The role of Science Parks in territorial dynamics of innovation. The case of Madan Park (Almada, Portugal)

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Abstract:

The links between the academic sector and the business community are the basis of the continuous development of innovative activities and technologies. In turn, the transfer of this knowledge enables economic agents to sustain innovation dynamics. Science Parks (SPs) are territorial infrastructures based on clusters and linear models of innovation that leverage spatial proximity and "agglomeration" forces as key factors to accelerate innovation. Increasingly, they assume the role of "connectors" with the global innovation ecosystem.
In Europe, SPs were influenced by EU innovation policies. Portugal's accession to the EEC (1986) paved the way to overcoming its scientific and technological delay. The first SP (Tagus Park) appeared in 1993 in Lisbon Metropolitan Area. It still accounts for almost half of the employment of the two dozen Portuguese SPs, which are home to some 1100 firms and 16500 jobs. On the whole, Portuguese SPs are young, poorly structured and they show difficulties in assuming the role of boosters of their surrounding economies.
In this paper, the characterization of national SPs is done based on information from TecParques and directly obtained from SPs. Madan Parque (Almada), located in Lisbon Metropolitan Area, a region with unique potentialities in the national context, is put forward as a case study. In particular, this SP benefits from the proximity to the Campus of FCT NOVA University and the availability of own land with tax exemption on activities with a strong R & D prevalence. The concept "walk in distance" is a qualifying and differentiating element, which promotes the relationship between the park, the scientific research entity (Uninova) and the FCT NOVA Campus. We used a methodology that combined interviews with project managers with questionnaires to more than 55% of the technology-based firms located in the park. Our study lays down some of the problems found, but concludes that the Madan Park has the conditions to become an engine of the regional economy and a national reference.

Keywords: Innovation, Territory, R&D, Science Park, Madan Park, Portugal
JEL codes: O31 Innovation and Invention: Processes and Incentives

1. Introduction

Since the middle of the last century, the decadence of the Fordist model of industrialization has boosted the emergence of techno-productive models that rely on flexible specialization. This process of industrial restructuring based on knowledge (Science) and technological innovation (Technology) as the main driving forces induced changes in methods and techniques of production, but also in the organization of enterprises and territories. The new socio-economic context allowed SPs to become privileged spaces for the territorialisation of business organization processes based on the transfer of technology and knowledge.

In the new productive models, Science, Technology, Innovation and their relationships are fundamental for the development and competitiveness of firms, regions and nations (Edquist, 2005). Science is "a set of organized knowledge about the mechanisms of causality of observable facts, obtained through the objective study of empirical phenomena" (Barata, 1992: 148). The same author considers that Technology is "a set of scientific or empirical knowledge directly applicable to the production, improvement or use of goods and services" (Barata, 1992: 148). Concerned about the relationship between Science and Technology, Ondategui (2001: 18) suggests that "in science things have value even if they do not serve immediately, whereas in technology things are only useful if they serve something immediate." That is, Technology is understood as a useful and specific knowledge in a given context and was created to solve specific problems. As Agostinho (2008: 26) suggests, Technology establishes the bridge between Science and productive process, facilitating and stimulating this same process, which is a condition for changing productive sectors, companies and territories.

The concept of Innovation, by its scope, is complex. One of the most valuable contributions to understanding it is found in Schumpeter, especially in his essays Theory of Economic Development (1934) and Economic Theory and Business History (1949). According to Melo (2001: 42) "Schumpeter brought innovation to the center of the economic system, attributing to it the real role of capitalist development and redefining its concept in a very broad way, extendable to any type of economic act; emphasized the nature of the process carried out by individuals or groups within the company, with creativity, vision and ability to read the medium, emphasizing the social nature and cultural specificity of the innovative function". Caraça (1993) admits that innovation represents something that has always existed, related to human curiosity,

necessity and will. For Vale (2012), to innovate is an inherent process of human nature that, according to Tidd, Bessant and Pavitt (2003) implies "finding new ways of doing things in order to obtain strategic advantages". Innovation requires persistence, cumulative and integrative knowledge, adaptation to the surrounding environment and predisposition to become more and more intensive in scientific knowledge.

The relations between universities and enterprises favors the continuous development of knowledge, technologies and innovative activities, allowing economic agents, especially companies, to sustain innovation dynamics (Vale, 2012: 16). The permanent and related development of information and communication technologies and the technologies of the productive process stimulate these dynamics at a pace never before experienced. They reinforce the competitive capacity of firms and the emergence of an entrepreneurial culture that constantly seeks to create products and develop methods and techniques of production and organization. This continuous "technological revolution" requires a period of assimilation and adaptation of the territories.

The relations between Science, Technology and the industrial environment gave rise to the concept of "Research and Development" (R & D). According to the OECD, R & D activities include "systematic creative work to increase knowledge and use it in new applications. These activities can be subdivided into fundamental research, applied research and experimental development "(OECD, 2002). The relationships between Science, Technology and R & D promote the diversification of the objectives and functions of the companies, making them more available for cooperation with research centers (adhesion and financing of research programs that meet their technological and commercial needs) and other companies for the provision of technologically specialized services that do not justify their internalization.

In order to remain competitive, firms are forced to permanently increase their technological capacity. According to Godinho and Caraça (1988) and Gama (1997), cited by Agostinho (2008: 35) for the maintenance of this competitiveness, technological innovation should not be conceived only as a result of the confrontation of market needs (market-pull logic) and the technological opportunities generated by the science-technology system (technology-push logic). The ability of an economy to innovate depends on the national innovation system, the environment and the levels of interaction between the various components of the system.

Fernandes (2002: 38) considers business innovation as a competitive advantage that is based on five essential factors: accumulation and application of theoretical and practical knowledge from other areas outside the company; high qualification of human resources; perceived and anticipated market needs; cooperation with scientific institutions; natural predisposition for innovation. In its turn, Guimarães (1998: 93) identifies four factors that stimulate innovation: endogenous corporate dynamics (the ability of firms to innovate); scientific and technological base of reference (determines the capacity that companies reveal to their environment); institutional context (legal, financial, educational, cultural) that is fundamental in creating an "environment" favorable to innovation; intermediation agents (facilitators of contributions from the various sectors involved in innovation activities).

Recent changes in industrial organization and business strategies have revealed the growing importance that "non-local innovation networks" or "networks without fixed spatial delimitation" assume in global production chains and sectorial innovation systems. The actual industrial organization and business strategies tend to increasingly incorporate these networks. These new interactions can take different forms (strategic partnerships, projects and participations in temporary events), electing new "proximities" to the detriment of spatial proximity (Amin and Cohendet, 2014). These new channels of communication or pipelines allow access to resources and knowledge, often not available locally (Vale, 2012). These new practices, potentially competitive with the "innovation clusters", allow us to understand some recent transformations that have taken place there, for example, through virtual incubation and the use of networking. Currently, the cohabitation between physical and virtual spaces shapes the concept of "smart territory" (Fernandes and Gama, 2009: 1). According to Komninos (2008), this results from the convergence of the complex innovation systems of innovative clusters, technology and learning institutions and digital spaces of innovation. According to the author's definition, intelligent cities and regions “are territories with a high capacity for learning and innovation, which is built in: (1) the creativity of their population; (2) their institutions for knowledge creation; and (3) their digital infrastructure and services for communication and knowledge management (...). (…) constitute advanced territorial systems of innovation, in which the institutional mechanisms for knowledge creation and application are facilitated by digital spaces and online tools for communication and knowledge management" (p.112-113).

Regardless of the concept, forms, techniques or tools used, local and regional development depends on the ability to integrate and connect in an effective and lasting way distant and innovative networks and places, thereby increasing the effectiveness and efficiency of innovation systems so that they can obtain collective benefits that can then be made available to the region and its people. The Science and Technology Parks, while infrastructures based on a model of productive business organization focused on Science, Technology and Innovation, are in an advantaged position to play this role.

2. The genesis and evolution of Science Parks

The idea of SPs development was born after World War II in the United States at a time when the country was entering a phase of economic expansion. The first SP, Stanford Industrial Park, was created in 1951 to enhance the link between Stanford University and the industrial sector, giving rise to Silicon Valley (Vale, 1990). Following this example, other infrastructures emerged in the United States and Europe in the following years: Research Triangle Park (USA, 1959), Cummings Research Park (USA, 1962); Herriot-Watt University Research Park (UK, 1965), Sophia-Antipolis (France, 1965) which hosted the first headquarters of the International Association of Science Parks (IASP) and Cambridge Science Park (UK, 1970).

In the meantime, Science Parks have spread worldwide in a more organized and planned way, integrating into the economic development policies and, in particular, the regional development policies. These new venues seek to bring together the best conditions for attracting technology-based companies from emerging sectors, especially in the field of information technology and telecommunications.

The emergence and diffusion of SPs resulted, according to Castells and Hall (1994: 3), from the convergence of three great historical processes: the technological revolution; the formation of a global economy and the emergence of an informational form of economic production and management, redefining regional and local development conditions and processes. From this convergence and the implementation of different policies, such as those of science, technology, innovation, economic dynamics and regional development that fostered the emergence and development of SPs, some concepts emerged that - translating the same reality or similar realities – were

adopted, such as Technology Parks, Research Parks, Innovation Centers, Business Parks or Technopoles.

Science Parks are seen by different national public policies as "accelerators" of industrial dynamics. Its rapid diffusion is also due to the easy replication in any part of the world, although its success depends on the capacity of adaptation to the endogenous conditions of each territory.

Defining the concept is not an easy task since the SPs themselves seek to adapt to the material and immaterial conditions specific to each territory. The difficulty in stabilizing the concept is clear in the fact that each of the three largest international Science Parks associations proposes its own definition. As for the OECD, according to Ondategui (2001: 60), Science Parks "are spaces with very variable dimensions with the following functions and characteristics: concentration of high technology industries and specialized service centers; relationships between universities or technological institutes and companies, so that they can easily communicate materially and intellectually; companies with a strong research and technological development component".

Science parks are descendent of clusters and linear models of innovation, valuing spatial proximity and clustering of companies and / or activities, as essential factors to create synergies and share technology and knowledge, accelerating dynamics of innovation. They are spaces that integrate the "thinking" with the "produce", with the use of science by the technique, but also of the use of it for the performance of that one, for its contribution to the reduction of intensive work and for privileging quality and speed to the detriment of quantity and rigidity in production methods (Lima, 1991).

Science parks are preferably located in (or near to) metropolitan areas, seeking to obtain the best conditions for complementarity and technology transfer between Universities, RTD + Innovation institutions and enterprises: population density; concentration of young and qualified population; economic, academic and research activity, focusing on the sectors related to innovation and technology; good accessibility and mobility conditions; quality of urban life. However, Science Parks are increasingly networked and give way to more spontaneous and informal spaces and concepts anchored in the digital communication supported by the Internet. In a way, this new approach conflicts with its original characteristics of strong territorial articulation, with its operations centered on the physical and real estate components. Informality is now perceived as a global trend of accelerating market ideas and streamlining cooperation. It

is possible that both approaches (territorialized and technologically mediated) combine to change the institutional nature of SPs, resulting in a more direct relationship with the environment and a more active role in process leadership. These changes result from the social changes that technology causes in the relationship between people, in the access to information and in the demography and structure of companies.

The activities and services carried out by the Science Parks will maintain their territorial focus, but formal cooperation will tend to exceed their physical limits. At the local level they function as nodes of innovation ecosystems supporting regional development, but are also the main "connectors" with the global innovation ecosystem. Therefore, public policies should continue to support them as platforms for revitalizing innovation ecosystems, which ensure the provision of essential services to the installed companies. But the strategy of change must start from the local base, avoiding models adopted in other contexts, disconnected from territorial values and realities. Taking into account the dynamism of the SPs in the most innovative regions, the emergence of new development models based on strategic partnerships between companies and the revitalization of the Academy-Government-Industry triangle is not surprising. These models follow the same development logic, but they acquire distinct geographical and organizational dimensions (Innovation Hubs, Innovation Districts) (Goetheer and Butter, 2017). More recent European policies welcome these trends to stimulate innovation and smart specialization. In the context of Digital Innovation Hubs (DIH), Science Parks as innovation ecosystem focal points could play an even more relevant role in the development of the regions, in line with the assumptions of the regional strategies of smart specialization (RIS3) whose implementation will become part of DIH. In Portugal a new Digital Innovation Hub, named iMan Norte Hub, was born on May 2018 in Leça da Palmeira (Porto). This Portuguese DIH is supported through the collaboration of UPTEC (Science and Technology Park of the University of Porto), PRODUTECH (Production Technologies Center), INESC TEC (Institute for Systems and Computer Engineering, Technology and Science), CATIM (Technological Support Centre for the Metal-Mechanic Industry), CITEVE (Portuguese Technological Center for the Textile & Clothing Industry, CTCP (Portuguese Footwear Technological Centre) and CTCOR (Cork Technology Center). The objetive of the iMan Norte Hub will accelerate the adoption of digitalization and robotics in manufacturing companies operating in the Northern region of Portugal in order to make the industry more

customer-focused, and contribute for a more sustainable and greater impact on the region's economy and employment.

Despite the wide spread worldwide and the investment involved, the effectiveness of SPs as instruments of innovation policy is not consensual among academics, practitioners and policy makers. Massey et al. (1992) and Hansson et al. (2005) consider that Science Parks have not produced a relevant impact on company results, while Siegel et al. (2003) and Hommen et al. (2006) argue that they provide business-friendly environments by facilitating the creation of strategic alliances and networks, with positive effects on entrepreneurial activity in innovation and research. However, more recent studies (Albahari et al., 2013) defend a more conciliatory position, considering that SPs are very heterogeneous, in some cases being efficient and generating added value for resident companies, while others are more modest or even inefficient. Based on a study of 849 companies in 25 SPs carried out in 2009 in Spain, these authors concluded that (i) the age of the park does not have a linear effect on the creation of innovative products; (ii) larger SPs generate and develop better-performing companies; (iii) the quantity and quality of human resources of the management teams affect positively the capacity of innovation, the structuring of the network of entrepreneurs and the transfer of technology; (iv) SPs perform better in less technologically developed regions, i.e. the competitive advantage of a Science Park is lower in more advanced regions and may be explained by the fact that firms find more locations with more favorable framework conditions.

After collecting information from the three main international associations, Pombeiro (2018) identifies four phases in the evolution of Science Parks (Figure 1):

- Phase I (decades 50-70), corresponding to the emergence of SPs in the founding countries (USA, UK, and Japan). Its growth was slow and marked by the adoption of distinct policies. In the USA, Science Parks have been developed by universities to value their resources and stimulate interaction with the industrial environment. In Europe there were two distinct approaches: the UK has focused on linking universities to enhance research potential; in France, SPs were the result of government policies of economic and territorial planning. In Japan, they have been linked to the need for regional decentralization, whereby technology transfer and stimulus policies for the creation of high technology enterprises have been combined with regional and urban

policies. It seems to be a greater similarity, on the one hand, between the American and English models and, on the other hand, between the French and Japanese models.

- Phase II ran from the early 1980s to the mid-1990s and corresponded to the strengthening of the institutionalization of SPs and their diffusion throughout the world. The number of SPs soared especially in the Western world, but also appeared in Asia, South America and Africa, and began to spread widely. The main national and international Science parks organizations have been set up, notably the IASP (with strong global representation), the UKSPA (more circumscribed to the UK) and the AURP (not represented outside the USA).

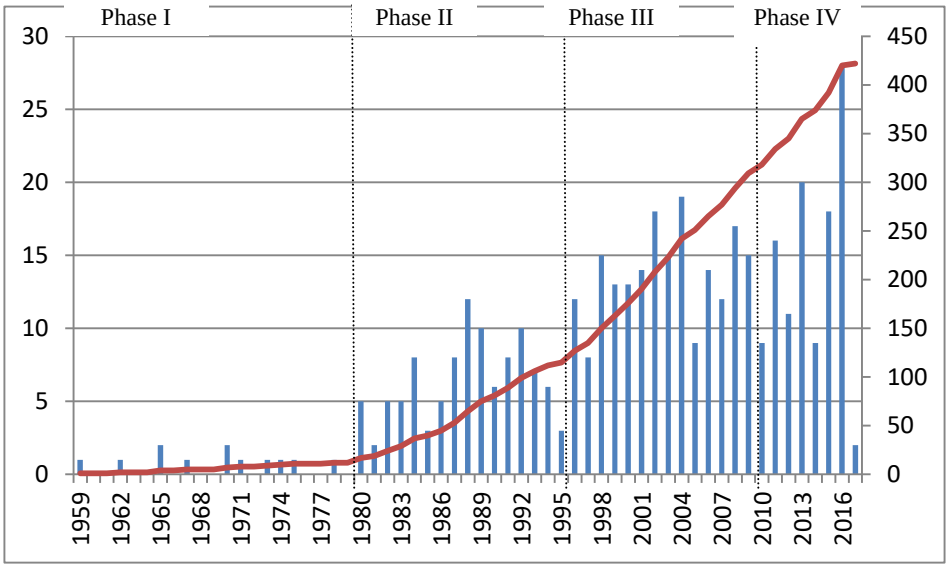


Figure 1 - Evolution of the associated SPs of the three main international associations.

- Phase III started in the mid-1990s and continued until 2010, reinforcing its presence worldwide, with diffusion to less industrialized or developing countries. Between 2000 and 2005 there was a significant growth of these infrastructures, especially in Asia, as a result of a clear commitment of the "central political powers" in these spaces as instruments associated with innovation and development policies, during a period of extraordinary economic and demographic growth in this region. SPs show slower but more balanced growth and a tendency to affirm their multifunctionality and the establishment of stronger cooperative relationships with other actors that can contribute to the development of the region in which they operate.

- in phase IV (post-2010) the pace of growth is still high, but the inter-annual variations in the number of SPs created seem to reflect the economic climate of greater insecurity following the financial and economic crisis of 2008. However, 2016 was the year in which more parks are associated.

The 422 associated SPs have a business universe of 109,105 companies, responsible for around 3.3 million direct jobs (Table 1). The figures show the distinct behaviour of the three largest regions in the world (Europe, Asia and the Pacific and North America). Europe accounts for the largest number of SPs (263; 62.3%), but only holds 30% of enterprises and 19.7% of jobs; the average size of SPs is the lowest in the universe (20 workers per company). North America with 63 SPs (14.9%), accounts for 9.3% of enterprises and 12.2% of employment; however, the average size of the companies is 39 workers, constituting the highest value in the universe. The Asia-Pacific region, with only 42 SPs (10%), is clearly dominant in relation to the other regions, both in the number of companies (54.8%) and in the associated employment (65.7%). The average number of workers per company is 36, also a high value. These values reveal that the parks are large with a high presence of companies and workers.

Table 1- Geographical distribution of Science Parks, its enterprises and jobs, by major world regions (2017)

	SPs (Nr)	**%**	**Firms**	**%**	**Jobs**	**%**
Europe	263	62,3	32707	30,1	645612	19,7
Asia and Pacific	42	10,0	59819	54,8	2156347	65,6
North America	63	14,8	10198	9,3	399941	12,2
Latin America	23	5,5	1509	1,4	43517	1,3
WANA	26	6,2	4503	4,1	35128	1,1
Africa	5	1,2	369	0,3	2879	0,1
Total	**422**	**100,0**	**109105**	**100,0**	**3283424**	**100,0**

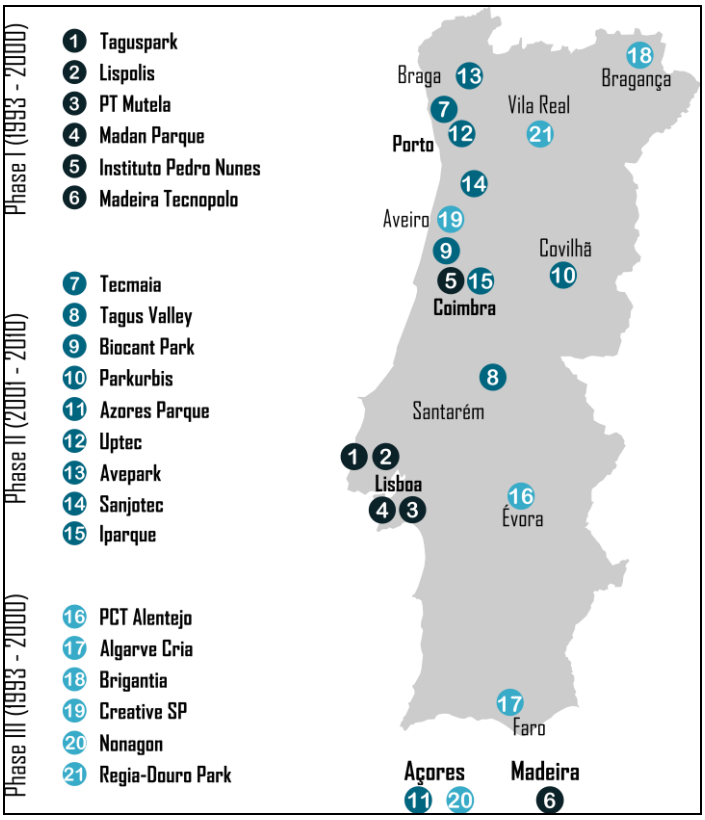
Source: IASP, UKSPA e AURP.

3. Origin and evolution of Portuguese Science Parks

In Portugal, Science Parks appeared late driven by the adhesion to the EEC and encouraged by the public policies that placed them on the political agenda dedicated to innovation. They began appearing in metropolitan areas with more favourable conditions, but were later extended throughout the territory (fig. 2) benefiting from specific support within the framework of sectoral and regional policies. However,

metropolitan areas still account for about 35% of SPs, 56% of enterprises and 80% of employment (Table 2). Portuguese Science Parks are very heterogeneous. Taguspark, in Lisbon Metropolitan Area, concentrates 51% of employment and 12% of companies. The five following parks (Lispolis; TecMaia; UP Tec; IPN and Ave Park) have 5728 employees (34.8% of the total), 1483 in technology-based companies (62.7%). The UP Tec, Tagus Park and IPN stand out in the incubation of companies, although in the last the virtual incubation is more important than the physical incubation.

In her analysis on Portuguese "SPs network" Azevedo (2011: 47) was very critical. She considered that they did not foster relations between the scientific and business cycles, that they did not create the necessary connections with the historical or emerging clusters and that they did not attract multinationals and did not leverage local and regional development. It acknowledged the lack of a common and consolidated strategy among SPs, which contributed to a fragmented network.



Source: Pombeiro, 2018, modified, based on TecParques

Fig. 2 – Location of Portuguese Science and Technology Parks, by phase

Table 2 - Main characteristics of Portuguese Science Parks (2017).

SPs	Location	Year	Employees (Nr)		Enterprises (Nr)				Eemployees per company
			Total	Technology based enterprises	Total	Physical Incubation	Virtual Incubation	Technology based enterprises	
Tagus Park	Oeiras	1993	8500	nd	130	120	10	nd	65
Lispolis	Lisboa	1994	1496	350	63	58	5	51	24
Mutela	Almada	1994	90	-	34	30	4	0	3
Madan Parque	Almada	1995	227	162	50	40	10	36	5
IPN	Coimbra	1995	850	250	114	46	68	46	7
Tec Maia	Porto	2001	1160	24	57	50	7	8	20
Tagus Valley	Abrantes	2004	72	15	32	21	11	6	2
Biocant	Cantanhede	2005	265	35	38	22	16	35	7
Parkurbis	Covilhã	2005	244	96	41	28	13	10	6
Azores	S. Miguel	2007	270	3	43	43	0	1	6
UP Tec	Porto	2007	1602	459	197	169	28	37	8
Ave Park	Guimarães	2008	620	400	43	41	2	24	14
Sanjotec	S.J.Madeira	2008	142	63	81	81	0	21	2
IParque	Coimbra	2010	262	20	16	11	5	5	16
SP Alentejo	Évora	2012	182	60	34	11	23	18	5
Algarve Cria	Faro	2015	76	64	34	22	12	28	2
Brigantia	Bragança	2015	81	47	14	14	0	7	6
Creative SP	Ílhavo	2015	0	0	0	0	0	0	0
Nonagon	S. Miguel	2015	173	149	22	17	5	14	8
Regia Douro	Vila Real	2015	160	40	43	43	0	10	4
TOTAL (20 SP in activity)			**16472**	**2366**	**1086**	**867**	**219**	**357**	**15**

Source: Pombeiro, 2018 (adapted).

In contrast, a study by TecParques (Tavares, 2013), with a more optimistic view, considers that Science Parks are qualified infrastructures in different stages of development that have diversified and been pivotal even if they still have much room for improvement. Although not all meet the characteristics and objectives of true Science Parks, their contribution to the business fabric and to regional development is undeniable. At the same time, some of them are recognized in the international context as spaces of excellence in research and innovation. The next phases of investment should focus on internationalization and intangible features, reinforcing human resources dedicated to management and incubation. New policies should guide fiscal and financial incentives for competitiveness factors, the use of endogenous resources (human and material) and the promotion of a "global mentality" culture. The Research and Technological Development (RTD) component should continue to be strengthened, stimulating entrepreneurship and partnership at national and / or international scales.

4. Science Parks and territorial innovation dynamics: the case of the Madan Park (Almada)

The creation of Madan Parque, like other Portuguese and international SPs, resulted from the convergence of academic, societal and local power interests. The implementation of specific policies at the initiative of the central government was also relevant. The concept was based on the Cambridge model (United Kingdom), where proximity to the University, according to the principle of "walking distance", was a preponderant factor, differentiating Madan Parque from the projects that were then discussed in Portugal. Thus, the Madan Park in Almada appeared next to FCT NOVA. In 1986, UNINOVA - New Technologies Development Institute, a non-profit private entity, was created with the objectives of developing scientific and technological research that, from the outset, positioned itself as a "facilitator" of knowledge and technology sharing between FCT NOVA and the business world, or be a kind of embryo of the "Madan Park".

Another important moment prior to the constitution of the Park was the "meeting" of principles and objectives between the Rectory of the NOVA University, the FCT and the Municipality of Almada, which were constituted as founders of Madan Parque. The Municipality considered the project as an exceptional opportunity to reinforce the model of qualified tertiary identified as preferential for the county, which was facing a socioeconomic crisis related to the deindustrialization process. The convergence of strategy and efforts among founders was crucial in bringing together scientific and business entities, creating a favorable environment for attracting innovative companies in knowledge and high technology (national or foreign).

Madan Parque, which was built on an infrastructure of 2.5 ha, was formally constituted in December 1995 (fig. 3). The headquarters building (3,097 m^2) was inaugurated in 2009. The Municipality's master development plan provided it with three areas for RTD + Innovation activities with a cumulative area of 10 ha. Madan Parque develops its activity around five axes: (1) Incubation support (physical, virtual and out-of-box) of business projects; (2) Support services for internationalization and cooperation (internationalization, identification of partners and cooperative networks); (3) FCT NOVA & UNINOVA, Bridging Innovation: Transfer of technology, RTD + I and Innovation Management activities (patents and trademarks); (4) Training and market-oriented events: Business development, networking and specialized training; (5)

Network of external partners and investors (support in the management of financing, business angels & venture capital, partnerships with banking).

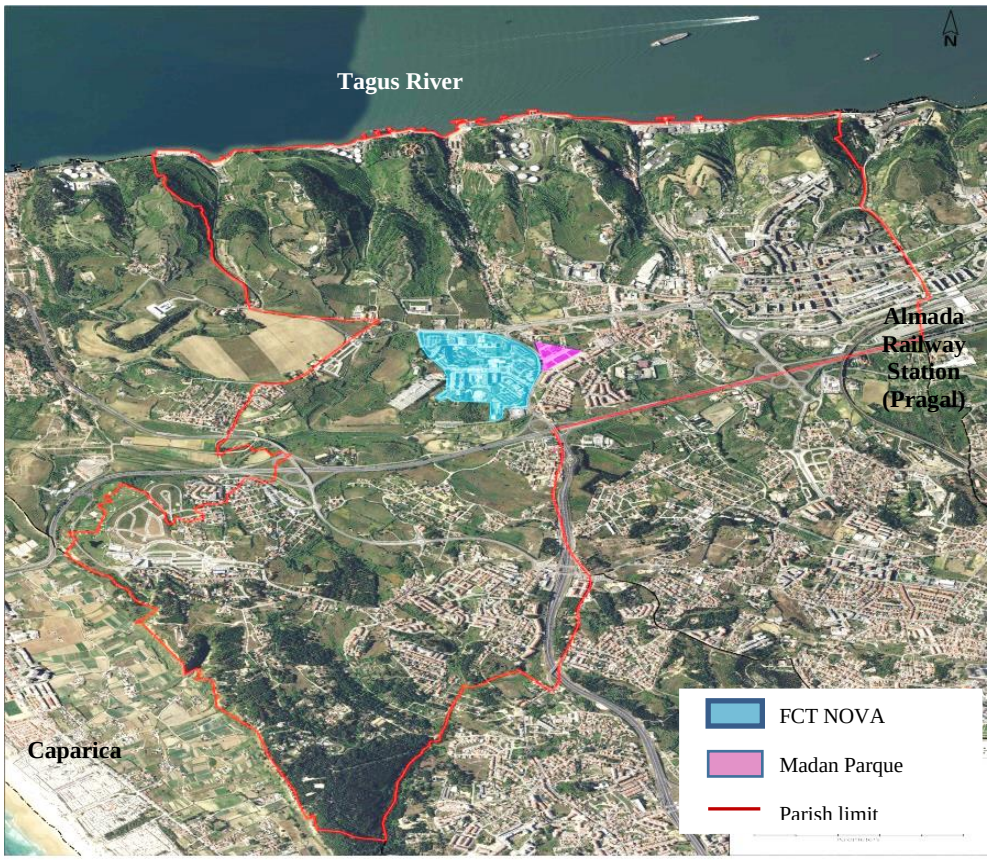


Figure 3 – Location of Madan Parque (Almada)

Madan Parque occupies the 4th and penultimate phase (maturity) of the development cycle of SPs. It is responsible for 227 direct jobs in its 50 companies. Of these, 40 (80%) benefit from physical incubation, while the remaining 10 (20%) are in virtual incubation. It is the Portuguese science park with the largest gross area for incubation of companies (3,775 m^2); has a high occupancy rate, maintaining a list of companies waiting for availability to stay there. We are faced with a consolidated business fabric based on small businesses (4.5 employees per company). Several business projects are the result of applied research projects (e.g. the university spin-offs Holos, S3 Portugal, STAB Vida, NMT).

Madan Parque is one of the main SPs in the creation and acceleration of technology-based companies, surpassing the national average in number of enterprises (32.9%) and direct employment created (14.4%). Its 36 technology-based companies (72%) are responsible for 162 jobs (71.4%). Another indicator of success is the approval

and development of European projects (15), short European courses (2) and national projects (2) in the period 2015-2017. The growing internationalization has a positive impact on the installed firms since they benefit from this increased exposure. The involvement of Madan Parque in international partnerships also allows the identification of financing and subcontracting opportunities for its companies.

Table 3- Characteristics of Madan Park (2017)

Nr of Development Phase	4th	Enterprises	50
Development Phase	Maturity	Enterprises in physical incubation	40
Location	Almada	Enterprises in virtual incubation	10
Legal Form	Association	Employees of the firms	227
Year of 1st firm	1995	Employees by firm	4,5
Land with infrastructures (ha)	4,0	Technology based enterprises	36
Universities in the SP (Nr)	1	Employees in technology based enterprises	162
R&D Institutions	21	Local Enterprises	34
Managing body	1	Employees in Local enterprises	75
Capital (million €)	0,9	Enterprises created in the MP but in activity elsewhere	35
Incubation Professionals	1	Total Investment (million €)	6,0
Incubation spaces(m2)	3800	Annual turnover (million €)	6,0

Source: Madan Parque and TecParques

A survey of 20 of the 36 technology-based companies allowed us to obtain information to evaluate the resident companies and their appreciation of the relationship with the Park's managing entity and other resident or foreign companies. We concluded that the companies consider that Madan Parque is well located in a region with unique potential in the national context. At the local level, the proximity and umbilical link to the FCT NOVA are highlighted, as well as the availability of infra-structured land owned by the Park and reserved by the municipality for the installation of technological companies, free of fees on its main activity. The recurrent reference to the excellent relationship between the partners helps to explain "resilience" during the post-2008 economic and financial crisis. Among all these advantages, the most important one seems to lie in the adopted model, which favours the development of projects and companies with a strong predominance of RTD activities, in addition to the concept of walking distance, which fosters relations between the Science Park and its companies and the professors and laboratories of FCT NOVA. This proximity was reinforced in 2009 with a direct pedestrian access (flyover). Table 4 summarizes the main strengths and weaknesses, opportunities and threats of Madan Parque based on the opinions of the companies and the privileged interlocutors who were interviewed.

Table 4 – Madan Parque: SWOT Analysis

Strengths	Weaknesses
▪ Connection to the "Campus" - "Walking distance" ▪ Link to entities of national / international prestige ▪ Identity with the concepts of "knowledge & technology", and "research & innovation" ▪ Highly qualified human resources ▪ Technology-based companies with national / international impact ▪ Environment of "success" and "prestige" ▪ Technical and logistical support to very "qualified" companies ▪ R & D projects with public and private, national and international entities	▪ Difficulty access to public financing - private entity of public utility ▪ Insufficient national and Community funding for development ▪ Economic sustainability very dependent on "incomes" ▪ Banking debt, which conditions the investment needs ▪ Reduced size of built space - need for expansion ▪ Reduced technical and administrative staff ▪ Insufficient proactivity in relations with higher education institutions and with the regional / national business system
Opportunities	**Threats**
▪ Proximity to Lisbon and centrality in AML ▪ Good access network ▪ Proximity to Lisbon airport and to the ports of Lisbon, Setubal and Sines ▪ Proximity to companies of relevant size and high technological intensity ▪ Potential to develop "unique", "innovative", "efficient" and "environmentally friendly" ▪ Potential to develop scientific capabilities in new areas (blue and circular economy)	▪ Uncertainty of economic and financial developments - shrinkage of public-private investment ▪ Region with restrictions or exclusion from access to Community funding ▪ Escape and / or transfer of companies and projects to regions with greater potential for financing ▪ Territory not "permeable" to inter-municipal cooperation strategies ▪ "Competition" rather than "complementarity" between SPs in the region

Source: Pombeiro, 2018 (adapted)

The development of Madan Parque cannot be separated from several circumstances (legal constitution and financial situation) that shape its current and future situation. In particular, investments are needed to build / expand physical spaces dedicated to the incubation and hosting of companies from other scientific and technological areas, identified and relevant in FCT NOVA, but still to be explored, such as nanotechnology and marine sciences. According to the key actors interviewed, Madan Parque can and should gain scale and visibility, transforming itself into the Setubal Region Park. To do this, it will have to be more proactive and extend research partnerships to other regional entities and institutions, with a vocation for scientific and technological research in areas not yet explored by FCT NOVA. Likewise, it should promote the connection to research projects of large companies with high technological intensity, some with activity in the Setubal Peninsula (Arsenal do Alfeite; SN Seixal,

Siderurgia Nacional, S.A.; AutoEuropa, Lisnave; Navigator, Fertagus, Megasa, Secil, among others).

In conclusion, the Madan Parque must increasingly become a main actor and a facilitating agent in the Region, guiding the articulation between companies and fostering the development of projects with other national or international Parks. Luring technological "anchors" to Madan Parque – capable of developing larger projects that ensure a significant financial inflow - is key to pave the way for a financial recovery and to finance new areas of research. Moreover, they strengthen the technical support team that contributes to the management of Madan Parque, especially by supporting the management of European projects as well as by supporting the business development and internationalization of companies. The park must also value a cultural dimension by providing a better link between economic and industrial interests and social and cultural interests. In this conception it is implicit an evolution for PSTC (Park of Science, Technology and Culture), more in line with the current vision of humanistic, intelligent and sustainable cities.

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