative analysis, associated with long term analysis (Scapolo and Miles 2004: 4). One of these areas is public policy, where the Delphi method is applied as a prospective and decision-making tool (Giannarou and Zervas, 2014: 66). This method allows to identify policy priorities and to define different development scenarios (Hsu and Sandford 2007: 1; Linstone and Turoff 1975: 84). Examples can be found in studies in education policy area (see Bruening et al., 2002; Stitt-Gohdes and Crews, 2004) or health policy (see Adler and Ziglio, 1996; Goula, 2013).

The application of the Delphi method in this research paper is justified, therefore, by its relevance as a methodology tested in public policy definition and in the process of decision-making. In this context, we apply the Delphi method using a panel of personalities responsible for the definition and implementation of innovation policies in Portugal between 2005-2015.

3. Methodology

Following the steps described in Scapolo and Miles (2004: 6) and Wright and Giovinazzo (2000: 57), the Delphi method applied in this research involved the following steps: preparation of the questionnaire (Step 1); identification of the participants in the Delphi questionnaire (Step 2); implementation of the questionnaire (Step 3); analysis of the results (Step 4).

In Step 1 we proceed to the preparation of the questionnaire. The structure thereof was based on the conceptual framework of open innovation activities defined in de Jong et al. (2010). This framework contextualizes the way companies organize their open innovation activities (internal conditions) and external factors that influence its adoption (external conditions). In sequence, seven areas were defined (groups of questions) to prepare the Delphi questionnaire: collaborations / networks and clusters, business entrepreneurship (intrapreneurship), R&D and innovation management, intellectual property management, human resources management, financing and venture capital and public policy instruments.

Although there are not an optimum number of questions for a Delphi questionnaire, the literature points to a maximum of 25 (see Wright and Giovinazzo 2000: 59). Thus, the questionnaire consists of 24 questions, grouped into seven thematic groups (blocks of questions) (Table 1).

(Table 1. Questions presented through the Delphi method)

The questions were structured in semi-open form, ie, in each of these seven blocks the respondents had space to complement their answers with either proposing new questions or with opinions they found pertinent be given. We intend for each of the 24 questions determine the degree of importance according to the opinion of each of the respondents. To this was applied the Likert scale with 5 levels (the 1st level corresponds to the lowest level of importance and the 5th to the highest level). Likert scale is often used in Delphi studies to measure different levels of agreement or different levels of importance of the questions. The Likert scale with 5 levels can be found in Geist (2010), Goula (2013), Ku Fan and Cheng (2006), Lee and King (2009) or Mason and Alamdari (2007).

The definition of the final list of questions of the questionnaire was preceded by a pre-test with five experts in innovation policy[2]. These experts were chosen due to their past experience in the defining of innovation policies. The pre-test was important to correct the questions initially formulated, but also to test the length of the questionnaire and the clarity of questions (Wright and Giovinazzo 2000: 56). The final questionnaire questions were adjusted to include the contributions received in the pre-test.

[2] The pre-test was elaborated and applied in April of 2015.

Then we proceed to the panel identification to inquire (Step 2). There is no ideal number of participants in Delphi studies, although the literature mentions that a number of respondents between 10 and 15 people is adequate to ensure the validity of results (Zervas and Giannarou 2014: 67). One of the requirements to apply the Delphi method is that the surveyed group consists of knowledgeable persons or experts on the subject to inquire (Hsu and Sandford, 2007: 3; Szpilko, 2014: 332).

Since we intend to ascertain the priorities of innovation policy for the period 2015-2025, we defined as targets for the application of the Delphi questionnaire the persons with responsibilities in the innovation policy in Portugal between 2000 and 2015. The assumption is that if they had responsibility in the design or implementation of the innovation policy, they can be considered as having in-depth knowledge of be experts in the innovation subject. In this sense, we have identified 13 people, all of them with responsibility for innovation policy in Portugal until 2015, both at the political or the executive level. At the political level we considered members of the Portuguese Government or in charge for the coordination of innovation policy in the Government; at the executive level were identified people from the management (Presidents / Directors /Board Members) of entities (Government Institutes / Agencies) responsible for the implementation of innovation policies. We have sought a balance between those who currently have responsibilities in innovation policy and those who had in the past, as well as having a diverse mix of institutions (Table 2).

Table 2. Level of responsibility in innovation policy by the members of the Delphi panel

Level of responsibility	**People surveyed**	**Period of responsibility**	
		Past	Current *(à data do questionário)*
Political level: Government / Policy coordination	A, E, F, K	x	
Executive level: Institut /agency	B, D, G, H, L		x
	C, I, J, M	x	

Note: To preserve anonymity, the 13 people surveyed are represented by the letters A through M.
Source: own ellaboration.

In the 3rd step we applied the questionnaire in two rounds. To this end, 13 people surveyed were contacted individually (personally, by mobile phone or email)[3], it was explained the scope of the study, duration and methodology. As all of them agreed to participate, the

[3] These contacts took place in the 1st week of May 2015.

questionnaire was made available in the 2nd week of May via the Internet[4] using the electronic platform Qualtrics Online Software (1st round). Along with the questionnaire, the platform contains an introductory text on the subject of study and methodology. Of the 13 people contacted, 11 people responded to the questionnaire, ie, a response rate of 84.61%. We proceed to the processing of data in June 2015, in qualitative terms (the semi-open nature of the questions enabled the introduction of feedback and suggestions) and quantitative terms. In this case, we used statistical techniques that have allowed to verify the central tendency (mean, mode) and the degree of dispersion (standard deviation and interquartile range), identifying the responses with greater or lesser consensus (Hsu and Sandford, 2007; Zervas and Giannarou, 2014)[5]. This processing of data allowed us to elaborate a second questionnaire sent to 11 members of the panel in July 2015 (2nd round)[6], where it was showed the results of the 1st round of responses (using the Qualtrics Online Software platform). Respondents could therefore compare their answers with those of other experts, in order to maintain or change their responses in this 2nd round (Szpilko 2014: 332). In this 2nd round again we contacted each of the 11 respondents (mobile phone and email), contributing this fact to a response rate of 100%.

The data were treated statistically again in August 2015, and the results were summarized and made available to the 11 panel members in September 2015 (Step 4). At this stage we've made a global analysis of the data collected in the two rounds of responses, checking the differences in views of consensus and its evolution between the two rounds. This analysis allowed us to establish and consolidate the views of the panel members on the priorities of innovation policy to stimulate open innovation (Section 4).

[4] Using the Delphi method over the Internet has several advantages, such as cost reduction and reduction of procedures relating to the preparation, completion and questionnaire analysis, as well as facilitating the interaction processes between the questioner and the respondent (see Donohoe et al., 2012).

[5] There is no single methodology to validate the results of a Delphi method and the determination of consensus on the answers given. The observation of other Delphi studies, developed by Hsu and Sandford (2007) shows that the most commonly used techniques are the mean, median and mode, and there are studies using the standard deviation or the interquartile ranges. For example, in studies involving Likert scale with 7 levels, it is recommended that at least 80% of the responses to focus on the highest two levels (6 and 7), whereas this percentage may be 70% by studies using Likert scale with 4 (Hsu and Sandford, 2007: 4).

[6] The 2nd questionnaire was made up of the same questions of the 1st questionnaire, given that none of the respondents suggested the modification or addition of new questions.

4. Open Innovation policy priorities using the Delphi method

For the identification of the questions that generated more (or less) consensus we used a combination of three statistical measures (instead of using just one, like the mean). This combination is proposed by Zervas Giannarou (2014: 75-77), being suitable when using a Likert scale of five levels. According to these authors, the consensus is generated when:

- At least 51% of the answers are concentrated in the highest categories of the Likert scale (4 and 5 level, on the Likert scale of 5 levels);
- The interquartile range is less than 1;
- The standard deviation is less than 1.5.

The application of this combined statistics to the two questions rounds allows a more robust assessment in identifying which generate greater consensus among the panelists. This is justified by the fact that there may be questions considered important or very important to most respondents (4 or 5 level in Likert scale), although they can have a high standard deviation or a high interquartile range (examples of questions No. 5 and No. 18 in the first round of responses, Table 3).

Table 3. Summary of the application of the Delphi method, according to the answers agreement

			Percentage of responses in level 4 or 5, Likert scale		**Standard deviation**		**Interquartile range (Q3-Q1)**		**Period for the implementation of priority (percentage of responses)**	
Open Innovation Area	**Nº**	**Subject of the question (open innovation priority)**	1st round	2nd round	1st round	2nd round	1st round	2nd round	Until 2020	2020-2025
Networks and Clusters	**1**	Cluster policy support	90,9	100	1,21	0,5	1	1	77,7%	22,3%
	2	Integration of companies in international innovation networks	81,8	100	1,03	0,52	1	1	87,5%	12,5%
	3	Requalification of interface entities with qualified personnel	81,8	90,9	0,81	0,67	1	1	87,5%	12,5%
Business entrepreneurship	**4**	User innovation stimulus	81,8	81,8	0,75	0,75	1	1	77,7%	22,3%
	5	Public incentives to intrapreneurship	72,2	90,9	1,08	0,6	2	1	75%	25%
	6	Legal and / or fiscal framework for spin-offs	100	100	0,47	0,4	1	0	75%	25%
Innovation and R&D Management	**7**	Support for collaborative projects (in relation to individual projects)	63,6	81,8	1,3	0,7	2	1	100%	0%
	8	Outsourcing of innovation and R&D activities	81,8	90,9	0,89	0,45	1	0	100%	0%
Intelectual Property Management	**9**	Valorization of R&D results	90,9	100	0,69	0,5	1	1	100%	0%
	10	Intellectual property awareness	81,8	90,9	1,14	0,6	1	1	87,5%	12,5%
	11	More flexible forms of intellectual property protection	63,3	90,9	1,25	0,45	2	0	80%	20%
	12	Support to the placement of PhD personnel in companies	90,9	100	0,69	0,52	1	1	100%	0%

Human Resources for Innovation	**13**	Hiring of qualified personnel by interface entities	45,5	54,5	1,36	1,12	3	1	75%	25%
	14	Attraction of international qualified human resources	81,8	90,9	1,01	0,69	1	1	71,4%	28,6%
	15	Requalification of the workforce in areas related to ICT and innovation	90,9	81,8	0,9	0,81	1	1	100%	0%
Venture Capital and Innovation Funding	**16**	State seed and venture capital	81,8	100	0,79	0,5	1	1	100%	0%
	17	Private venture capital supported in part by public funds	45,5	63,6	0,93	0,81	1	1	100%	0%
	18	Legal framework for new forms of innovation funding (eg. crowdfunding)	72,7	100	1,12	0,5	2	1	85,7%	14,3%
	19	Public funding: quality and experience of management teams as a criterion	81,8	100	0,82	0,47	1	1	85,7%	14,3%
	20	Companies`s reimbursement in case of future profits from public support	63,6	90,9	0,89	0,54	2	0	85,7%	14,3%
Public Policy Role	**21**	Public procurement for innovation	90,9	100	0,69	0,47	1	1	100%	0%
	22	Diplomacy for innovation and science	100	100	0,52	0,48	1	1	100%	0%
	23	Mapping major technological, entrepreneurship and innovation infrastructures	90	100	0,67	0,47	1	1	100%	0%
	24	Public and private resources to solve societal problems	81,8	100	0,71	0,4	1	0	83,3%	16,7%

Note: at yellow, questions with no consensus according to statistical measures used.
Source: own elaboration, based on data extracted from the Delphi survey (responded by the Portuguese innovation policy experts).

The data from the two Delphi rounds show that the questions that get full consensus in both rounds are those that fall in the areas of networks / clusters and the role of public policies. However, in all of the other areas there is at least one of the questions that not achieved consensus among the opinions given in the first round (using the three statistics combined). In all, there were seven questions without consensus in the first round (29% of total). However, consensus was reached on these questions in the second round, but with distinctions in relation to the importance given to questions. When asked when the priorities should be implemented (if they have been considered important or very important in the 2nd round) most respondents chose the period to 2020, over the period 2020-2025 (Table 3). This indicates the urgency and relevance of these priorities.

In the area of networks / clusters there is a consensus on the importance of the three questions considered, in particular as regards the need to strengthen the cluster policy, to support the inclusion of companies in the international networks of knowledge and to requalify interface entities[7]. Between 82% and 91% of respondents considered these issues

[7] Interface entities are those that promote the relationship between businesses and entities producing knowledge, such as universities. As examples we can appoint the technology centers, State laboratories, R&D centers, associated laboratories or technological intermediaries.

important (level 4 in the Likert scale) or very important (level 5) in the 1st round, reaching the percentage between 91% and 100% in the 2nd round. Between the two rounds there was even a greater convergence of views, visible by the decrease of the standard deviation of the responses (Table 3).

In business entrepreneurship, one of the three questions did not deserve the consensus of the respondents in the 1st round. While the need for public support for intrapreneurship were considered important or very important by 72% of respondents in the 1st round, and the standard deviation was within the defined criteria (<1.5), the dispersion of responses measured by the difference between the interquartile range was greater than the defined maximum limit (Table 3). In the 2nd round, this dispersion decreased, meaning a convergence of favorable opinions. Opinions were more consensual in the other two questions raised, including the need for public policies to promote innovation from users (user innovation) and a specific framework (fiscal / financial) for spin-offs from companies. The finding by the experts of the importance of these questions is relevant because the academic literature confirms the importance of these areas for open innovation (Baldwin and von Hippel, 2011; Piller and West, 2014). In this sense, the opinions of the experts stress the importance of this issue to be considered by the innovation policy, acting on a clear market failure.

In the management of R&D and innovation area, we tried to understand the views of experts on the possibility of public policy can positively discriminate collaborative projects (in relation to individual projects), as the lack of collaboration between innovation actors is one of the problems identified in the Portuguese innovation system (see Godinho, 2013). We also wanted to validate the importance of having incentives for outsourcing R&D and innovation activities. This last question merited the consensus of experts in the two rounds, according to the three statistical criteria (Table 3). Most of respondents found the subject important in both rounds, i.e., level 4 on the Likert scale. The same did not happen in relation to the first question, in which there was a greater dispersion in the responses, varying responses from unimportant (in the opinion of one expert) to very important (to five experts). However, in the 2nd round, there was a convergence of views, with the responses ranged between the level 3 (moderately important) and level 5 (very important).

In the group of questions related to intellectual property management, we seek to validate if public policy could have a significant role in the awareness on companies and other entities

about IP protection strategies and in public incentives for the exploitation of R&D academic and business results (eg., IP licensing mechanisms). For both questions there was consensus in the two rounds, being higher with regard to the need of IP exploitation (question No. 9 and No. 10, Table 3). There was also a question regarding the need for public policy to promote more flexible forms of IP (such as creative commons), considered by the open innovation literature as mechanisms to accelerate the flow of knowledge and stimulate innovation (Chesbrough and Ghafele, 2014). The answers were not consensual in the 1st round, with wide range of responses: three experts considered this need as moderately important, the other three as important, one said it was unimportant (level 1 in the Likert scale) and four mentioned as very important. In the 2nd round, and after experts confront their answers with those of the other experts, there was a convergence of views, with 91% agreeing that it is important or very important that public policies support more flexible forms of IP.

In the human resources for innovation area, we placed four questions. Of these, there were divergent opinions in relation to one of the questions in the 1st round, according to two of the three statistical criteria (Table 3). In this question we intend to investigate the relevance of public support for hiring qualified personnel (including PhDs) be redirected to the interface institutions as an alternative to direct support to companies. The justification for putting this question relates to the reduced number of PhDs in companies in Portugal (Barroca et al, 2015; Henriques, 2013) and the recent difficulties that higher education institutions have to absorb all the doctorates (Godinho, 2013). According to Henriques (2013), the interface entities can be seen as alternative employment opportunities for PhDs. In the 1st round of the Delphi about 54% of the experts did not consider this question important or very important, and there was also a high amplitude of responses (interquartile range of 3). However, in the 2nd round it was reached consensus on the three statistical measures considered, although 45% of experts attributed as maximum importance the level 3 of the Likert scale. Other issues considered important to boost innovation, as the attraction of qualified human resources to Portugal (Heitor et al., 2014) or the retraining of workers for ICT areas (Valente and Correia, 2015) obtained statistical consensus by the respondents experts .

Questions 16 to 20 intended to have the opinion of the experts about the importance of public policy in supporting new financing instruments for innovation and public incentives to venture capital. This was the group where there was a higher percentage of divergent

responses in the 1st round (60%, that is, three of the five questions). Specifically, there was no consensus in the following questions (Table 3): should the private venture capital be supported in part by public funds (in question 17) - given the scarcity of venture capital in Portugal, according to Godinho (2013) and Mateus (2015); if there must be a proper framework for new ways of financing innovation, such as crowdfunding (question 18); and if the projects financed by public funds should reimburse part of that amount to the State in case of future profits from that support (question 20) — promoting the sharing of risk and profit, generating new resources to support innovative projects (Mazzucato and Penna, 2015). More consensual were questions about the role of public policies in the other two areas where Portugal has recognized deficits — the venture capital and company management skills. When asked about the importance of having public seed and venture capital and about the quality of company management teams be used as criteria in the allocation of public funds (questions 16 and 19, respectively), there was convergence of opinions of experts in two rounds.

A last group of questions was dedicated to clarify the opinion of respondents on the action of public policies instruments that could influence the adoption of open innovation. The four questions posed met the statistical criteria defined in the first round of Delphi, showing a convergence of views, with this convergence been strengthened in the second round (Table 3). The questions that deserved a stronger consensus at the end of the two rounds were related to the need of public procurement be used to promote business innovation and the creation of public and private resources in a collaborative way to address societal challenges (Mazzucato and Penna, 2015). The relevance of developing a diplomacy for innovation (Carayannis, 2013), promoting innovative projects and products produced in Portugal and attracting foreign investment to innovation, as well as the mapping and dissemination of technological, entrepreneurship and innovation infrastructures were also considered as important or very important by all consulted experts (level 4 and 5, Likert scale).

In summary, the results of applying the Delphi method indicate to us that the priorities for innovation policy in Portugal must include the principles of open innovation.

5. Proposals for public policy measures to stimulate Open Innovation in Portugal

The opinions of experts in innovation policy, collected through the Delphi method (Section 4), helped to identify the priorities of public policy oriented to an open innovation approach, according to their degree of importance. We conclude that there is a convergence on the importance of the priorities for innovation policy, albeit with different levels of importance. In sequence, we move forward in this Section with the operationalization of these priorities, by proposing concrete measures framed in policy instruments.

According to Howlett and Rayner (2007), the literature that studies innovation policy considers that there is no single tool or a good policy with respect to the encouragement of innovation. Policies and instruments should be adapted and combined in a complementary manner (policy mix), given the complexity and multidimensional characteristics of the problems related to the innovation process (Edquist, 2014;. Flanagan et al, 2011). The instruments can be classified into four categories of innovation policy (see Borrás and Edquist, 2013: 18): provision of knowledge resources for the innovation process (inputs), stimulating activities on the demand side, strengthening innovation system components and services to support innovative companies.

This means that the definition and implementation of policy mixes requires a complex coordination between various policy areas such as education, promotion of investment, competition, regional policy, industrial policy, health, energy, environment policy, etc., in order to respond to the challenges that companies face. In a systemic perspective of the innovation process, public policy should also promote learning at all levels and the development of individual, organizational and interorganizational skills through various sources and methodologies, as well as new forms and process of innovation in management and in public services (see Havas et al, 2015:. 46).

In this sense, we propose some measures in Table 4 (framed in policy instruments), which are intended to exemplify how can the 24 priorities that have been validated in the Delphi method (Table 3) be implemented. We also identify the conditions for the implementation of these measures, including time requirements, implementation costs and public entities that can be involved in this implementation:

- In the estimation of time, we considered the procedures for its implementation, i.e., if it requires legislative changes, allocation of public or private funds or the involvement of external entities (to the Public Administration). The implementation of all measures was considered by the year 2020, as have been the time period indicated by the majority of respondents surveyed by the Delphi method (Table 3);

- Regarding possible costs, we consider: i) the measures that require legislative changes (ie, without associated costs); ii) the measures that need coordination between Public entities or between them and private entities (not involving direct costs except the human and physical resources allocated by the entities involved); iii) the measures that require public / private funds, identifying the sources of financing (when possible);

- In the entities involved, we consider the nature of the proposed measures. We identified the Public entities that may have more responsibilities on the implementation of each measure, both at legislative and operationalization level. The measures that require the involvement of private, were also identified possible entities to be involved.

(**Table 4.** Proposal of measures of public policy to boost open innovation in Portugal)

More than an exhaustive list, these measures are practical examples of how innovation policy in Portugal can contribute for the creation of a favorable context for the use of open innovation by the economic agents, particularly by companies. Some of these companies, particularly large ones, are already in their strategies assume a pro open innovation approach, either explicitly or implicitly. This highlights the relevance of the open innovation approach and its relevance as a model of action and strategic direction for some companies in Portugal, and not necessarily in areas of intensive technology. These facts lead us to suggest that public policy should consider the open innovation approach in its formulation. Thus, the exercise of Section 5 takes explicitly a normative character, whose contribution we consider important for a possible appropriation of open innovation by the entities that define public policy in Portugal.

6. Final remarks

In this research paper we drew up a survey on the priorities for a more open innovation policy in Portugal for the period 2015-2025, using the Delphi method. This exercise offers a new contribution to the literature on innovation and on open innovation, in the absence of similar exercises applied to Portugal. With the development of this qualitative research we had the intention to contribute to the inclusion in the innovation policy of guiding principles for an open innovation approach.

As a result of this research we can say that open innovation is a valid approach to the future definition of innovation policy in Portugal. This conclusion is supported on the convergence of views of policy makers (and policy executives) of innovation policy in Portugal, with regard to priorities for a more open innovation approach. This convergence is also reflected in the urgent need to operationalize these priorities to be implemented in the short and medium term, with the year 2020 as preferred time horizon. The divergence of Portugal compared to the EU average in key innovation indicators in the first half of the 2010s (see European Commission, 2016) may have been a factor influencing these positions, given the acknowledged contribution that innovation has for economic growth and social development in the long term.

This conclusion is reinforced by a normative exercise of measures to be implemented by public policy, based on the identified priorities. This exercise aims to contribute to its feasibility, by advancing with time implementation estimations, associated costs and the identification of Public bodies that currently have the political responsibility for the areas of each measure. However, innovation policy as a priority of public policy and the assumption of open innovation as a guiding principle of the innovation policy will be important aspects for the successful implementation of these measures, or others that may be set.

We can conclude, therefore, that open innovation approach should not be disregarded as a theoretical and practical framework for the design and implementation of innovation policy in Portugal. The principles of collaboration and exploitation of knowledge can strengthen some of the Portuguese innovation system components and their systemicity, extending the search for possibilities of knowledge sources on a global scale, adjusting the innovation system to the demands of a globalized and interdependent economy.

References

- Adler, M. and E. Ziglio (1996), *Gazing Into the Oracle: The Delphi Method and Its Application to Social Policy and Public Health*. London: Kingsley Publishers.
- Baldwin, C. and E. von Hippel (2011), Modeling a paradigm shift: from producer innovation to user and open collaborative innovation, *Organization Science* 22(6), 1399-1417.
- Barroca, A., G. Meireles and C. Neto (2015), *A Empregabilidade dos Doutorados nas Empresas Portuguesas*. Porto: Advancis Business Services.
- Borrás, S. and C. Edquist (2013), The choice of innovation policy instruments, *Paper nº 2013/04, CIRCLE*, Centre for Innovation, Research and Competence in the Learning Economy, Lund University.
- Brown Jr., A., L. Rusin and H. Rakouth (2010), Open Innovation: An Automotive Supplier's Perspective, *Society of Automotive Engineers technical paper series* 2010-01-2340, doi:10.4271/2010-01-2340.
- Bruening, T., D. Scalon, T. Hoover, C. Hodes, X. Shao, P. Dhital *et al*. (2002), *Attributes and Characteristics of Exemplary, Leading, and Innovative Career and Technical Education Teacher Preparation Programs*. National Research Center for Career and Technical Education, University of Minnesota, http://tinyurl.com/qfeztbo.
- Carayannis, E. (2013), Innovation diplomacy as driver of democracy, innovation and development: The case of Greece, in Carayannis, E. e G. Korres (Eds.), *The Innovation Union in Europe: A Socio-Economic Perspective on EU Integration*, Edward Elgar Publishing Limited, 123-143.
- 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 and J. West (Eds.), *New Frontiers in Open Innovation*, Oxford: Oxford University Press, 3-28.
- Chesbrough, H. and R. Ghafele (2014), Open innovation and intellectual property: A two-sided market perspective, in Chesbrough, H., W. Vanhaverbeke e J. West (Eds.), *New Frontiers in Open Innovation*, Oxford: Oxford University Press, 191-207.
- De Jong, J.P.J., T. Kalvet and W. Vanhaverbeke (2010), Exploring a theoretical framework to structure the public policy implications of open innovation, *Technology Analysis an Strategic Management* 22(8), 887-896.
- Donohoe, H., M. Stellefson and B. Tennant (2012), Advantages and limitations of the e-Delphi technique: Implications for health education researchers, *American Journal of Health Education* 43(1), 38-46.
- Edquist, C. (2014), Striving towards a holistic innovation policy in European countries — but linearity still prevails!, *STI Policy Review* 5(2), 1-19.
- European Commission (2016), *Innovation Union Scoreboard 2015*. European Commission.
- Flanagan, K., E. Uyarra and M. Laranja (2011), Reconceptualising the 'policy mix' for innovation, *Research Policy* 40(5), 702-713.
- Geist, M. R. (2010), Using the Delphi method to engage stakeholders: A comparison of two studies, *Evaluation and Program Planning* 33(2), 147-154.
- Giannarou, L. and E. Zervas (2014), Using Delphi technique to build consensus in practice, *International Journal of Business Science and Applied Management* 9(2), 65-82.

- Godinho, M.M. (2013), *A Inovação em Portugal*. Lisboa: Fundação Francisco Manuel dos Santos.
- Goula, A. (2013), *The Organizational Culture of Public Hospital: Factors of Transition from the Bureaucratic to a New Model of Management* (in Greek). PhD Thesis, Panteion University of Political and Social Sciences.
- Havas, A., K. Izsak, P. Markianidou and S. Radošević (2015), Comparative analysis of policy-mixes of research and innovation policies in Central and Eastern European countries, *GRINCOH Working Paper* 3(12).
- Heitor, M, H. Horta and J. Mendonça (2014), Developing human capital and research capacity: Science policies promoting brain gain, *Technological Forecasting and Social Change* 82, 6-22.
- Henriques, L. (coord.) (2013), *Diagnóstico do Sistema de Investigação e Inovação: Desafios, Forças e Fraquezas rumo e 2020*. Fundação para a Ciência e Tecnologia, Ministério da Educação e Ciência.
- Howlett, M. e J. Rayner (2007), Design principles for policy mixes: Cohesion and coherence in 'New Governance Arrangements', *Policy and Society* 26(4), 1-18.
- Hsu, C.-C. and B. Sandford (2007), The Delphi technique: making sense of consensus, *Practical Assessment, Research & Evaluation* 12(10), 1-8.
- Ku Fan, C., and C. Cheng (2006), A study to identify the training needs of life insurance sales representatives in Taiwan using the Delphi approach, *International Journal of Training and Development* 10(3), 212-226.
- Lee, C., and B. King (2009), A determination of destination competitiveness for Taiwan's hot springs tourism sector using the Delphi technique, *Journal of Vacation Marketing* 15(3), 243-257.
- Linstone, H.A. and M. Turoff (1975), *The Delphi Method*. New York: Addison-Wesley Publishing Company, Inc.
- Mason, K. J., and F. Alamdari (2007), EU network carriers, low cost carriers and consumer behavior: A Delphi study of future trends, *Journal of Air Transport Management* 13(5), 299-310.
- Mateus, A., Sociedade de Consultores & Associados (2015), *Avaliação ex ante dos Instrumentos Financeiros de Programas do Portugal 2020: Lote 1 — Instrumentos Financeiros para o apoio direto às empresas — Relatório Final*. Lisboa: Agência para o Desenvolvimento e Coesão, I.P.
- Mazzucato, M. (2013), *The Entrepreneurial State — Debunking Public vs. Private Sector Myths*. London, UK e New York, USA: Anthem Press.
- Mazzucato, M. and C. Penna (2015), *Mission-Oriented Finance for Innovation — New Ideas for Investment-led Growth*. London: Policy Network and Rowman & Littlefield International.
- Mendonça, S. (2001), Socio-tecnologia e cenarização: O caso da Shell", in Godinho, M.M., A.S. Ferreira and J.Z. Mendes (Eds.), *Como Está a Economia Portuguesa?*, Livro de Actas da IV conferência sobre economia portuguesa, Lisboa: CISEP, Europress, 913-924.
- Nelson, R. R. and B.N. Sampat (2001), Making sense of institutions as a factor shaping economic performance, *Journal of Economic Behavior & Organization* 44(1), 31-54.
- Piller, F. and J. West (2014), Firms, users, and innovation: An interactive model of coupled open innovation, in Chesbrough, H., W. Vanhaverbeke e J. West (Eds.), *New Frontiers in Open Innovation*, Oxford: Oxford University Press, 29-49.
- Santos, A.B. (2015), Open Innovation research: trends and influences – a Bibliometric Analysis, *Journal of Innovation Management* 3(2), 131-165.

- Scapolo, F. and I. Miles (2004), Eliciting expert's knowledge: A comparison of two methods, *EU-US Seminar: New Technology Foresight, Forecasting & Assessment Methods*, Seville, Spain, http://tinyurl.com/pomtcoy.
- Stitt-Gohdes, W. and T. Crews (2004), The Delphi technique: A research strategy for career and technical education, *Journal of Career and Technical Education* 20(2), http://scholar.lib.vt.edu/ejournals/JCTE/v20n2/stitt.html
- Szpilko, D. (2014), The use of Delphi method in the process of building a tourism development strategy in the region, *Economics and Management* 4/2014, http://tinyurl.com/q8nc5xv.
- Tornjanski,V., S. Marinković, M. L. Jakšić and V. B. Arsić (2015), The prioritization of open innovation determinants in banking, *Industrija* (43)3, 81-105.
- Valente, A.C. and Correia, I. (2015), *Mapeamento da Oferta de Educação e Formação em TICE em Portugal*. Fundação Calouste Gulbenkian e Fundação para a Ciência e a Tecnologia, I.P.
- Wright, J. T. C. and R.A. Giovinazzo (2000), Delphi — uma ferramenta de apoio ao planejamento prospectivo, *Caderno de Pesquisas em Administração* 1(12), 54-65.