Science parks as knowledge organizations – The ’ba’ in action?

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Abstract

Recent studies of the impact of science parks have questioned traditional assumptions about the effect of such parks on innovation and economic growth. Most studies tend to measure this effect by rather traditional measures, such as the revenue or the survival rate of new firms, without taking into account the fact that knowledge is of growing importance in the new economy. If we shift our focus to the discussions that are going on within organization theory we see that this field has specialized itself in relation to the processes of creating knowledge, and of managing it, organizing it, sharing it, transferring it, etc. The evaluation of science parks has to come to grips with the changed role of knowledge in the creation of economic growth. With the help of Nonaka’s concept of *ba*, this paper discusses whether and how traditionally organized science parks can become central actors in the new regime of knowledge production or whether they must be viewed as an outdated institution, left over from industrial society.

Keywords: knowledge creation, ba, science parks, knowledge management

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 for science policy in the EU and in the individual member countries has produced a renewed interest in science parks[i].

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 as we know it today. In the science policy of the 70s and 80s we witnessed science parks develop to be 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 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 very 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 90s, and especially the fast growing role for 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 70s and 80s 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 21st 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 & 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 2000). 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 new 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).

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 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 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 in order to locate 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).[ii]

On the other hand, in-depth studies of science parks have compared relatively detailed information on 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 fifteen years focused directly on the new questions and new demands for institutional or organizational changes in relation to 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 organizations: it focuses on where knowledge is created or produced and on how it depends on people, organizations and relations in networking with other knowledge-producing organizations (Dierkes et.al. 2001, Tsoukas and Knudsen 2003). It 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 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 on technical, 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 among the many theoretical concepts that have been applied in recent discussions on knowledge and organization. I have chosen to use the concept of *ba* as it figures in discussions of knowledge creation in the work of Nonaka and his colleagues in several theoretical papers [iii]. *Ba* is the single most used and discussed concept on knowledge creation and it is a clear marker of literature on knowledge creation in organizations as an individual enterprise.

I then proceed to a discussion of recent literature reviewing studies of science parks in order to trace the discussion of the role of science parks and especially the impact or lack of impact on these by recent work being done in organizational theory. The literature reviewing science parks can be divided into tree major categories, one measuring science park performance by larger comparative empirical studies, one based on a meso approach to science parks and one that takes a case-based approach centred on in-depth studies of a few science parks.

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), ‘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 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 from 1994, Nonaka 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. (Nonaka 1994, 17)

From the analysis of the important role of the individual in knowledge creation, Nonaka, in collaboration with Takeuchi and Konno, 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 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 offer 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, Toyama, and Konno 2000, 12). The SECI model depends on knowledge creation and

> the *ba* is here defined as a shared context in which knowledge is shared, created and utilised. In knowledge creation, generation and regeneration of *ba* is the key, as *ba* provides the energy, quality and place to perform the individual conversions and to move along the knowledge spiral. (Nonaka et.al 2000, 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 between *ba*s 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, Toyama, and Konno 2000, 16)

As a metaphor for the individual and social dimensions in knowledge creation, *ba* has been systematised and highlighted by the analysis of 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[iv]. Nevertheless, the strength of the concept of *ba* is the fascinating combination of the three central dynamics in individual knowledge creation: complexity, process and 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 the role of knowledge producers, the middle managers who are at the centre of the dynamic knowledge-creating process. (Nonaka, Toyama, and Konno 2000, 30)

I have chosen concept of *ba* as the point of reference for an evaluation of the role of science parks in the knowledge economy because the concept combines a number of the central problems of knowledge creation that have been discussed in recent literature. 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, Toyama and Konno 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, Toyama, and Konno 2000, 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) see the parks from a more organizational and managerial point of view and define it 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. (IASP 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. The same orientation toward the space or location dimension was found by Massey, Quintas and Wield (1992: 14) 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, on 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 toward new technology-based firms in the EU Storey and Tether (1998) defines 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.

> (i) To enable academics at the local university to commercialise their research ideas in a convenient location.
> (ii) 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.
> (iii) 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: 1038)

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

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

A science park 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 distinguish 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. 2000) 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 *ba* by Nonaka and Konno. The parks very seldom have a policy in relation to the central problem for knowledge producing organizations formulated by Nonaka: how to organize individual knowledge creation in the pursuit of company profit (Nonaka 1994). 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 *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 separates 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 *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 *ba*. In order to investigate if science parks do support creative knowledge organizations like *ba* in the 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 look into the relations between the parks and the organization of the knowledge creation processes.

The concept of *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 can be reformulated into a question about how and to what degree science parks are able to demonstrate 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, Gray and Neely 2003). In light of the rapidly growing interest in measuring intellectual capital assessment in companies and especially in business start ups (Peña 2002). 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 *ba*.

Impact of science parks

The abundance of empirical studies of science parks can be divided into two major groups. 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 much more differentiated but are based on the comparison of a few detailed cases in order to produce a variegated 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 tend 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 methodological limitations regarding the validity and generalizability of the results.

The indicator approach to evaluating science parks

Siegel, Westhead & Wright (2003a: 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 (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:

> • Do firms located on a science park have higher research productivity than observationally equivalent firms not located on a science park?
> • Do the "returns" to location on a science park vary according to the type of park (e.g., a university science park)?
> • Do the "returns" to location on a science park vary according to the type of entrepreneur who locates on a park?
> • 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: 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'. Siegel, Westhead and Wright (2003a) are caught by the methodological difficulties of indicator-based 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. By so doing they overlook the processes that organize knowledge. They also do not examine 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 these methodological 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, Westhead and Wright have investigated a number of science parks in another study (2003b). The empirical material in this study has some clear 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. The authors are aware of this methodological limitation but do nothing to transgress it. 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 endogenity bias, or the possibility that location on a university science park and the generation of research output are jointly determined.... . (Siegel, Westhead and Wright 2003b)

Massey (1992), Storey and Tether (1998) and Mønsted (2003) found that in most European science parks the average number employed by a firm is between 10 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 life-span and economic conditions should be taken into consideration when making comparisons between science parks in the US and in Europe. According to Storey and Tether, it is premature to make definitive judgements about the effectiveness of science parks in Europe. They argue that the effects of science parks are to a great extent 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 the role played by all sorts of relations and networks between different parts of large research based firms who have placed parts of their research or development departments or groups in science parks as well as organizations like universities who locate a center or some other smaller unit in a science park. The same methodological point of departure can be found in a study of the impact of science parks in Sweden by Lindelöf and Löfsten (2003) who argue that in order to measure performance of small entrepreneurial businesses in and outside the science parks it is necessary to apply some methodological exclusions or limits on the unit of the study.

The approach used by these comparative indicator studies has some inherent limits that stem from restricting them to traditional firms as the object of observation and to some rather well defined and measurable indicators on performance. The approach itself hinders a systematic registration of activities in science parks that do not bear the mark of a clear-cut firm association, or are located inside a single (large) firm. Also, possible knowledge activities of a more probing or untraditional character like learning, interchange of knowledge, networking and other organizational activities that not necessarily found in all science parks will not be measured by these studies. No attempts can be found in these studies to measure activities of the kind normally associated with intellectual capital. And, while many studies of knowledge creation across boundaries within organizations emphasise the fact that measures of intellectual capital are probably the best macro-indicator of not-so-traditional knowledge creating activities that include elements of learning, change, cross-over and collaboration, information on this kind of activities is very difficult to find in most comparative studies of science parks. And these activities are precisely central aspects of *ba* – as iscussed above – constituting he core of how knowledge is created by individuals and organized in the firm. So a preliminary conclusion is that organizational knowledge creating activities, exemplified as *ba*, are difficult to find in most science parks.

But methodologies are seldom chosen arbitrarily and the many studies that use definitions of science park activity of the kind here discussed do so because they assume that they are able to capture the larger part of knowledge creation and value addition in science parks. Reflecting on the lack of differences in their own measures of innovation between inside and outside firms, Lindelöf and Löfsten (2003: 257) conclude that science parks might better be understood as centers for learning than for innovation. Their own study, however, was not set up to measure learning.

The meso-study approach to science parks

A number of studies of science parks belong to a somewhat differentiated group that occupy the range between the macro-approach of the comparative studies and the micro-approach of the case studies. What these meso-studies of science parks have in common is that they have all selected empirical material that is related to either a special program or policy initiative, particular to local technology, to a geographical area or to structural changes in the parks.

Mian's (1994) study of university sponsored incubators compares six different parks and presents detailed information on the success rate of the parks and the role of different programs and local policies. It addresses especially the role of the participating universities. But Mian does not present material on the more detailed aspects of how knowledge management is operating in the six parks. The available empirical data in the study does not give information on the degree to which these parks have programs to help knowledge creation. While Mian concludes with some advice for university technology incubator programs, he does not touch the question of knowledge creating support systems.

Lindholm Dahlstrand and Klofsten (2002) conclude a study of Swedish science parks with some observations on the role of universities, much in line with what has been discussed in the more general frame of reference of the triple helix.

> 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. (p. 44)

This study also offers 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. Much of the same can be said in relation to a study of changing network relations by Johannisson (1998) who finds that due to higher degree of academic trained entrepreneurs the networking behavior between entrepreneurs is changing. But to what degree these changes are related to the question of knowledge creation systems, i.e., to *ba*, is not clear from these data.

The case-study approach to evaluating science parks

The idea of changing the focus to learning instead of innovation when studying the effectiveness of science parks was, as noted above, suggested by Lindelöf and Löfsten (2003). They concluded that difficulties in measuring innovation and other indicators demanded studies able to go beyond the level of the many comparative studies that depend on rather crude macro economic indicators with the result that they very often end up without any clear conclusion regarding the question of whether science parks firms are more or less innovative and productive than outside park firms. The case study approach has methodological advantages compared to the limits in macro-indicator studies because they can use a whole array of different qualitative methodologies and do in-depth studies.

According to the comparative indicator studies, the contributions of science parks to knowledge creation and technology transfer in the park's firms are negligible, almost non-existent. A large number of studies of science parks concluded that there is almost no valid documented impact of science parks in relation to innovation and knowledge creation that can be measured by comparing in-park firms with outside firms. The continuous existence of science parks and the renewed local political interest in building new parks can, according to these studies, be explained by local policy interests and unspecified and unverified hypotheses about the learning opportunities that the parks provide. Do these learning opportunities exist? The many comparative studies of science parks have not been able to demonstrate this but, then again, they all have demonstrable methodological limitations. Most science parks, moreover, present themselves as being very much in line with the basic assumptions of the comparative studies by stressing their strength in setting up innovative firms, not in creating a 'learning environment'. By ignoring the importance of 'softer' creative and organizational knowledge dimensions, like learning, networking and distribution processes in the day-to-day operation of the science parks, the comparative approach completely neglects the role of the organizational dynamic in knowledge creation both between firms conceptualized as communities of practice (Brown and Duguid 2001), absorptive capacity (Cohen and Levinthal 1990) or locationality (*ba*))..

A number of meso-approach studies have a more open view of the role of systems of collaboration and organizing and conclude with demands for changes in the relations between parks and universities but do not present any information on knowledge creation processes.

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 lack of empirical evidence from a number of comparative indicator-based studies of science parks, might be solved if we take a closer look at case based studies of science parks. The case based approach has the openness needed to inquire into science parks from the obvious path laid out by the many central themes from studies of knowledge organitions.

The importance of looking for these complex organizational processes disregarding the extra trouble of measurement is demonstrated by Lindholm Dahlstrand's (1999) case study of new high-tech SME's in the Gothenburg region. The study questions 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 SME's 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 spinn-offs, and the transformation of entrepreneurs and knowledge, from well-established organizations into new independent entreprises seem to be one of the main processes of intra-regional learning in Göteborg. (Lindholm Dahlstrand 1999: 387)

What we have here is a demonstration of the complexity of knowledge creation, where science parks are no longer the most basic or central unit but only a part of a larger regional system of innovation. The Gothenburg case has further implications, because it challenges the standard methods used in the literature for measuring the impact of science parks. It does so by including all types of organization in a whole region and not limiting the study to what is a 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 if seen only as a traditional location for new companies. The conclusion is a combination of what can be expected to emerge under the usual methodological constraints and a reality behind these methodologies – namely, that 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 serious problems arise when one limits studies of the development of creation of new knowledge and innovation to one traditional organizational construction, the science park. A central result of the Gothenburg study is that in a few modern and successful science parks the picture is much more complicated and it is in these environments that we find evidence to suggest that knowledge creation crosses the boundaries of the firm, that knowledge is transformed through a number of different processes.

Another case study presents more elaborate systems 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 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. (Hansson et.al. 2004) Also, 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 attempts 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 as a matter of course 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 also 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 is that 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. 2004)

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 the 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 realised 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) has collected information on more than three hundred new projects in nine business incubators or science parks with special focus on the intellectual capital dimension. Compared to the two 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 Peñas' 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 consist 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 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. (Peña 2002: 19)

The conclusion is clear. While the intangible activities and processes in the start-up firms as measured by the concept of intellectual capital do not all fit exactly into the definition of the core elements in Nonaka's model of *ba*, 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 with in the park's firms and in the organization of the park that resemble Nonaka's concept on many points.

This paper opened with the question of the role of science parks as 'providers of *ba* for knowledge creation' and tried to find an answer by reviewing a number of science parks studies. What was found in the comparative studies was, first of all, 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, like science park studies, tend to be focused on the firm – and on a rather old-fashioned definition of the firm as a single, independent company - as the basic organizing principle in the science parks. This is reflected in the methodology used in most studies of science parks and the management practice of the parks themselves. 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 reality of most science parks but, on the other side, this one-sided methodology makes it almost impossible to trace what goes on in science parks beyond the creation of value for firms.

Science parks provide physical locations and managerial help to establish new firms (the incubator function) but, according to the studies considered here, most science parks limit their management functions to the more tangible organization of the park and the benefits to the firms. The management of knowledge creation in the complex world of networks, learning, boundary crossing, cross- and trans-disciplinary work, team-based cooperation in- and outside formal organizational structures, seems to be far away from the daily world of most science parks.

In science policy discussions, science parks have had a revival because science parks have been understood 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 & Leydesdorff 2000) and the growth of cross-disciplinary and trans-diciplinary 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 ambitious SECI model, and the meso-level proposed by organizational theory. Until now, however, it has not influenced the science policy discussion and consequently left the concept and organization of science parks almost untouched. If science parks are to have an important role to play in fostering creativity in a global knowledge economy it has 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. It must become an active organizing partner in the creation of *ba* inside the park – crossing the boundaries between different firms and adapting to a constantly changing world.

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[i] Benchmarking of Business Incubators Final Report, 2002 by Centre for Strategy & Evaluation Services (CSES) for the European Commission's Enterprise DG.

[ii] See the ongoing discussion in the *Journal of Intellectual Capital*.

[iii] Some of the major works by Nonaka on knowledge creation and *ba* are:
Nonaka, I. (1994), Nonaka, I. & Takeuchi, H. (1995), Nonaka, I. & Konno, N. (1998), Nonaka, I. & Konno, N. (1998), Nonaka, I., Toyama, R., & Konno, N. (2000), Nonaka, I. & Toyama, R. (2002).

[iv] 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 can be 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 as contribution to the theoretical development of knowledge in organizations.

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