

The Role of Networks in the Performance of Business Incubators in Portugal

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Abstract. Currently, incubator networks are essential for the success of the companies that are part of them. This study proposes to analyze a set of data for the Portuguese case, understand the effect of networks on incubator performance and consequently contribute to the still scarce scientific literature on this matter as well as to the practice of incubator management. After a review of relevant literature, research questions and hypotheses were formulated to be empirically tested, using statistical methods. The objective is to understand to what extent the quantity and type of formal networks that exist within Portuguese incubators influence their performance in terms of the number of companies that graduate. A particular focus is given to the typology of incubators, proposing a comparative analysis between technological and non-technological incubators as regards networks and performance. Furthermore, in addition to the deductive and quantitative approach described above, qualitative research methods were also employed, more specifically, a questionnaire with 55 replies from incubator managers/executive directors, who enabled a better characterization of incubator networks in the country. And finally, a triangulation of these methods and results was conducted enabling the greatest possible robustness to the issues under study in this study.

Keywords: Business Incubators, Technology Incubators, Incubator Networks, Performance of Incubators, Portugal

1 INTRODUCTION

Entrepreneurship contributes with the creation and development of new companies and consequently with the generation of jobs, which translates into an expectation of the improvement of a country's economy, growth, and economic development. Business incubators are organizations that facilitate entrepreneurship and innovation (Aernoudt, 2004; Aerts et al., 2007), contributing to economic growth (Phan et al., 2005), playing a crucial role in the survival of start-ups since they provide a favorable environment for their development and make fundamental services available so that they become successful in the initial stages, a period in which they are more vulnerable (Aerts et al., 2007).

Since the beginning of the 21st century, access to networks became the focus of the services made available by incubators, the most relevant incubation dimension (Hackett & Dilts, 2004). However,

literature is still scarce concerning this theme and there are few studies concerning the impact of incubator networks on their performance given that research conducted concerning incubator performance tend to consider other factors such as: selection policies, incubator manager competencies, management of services supplied, access to funding, amongst others. In this context, it was considered relevant to study this topic to produce knowledge to contribute to bridging the existing gap. Thus, based on the literature, questions and research hypotheses were established. The research questions are as follows:

- What are the main characteristics of technological and non-technological incubator networks?
- What is the role of incubator networks on incubator performance?

In terms of working hypotheses, the following are formulated:

- H1: The more formal networks that exist between an incubator and its counterparts, the better the performance of that incubator in terms of the number of firms graduated;
- H2: The more formal networks that exist between a technological incubator and other incubators, the better the performance of that incubator in terms of number of companies graduated when compared with non-technological incubators.

Therefore, the objective of this work is to analyze a set of data for the Portuguese case to understand the impact of networks on the performance of technological and non-technological incubators, having as main variables incubator networks and performance. The article is structured into four chapters with the introduction. The theoretical referential, with reference to incubation of companies, incubation in networks and technological incubator networks. Chapter 3 addresses research methodology and research results. And the last chapter presents the conclusions and limitations of the study.

2 LITERATURE REVIEW AND THEORITICAL FRAMEWORK

Incubators focused on the creation of companies, as instruments for economic development and the promotion of innovation for companies recently on the market, emerged in the 80s. And the first ones in Portugal, which began their activity in 1987, were AITEC in Lisbon, created by INESC - Institute for Engineering and Computer Systems (focused on information technologies) and the incubator New Companies and Technologies (NET) in Porto (focused on regional economic development because of a European project associated with the Business Innovation Centres – BIC)¹.

Regarding the definition of a business incubator, there is no consensus in academic and professional literature (Hackett & Dilts, 2004), however the most widely used (and adopted in this study) is that of the National Business Incubation Association (NBIA)², according to which:

¹ < <https://pme.pt/incubadoras-empresas-portugal/> > accessed on 23-04-2021.

² < <https://www.inc.com/encyclopedia/national-business-incubation-association-nbia.html> > accessed on 29-06-2022.

“Business incubation is a business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services” (NBIA, 2019).

The quality of an incubator is measured by the existence of five offers: i) access to physical resources; ii) administrative support; iii) access to financial resources; iv) business support to new companies; v) access to networks (Carayannis & Von Zedtwitz, 2005). Access to networks is part of the third generation of incubators and since the beginning of the 21st century has contributed to the increased importance of intangible resources and has been considered as one of the most important services as they represent one of the critical success factors of incubators (Hansen et al., 2000). This is because, McAdam & McAdam (2008), state that the contact between incubated companies and the networks made available at the host incubator aid in building their social capital, which in the first years of life is crucial for companies. And, given the fact that networks provide companies access to specialized counseling on more specific matters, from the strategic to the operational level (Campos, 2015).

The incubation process is enhanced when the incubated is in an incubator that works in a strategic network, provides powerful and extensive business connections and collaborations, and consequently, collaborates in value creation (Hughes et al., 2007). On the other hand, Zhang et al. (2019) confirmed in their research that networks enable incubates, to graduate more likely to be successful, influence their growth and enable a more diverse incubation experience. Incubation networks occur through connecting nodes between universities, incubator managers, consultants, funders, and other start-ups (Eveleens et al., 2017). The typology of incubation networks is broad, however this paper focuses on the formal and informal networks that exist between incubators. Caetano (2019), considers that formal networks are contractual or other formal links, such as protocols, institutional partnerships, cooperation agreements, consortia, etc. On the other hand, informal networks are the personal or social ties, contacts with entrepreneurial value and other non-contractualized informal connections that incubators have amongst themselves.

Incubators began making intangible resources, such as business knowledge and networks, available in the early 90's when they started supporting technological start-ups (Bruneel et al., 2012). This is because, they realised how important technology start-ups were for the development of science and innovation (Mian et al., 2016), but lacked resources, skills, professional expertise, investments, internal and external partners, physical facilities, and advanced equipment (Mian et al., 2016). On the other hand, start-ups need legitimacy and reputation (Bruneel et al., 2012), as they were usually created based on poorly documented business models because they lacked solid management expertise (Elfring & Hulsink, 2003). In this context, technological incubators emerged with the purpose of providing access to sector specific resources (Vanderstraeten & Matthyssens, 2012); the financial support that usually comes from multiple entities, such as financial institutions, government and companies (Bruneel et al., 2012); the internationalization achieved through the network partners (Durda & Ključnikov, 2019). And, as Van Weele et al. (2020) argues, the stronger the networks, the greater the connection, accessibility, and willingness to help each other.

Rubin et al. (2015), according to research conducted in Australia and Israel, concluded that the network between incubated companies, graduated companies and technology incubators broadens incubated companies' knowledge in relation to technology and the market. Technology incubators directly provide start-ups with tangible and intangible resources or enable access to external resources through the incubator's networks (Eveleens et al., 2017). One of the crucial capabilities of incubators is that they enable the transfer of resources to technology entrepreneurs and start-ups, as well as the transfer of knowledge through social relationships between innovators and entrepreneurs (Wang et al., 2020). Information and knowledge sharing facilitate the increase of technology entrepreneurs (Revill & Jefferson, 2014), which arises through networks between innovators and incubated companies and are made available by incubator managers to facilitate the research and development process (Hansen et al., 2000).

3 RESEARCH METHOD

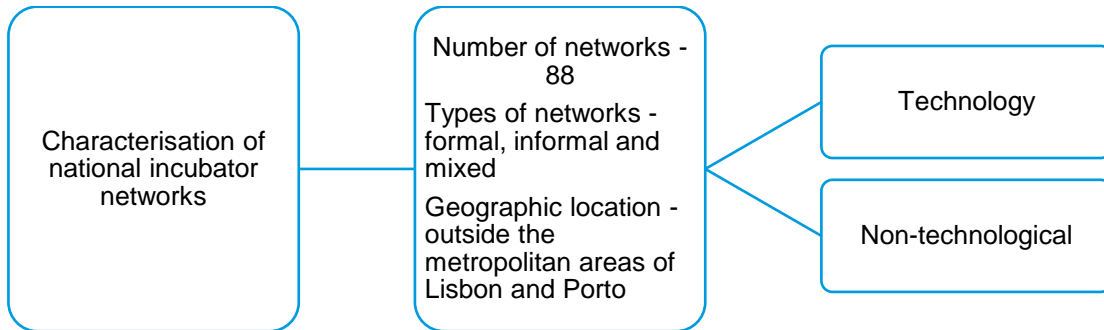
The present study presents two types of data, namely secondary data, and primary data. Secondary data is quantitative in nature with predominantly qualitative analysis. Given that the purpose was not to conduct an exhaustive survey of the incubation context in which incubators operate, one chose some of the incubators' general characteristics at the time of observation (2017), such as: incubator type, size, incubator management, incubator age and location. With views to validating research hypothesis, secondary data was analyzed by means of its submission, via Excel, for statistical treatment at the Statistic Data Analysis (STATA) program, version 15.1 Windows.

And primary data is of quantitative nature, with predominantly qualitative analysis, collected via a self-designed, structured questionnaire, consisting of both closed and open questions, sent via email to the managers/executive directors of 181 incubators that are listed in the Accredited Entities in Portugal, applied between the months of January 2022 and April 2022, from which 55 responses were obtained. The objective was to analyze both the general perception (national context) and the specific perception (context of the incubator in question) that incubators have concerning the effect of formal networks on their performance in terms of the number of graduated companies. The purpose was also to better understand the perception of incubator directors as to the difference between technological and non-technological incubators in as much as their formal networks are concerned.

Result and Discussion of Secondary Data

Figure 1 summarizes the characterization of the national incubator networks. From the available data (n = 106) one registers a greater incidence of formal networks and mixed networks as opposed to informal networks, which demonstrates that incubators favor the establishment of relationship networks based on cooperation agreements, consortiums, formal connections as opposed to informal contacts and relations.

Figure 1. Characterization of national incubator networks



Source: Own elaboration (2022)

In relation to technological incubators (n = 22), it was found that most have more than 3 employees (59.1%), are managed on a full-time basis (68.2%), have been in the market for more than 5 years (54.5%) and are in other regions, outside of the metropolitan areas of Lisbon and Porto (72.7%). And, the non-technological incubators (n = 84), mostly have less than 3 employees (53.9%), are managed full-time (57.1%), have been in the market for less than 5 years (53.6%) and are in other regions (77.4%).

For this purpose, the number of graduated companies was defined as the dependent variable and independent variables were the incubator's age, technological incubators, formal networks between incubators and informal networks between incubators. In the course of linear regressions, independent variables underwent alterations so as to verify whether any of them would have any effect on the number of incubators graduated, but regressions demonstrated that there is no statistical relation (table 1), i.e., neither formal networks nor variables defined possess significance in the number of incubators graduated, resulting in the rejection of the formulated hypothesis. There was also verified a N = 68 and an $r^2 = 0,058$, very low values, which demonstrate that the model does not have much explanatory power of the phenomenon in question. However, since the sample is small, it is not possible to obtain conclusive results with these data to confirm the hypotheses in question.

Table 1. Regression results

VARIABLES	OLS ALL
Ano de fundação da incubadora	-0.025 [0.151]
Incubadora Universitária (1=sim, 0=não)	0.411 [2.047]
Links informais com outras incubadoras (1=sim, 0=não)	2.557 [1.774]

Links formais com outras incubadoras (1=sim, 0=não)	2.332 [1.961]
Constante	50.973 [303.521]
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N	68
R ²	0.058

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Result and Discussion of Primary Data

The following analysis focused on the results of the self-elaborated questionnaire and the replies obtained by 55 national incubators. The formal networks are based on official protocols, possessing well defined rules and management structures. And, on the contrary, informal networks have no rules or management structures, being based solely on the interaction and sharing of information and experiences by its members (Caetano, 2019).

Although several authors (e.g., Hansen et al., 2000; Peters et al., 2004; Rubin et al., 2015) acknowledge the importance of networking provided by incubators and the access to external resources made available (Bruneel et al., 2012), the literature does not offer specific studies on formal and informal networks between incubators. And it was found that 80% of the interviewed incubators have formal networks and 20% have informal networks. It can therefore be stated that, in general, the incubators surveyed chose to establish formal connections with other incubators. In comparison with secondary data, one notices that the quantity of formal networks (41%) is also higher than that of informal networks (16%), however, 43% of the incubators surveyed possessed hybrid networks (formal and informal).

Zhang et al. (2019) confirmed that networks enable incubates to successfully graduate. Although these authors did not specifically address networks between incubators, one would expect that these would also have a positive association with number of graduated firms (in line with the literature review of this dissertation and the development of hypothesis 1). However, it was found that in general, 47% of respondents are indifferent, 5% totally disagree and 4% disagree concerning the influence that formal networks have in terms of the number of graduated companies. In contrast, 38% of the respondents agree and 5% totally agree that formal networks have an influence in terms of the number of graduated firms, in general terms. In specific terms, in figure 9, one may observe that the same does not occur with the Portuguese incubators since of the 44 incubators that have formal networks, the majority do not consider that the existence of this type of networks influences the number of graduated companies (63%). This phenomenon may be at the basis of the fact that the hypotheses were not validated since 51% of incubators are indifferent, 9% disagree and 2% totally disagree. On the other hand, 7% of incubators totally agree and 30% agree, i.e., 37% of respondents have the perception that formal networks influence increasing the number of their graduated companies.

Valadão (2017), considers that incubator networks contribute with the development of partnerships between companies that possess similar activities. In the absence of specific literature concerning networks between incubators, one would expect this phenomenon to also occur within the context of these networks. However, overall, 60% of incubators consider that formal peer-to-peer networks have an impact on the development of partnerships between firms operating in similar and different sectors, 25% consider it to be only in similar sectors, 7% consider it to be only in different sectors and 7% consider it to have no impact on the development of partnerships. And specifically, 67% of incubators consider that their formal network with other incubators occurs in similar and different sectors, i.e., networks between incubators largely influence partnerships between incubates that are indistinct in terms of sector. Importantly, 28% consider it to exist only in similar activity sectors (in line with Valadão, 2017) and only 5% consider it to be in different activity sectors.

Groen et al. (2008) state that networks enable interaction both between entrepreneurs and incubators, whereby both help each other. Although the authors do not specifically refer to networks between incubators, one would expect them to have the same effect. But overall, 50% of incubators consider interaction to be weak with other incubators and 5% consider it to be very weak. However, 43% consider it to be intense and 2% very intense as they feel that there is a strong connection in their networks. It is noted that there is only a difference of opinion between 2 incubators regarding incubator interaction being weak or intense. However, one notices that 86% of incubators are indifferent as to whether the initiative comes from them or from partner incubators. And one might consider two options in this case, either not part of any of them or part of both. However, 5% consider that it starts from the partner incubators and 9% consider that it starts from their own incubator.

The main difference between technological and non-technological incubators consists in the business area, with the former supporting new technology-based ventures and the latter supporting a greater variety of new ventures in different areas (Aernoudt, 2004). Those incubators that affirmed there were differences between technological and non-technological incubators (n = 34), presented the following arguments in relation to formal technological incubator networks favoring the entrepreneurial process:

- More potential for scalability and eligibility for financial support;
- More technical and international relationships, which capture diverse initiatives;
- Profile of entrepreneurs, project financing structure, type of mentors and type of support to be provided;
- They have laboratories and equipment to support the projects;
- Possess greater availability of technological infrastructures as well as mentors;
- They have faster access to data as well as more fluid interactions;
- They have greater growth, investment, attractiveness and specialization.
- They are aimed at different publics in relation to the support services provided;
- They have technological infrastructure support or support in terms of business development;
- More comprehensive typology of partnerships.

And, it can be observed that the differences coincide with the literature, as it mentions the following aspects: universities serve as a source of new ideas and collaborate in the development phase of new products (Rubin et al., 2015); financial support enables the acquisition of advanced technology and the hiring of research and development experts (Zhao et al., 2017); provision of expert assistance with business basics and links with investors, strategic partners, mentors and consulting teams (Wiggins & Gibson, 2003).

There is a set of formal regional networks established in Portugal, which are often the target of public funding and top-down public policy strategies. And within these formal networks, specific and generic projects are developed. From the data collected, the quantity of technology-based projects developed within the formal networks between incubators stands out, demonstrating that technological incubators, effectively, assume relevance and confirm the large supply of projects originating from universities (Stainsack, 2003).

CONCLUSION

The present work intends to contribute in three fundamental aspects. Firstly, to provide a contribution to researchers in the field of incubation with greater emphasis on formal networks between the various incubators in the country. Secondly, to give a contribution to business incubators and their management teams to continuously improve the offer of their services. And finally, to encourage the increase of policy measures that contribute to partnerships between incubators in the country, since the RNI states that incubators are the institutions that have contributed most to the development and dynamism of the Portuguese business fabric, and consequently in the competitiveness and national economic performance.

Incubator networks are crucial for the growth and autonomy of incubates, given the inter-firm relationships it provides (Hackett & Dilts, 2004; Peters et al., 2004) and contribute to their successful graduation (Zhang et al., 2019). In the data analysis and discussion, it was concluded that national incubators prefer to establish formal networks vis-à-vis informal networks. But, on the other hand, although formal networks exist, it was found that they are not energized as they should be and do not have the expected impact on the number of graduates, according to the literature, which resulted in the rejection of the two research hypotheses. This phenomenon might occur, based on the perception of incubators, because entities work differently, bureaucracy (lengthy processes), incubators possess distinct company selection criteria, the fact that graduated companies are minimal, the lack of knowledge of incubated companies and the lack of agenda availability.

As to the differences between formal networks between technological and non-technological incubators, the following stand out: financial support; techniques and international relationships; profile of entrepreneurs and mentors; type of support; specific needs; growth; specialization; public; partnerships. In view of the examples of projects developed within the formal networks, it was concluded that in fact

there is a large supply of projects originating at universities (Stainsack, 2003), i.e., technology-based projects.

The theme of business incubation is quite broad, and the lack of empirical studies is a challenge for any researcher but also enables the practical application of much theoretical knowledge in the fields of engineering, technology, technology-based entrepreneurship, and business management. The result of this study contradicts literature but nevertheless provides evidence as to the reality of Portuguese incubators and those incubators must seek to take advantage of their strengths (internal environment) and opportunities (external environment) to improve their performance relative to the number of graduated companies.

REFERENCES

Aernoudt, R. (2004). Incubators: Tool for Entrepreneurship? *Small Business Economics*, 23(2), 127-135.

Aerts, K., Matthyssens, P., & Vandenbempt, K. (2007). Critical role and screening practices of European business incubators. *Technovation*, 27(5), 254-267.

Bruneel, J., Ratinho, T., Clarysse, B., & Groen, A. (2012). The Evolution of Business Incubators: Comparing demand and supply of business incubation services across different incubator generations. *Technovation*, 32(2), 110-121.

Caetano, D. (2019). Contextos de Incubação, Redes e Desempenho Organizacional: Criação de Valor em Incubadoras de Empresas. Tese de Doutoramento em Ciências Económicas e Empresariais não publicada. Universidade do Algarve, Portugal.

Campos, J. P. (2015). A Incubação de Empresas: Boas práticas e fatores críticos de sucesso. Relatório de Estágio de Mestrado em Gestão não publicado. Universidade de Coimbra, Portugal.

Carayannis, E. G., & Von Zedtwitz, M. (2005). Architecting gloCal (global–local), real-virtual incubator networks (G-RVINS) as catalysts and accelerators of entrepreneurship in transitioning and developing economies: Lessons learned and best practices from current development and business incubation practices. *Technovation*, 25(2), 95-110.

Durda, L., & Ključnikov, A. (2019). Social networks in entrepreneurial startups development. *Economics & Sociology*, 12(3), 192-208.

Elfring, T., & Hulsink, W. (2003). Networks in entrepreneurship: The case of high-technology firms. *Small Business Economics*, 21(4), 409-422.

Eveleens, C. P., van Rijnsoever, F. J., & Niesten, E. M. (2017). How network-based incubation helps start-up performance: A systematic review against the background of management theories. *The Journal of Technology Transfer*, 42(3), 676-713.

Groen, A. J., Wakkee, I. A., & De Weerd-Nederhof, P. C. (2008). Managing tensions in a high-tech start-up: An innovation journey in social system perspective. *International Small Business Journal*, 26(1), 57-81.

- Hackett, S. M., & Dilts, D. M. (2004). A systematic review of business incubation research. *The Journal of Technology Transfer*, 29(1), 55-82.
- Hansen, M. T., Chesbrough, H. W., Nohria, N., & Sull, D. N. (2000). Networked Incubators: Hothouses of the New Economy. *Harvard Business Review*, 78(5), 74-84.
- Hughes, M., Ireland, R. D., & Morgan, R. E. (2007). Stimulating dynamic value: Social capital and business incubation as a pathway to competitive success. *Long Range Planning*, 40(2), 154-177.
- McAdam, M., & McAdam, R. (2008). High tech start-ups in University Science Park incubators: The relationship between the start-up's lifecycle progression and use of the incubator's resources. *Technovation*, 28(5), 277-290.
- Peters, L., Rice, M., & Sundararajan, M. (2004). The role of incubators in the entrepreneurial process. *The Journal of Technology Transfer*, 29(1), 83-91.
- Phan, P. H., Siegel, D. S., & Wright, M. (2005). Science parks and incubators: Observations, synthesis and future research. *Journal of Business Venturing*, 20(2), 165-182.
- Revill, J., & Jefferson, C. (2014). Tacit knowledge and the biological weapons regime. *Science and Public Policy*, 41(5), 597-610.
- Rubin, T. H., Aas, T. H., & Stead, A. (2015). Knowledge flow in technological business incubators: Evidence from Australia and Israel. *Technovation*, 41, 11-24.
- Valadão, R. A. (2017). Empreendedorismo de base tecnológica: O estudo de caso do Instituto Pedro Nunes. Dissertação de Mestrado em Ciências Económicas e Empresariais não publicada. Universidade dos Açores, Ponta Delgada.
- Van Weele, M. A., van Rijnsoever, F. J., Groen, M., & Moors, E. H. (2020). Gimme shelter? Heterogeneous preferences for tangible and intangible resources when choosing an incubator. *The Journal of Technology Transfer*, 45(4), 984-1015.
- Vanderstraeten, J., & Matthyssens, P. (2012). Service-based differentiation strategies for business incubators: Exploring external and internal alignment. *Technovation*, 32(12), 656-670.
- Wang, Z., He, Q., Xia, S., Sarpong, D., Xiong, A., & Maas, G. (2020). Capacities of business incubator and regional innovation performance. *Technological Forecasting and Social Change*, 158, 120125.
- Wiggins, J., & Gibson, D. V. (2003). Overview of US incubators and the case of the Austin Technology Incubator. *International Journal of Entrepreneurship and Innovation Management*, 3(1-2), 56-66.
- Zhang, L., Gao, P., Zhou, Y., Zhang, Y., & Wang, J. (2019). Surviving through Incubation Based on Entrepreneurship-Specific Human Capital Development: The Moderating Role of Tenants' Network Involvement. *Sustainability*, 11(10), 2866.
- Zhao, L., Zhang, H., & Wu, W. (2017). Knowledge service decision making in business incubators based on the supernetwork model. *Physica A: Statistical Mechanics and its Applications*, 479, 249-264.