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Science Parks and Entrepreneurship: Enhancing Territorial Absorptive Capacity in a Hostile Region
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Science Parks and Entrepreneurship: Enhancing Territorial Absorptive Capacity in a Hostile Region
Science Parks and Entrepreneurship: Enhancing Territorial Absorptive Capacity in a Hostile Region

Carmela Elita Schillaci¹, Marco Romano², Melita Nicotra³

Abstract
In the paper, the concept of absorptive capacity, already successfully applied to firms, is extended to territories. At the regional level enhancing territorial absorptive capacity is strictly related to improving the level of entrepreneurship in an area.
From a theoretical point of view, territorial absorptive capacity is dependent on increasing investment in human resource learning, promoting R&D activities and, above all, integrating research and business actors.
In such a context, we propose a notion of Science Parks playing a strategic role in increasing territory absorptive capacity and thereby entrepreneurship by acting as knowledge gatekeepers that acquire external knowledge through their national and international networks and improve learning among organizations in a region.
The “Science and Technology Park of Sicily – PSTS” case-history is particularly significant in showing the role of Science Parks for the development of absorptive capacity in “hostile regions”.

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Editorial notes

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1. Introduction

The phenomenon of globalization and the current digital revolution has generated fundamental structural changes. Knowledge has become the most important production element. At the same time, science, technology and markets are getting closer than ever and innovation processes are moving from a linear model to a networking approach.

Some new theories of innovation management, such as National System of Innovation (Freeman, 1987; Lundvall, 1992), Tri-Helix model (Leydesdorff & Etzkowitz, 1998), Mode 1 and Mode 2 (Gibbons et al, 1994), the fifth generation innovation process (Rothwell, 1994), and Open Innovation (Chesbrough, 2003), are changing the traditional ideas of learning and innovation.

Such models assume inter-organizational knowledge flows do not materialize automatically, but organizations should develop skills to tap into external sources of knowledge and technology. The ability to recognize, value and exploit external sources of knowledge, generally identified with the term “absorptive capacity”, is crucial in explaining organizations’ innovative capabilities (Cohen & Levinthal, 1990; Leonard-Barton, 1992; Dyer & Singh, 1998).

The concept of absorptive capacity, already successfully applied to firms, is here extended to territories. At the regional level enhancing absorptive capacity is strictly related to increasing investment in human resource, learning, to promoting R&D activities and, above all, to integrating research and business players.

In such a context, we propose a theoretical notion of Science Parks playing a strategic role in increasing territory absorptive capacity by acting as knowledge gatekeepers that acquire external knowledge through their national and international networks and improve learning among organizations in a regional innovation system.

They can be considered as changing agents adopting a mission to create and sustain social and economic value deriving from entrepreneurship, recognizing and pursuing new opportunities to serve such mission, engaging in a process of continuous innovation and learning.
The “Science and Technology Park of Sicily – PSTS” case-history is particularly significant in showing the role of Science Parks for the development of absorptive capacity in “hostile regions”.

A “hostile region” or “wrong place” is a peripheral territory with low competitiveness in terms of infrastructures, logistics, services, facilities, distribution and marketing systems.

In a knowledge based society, “wrong places” can generate a particular advantage that is known as “the strength of wrong places”: they can appropriate the benefits deriving from the creation of a new knowledge system, being not embedded in already established structures.

PSTS in particular foster knowledge generation processes in which laboratories, universities, companies and spin-offs cooperate to reach higher levels of territory competitive advantage. In this way a “wrong place” becomes a favourable economic and social context.

Basing on these assumptions, in the first section of this work the determinant of absorptive capacity, R&D activities, human skills and organization structure, as defined by Cohen & Levintal (1989, 1990) are presented. The second section aims at applying such categories to territories, and showing how they are connected to entrepreneurship. In the third, the role of Science Parks emerges as knowledge gatekeepers able to improve the absorptive capacity of regions. The last section shows the importance played by the PSTS in a hostile region at the innovation/learning level and finally it presents three propositions for future research basing on considerations developed in the previous sections.

2. Theory - Determining absorptive capacity: R&D activities, human skills and organization structure

Absorptive capacity is defined as the “the firm’s ability to identify, assimilate and exploit knowledge from the environment” (Cohen & Levintal, 1989, 1990).

Such a definition introduces three capabilities that are labelled as components of absorptive capacity: recognizing the value, assimilating and applying
new external knowledge to commercial ends (Lane et al., 2001; Zahra & George, 2002; Lane & Lubatkin, 1998).

The concept of absorptive capacity implicitly embodies a vision of learning as a complex, cumulative and non-linear phenomenon.

The development of innovations comes from the knowledge accumulated in the past. New ideas reflect existing knowledge in the firm, although combined in new and different forms.

Moreover, the creation of new knowledge is the result of the continuous and non-linear interaction between heterogeneous agents, and access to knowledge depends on the firm's ability to interact with such agents.

The majority part of innovative processes is powered by the continuous activation of feedback mechanisms, both between individuals within the company, and between these and other external actors.

Such essential properties of new knowledge generation processes on the one hand suggest that the pace of learning processes depends on the ability of individuals and companies to identify external knowledge. On the other hand, they suggest that the effectiveness of interactions (eg. with actors outside the firm) and so the acquisition and use of complementary external inputs, depend on prior accumulated knowledge.

The concept of absorptive capacity proposed by Cohen & Levinthal (1989, 1990), summarizes these characteristics. It expresses the dual role played by R&D activities in companies, which generate some useful knowledge to innovate, while increasing the stock of knowledge necessary to reveal more cognitive needs and to identify external sources of knowledge that can satisfy them.

It is the firms’ ability to generate value from their research as much as to benefit from the activity of others.

Consequently, the ability to "absorb knowledge" depends on the knowledge base of the firm, the R&D activities carried out, the level of human resources training and experience, the organization structure. Companies can "understand" external knowledge and incorporate it into subsequent development ideas only if they have already accumulated a sufficient level of experience and knowledge.

If companies do not invest in a planned development to create knowledge, they do not create the conditions to generate absorptive capacity needed to
transfer and exploit external know-how. The knowledge accumulated in previous innovation processes plays an important role in directing research towards the outside and in facilitating the recognition and assimilation of new knowledge.

The absorptive capacity is path dependent. In this respect Cohen and Levinthal point out that “absorptive capacity affects a firm’s expectation formation, permitting the firm to predict more accurately the nature and commercial potential of technological advances”.

In their contribution in 1990, Cohen and Levinthal also support the importance of purely organizational aspects contributing to the development of absorptive capacity.

While acknowledging the importance of prior knowledge, even recent reviews of the literature (Lane et al., 2006; Foss et al., 2010) point out that specific organizational solutions are required to make the absorption processes structured and ongoing. Organizational structures oriented to the absorption of exterior ideas should be designed to capitalize on prior knowledge and individual cognitive processes and to enable knowledge management processes for the recognition, assimilation and exploitation of external knowledge (Van den Bosch et al., 1999; Minbaeva et al., 2003; Jansen et al., 2005; Vega-Jurado et al., 2008). Such open processes also allow organizations to avoid the emergence of cognitive and relational lock-in.

Therefore, the determinant of absorptive capacity can be synthesized in the following three groups.

1. Human Skills: a firms’ absorptive capacities depend on those of their employees, related to their general level of education, experience and training. Rothwell & Dodgson (1991) found that firms need well-educated technicians, engineers and technological specialists to access knowledge from outside their boundaries. Frenz et al. (2004) took this into account in their analysis by including in their model the share of scientists and engineers in total employees as well as training expenditures.

2. R&D activities: Cohen & Levinthal, (1989) focus mainly on the role of R&D expenditures in building absorptive capacity and point to the dual role R&D plays in the innovation process of firms (generating new knowledge and innovations and building absorptive capacity). Many other scholars have thus
used R&D-related measures and approaches to model absorptive capacity at the firm level (Stock et al., 2001; Rocha, 1999; Cantner & Pyka, 1998; Grünfeld, 2003; Oltra & Flor, 2003; Veugelers, 1997).

3. Organizational structure: a firm’s absorptive capacity depends on the ability of an organization as a whole to stimulate and organize the transfer of knowledge across departments, functions and individuals. It has been shown that the absorptive capacity of a firm is determined by its expertise in stimulating and organizing knowledge sharing (Van Den Bosch et al., 1999). Daghfous (2004) review yields that the organizational structure of a firm and the cross-functional communication improve absorptive capacity if they lead to knowledge sharing among departments and individuals within a firm (see also Van Den Bosch et al., 1999, 2003; Lane & Lubatkin, 1998). In addition, according to Daghfous (2004), organizational culture has a positive influence on the level of absorptive capacity if it provides incentives for knowledge diffusion through the empowerment of employees and managers. Gradwell (2003) points to the strong influence of close networks and relationships within firms in stimulating the transfer of tacit knowledge.

The three described determinants have been largely treated as independent of each other. Nonetheless, it is feasible to assume that they are at least to some degree interrelated. As a firm’s ultimate goal is to put acquired knowledge to good use, it has to ensure that all three components of absorptive capacity are built up and not just a single one.

3. Research design - From “firm’s absorptive capacity” to “territory’s absorptive capacity”

Due to the strong competitive dynamic imposed by globalisation it is important to focus on competitive advantages of territories. In this era, competition is not only among firms but also among regions whose development processes are mainly determined by their ability to generate, acquire and exploit knowledge to wealth creation in local economies.

It is for this reason that the concept of firms’ absorptive capacity and its determinant is here translated to territories.
Learning and innovation are the two faces of R&D at the firm level. In-house R&D efforts produce internally-generated knowledge, but they also bring external knowledge to the firm, as companies update their stock of information in order to create novelty.

At a territorial level, R&D activities within the local area generate new knowledge, but also foster the incorporation of externally-generated knowledge into the region. This learning process could be, as well as for firms, disaggregated into its main components.

As seen in the previous section, the basic component of learning and innovation is human capital. It is made of the skills and knowledge embodied in the labour force and it is usually defined as the aggregate number of years of formal education within a population. Education is an investment in learning activities and it has important positive externalities that spread in the region. All learning processes are first and foremost individual human learning. Without human capital there may be no absorptive capacity at the level of firms and of territories. Thus, training and higher education institutions, as well as the capacity to attract human capital from other areas, are key elements of the absorptive capacity of the region.

Secondly, local R&D expenditure are key elements of the region absorptive capacity. They do not only increase learning capabilities but they also increase the ability to transform and exploit external knowledge. However, in order to increase the absorptive capacity of the region, R&D activities should be in line with the institutions and organisations that represent the core competencies of the region.

Third, as for firms, in territories, learning is more complex than simply a process of individual education and R&D expenditure. Even for territories the presence of so-called “gatekeepers” plays an important role in determining absorptive capacity, favouring collective learning processes. Vinding (2006), referring to firms, claims that gatekeepers, whose role is to create a language which can be understood by different departments, improve a firm’s absorptive capacity through knowledge sharing. Gradwell (2003) stresses that gatekeepers’ intermediary role involves screening the environment for knowledge and transforming the relevant knowledge so it can be understood by other employees. Transferring these concepts to regions, gatekeepers are organizations...
able to act either as a “boundary spanner” among actors in the territory and as an interface between the local region and national and international contexts.

Territories should endow themselves of organizations that meet the need for co-ordination among actors, reflecting the local technological structure and their prospective paths, and promoting learning processes and new entrepreneurial activities.

The settings for appropriate informal interactions to happen, contributing to open channels between different institutional actors, is important to be created. At the same time when domestic networks facilitate more efficient and successful R&D activity and strengthen local and regional innovation activities, it is a matter of great importance to link themselves to international networks. Therefore, territories have to find a fruitful balance between regional networking action and building of national and international interactive links.

Science parks, as public-private organizations, in a region could serve to this aim. They can provide particular conditions for the development of partnership and collaboration among firms, universities, public and private research institutions.

They can have a positive impact regarding the wider informal contacts that are fostered through the close proximity among companies and universities or other research centres.

At the policy level, this implies that not only public financial aid for R&D activities is needed to succeed but above all supporting high performance organizations able to orchestrate and to improve knowledge flows among actors is a strategic elements for territory growth.

Table 1 shows the measure of the three factors that are assumed to influence territorial absorptive capacity.

4. Science parks as knowledge gatekeeper of territories enhancing absorptive capacity

IASP- International Association of Science Park (2002) defines a Science Park as “an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation
and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities”.

Table 1: Measuring factors determining absorptive capacity

| Territorial human capital | Average years of schooling (e.g. Benhabib and Spiegel, 1994, Barro and Sala-i-Martin, 1995; Islam, 1995; Barro, 1997, 1999; Temple, 1999; Wolff, 2000; Krueger and Lindahl, 2001). Quality of schooling (e.g. Barro and Lee, 1996; Lee and Barro, 2001; Hanushek and Kimko, 2000; Wößmann, 2003). R&D employees in firms (e.g. Frenz et al., 2004). Employees training at the firms level (e.g. Rothwell and Dodgson, 1991). |
| Territorial R&D expenditure | R&D investment (Leahy and Neary, 2004; Grünfeld, 2003; Stock et al., 2001; Rocha, 1999; Cantner and Pyka, 1998). Number of R&D labs (Becker and Peters, 2000; Veugelers, 1997). |
| Territorial “Knowledge Gatekeeper Organizations” | Number of Knowledge Gatekeeper organizations – e.g. Science Parks, Tecnology Districts, Productive Districts, ILO, Tecnolgy Transfer Office, Universities. Knowledge Gatekeeper performance - in terms of R&D cooperation; licensing agreements; patent agreements; technology transfer contracts (e.g. Rowley et al., 2000). |

Science Parks, started from the early 1950s near Stanford University and boomed in 1980/90s, are playing a more and more important role in enhancing absorptive capacity, acting as knowledge gatekeeper in a region.

During the past 20 years, Science Parks have developed rapidly and showed their vitality with the growth of number of parks, tenant firms, and employments.
The aims and objectives were formed gradually during their rapid development. The most often mentioned were as follows (Quintas et al, 1992): facilitation of R&D links and technology transfer between academic institution and tenants; the formation, attraction and growth of new firms; the promotion of high technology or R&D-based technological activity; employment creation; regenerating local economy; and commercial return on investment.

For our aim, it is important to focus on the fact that Science Parks can have a strong networking effects. Science Parks contribute to the development of heterogeneous networks, including diverse actors, different disciplinary backgrounds or even industrial sectors. They facilitate the exchange of tacit knowledge, the formation of ‘communities of practice’ and the greater access to advanced human resources (Lave and Wenger, 1991).

In a knowledge based economy, that is global and interlinked, there is a strong need to combine knowledge theory and business practice, to strengthen the cooperation between two different environments: research and business. Science Parks are a widely accepted tool which is promoting this cooperation.


The first generation Science Parks are ‘science push’. They are extensions of universities with incubating facilities for start-up firms, offering related business services, developing research-based technology for potential investors and other business entities.

The new ideas stemming from research are channelled to new firms established within or aggregated around the Science Park.

A ‘linear approach’ to innovation is implemented, where scientific results are considered raw material for innovative activities among the business firms in the Science Park.

The second generation Science Parks are ‘demand pull’. The driving energy comes from businesses, interested in the creation and growth of innovation-based companies.

They respond to business needs by making available a mix of high-quality facilities in the Park, by streamlining the flow of technology and related knowledge, and by advancing and combining value-adding business services. They are less concerned with the early exploitation of scientific results and capabilities than with the final stages of the innovation process.
The passage to the third generation of Science Park has emerged coherently with the rising of new conceptions of knowledge production and innovation process.

Philosophers such as Ryle (1949) and Polanyi (1958) were among the earliest scholars who expressed an interest in knowledge. Since then, the number of studies in knowledge have been growing rapidly.

In particular, in 1974 Collins underlined the importance for high-tech firms to develop strong connections with academic labs in order to master new knowledge. In accordance to this concept, Cohen & Levinthal (1989) focused on the circulation of knowledge.

In the same period, Rosenberg (1974) portrayed the innovation process as a set of activities linked to one another through complex feedback loops (chain linked model). Innovation was seen as a “trial-error process”, the result of an interactive and collective process within a set of connections among people and institutions which evolve over time (Kline & Rosenberg, 1986).

This gave progressively rise to a “network model of innovation” with the notion of “techno-economic networks” (Callon, 1992; Laredo & Mustar, 1996) or more recently “distributed innovation process” (Coombs et al., 2002) or “open innovation” (Chesbrough, 2003).

The growth of interest in the connections leading to new knowledge production and the importance given to “contamination” and “cross fertilization” among different institutions in the innovation process, was at the base of the new conceptual framework proposed by Freeman (1987), Lundvall (1992), Nelson (1993) and Edquist (1997) where research centres not only produce new knowledge, but they do it with a social and economic perspective in mind.

Therefore, we define the third generation Science Parks as organizations that, coherently with the new conceptions of knowledge production and innovation process, address their effort towards “interactive innovation”. Their objectives is to increase the wealth of the territory by promoting science-industry-government relations, offering more broadly-based and more comprehensive varieties of innovation-related services, creating communicative linkages among a big spectrum of entrepreneurial activities and so acting as a catalyst for innovation that could influence also the broader culture of entrepreneurship in the region.
Science Park can create the highest level of integration and interactions among actors in a territory. This can lead to easier knowledge transmissions, more innovation, and effective management, which can enhance firms’ long-term competitiveness.

5. Research Propositions - Science and Technology Park of Sicily: its role in a hostile region as the core of an innovation network

The Science and Technology Park of Sicily (PSTS) is a public-private owned consortium arising from the initiative of Sicilian Region. PSTS has developed a complex system of relationships between Sicilian universities, research centres, institutions and companies that share the mission of enhancing the competitiveness of the region through research, innovation, technology transfer and dissemination of a culture of quality and specialized training.

PSTS operate in the Sicilian territory, often define as a “wrong place” because of its inability to exploit territorial potential. In such a context, the role of PSTS is to establish an innovation network consisting in a number of positions or nodes, occupied by individuals, firms, business units, universities, governments, customers or other actors, and it is an organizational response to the complexity or uncertainty of technology and market (Tidd et al, 2005).

The innovation network exists at multiple levels, including sector, regional, national, or global, and it is open to host universities and other research institutions, on-park or off-park firms, and regional and international organizations. It shows flexible structure rather than clear hierarchy and boundaries, it is dynamic and orient to long term collaboration (Tidd et al, 2005). The network is made up of various organizations, which have a core with both weak and strong ties, formal and informal links, among constitute members.

The PSTS acts as an intermediary or organizer to exchange information and solve the interface boundaries between different organizations.

Secondly, since the current innovation is full of complexity and uncertainty, and it is almost impossible for any actor to finish innovation independently, each actor in the network has its own core competence and expertise. As an
innovation network, PSTS is a learning organization. By learning, new capabili-
ties and assets are identified, acquired, shared among network participants, and
continuously updated to give the network a whole competitive leadership (Ry-
croft & Kash, 2004).

Finally, such collaborative R&D activities around PSTS are oriented directly
to solving problems. Numerous studies have confirmed the vital importance of
user-producer linkages, and successful innovations were characterized by de-
veloping an understanding of special needs and circumstances of potential fu-
ture users of new products, process, or service. Since the collaborative R&D
fully take the user needs into account at the beginning, the commercialization-
oriented innovation can achieve the goals of rapid response to market, sharing
R&D costs, reducing risk and uncertainty.

Starting from these elements and relating to considerations developed in the
previous sections, three propositions emerge. They are addressed to the study
of territory’s absorptive capacity, with a special focus on PSTS local area, and
they could be tested in future researches:

**Proposition 1 a**: Territory’s absorptive capacity is dependent on the skills
and knowledge embodies in the local labour force.

**Proposition 1 b**: R&D expenditure in a local area increases learning capa-
bilities and the ability to transform and exploit external knowledge, positively
influencing territory’s absorptive capacity.

**Proposition 1 c**: The more is the performance of “knowledge gatekeepers”
the more is the level of territory’s absorptive capacity.

**Proposition 2**: Science Parks act as knowledge gatekeepers by developing
innovation networks at multiple levels, and continuously updating and sharing
knowledge among network participants, with a closer look at market needs.

The first proposition is related to the fact that transferring the concept of ab-
sorptive capacity from firms to territories is possible to detect that at a territo-
rial level, R&D activities within the local area generate new knowledge and fos-
ter the incorporation of externally-generated knowledge into the region. More-
over, local R&D expenditure increases learning capabilities and the ability to
transform and exploit external knowledge. Finally, knowledge gatekeepers, as
organizations able to act as a “boundary spanner” among actors in the territory and as an interface between the local region and national and international contexts, can create the right setting for appropriate knowledge interactions to happen, contributing to increase territorial absorptive capacity (Singh, 2005).

As far as the second proposition is regarded, it aims at testing if Science Parks act as knowledge gatekeepers. In the matter of facts, Science Parks are organizations that stimulate and manage the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; facilitate the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities.

6. Conclusions

Starting from the original concept of firm’s absorptive capacity, the paper extends this notion to territories, defining four propositions that could be later tested.

Territory’s absorptive capacity determinants are identified in the skills and knowledge embodies in the labour force, R&D expenditure and the performance of “knowledge gatekeepers”.

At the policy level, this implies that not only public financial aids for R&D activities are needed to succeed but above all supporting high performance organizations able to orchestrate and to improve knowledge flows among actors is a strategic elements for territory growth.

In particular, Science Parks are considered as knowledge gatekeepers able to develop innovation networks among actors in territories.

Final considerations regard the fact that the more is the performance of Science Parks as knowledge gatekeeper developing innovation networks, the greater is a territory’s absorptive capacity.

The paper focuses mainly on Scientific and Technology Park of Sicily - PSTS as an economic player for the development of absorptive capacity in a hostile environment whose hope is to reach a significant regional competitive advantage to face challenges imposed by international competition.
PSTS could provide a promising opportunity to make changes needed to put the region on a more entrepreneurial growth path and to pave the way for a more prosperous future.
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