Science parks as knowledge organizations – the “ba” in action?

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Abstract
Purpose – The purpose of this study is to contribute to the understanding of the failure of science parks to become a central actor in the knowledge economy and, with the help of new organizational theory, to propose new solutions.

Design/methodology/approach – The paper reviews a number of recent studies of science parks and their effect on innovation and economic growth, measured by revenue or survival rate of new firms, but demonstrating no positive result of the parks. The paper then introduces modern organization theory, specializing in analyzing the processes of creating, managing, organizing, and transferring knowledge distributed through a number of networks and other volatile organizations in order to investigate the set-up of science parks in the knowledge economy.

Findings – Using Nonaka’s concept of ba as a metaphor for the new tradition in organizational theory, the paper finds very few – if any – signs of these new ways of organizing in traditional science parks. The paper argues that principles from modern knowledge organizations has to be installed in science parks if the parks are to regain the initiative and become an important actor in the new regime of knowledge production. Otherwise, science parks must be viewed as an outdated institution, left over from the industrial society.

Practical implications – The paper proposes a system of certification and quality assessment that might speed up the change in science parks from organizations formed by the industrial society to organizations serving the needs of the knowledge society.

Originality/value – The paper is an original contribution to the theory of science parks and innovation policy. The use of new organizational theory on knowledge management, illustrated by Nonaka’s concept of ba, presents a new solution to overcome the traditional thinking on how to organize science parks.

Keywords Knowledge creation, Learning organizations, Science parks, Knowledge management, Innovation

Paper type Research paper

Introduction: science parks and the knowledge economy
After a number of years of relative silence, science policy has gained a new and central significance as a key actor in the creation of wealth and economic growth based on the creation and application of knowledge. The new and important role of science policy in the EU and in individual member countries has produced a renewed interest in science parks[1].

Science parks are well known institutional instruments in science policy but, as Clark (2003) points out, it is not correct to understand science parks as the result of a rational model of technology transfer founded in economic theory. Science parks first came into being as a practical experiment in California in the late 1950s. The idea was to locate new industrial sites close to a university – in this case Stanford – in order to facilitate the application of science to technological innovation. The success that followed from this geographical proximity between research (the university) and
business was noted, and the lessons that were learned were later organized and
developed into the model of science parks we know today. In the science policy of the
1970s and 1980s we witnessed science parks developing to become one of the most
important instruments in Western societies when it came to developing local or
regional economic growth that was to be based on the application and distribution of
new technology and knowledge in combination with entrepreneurship and the
establishing of new firms. In this period of optimistic economic growth, science parks
often successfully combined a local policy interest in regional economic or industrial
development with a more general policy interest in setting up new firms through the
promotion of entrepreneurship. Academic interest in this phenomenon has
consequently had its base in regional and industrial economics and
entrepreneurship theory within business economics from the beginning, while
general economic theory has been slow to take up the problems of connecting the firm
with macro economic developments (Massey et al., 1992; Clark, 2003; Mønsted, 2003).
Later, in the wake of recessions and much slower economic growth, science parks lost
some of their glamour as a policy instrument.

The parks have been a central part of the solution to the difficult and complex
problems of regional economic development, employment and the creation of new
businesses. The European Commission sees a science park as “a business incubator”:

... a place where newly created firms are concentrated in a limited space. Its aim is to
improve the chance of growth and rate of survival of these firms by providing them with a
modular building with common facilities (telefax, computing facilities, etc.) as well as with
managerial support and back-up services. The main emphasis is on local development and
job creation. The technology orientation is often marginal (European Union, 1990).

The official EU model of science parks emphasises the traditional idea of science parks
as a means to local development and job creation.

With the economic upswing in the 1990s, and especially the fast growing role
of knowledge-based industries, the role of setting up new firms (the entrepreneur) once
again came into focus in economic policy, setting a new agenda for science policy. But
if the science policy of the 1970s and 1980s had a strong tradition of setting up
institutions and distributing knowledge and technology based on the idea of a rather
linear and straightforward model of implementation, the role for the science policy of
the twenty-first century is much more complex and multi-dimensional, combining
processes of learning, organizational development and institutional change in relation
to a much more intangible object: knowledge. In the knowledge based economy the
most important part of the dynamic depends on the creation of new organizational
frameworks for knowledge creation, production and application (Lundvall, 2002a, b;
Archibugi and Lundvall, 2001). The changes in knowledge production imply new roles
for the traditional providers of scientific knowledge (the universities) formulated as a
transition from a more traditional form of research organised by disciplines, or what is
now called Mode 1 knowledge production, to a much more transdisciplinary or
interdisciplinary form of research organization with close collaboration with partners
outside the universities, or what is called Mode 2 knowledge production (Gibbons et al.,
1994; Nowotny et al., 2001). We have also seen the emergence of closer and more
interactive relations between universities, (local) state agencies and industry, which are
based on setting up new institutional arrangements – the triple helix concept
(Etzkowitz and Leydesdorff, 2000).
One important consequence of the “new turn” in science policy is the focus on old as well as new institutional arrangements in fostering cooperation between the many old institutions that produce knowledge and innovation and the new institutional arrangements that hope to leverage their results. The idea of the triple helix not only argues for closer institutional collaboration between these institutions, universities, research organizations, private firms – it also argues for the development of new means to govern the interaction between these institutions. This argument follows as a consequence of the intensive collaboration that has been witnessed in different research projects and includes a push for changes in the institutions themselves, especially the universities, in order to comply with the new demands for knowledge and innovation (Martin and Etzkowitz, 2000) or develop new institutions like the entrepreneurial university (Clark, 1998).

The new focus on knowledge highlights the role of the institutions that produce it in the economy, old as well as new, and cannot avoid having an important impact on the roles science parks play and the conditions under which they operate.

What are the consequences for science parks of the new interest in institutional changes in knowledge creation and organization? The paper will try to discuss the important questions asked by the new knowledge economy to the existing institutions. How do the recent discussions of major changes in the conditions of knowledge production and distribution in and between companies and knowledge organizations influence the recent development, organization and function of science parks? The paper will outline some of the recent challenges that science parks face found in theories on organizational knowledge creation and discuss if and how the parks can be integrated into and become an important part of the new knowledge economy. By looking at recent studies of science parks the paper will try to locate barriers to the influence of the new knowledge creating organization on the more traditional concept of science parks.

A number of studies of the impact of science parks have questioned the traditional optimistic view of the effect of the parks on innovation and economic growth (Siegel et al., 2003b; Mønsted, 2003; Clark, 2003). On the one hand, a large number of studies of science parks and incubators tend to measure the effect on rather traditional economic indicators (annual growth, profitability, employment rate, number of new companies), seldom taking the growing importance of knowledge in the new economy into account. The role or function of knowledge in the new economy is very difficult to measure, as the extended discussions on measurement and guidelines for assessing intellectual capital have demonstrated (Bontis, 2001)[2].

On the other hand, in-depth studies of science parks have compared relatively detailed information on a few science parks and then condensed it to a more differentiated picture of the internal working life of the park. Being based on a small number of cases, however, these studies present in-depth analysis that is methodologically limited regarding the generalization of the results.

The literature on new organizational theory has for the last ten to 15 years focused directly on the new questions and new demands for institutional or organizational changes in how to create and organize knowledge production. It has introduced a number of novel concepts in order to analyze the ongoing turbulent changes in (private) knowledge organizations. The literature on knowledge management and knowledge organization has a common focus on the inner life of the organization: it focuses on where knowledge is created or produced and on how it depends on people,
organizational setups and relations in networking with other knowledge-producing organizations (Dierkes et al., 2001; Tsoukas and Knudsen, 2003). The theory has shown itself to be of central importance for the analysis and understanding of the dynamics of knowledge creation in the new economy and has shifted the focus in organizational knowledge production from technical to social dimensions. The new agenda for the knowledge producing organization has not only made its way into organizational theory, but has also been implemented in knowledge-based organizations worldwide.

A vital question for science parks is whether the new emphasis on knowledge creation has found its way into the more traditional models of science parks, with a history that used to be focused more on the linear application of technical knowledge and local and regional perspectives.

In order to be able to discuss the research question about the role or function of knowledge creation in science parks, the paper will first present some central concepts from the literature on knowledge creation and organizing. The discussions on organizational theory are broad, differentiated and complex (Dierkes et al., 2001). In order to have a standard against which to discuss and evaluate science parks as creative knowledge organizations it is necessary to select from the many theoretical concepts that have been applied in recent discussions on knowledge and organization. In this paper use the concept of *ba* is chosen as it figures in discussions of knowledge creation in the work of Nonaka and his colleagues in several theoretical papers [3]. *Ba* is one of the most used and discussed concepts of knowledge creation and it is a clear marker of the literature on knowledge creation in organizations as an individual enterprise.

The paper then proceeds to a discussion of recent literature reviewing the impact of science parks in order to trace the discussion of the traditional role of science parks and especially the impact or lack of impact by recent work being done in organizational theory. The literature reviewing science parks can be divided into two major categories, one measuring science park performance by large comparative empirical studies and one that takes a case-based approach centred on in-depth studies of a few science parks. The key question in reviewing these evaluations of science parks is whether these studies have produced knowledge on how the parks can regain initiative and become an important actor in the knowledge economy.

**Knowledge creation in organizations**

First, then, it is necessary to discuss some of the key concepts in organizational theory related to knowledge and knowledge creation. It is possible to distinguish between models that analyze the knowledge creation process as a set of activities that take place primarily inside an organization and models that are based on the individual as knowledge creator. The concept of *ba* (Nonaka et al., 2000) is the most well-known, used and expounded concept of internal knowledge creation in organizational theory on knowledge organization.

Other core concepts in organizational theory imply a more collective approach to knowledge and knowledge creation, where knowledge is understood not as individual or personal qualities but as an activity based on complex processes between groups of individuals, teams, collectives or organizations. Central concepts in this line of inquiry are “communities of practice” (Brown and Duguid, 1991; Wenger, 2000), “sticky and leaky knowledge” (Brown and Duguid, 2001), “structural holes” (Burt, 2002), and “absorptive capacity” (Cohen and Levinthal, 1990). These concepts are drawn from the
part of organizational theory that is founded on sociological perspectives and focus on
the relations that obtain between knowledge organizations and the exchange processes
within and between organizations. All try to capture some central aspect of the
interpersonal dimension of the new, important and complex role of knowledge creation
in organizations.

These quite different approaches have one thing in common: they all question the
relevance of established ideas of the linear implementation of knowledge, running from
the original innovation to the commercial product. The linear approach has been
concentrated mainly on control systems and the formal management of the production
and use of knowledge in the organization and not on the less predictable “soft”
processes, whether individual or organizational, including learning processes. The
implementation of new knowledge in organizations was for many years understood
only in terms of technical problems and their solutions, not as one of continuous
learning and creativity. It was, moreover, normally approached as a rather isolated set
of processes taking place within the clear-cut and closed boundaries of an organization.

The creation of knowledge and \( ba \)

In his widely cited paper, Nonaka (1994, p. 17) formulated the central role of the
individual in knowledge creation:

At a fundamental level, knowledge is created by individuals. An organization cannot create
knowledge without individuals. The organization supports creative individuals or provides a
context for such individuals to create knowledge. Organizational knowledge creation,
therefore, should be understood in terms of a process that “organizationally” amplifies the
knowledge created by individuals, and crystallizes it as a part of the knowledge network of
the organization. [..] The prime movers in the process of organizational knowledge are the
individual members of an organization. Individuals are continuously committed to recreating
the world in accordance with their own perspectives. As Polanyi noted, “commitment”
underlies human knowledge creation activities. Thus commitment is one of the most
important components for promoting the formation of new knowledge within an
organization.

From the analysis of the important role of the individual in knowledge creation,
Nonaka, in collaboration with Takeuchi and Konno (Nonaka and Takeuchi, 1995;
Nonaka and Konno, 1998) went on to present one of the first and most elaborated
critiques of the linear approach based on the idea of the individual knowledge creator.
With the help of the two concepts of explicit and tacit knowledge they elaborated the
analysis of the knowledge creation process into a model called SECI, which made
essential use of the concept of \( ba \). The interaction between management, organization
and the creation of knowledge is the core of the concept of \( ba \). It was originally
presented in a seminal article by Nonaka and Konno (1998), to be followed by
discussions in several other publications, where they offered a complete model of a new
understanding of dynamic knowledge creation. SECI is a model of the conversion of
tacit to explicit knowledge and vice versa by the use of externalisation, socialisation,
internalisation and combination in a spiralling process (Nonaka et al., 2000, p. 12). The
SECI model depends on knowledge creation and:

\[ \ldots \text{the } ba \text{ is here defined as a shared context in which knowledge is shared, created and}
\text{utilised. In knowledge creation, generation and regeneration of } ba \text{ is the key, as } ba \text{ provides} \]
the energy, quality and place to perform the individual conversions and to move along the knowledge spiral (Nonaka et al., 2000, p. 14).

*Ba* exists in four different forms, as the originating *ba*, the dialoguing *ba*, the systemising *ba* and the exercising *ba*, where the type of interaction (individual or collective) and media (face to face or through virtual media) is decisive. The internal relation dynamics between different types of *ba* and their interaction and media is described with the help of a spiral, illustrating the complexity of the creation processes.

Each *ba* offers a context for a specific step in the knowledge-creating process, though the respective relationships between each single *ba* and conversion modes are by no means exclusive. Building, maintaining and utilising *ba* is important to facilitate organizational knowledge creation (Nonaka et al., 2000, p. 16).

This can be illustrated with the much used figure (see Figure 1), where the spiral introduces the dimension of time and dynamics (e.g. the process goes on and on between the different stages of *ba*).

Used as a metaphor for combining the individual and social dimensions in knowledge creation, the concept of *ba* has been systematised by Nonaka, Toyama, Konno and others. Not all dimensions in *ba* are as original as postulated and the authors use their own reading of other theoretical contributions like the concepts of tacit and explicit knowledge in ways that are rather different from the original discussion by Polanyi[4]. Nevertheless, the strength of the concept of *ba* is the fascinating combination of the three central dynamics in individual knowledge creation:

1. complexity;
2. process; and
3. learning.

The analysis leads us to focus on teams, trust-building, social competences and new roles for managers:

Creating and understanding the knowledge vision of the company, understanding the knowledge assets of the company, facilitating and utilising *ba* effectively, and managing the knowledge spiral are the important roles that managers have to play. Especially important is

![Four types of ba](image)

**Figure 1.**

*Source: Nonaka (2000, p. 16)*
the role of knowledge producers, the middle managers who are at the centre of the dynamic knowledge-creating process (Nonaka et al., 2000, p. 30).

I have chosen the concept of *ba* as a useful metaphor for the kind of challenges modern knowledge organizations are facing and as an ideal of what the modern science park should be. The main questions in the following discussion of a number of evaluative studies of science parks are whether these studies have produced knowledge on whether science parks are moving in this direction (the direction of *ba*), or what has to be done in order to establish knowledge creation systems in science parks.

According to Nonaka, the concept of *ba* combines the learning dimension and organizational commitment with an understanding of the complexity of knowledge creation and the dynamic nature of knowledge creation in the organization. Nonaka et al. (2000) end their analysis of the SECI model and *ba* with a very clear formulation of the relevance of *ba* for studies of science parks:

> The market, where the knowledge held by companies interacts with that held by customers, is also a place for knowledge creation. It is also possible for groups of companies to create knowledge. If we further raise the level of analysis, we arrive at a discussion of how so-called national systems of innovation can be built. For the immediate future, it will be important to examine how companies, governments and universities can work together to make knowledge creation possible (Nonaka et al., 2000, p. 30).

**What is a science park?**

The concept of science parks has a long and complex history and has been implemented in several different settings all over the world. The result is a multi-dimensional concept and it is difficult to give an all-encompassing authoritative definition. According to the EU, it is:

> ... [a] place where newly created firms are concentrated in a limited space. Its aim is to improve the chance of growth and rate of survival of these firms by providing them with a modular building with common facilities (European Union, 1990).

The International Association of Science Parks (IASP) sees science parks from a more organizational and managerial point of view and defines a science park as:

> ... an organization managed by specialized 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 (International Association of Science Parks, 2004).

The definitions of the IASP and the EU differ in their emphasis on the active role of managing the organizations and networks related to the parks. The IASP definition clearly focuses on science parks as a special facilitator between institutions in relation to the incubation and implementation of scientific knowledge into innovative commercial applications. Contrary to this, the definition by the EU is very oriented toward providing spaces, buildings and other physical facilities for new entrepreneurs. Massey et al. (1992, p. 14) found the same orientation toward the space or location
dimension in a study of different definitions of science parks in Europe and Great Britain. The dominating idea of science parks in Europe is that of a property-based initiative with formal links to a university or other higher educational or research institution. A science park, in this view, is designed to encourage the formation and growth of knowledge-based business and to support a management function that is actively engaged in the transfer of technology and business skills to the organizations on site. In a large study of policies towards new technology-based firms in the EU, Storey and Tether (1998) defined science parks from a macro-policy perspective. They, too, hold the property dimension to be very important and the rationale underlying the development of science parks is that they can play the following roles:

- To enable academics at the local university to commercialise their research ideas in a convenient location.
- To provide accommodation for existing well-established (possibly large multinational) businesses wishing to locate near, or on, a university campus so as to facilitate research links with individuals or departments within the university.
- To provide high-quality prestigious accommodation for existing/established (small) businesses which are using and developing sophisticated technologies. The aim is to enable them to obtain the benefits of close association with the university, other similar businesses on site and the managerial services provided by the park staff (Storey and Tether, 1998, p. 1038).

Despite differences in the definitions of science parks, most of the literature emphasises the importance of three aspects or dimensions:

1. that the physical location is in close proximity to a research institution;
2. that knowledge or high-tech business is the core business; and
3. that there is a specialized managerial function to help the start-up of new business (incubation).

A science park then is first of all characterized by its physical setting with buildings, laboratories, etc., combined with managerial support and with close access to a public research organization – often one with a research knowledge base in high tech or biotech. The combination of a particular physical location and a high level of technology or knowledge distinguishes science parks from a number of newer competitors like business parks, business incubators and innovation centres. This dimension is also central to the understanding of science parks in the science policy literature, especially in the discussions of Mode 2 science (Nowotny et al., 2001) and the concept of triple helix (Etzkowitz and Leydesdorff, 2000), where science parks are described as one of the central institutions working together with universities and business in order to provide new collaborations between universities and business in order to boost the transfer of technology and the application of scientific knowledge in the interest of economic growth.

The kind of science parks described by these definitions does not look like the kind of organizational set up for the creation of the creative knowledge producing organization, described as 

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On the other hand, Nonaka and Konno (1998) use a number of very different cases to demonstrate how differently the creation and continuous transformation of \textit{ba} can be organized. The management function in science parks does not normally go beyond the role of a facilitator in the use of tangibles or as an incubator, working with relations between separate organizations and companies. The park’s management functions have limited opportunities to intervene or assist in the operations of the independent firm or organization, and this is far removed from the idea of \textit{ba}, with an active and intervening (middle) management. But descriptions or definitions of science park praxis are clearly not enough to discuss the reality of science parks in relation to organizing knowledge creation and does not provide a solid basis to rule out the idea that science parks could develop into creative knowledge organizations that are organized in terms of \textit{ba}. In order to investigate whether science parks do support creative knowledge organizations like \textit{ba} in their daily operations it is necessary to take a closer and more systematic look at the recent literature on the impact and function of science parks, and especially to look into the relations between the parks and the organization of the knowledge creation processes.

The concept of \textit{ba}, like other central concepts from organizational theory, is a theoretical construct and needs an operational, empirical interpretation in order to serve as a basis for the investigation of the amount of organizational support and processing that is at work in science parks. The central research question is then reformulated into a question about the ability of science parks to reorganize and develop internal knowledge creation systems. One possible measure of this is the existence of intellectual capital assets. The measurement of intellectual capital and assets has become of central importance for companies (M’Pherson and Pike, 2001; Marr \textit{et al}., 2003). In light of the rapidly growing interest in measuring intellectual capital assessment in companies and especially in business start-ups (Peña, 2002) and it should be possible to find empirical evidence on the basis of which to assess the amount of intellectual capital in science parks in different studies and relate this to the question of \textit{ba}.

\textbf{Impact of science parks}

The abundance of empirical studies of science parks can be organized by several dimensions. One consists of studies measuring the effect of science parks in the economy in a rather traditional manner (based on economic indicators like annual growth, profitability, employment rate, number of new companies). The other consists of a group of studies that are more differentiated but all based on the comparison of a few detailed cases in order to produce a varied and complete picture of the internal working life and procedures of the firms involved and their interaction with the parks. While the first group of studies tends to measure only a few variables and indicators across a large number of parks, thereby leaving out the more differentiated and individual variations between parks, the case-based studies have other limitations regarding the validity and generalizability of the results. Nevertheless, both types of studies of science parks contribute to the general evaluation of science parks by highlighting different but equal important limitations in the set-up of traditional science parks compared to the questions and demands presented by the knowledge economy. The macro or indicator studies evaluate the economic performance of the parks, especially the creation of new firms, while the case studies evaluate the internal
or organizational performance of the parks in relation to producing innovations, to overcome boundaries and integrate in networking with other actors.

The macro approach to science parks studies
Siegel et al. (2003a, p. 181) reviewed a large selection of the newest literature on the effect and impact of science parks and found a number of serious methodological weaknesses. The data that was used to demonstrate impact was often too limited in scope, the conclusions were based on an overestimation of data, or studies based on longitudinal data demonstrated no significant differences in performance (Siegel et al., 2003a, p. 179). Based on a review of this literature, they formulate four critical research questions to be answered in order to measure direct impact of science parks:

1. Do firms located on a science park have higher research productivity than observationally equivalent firms not located on a science park?
2. Do the “returns” on location in a science park vary according to the type of park (e.g. a university science park)?
3. Do the “returns” on location in a science park vary according to the type of entrepreneur who locates in a park?
4. How does activity on a university science park affect other dimensions of university technology transfer (e.g. licensing agreements and other university-based start-ups)? (Siegel et al., 2003a, p. 182).

These research questions are clearly relevant in relation to a general conception of the performance of science parks, but it is important to note that the four questions do not cover the organizational and managerial side of knowledge creation and do not raise questions about the intellectual capital that is at work in the science park. In reality, the questions presuppose that knowledge production is already organized and taking place and the role of the science park is exclusively one of managing the relation between the general organization of the park and the outcome from the firms, measured in “returns”. The study by Siegel et al. (2003a) demonstrates the methodological difficulties inherent in the macro approach to measurements of the effect of science parks. In order to have measurable comparative units, and because a firm is a well-defined legal and economic unit, most of the studies compare science park firms with off-park firms, because it is the official statistical information available. However, restricted to this type of information they are unable to analyze the processes that organize knowledge as well as the knowledge creation (networking) that occurs in the interaction between different units in the parks and between the parks and the off-park environment.

Reconsidering the difficulties inherent in estimating the productivity of university science parks, and especially the impact or role of technological spill-overs on productivity of firms, Siegel et al. (2003b) investigated a number of science parks in a further study. The empirical material in this study has other methodological limitations because the authors decided to survey only “independent” science park firms, thereby precluding, among other things, the comparison of large firms with smaller R&D units on such facilities. In relation to the question of location, however, the consequences of the limitation are serious, as their own conclusion indicates:

Our preliminary results suggest that firms located on university science parks have slightly higher research productivity than observationally equivalent firms not located on university
science parks. These impacts are not as strong when we control for endogeneity bias, or the possibility that location on a university science park and the generation of research output are jointly determined (Siegel et al., 2003b).

Based on a much smaller sample, Lindholm Dahlstrand and Klofsten (2002) concluded a study of Swedish science parks with some observations on the role of universities, adding some open questions to the results by Siegel et al. (2003b, p. 44):

One main objective of Swedish science parks is to transfer and commercialise academic research, and thus create opportunities for collaboration with universities and/or other institutions of higher education and research. [...] However, it seems like the frequency of university spin-offs might be declining, and today we can only find that 25% of the tenants in the parks are university spin-off firms. It is hard to believe that the remaining 75% of the tenants have even lower needs of technology-related services.

This study also have some critical remarks aimed at the operation or function of universities in the field of entrepreneurship, but it leaves out the complex question of knowledge creation. In another study, Johannisson (1998) found that due to a higher degree of academically trained entrepreneurs the networking behavior between entrepreneurs is changing. But to what degree these changes are related to the question of organizing knowledge creation systems – i.e. to _ba_ – is not clear from these data.

Massey et al. (1992), Storey and Tether (1998) and Mønsted (2003) found that in most European science parks the average number employed by a firm is between ten and 20, and except for France, which established a number of science parks in the 1970s, most European science parks are comparatively new with the major part of the parks established in the 1980s and 1990s. These important differences in lifespan and economic conditions should be taken into consideration when making comparisons between science parks in the USA and in Europe. According to Storey and Tether (1998), it is premature to make definitive judgements about the effectiveness of science parks in Europe. They argue that the effects of science parks are largely mediated and indirect, take a long time to be implemented and depend on a number of other public policies to create support for new high-tech firms. Such policies, for example, condition the supply of PhDs, relations to universities and research institutions (the triple helix), and the amount of direct national financial support and advisory services.

The restriction of scope to only legally independent firms or owner firms in the study of science parks in order to make comparisons with outside, off-park smaller firms excludes most of the role played by all sorts of relations, public policies and networks.

The approach used by these comparative macro studies has some inherent limitations that stem from focusing on traditional firms as the object of observation and as the rather well defined and measurable units of performance. The approach itself hinders a systematic registration of internal and organizational activities in science parks that do not bear the mark of firm, or are located inside a single (large) firm. Also, possible knowledge-based activities of a more probing or untraditional character like learning, interchange of knowledge, networking and other organizational activities not necessarily found in all science parks will not be measured by these studies. And, while many studies of knowledge creation across boundaries within organizations emphasize the fact that measures of intellectual capital might be the best macro-indicator at the moment of not-so-traditional knowledge creating activities that include elements of learning, change, crossover and
collaboration, information on this kind of activity is very difficult to find in most comparative studies of science parks. Moreover, these activities are precisely central to the \( \text{ba} \) – and as discussed above – constitutes the core of how knowledge is created by individuals and organized in the firm. When we tried to evaluate science parks’ performance on organizational knowledge-creating activities, exemplified as \( \text{ba} \), we found that it was difficult to find in most science park studies.

To what degree science parks as a whole have changed from an innovation- and product-oriented organization to one where knowledge creation and learning is in focus is difficult to evaluate on accessible macro data.

**The case-study approach to science park studies**

The idea of changing the focus to learning instead of innovation when studying the effectiveness of science parks was suggested by Lindelöf and Löfsten (2003). They concluded that there were difficulties in measuring innovation by indicators and a need for studies able to go beyond the level of the many comparative studies. These studies depend on macro economic indicators and are too often unable to come up with any clear conclusion regarding the questions raised in this paper, i.e. whether or not science park firms are more or less innovative and productive than firms outside science parks. The case study approach has methodological advantages compared to the limits in macro-indicator studies because it can use a whole array of different qualitative methodologies and do in-depth studies but at the same time, the conclusions are local.

Local or regional policy interests founded on unspecified and unverified hypotheses about the learning opportunities that the parks provide can according to these studies, explain the continuous existence of science parks and the renewed local interest in building new parks. Do these learning opportunities exist? The many comparative studies of science parks have not been able to demonstrate science parks as learning organizations. Most science parks, moreover, present themselves as being very much in line with the basic assumptions of the macro studies by stressing their strength in setting up innovative firms, not in creating a “learning environment”. The seeming contradiction between the results of an almost endless number of studies of established and up-and-coming knowledge organizations in organizational theory and the missing empirical evidence from a number of comparative studies of science parks might be solved if we take a closer look at science parks with the help of case-based studies. The case-based approach has the openness needed to inquire into many different aspects in science parks from the obvious path laid out by the many central themes from studies of knowledge originations.

The importance of looking for these complex organizational processes is demonstrated by Lindholm Dahlstrand’s (1999) case study of the origin of new high-tech SMEs in the Gothenburg region. The study questioned the conventional wisdom of measuring and comparing “normal” firms in and outside science parks and demonstrates the importance of looking at other types of learning processes for new SMEs. After all, most of the new SMEs in the region have a local origin that can be traced to either a university or some major company, and they continue the collaboration in different forms over time:

The empirical findings clearly demonstrate that there are two main sources of new entrepreneurs of technology-intensive SME’s in Göteborg region: Chalmers University and the well-established large, and medium sized, industrial firms. Almost all new entrepreneurs
come from within the region, or are former students returning to the region. [...] Local spin-offs, and the transformation of entrepreneurs and knowledge, from well-established organizations into new independent enterprises seem to be one of the main processes of intra-regional learning in Göteborg (Lindholm Dahlstrand, 1999, p. 387).

What we see here is one case demonstrating the complexity of knowledge creation in situations where science parks can no longer be used as the only or basic unit but only as a part of a larger regional system of innovation. The Gothenburg case has further implications, because it explicitly challenges the standard methods used in the literature for measuring the impact of science parks. It does so by including all types of innovative organization in the whole Gothenburg region and not limiting the study to what is a formal firm inside and outside a science park. In this way, the study is able to focus on the direct and indirect relations between entrepreneurs and universities and major companies. The result is that science parks do not have any visible impact in this Gothenburg case if seen only as a traditional location for new companies. Normally very few of the managerial activities that go on in science parks seem to be related to the knowledge creation that in fact takes place in them.

The case study by Lindholm Dahlstrand (1999) illustrates how problems arise when one limits studies of the development of creation of new knowledge and innovation to traditional organizational constructions, i.e. the science park and the firm. A central result of the Gothenburg study is a picture of modern and successful science parks because the case approach went beyond studying only parks and firms but also included network relations to other knowledge organizations. This way the picture gets much more complicated and it is in these environments that we find evidence to suggest that knowledge creation crosses the boundaries of the firm, and that knowledge is transformed through a number of different processes.

Another case study presents a more elaborate system of collaboration between a local university and different organizational and financial arrangements and initiatives. The INEX in Newcastle is a new science park initiative set up in 2001 to boost commercialization of university research through a number of different concepts and initiatives. These initiatives, like the technology village, a spatial reordering of participating schools and institutes and a mapping of the research at the university related to centers of excellence in the region, redefine the concept of science parks (Hansson et al., 2005). In addition, a number of initiatives to develop an entrepreneurship culture at the university have been implemented, including professional development courses and an active management team with a business background. But one of the most important new initiatives is the attempt to organize the active involvement of researchers in the project. The basic idea in the Newcastle model is to avoid the departure of top researchers as they start their own companies, thereby weakening the capacity for any future production of new ideas in the university, but to combine the established research system with the fact that an unending inflow of new ideas in the form of PhD projects passes through the university, and then to institutionalize systems that promote entrepreneurship by a number of different initiatives. This is where Ken Snowdon, professor and director of INEX at the University of Newcastle, sees some real promise for the park:

These young people – undergraduates, postgraduates and post-docs – represent the largest untapped resource within the UK university system. They are enormously enthusiastic and highly possessive of their research projects. They are the key to the establishment of new
high-tech companies and the development of rapidly expanding advanced technology clusters with strong links to the knowledge base (Snowdon, 2003).

The major difference between the case from Gothenburg and the Newcastle case is how the science park concept is organized and extended to include changes and new structural arrangements both between the university and the park and within the university itself. The Newcastle model is far-reaching in its scope; it implies some fundamental changes in the classic concept of science parks as well as organizational changes inside the university in relation to research management:

Here the vision is not to transfer certain research results with particular commercial difference between this and the traditional model, the latter is tailored to help commercialise research, whereas the Newcastle model seeks to build an institution that is capable of producing commercialisable research (Hansson et al., 2005).

What the two cases have in common is that they demonstrate convincingly some very important limitations to the traditional idea of a science park as a rather passive organization based on providing support to incoming new innovative ideas and transforming them into commercial business start-ups. The model is inadequate when it comes to attracting dynamic new business start-ups and especially when it comes to acting in more complex situations where innovations are not already there but are merely a possibility that needs to be realized by creative work in very different organizational settings that involve unknown participants (new PhD students). The Gothenburg case showed that cooperation in knowledge creation between very different types of organization – large firms, small firms and university departments – is crucial. The Newcastle case goes even further and presents a scenario that includes organizational changes in the university in order to foster or nurture potentially innovative ideas as well as setting up support for new start-up business.

Conclusion
In a recent study of the role of intellectual capital for business start-ups in science parks in Northern Spain, Peña (2002) collected information on more than 300 new projects in nine business incubators or science parks with special focus on the intellectual capital dimension. Compared to the cases presented above, the study is not nearly as far reaching and probing in relation to knowledge creation and the practical use of new knowledge in the form of innovation and commercialisation. Nevertheless, Peña’s (2002) data shows that organizational and human capital elements play an important and growing role in relation to the success of business start-ups. Intellectual capital consists of human capital (knowledge, experience and motivation), organizational capital (intra-firm learning) as well as relational capital (networking). All are important intangible components with important consequences for new firms survival and growth and Peña (2002, p. 19) concludes:

Our results show that the most successful entrepreneurs from our sample are the ones who value most not only the tangible services provided by the business centers. […] They also value most the opportunity offered by the incubation center to share experiences and discuss business issues with other entrepreneurs hosted by the same center and living under the same roof. Obviously, the business incubation center offers a unique setting to develop an important relational capital element, such as the support climate among entrepreneurs created within the incubator to overcome together the difficult moments of the firm gestation period.
One conclusion can be drawn from this study. The intangible activities and processes in the start-up firms as measured by the concept of intellectual capital do not fit exactly into the definition of the core elements in Nonaka’s model of \( ba \). Nevertheless, the measures of intellectual capital assets in science park firms can be interpreted as an indicator of the existence of a number of internal knowledge creating processes within the park’s firms and in the organization of the park that resemble Nonaka’s concept on many points.

Based on the literature on knowledge organizations and the different evaluations of science parks, Table I shows the important differences between knowledge organizations and science parks. What seems to be very clear in the compressed presentation in Table I is the difference between the two organizational systems, regarding the major functions of producing new knowledge and innovation. A large part of the difference is related to the fact that the knowledge organization is a child of the knowledge society or economy and the science parks is just as much a child of the late industrial society and its focus on linearity and material products and not on the intangible knowledge.

This paper opened with questions to the role of science parks as “providers of \( ba \) for knowledge creation” and tried to find answers by reviewing a number of science parks studies. What were found in the comparative studies were, first, very few indications, if any, of serious attempts in science parks to implement or just recognize the many new organizational features necessary for creative knowledge production and exchange as expressed in \( ba \).

Science parks tends to be focused on the firm – and on a rather old-fashioned definition of the firm as a single, independent company – or on the entrepreneur with his/hers innovation as the basic organizing principle with the aim of getting the innovation into the market as a product or commodity. The emphasis on comparing in-park firms with outside firms in order to measure whether more value is produced by inside-firms reflects, on the one side, the political reality of most science parks when it comes to evaluating the parks from policy makers. This is not an arbitrary idea from studies of science parks: it is more or less the general picture that science parks and their organizations (e.g. ISAP) produce. Science parks provide physical locations and managerial help to establish new firms (the incubator function) but, according to the studies reviewed here, most science parks have limited their management functions to the more tangible and practical managerial functions.

<table>
<thead>
<tr>
<th>Characterization of the knowledge organization (( ba ))</th>
<th>Characterization of science parks</th>
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<tr>
<td>Basic unit of operation</td>
<td>Knowledge creation (tacit, explicit)</td>
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<tr>
<td>Principles of organization</td>
<td>Networking, complexity, communities of practice, knowledge spiral</td>
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<tr>
<td>Measures of success</td>
<td>Learning processes, transfer of knowledge, intellectual capital</td>
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<tr>
<td>Management functions</td>
<td>Self-managing, knowledge management</td>
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Table I. Evaluation of science parks as knowledge organizations
The new knowledge-based economy, on the other hand, tends to integrate knowledge and innovation in organizational processes, as is clearly stated in the quote from Nonaka discussing conditions for organizational knowledge creation (Nonaka, 1994, p. 17). The management of knowledge creation in the complex world of networking, learning, boundary crossing, cross- and trans-disciplinary work, team-based cooperation in and outside formal organizational structures, is the focus in the literature on knowledge organizations. However, most science parks live partly in the shadow of the industrial economy, where the focus is on the relation between innovation, products and the firm. Integrating the open boundaries and networks of the knowledge organization seems to be far away from the daily world of most science parks. The most successful knowledge creating organizations have integrated large research and development groups in their organization because the transfer of knowledge into innovation and further on to products and profits is a social process, not a process of either systematic and linear work on new technologies or of a “lone rider” entrepreneur coming from outside with his/her ideas.

Nevertheless, in recent science policy discussions, science parks have had a revival because science parks stands out as an organizational link between public research organizations, entrepreneurs and firms – the triple helix concept. But what about the organizational implications of these major changes in the organization of knowledge producing institutions (the triple helix; Etzkowitz and Leydesdorff, 2000) and the growth of cross-disciplinary and trans-disciplinary work and new modes of knowledge production (Nowotny et al., 2001) for science policy? The claims of Notwotny and others in regard to a “new production of knowledge” ought to have directed our attention to problems of managing knowledge and knowledge creation in line with Nonaka’s concept of ba and the meso-level proposed by organizational theory.

If science parks want to become an important partner in the knowledge economy, following the trends toward new organizations of the production of knowledge, the parks have to integrate themselves in other knowledge-creating organizations. Primarily but not exclusively it is the universities, who on the other hand are under fierce policy attack for not producing enough practical and economical results of their basic research. University of Newcastle is one of the more successful recent examples of a construction of an integrated science park (INEX) in the university organization but with its own independence (Hansson et al., 2005), where close organizational ties makes it possible to overcome the traditional waiting position of science parks.

Until now, however, it has not influenced the science policy discussion much and consequently left the concept and organization of science parks almost untouched. If science parks are to have an important role in fostering creativity in a global knowledge economy the parks have to do more than offer locality and venture capital to new entrepreneurs. Managing science parks in the future has to go far beyond the practical and restricted management we see today. The parks must become active organizing partners in the creation of ba in networks between knowledge organizations and the park – crossing the boundaries between different firms and adapting to a constantly changing world.

The intellectual capital statements used by Peña (2002) is helpful but until some standards for the construction of these statements are set up, the content of these statements will be too varied to be useful as valid indicators on the organizational learning processes in science parks.
One possible strategy to reach such a goal could be to develop a more open forum for discussions of what the major tasks of science parks are. Prizes like the European Quality Award (European Foundation for Quality Management, 2006) or other kinds of certifications (of intellectual capital statements) and quality assessment system for science parks could be tools to foster changes. Such innovations in science parks could on the one hand produce more visibility of the operations of the parks and on the other hand produce a certain assurance of the degree to which a specific science parks is working with its internal organization in order to accommodate the changing demands from the knowledge economy. The implementation of such a system should be the task for the European Commission and the International Association of Science Parks in order to have most of the parks in Europe participating.

Notes
2. See the ongoing discussion in the Journal of Intellectual Capital.
4. Gourlay has reviewed the discussion of tacit knowledge in recent organizational theory and concludes that Polanyi’s original concept is much more about semiotic processes and other non-verbal types of communication than the impression given by Nonaka and other organizational theorists who insist that tacit knowledge is made explicit (Gourlay, 2004). This is an important point in relation to the development of general theoretical models. For the purpose of a discussion of science parks in this paper the concept of ba should be understood as a benchmark for the general understanding of knowledge production – not as a contribution to the theoretical development of knowledge in organizations.

References


Further reading


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