

MEETING THE NEEDS FOR SKILLS UPGRADING IN SMEs THROUGH MOBILISATION OF SCIENCE PARKS AND INCUBATORS: SWEDISH EXPERIENCE AND ISSUES FOR DEVELOPING COUNTRIES

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Abstract

Relevant and effective competence upgrading is of crucial importance for firm competitiveness as well as regional and social development. R&D is important for innovation in many kinds of firms but takes secondary importance in many situations. In Africa and other developing regions it is crucially important to identify what mechanisms can effectively support the upgrading of relevant skills broadly in the economy, drawing on and combining what useful capabilities are available. Sweden, being a country with high R&D-intensity, strongly internationalised big business and extensive research in universities, presents some specific examples of new approaches in this area. Reviewing the experience of Science Park Jönköping in cooperation with Jönköping University, the paper presents lessons and conclusions how, and by which actors, more relevant capabilities and matching roles may be nurtured. Particular attention is paid to the challenges confronting SMEs in the upgrading of skills. Measures bridging the supply of general training by universities and the demand for idiosyncratic skills on the part of SMEs should be paralleled by those that mobilise more complementary contributions of external professional service providers. Rather than general knowledge promotion, programmes need to strongly emphasize local adaptation and specialisation.

1 Introduction¹

Scientific discovery and technical progress are often viewed as natural drivers of innovation and economic growth. Consequently, many countries around the world view R&D as a vital component of their overriding economic policy objectives. Although there is a significant relationship between R&D and some measures of competitiveness and growth across countries, the relationship is an evasive one. In practice, a range of factors influence to what degree technology is diffused and applied in an economy. Among the most important and difficult questions is the issue of how small and medium-sized enterprises (SMEs) become able to utilise technology. This is in part because of the sheer number of such firms, their importance for social and local development, but also because of what is seen as their growing importance in the area of technical change and economic renewal.

Technical progress, falling costs in information and communications technology (ICT), and the globalisation of goods and factor markets are opening up new avenues for small and medium-sized enterprises (SMEs) to pursue wider business options. With the rapid diffusion

notably of information and communications technology (ICT), market opportunities are becoming known and easier to identify for firms anywhere in world, including in developing regions, provided that businesses and individual human beings can acquire the knowledge that is relevant for their particular situation. On the other hand, sharpening competition is pushing for greater focus by firms on core business and a decompartmentalisation of production chains across national borders. While SMEs may enjoy a relatively high degree of flexibility at firm level, and combine that with capturing of economies of scale and scope through networks with other firms, they face difficulties in accumulating the skills that are required for managing specialised production systems and international interactions.

Not only are SMEs in a weak position to acquire the training they need, they also experience difficulties in estimating the value of investing in skills internally as well as accessing external expertise. At the same time, the weaker their skills basis, the less capable firms are in handling external counterparts, the weaker their bargaining power and the greater the risk that they are bullied by larger and more influential suppliers or customers. This may be particularly serious in developing countries, where market mechanisms tend to be relatively undeveloped resulting in less transparency and more opaque information on prices and qualities. However, barriers to skills upgrading worsen because of complications in incentive structures internal to firms. In particular, the prospect of worker mobility tends to reduce the incentive of employers to invest in the general-purpose skills of employees. Again, developing countries may be lacking regulated conditions in support of employment stability, especially for SMEs and in the informal sector, resulting in high churning of labour and little confidence on either part of the employer-employee relationship that their contractual bond will last for an extended period of time.

Whereas the needs of SMEs for upskilling may be idiosyncratic, universities tend to focus on acquiring high-profile generic scientific competencies. In relations with society as regards skills upgrading and training, they opt for supplying general skills packaged in sufficiently large quantities. University offers are compounded by traditional incentive structures which put up barriers to entrepreneurship and tend to nurture attitudes that are weakly compatible with the appreciation of business relations.

What measures are thus warranted to address the issues confronting SMEs in competence development? National policies have an important role to play in promoting public goods in the form of scientific and basic knowledge,

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but also in ensuring sound conditions for risk-taking and entrepreneurship. The interplay between universities and enterprises as regards matching the supply and the demand of skill development represents part of this mission. Special issues arise because the properties of effective interaction of this kind are largely determined by specific local conditions, and such relations must primarily be managed locally. In this context, not only the competencies but also the organisational structure and attitude of universities matter.

Other kinds of actors, which can provide vital fora for the interface between universities and business, are also important, however. Science parks and incubators are clearly relevant in this context. Although it has generally not been seen as their prime mission, these organisations can fill specific functions in addressing the issues that arise in skills upgrading for SMEs. This paper takes special note of experience accumulated in this context by Sweden. It should be noted that Sweden is a country that is characterised by high R&D-intensity, big internationalised business and extensive R&D in universities. The country is nevertheless faced with distinct challenges to foster competitive SMEs, an agenda that has grown in importance as the large firms have become increasingly internationalised and footloose (Andersson, 2006). The focus here is on a specific innovative approach which helps illustrate more generally valid aspects of what is needed in order to shape a locally adapted approach that can help enhance the diffusion and use of technology broadly in the economy. This is the case of *Science Park Jönköping in cooperation with Jönköping University*. The latter is one out of only three universities in Sweden that is not owned by the government, the implications of which are further reflected on below.

The paper is organised as follows. Section 2 discusses the importance of skills upgrading in SMEs. In Section 3, we take note of the mismatch between the actors involved in this area. The role of science parks and incubators is introduced in Section 4. In Section 5, attention is turned to the experience of Science Park Jönköping in Sweden, including which issues it is currently confronted with and what more lessons can be learned for African countries specifically. Section 6 concludes.

2 Skills upgrading and SMEs

Among developed countries, broadly speaking, there is a positive relationship between R&D-intensity and GDP per capita, as illustrated by Figure 1. There is no one-to-one relationship; however, as can be observed in many individual countries a range of factors influence the presence of links between R&D and economic performance. Whereas the EU views its relatively low R&D-intensity (compared to the US and Japan), as a major factor contributing to its weak economic record in recent decades, individual EU-member countries, such as Finland and Sweden, have a high R&D-intensity. As illustrated in Figures 2 and 3, these countries indeed display a healthy position with regard to scientific publi-

cations and patenting. With the Lisbon Agenda in 2000, the European countries committed to undertake a series of reforms which would lead to higher R&D-intensity, and enable a better environment for, e.g., patenting and the start-up and growth of new business. Progress, however, has been meagre.

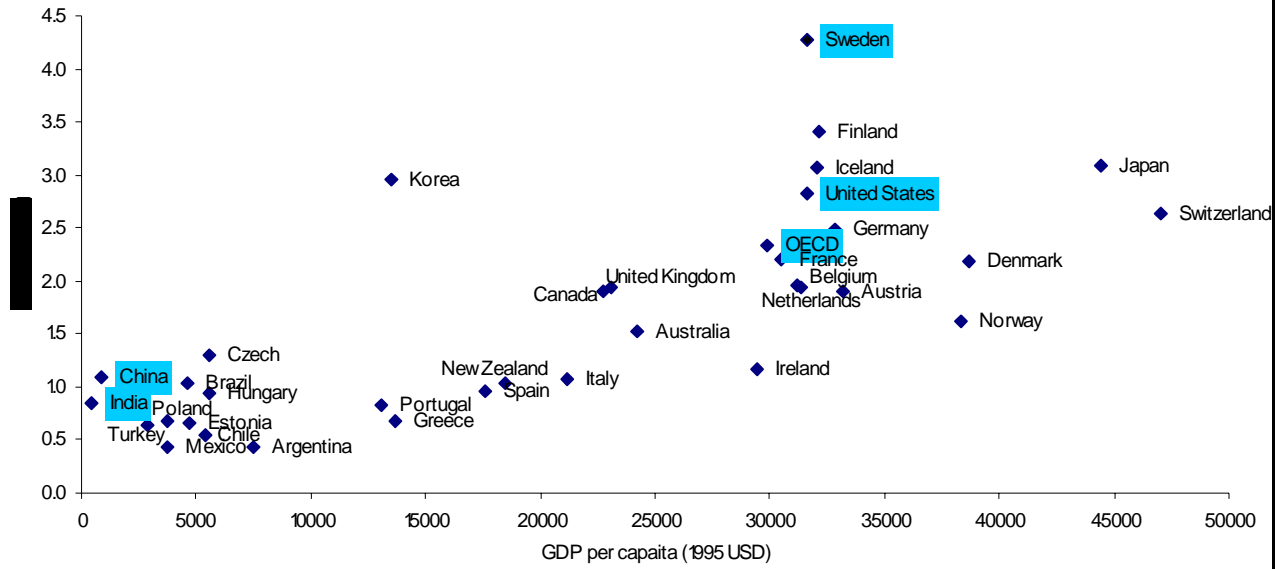
Another priority area for most countries is that of educational attainment, which traditionally has been viewed as greatly important for economic performance. Though the share of the population attaining higher education has increased in both developed and developing countries, the notion of a simple relationship between quantitative measures of education and economic performance has faded (Barro and Lee, 1996; OECD, 2001). The contribution of human capital to society and the economy crucially depends on quality, and how skills are put to use. Some of the potential impact of human capital emanates from the link to better use of technology, innovation and entrepreneurship.

A fuller understanding of how human capital, training and renewal can contribute to societal progress requires consideration in a number of factors. Compared to tangible assets, knowledge and skills are typically less visible to competitors and more difficult to imitate, providing a viable basis in many firms for building sustainable and robust advantages. This aspect reflects the broader phenomenon that intangible assets and intellectual capital are gaining ground as decisive determinants of industrial competitiveness.

Technical progress, combined with reduced costs for diffusing and accessing information, now opens up a range of opportunities for individuals and firms to become more efficient by learning from a wider range of experiences, and emulating (after due adaptation) proven "best practices". At the same time, a desire to rely on past successes tends to induce established groups to act so as to hinder adjustment processes. Excessive reliance on given contacts and tacit knowledge in combination with neglect of external linkages and lack of foresight may account for lock-in effects due to the dominance of established practices (Amin and Cohendet, 1999; Martin and Sunley, 2001). The adoption of new work practices can thus be at odds with learning accumulated collectively through previous success periods, leading to the gradual failure to recognise changing trends, and thereby a distortion towards excessive reliance on incremental improvement at the expense of openness to radical renewal (Harrison and Glasmeier, 1997).

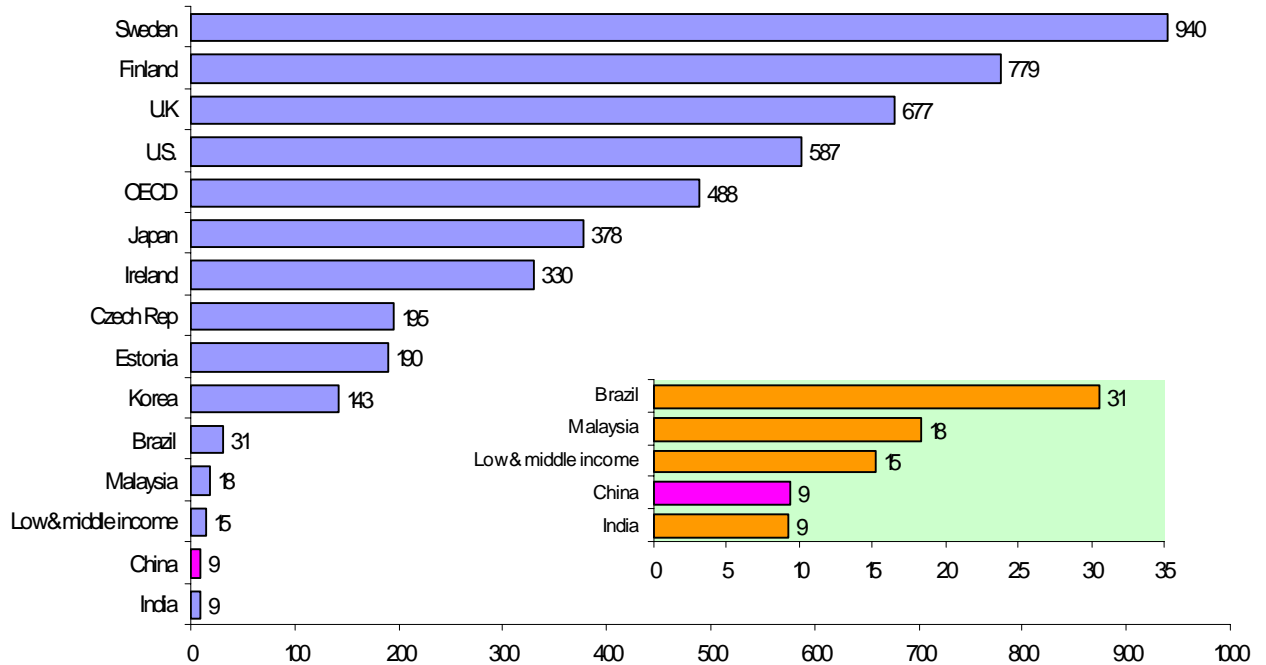
Meanwhile, competitive pressures are also intensifying across a spectrum of economic activities. Whereas basic education represents a building block, follow-up through better targeted skills upgrading is often required. Further, SMEs account for the bulk of employment in practically all countries except for the United States (OECD, 2005b). These firms usually possess less managerial as well as work force skills and also make disproportionately small investments in vocational training. Yet, SMEs are now known to be important for the overall vitality and dynamism of most economies, in part due to their higher

Figure 1. R&D intensity (i.e. R&D expenditures relative to GDP)



Source: OECD (2003)

Figure 2. Number of scientific publications per million people, 1999



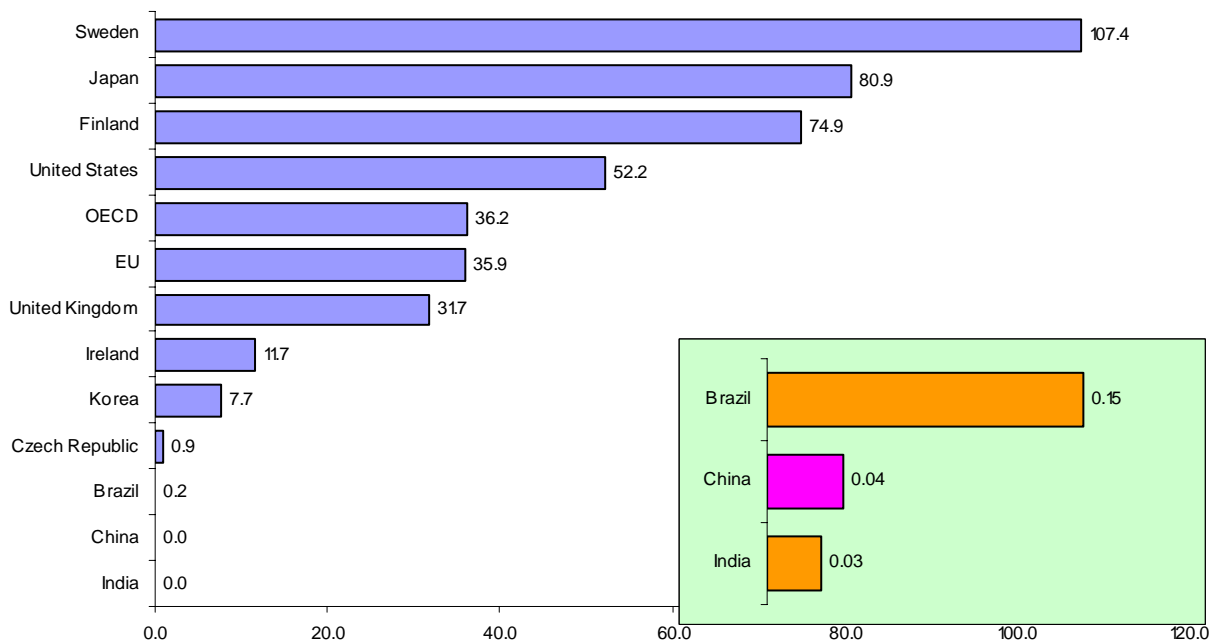
Source: World Bank (2004)

Box 1: Main methods for improving the competence base of human resources in SMEs

| Method | Mode | Arena |
|--|--------------------|------------------------------------|
| 1. Visiting expos/trade fairs | Formal activity | External activity |
| 2. In-house training courses | Formal activity | Internal activity |
| 3. External courses | Formal activity | External activity In./Ex. activity |
| 4. Work rotation | Informal activity | External activity |
| 5. Study visits outside firm's location | Formal activity | Internal activity |
| 6. Delegation of work tasks | Informal activity | External activity |
| 7. Financing professional literature for reading after working hours | Informal activity | Internal activity |
| 8. Permitted/encouraged (Permitting/Encouraging) reading of professional literature during working hours | Informal activity | Internal activity |
| 9. Personal development meetings | Informal activity | Internal activity |
| 10. Regular meetings with employees incl. elements of education | Inf./For. activity | Internal activity |
| 11. Recruitment of for the firm new competence | Formal activity | External activity |
| 12. Tutor/mentor for newly-employed | Informal activity | Internal activity |
| 13. Senior tutor/mentor for already employed | Informal activity | In./Ex. activity |
| 14. Cooperation with external competence | Inf./For. activity | External activity |
| 15. Linking competence development to salary by e.g. a bonus system | Formal activity | Internal activity |
| 16. Project work | Formal activity | Internal activity |
| 17. Participation in networks | Informal activity | External activity |
| 18. Study visits at the same location | Informal activity | Internal activity |
| 19. Temporary work in another firm | Formal activity | External activity |

Source: Andersson et al. (2007).

Figure 3. Number of triadic patent families per million people, 1998



Source: OECD (2003)

flexibility and ability to assume risk in new business activities (Jovanovic and Nyarko, 1996; Peneder, 2002). In addition, the performance of SMEs and what conditions they can offer the workers matter greatly for local progress, and for the conditions and outlook facing disadvantaged groups.

The importance of skills in developed countries shows up, e.g., in a positive correlation between the availability of qualified personnel, the share of successful innovators in a population of firms and the share of new products in the turnover of firms (OECD, 2005a). Both the managerial and economic literature has shown that human capabilities critically influence firm performance, including what returns can be earned from R&D (Black and Lynch, 2001; Piva and Vivarelli, 2007). Whereas this is more or less universally applicable, special issues arise for SMEs, and in developing countries.

Although the heterogeneity of SMEs needs to be kept in mind, the challenges of accessing and governing the right mix of skills, as well as mobilising appropriate complementary external skills, are inherently severe for this category of firms. This situation, however, also in itself offers business opportunities. Responses typically applied are presented in Box 1. Practices include sending off employees to specific expos and trade fairs. Show floors may provide a mix of established and potential customers as well as suppliers, and may therefore serve as a venue for useful networking and fostering of new business relationships. Other methods include reading professional literature, internal meetings for knowledge exchange, personal development meetings and work rotation (in-house or in other companies).

Furthermore, under conditions of rapid technical progress, capturing the gains from skills upgrading in an individual activity requires an enhanced capacity to relate to and exploit other connected, complementary skills. For instance, in order to cope, SMEs often need to upgrade, in parallel, the following kinds of competences: i) specific technical skills related to modern communication tools and equipment, materials and substances, methodologies, etc.; ii) marketing and sales channels and competencies that are crucially needed for enabling them to adapt to and exploit their specific products within an increasingly globalized economy; iii) upgrading process and product development capabilities, including the management of protection of intellectual property rights, brand names, etc., and; iv) in organising an effective, constructive and dynamic division of labour vis-à-vis other enterprises within networks or clusters.

Ample evidence from both the United States and Europe shows that an increasing number of SMEs are in the process of outsourcing and off-shoring parts of their production activities, in part to developing countries. This is by many firms viewed as a prerequisite for remaining competitive. It is in some cases also a condition for retaining links with internationalising larger customer firms. Many SMEs in developed countries are thus forced to renew their combined business and market approaches to cope with a global production environment, and to manage distributed product development within global supply chains.

Several studies demonstrate that SMEs commonly fail to cope with the requirements of this situation. Not only are SMEs bestowed with limited skills acquired through formal education, but SMEs commonly lack the experience, information and planning capabilities to judge what is required to succeed with respect to internationalisation. Embarking on rapid technical and organisational upgrading in an internationalised environment, many SMEs can be observed making mistakes and, as a result, are subjected to high costs. The result may be an accelerated decline of industrial production and employment.

SMEs play a critical role in job creation and social cohesion. Peripheral regions may thus be struck by a thinning of their production structures, industrial decay, unemployment and migration problems. In managing to raise their work force and management skills, SMEs can increase their adaptability while also strengthening their position relative to large industrial firms and invoke healthy competition effects. All in all, notably in developed countries, such progress may be greatly important for enabling globalisation to stay on a course which is viewed as socially and economically acceptable, thereby counteracting pressures for protective barriers or state subsidies in order to halt, rather than embrace, needed structural adjustment. In developing countries, much fewer SMEs are in a position of opting for internalisation of their production activities. Yet, in these countries too, SMEs now meet with both new pressures and with new opportunities to develop strategies for coping with enhanced competition at home, as well as succeeding in penetrating foreign markets. The priorities in needs for skills upgrading differ from those in developed countries but, similarly, the issue is greatly important and the precise challenge highly specific to the case of the individual firm.

Sweden, although part of the European Union policy framework, displays an exceptionally high R&D-intensity, second in the world only to Israel. Similar to other countries with high R&D, it is primarily the highly internationalised multinational firms that originated in Sweden, which account for the bulk of R&D. There is also a strong emphasis on public support of R&D in universities. For a long time, there have been favourable relations between R&D in big businesses and in universities. Sweden also has a significant SME-sector. The subcontractor industry commonly consisting of SMEs has strongly contributed to the competitiveness of the giant industrial firms.

Yet, in a sense, the Swedish innovation system displays signs of a dual, polarised, structure, reliant on two main poles. On the one hand there is an advanced and highly internationalised community of large, R&D-intensive firms, on the other hand, a well-established university sector which receives the bulk of public R&D support. In between, the SME-sector has low R&D-intensity as well as workers with relatively weak formal education. Levels of entrepreneurship are low, and one may speak of an "under-performance" in the creation of new high-growth firms.

The Swedish situation may be viewed as extreme, but the issues displayed are high on the agenda in devel-

oped and developing countries alike. The large EU countries present structural deficiencies that are generally worse but related to those plaguing Sweden, and which suggest that increased R&D in itself does not present the answer to sluggish growth performance. Nevertheless, given its investments in knowledge assets, the Swedish economy is viewed as underperforming relative to its potential, especially with regard to commercialisation of its science and technology assets. While there has been a noteworthy improvement in recent years, there is little doubt that a stronger human capital accumulation in the SME-sector, coupled with a better supply of entrepreneurship and risk-taking in growth-oriented businesses, could account for further improvement (Andersson, 2005).

3 Mismatch in response to the SME-issues

SMEs are commonly observed to be reactive in their training activities and unfamiliar with strategic plans for training. A number of studies emphasise the particular importance of direct communication if such firms are to act differently (Prahalad and Ramaswamy, 2000). The most important information is “tacit” rather than “general/codified” (Polyani, 1962). Insights needed for putting information to good use must often be gained through the personal exchange between managers and staff on the one hand, and relevant partners and customers on the other hand, in ways that enable an effective articulation and manifestation of the firm-specific needs for training and competence upgrading.

Another aspect is that the question of what particular skills, and combinations between them, are relevant in the individual case, is likely to vary radically. Some needs are likely to be idiosyncratic. At the same time, there is also a notion of “task-specific human capital” that cuts across particular sets of firms, possibly interwoven with local or regional societal and industrial commonalities, traditions and particularities in local skills profiles (Gibbons and Waldman, 2005; Balmaceda, 2006).

Whereas the demand of SMEs for upskilling is far from straightforward and requires careful attention, a key issue concerns what mechanisms are available to mobilise a supply side for the provision of what they need. For their highly specific requirements to be met it will not suffice that universities or other training and service providers simply offer their general lectures and programmes for skills upgrading. Serious issues arise because of the incompatibility of incentives, traditions, and established means of communication between several of those actors which have a bearing on whether an effective matching between supply and demand in this area is possible.

A fundamental difficulty for SMEs to manage the challenge of upgrading their skills has to do with the fact that their requirements far from always are well understood by firms themselves, especially in the early stages of firm formation, or at the midst of stages marked by rapid technological and organisational renewal. The level of management skills and strains in

work organisation, including severe time pressure, compounds the difficulties. In part connected with the situation is a second factor, namely that their needs tend to be highly idiosyncratic (Hamel et al. 1994, Becker, 1993). SMEs thus often sense the urgency of obtaining certain specific capabilities, whereas general purpose-skills may not be in demand.

The latter consideration involves a contradictory interest between employers and employees. Upgrading the skills of employees may increase the risk of poaching by other firms, i.e. employers investing in skills upgrading may subsidise competitors (Leroy 2002). Employers may thus have to pay higher salaries to maintain a worker once he or she has become trained, lowering the return on investment (Becker, 1993). The relevance of such arguments depends in part on the distinction between “specific” and “general” human capital. Specific human capital refers to skills or knowledge that is useful only to a given context, possibly only a single employer (who will then be more willing to pay for it), whereas general human capital (such as literacy) is useful to all employers.

If a company invests time and money in upgrading the skills of an employee, and if the employee comes to possess rare knowledge needed for efficient production, the individual also risks being loaded with increased work. Fear of extended responsibility in combination with limited time, e.g. due to family responsibilities or low possibility of career development in spite of the extra effort invested at work, may reduce the incentives for an employee to attend such job training activities. Problems are worsened by progressive taxes and social attitudes reducing appreciation for social upgrading.

Factors such as these may typically hinder or impair demands for the upgrading of skills within enterprises, particularly SMEs. For fear of losing control, management may be hesitant to accept increased independence of employees as well as to involve outside specialists. According to the ENSR Enterprise Survey 2002, lack of skilled labour had been the main constraint for the business performance of European SMEs in the preceding years. The fact that SMEs underline the importance of upgrading of skills may, in itself, be viewed as an indication of the problems they are confronted within this area.

Throughout most economies, universities serve as the prime authority in knowledge creation. Their coverage is traditionally based on broad scope, stability, and resistance to change (Martin 2003). At the same time, there is a common perception that programmes within higher education institutions encounter difficulties to raise students’ ability to apply their knowledge, skills and understanding of the workplace, i.e. education is confronted with challenges to meet market needs (Storey 1998).

In developing countries, and to a very high extent in Africa, policymakers and academics enter an alliance to establish mechanisms that can support the evolution of an internationally competitive science base. This challenge is in itself daunting and it is often believed that the actors involved cannot afford any disruption in such efforts. At the same time, strong belief in the value of rigid

administrative principles and fear of leaving room to manoeuvre to individual judgement in specific cases, leads to a high tendency of applying forms of regulation and distribution of public funding that in effect ensures highly standardised strategies and profiles of academic institutions.

In developed countries, it is increasingly recognized that universities cannot operate in isolation. Their position is becoming viewed as integrated with society. The new expectations are exemplified by the notion of the entrepreneurial university (Clark 1998; Hay et al., 2002), and the importance of co-operation with both the public sector and industry as elaborated within the Triple Helix (Etzkowitz and Leydesdorff 2000). It is also increasingly understood that the potential for learning and successful innovation is dependent on conditions allowing for effective buy-in by the actors concerned, and for constructive interactions between different kinds of assets and competences.

For various reasons, the functions that breed scientific progress, technical progress, innovation, and skills upgrading in the workforce, meet with particular matching problems in the case of the SME-sector. Educational programmes in universities and other formal education institutions are typically generalised in ways that are incompatible with SME needs. Too theoretical, not tailored for the needs of the specific company, not adjusted to fit contemporary problems, not provided in the near vicinity or at manageable hours, are some of the features pointed out as typical reasons for not sending employees to formal training courses. These issues reflect fundamental factors affecting the general direction and nature of knowledge development in universities. For a host of institutional reasons, traditional academic institutions lack interest to engage in commercial activities¹, notably with SMEs and for the purpose of supporting entrepreneurship. Differences in culture and language between entrepreneurs and academics fortify the barriers that hinder the offering of programmes that are relevant to SMEs.

According to some scholars, the observed difficulties are not inherent, but academics may be well placed to develop entrepreneurial qualities (Hay et al., 2002). Today, there are also well-known instruments available to support spin-outs of commercial ventures from universities (Wright, 2004). The academic, governmental and business spheres may go through stages of mutual adaptation during which such linkages evolve (Etzkowitz and Leydesdorff, 2000). On the other hand, it is less known what conditions and institutional set-ups can help support such processes in a constructive manner. Progress may be contingent on certain enabling factors. It may also not be spontaneous but hinge on mechanisms that can allow for the build-up of those capacities that are required for the outstanding needs of SMEs to be articulated and communicated, for impeding factors within universities to be countered and overcome, and for a critical mass of network-building drivers to be in place (Amin and Cohendet, 1999; Martin and Sunley, 2001).

Additional factors limit the ability of universities to respond to the needs of SMEs. First, it is problematic to

identify which training capabilities are indeed relevant, in part due to the difficulties of SMEs to articulate their needs, as discussed above. This also brings difficulties in knowing what potential services could potentially be packaged effectively in ways that would allow a critical mass of customers to be formed. Second, adjusting to the concrete, perhaps somewhat trivial and repetitive needs that characterise skills upgrading among great numbers of SMEs, may square oddly with the incentives of academic institutions, which above all strive for scientific excellence.

For such reasons, industrial institutes and other agencies that are specialised in diffusing skills and technologies to industry, have an important role to play. At the same time, such institutions are more weakly placed than universities when it comes to linking to education, and also with regard to linking to academic research as well as arranging with spontaneous connections between multiple areas of knowledge creation. While industrial institutes still matter, their role thus has limited reach, and it will not be subject to any further detailed consideration in this study. Another set of relevant actors is that of science parks and incubators, which may operate in closer conjunction with universities, and may be relatively well-placed to combine some of those disparate functions that need to go together if the gap between SMEs and knowledge-generation in universities is to be overcome.

4 Options for science parks and incubators

The role and efficiency of science parks and incubators vary depending on context. Many are explicitly mandated to take a responsibility for contributing to regional development. Often this focuses on supporting new businesses as well as generating new employment. There are also other kinds of expectations, generally reflecting a science park working within a specific community/context. Most science parks are characterised by the following, however:

- ⇒ formal and operational links with some kind of major centre of research;
- ⇒ a structure designed to encourage the formation and growth of knowledge-based businesses; and
- ⇒ a management function actively engaged in the transfer of technology, mobilising finance and management skills to the organisations on-site, but also handling basic administration such as office space.

Business incubators are related technology-based entities devoted to the establishment and growth of young entrepreneurial companies with high-growth potential (Lavrow and Sample, 2000). Boundary crossing is in both cases at the heart of the mission, applying to: i) the boundary between idea and firm, i.e., between university-based knowledge or technology and the firm which bears the potential to commercialise it; ii) the boundary between the firm and the wider network in which the firm is situated, which serves to bridge the rise of complementary skills and thus local specialisa-

learning processes, may be equally demanding for these firms.

Rather than the uniqueness of such features, however, the prime issue of interest here has to do with what general lessons can be derived from this example. As in the case of most other countries, notably in Europe and in Africa, the Swedish university system is dominated by public universities which have to obey public laws and regulations that detail the nitty-gritty of their governance structure. Only three universities are not owned by the government but have greater freedom to organise themselves appropriately. Of these, two are basically oriented towards big business, i.e. the Stockholm School of Economics in Stockholm and Chalmers Institute of Technology in Gothenburg. Being the third institution, located in Jönköping - the 10th largest city in the country and the main centre of the entrepreneurial southern province of Småland - Jönköping University is dedicated to relevance to SME-development⁴. In the region, there is widely-spread appreciation of the virtues of entrepreneurship, and of "subsidy-free culture". At the same time, sharpening international competition and the rapid internationalisation of industry now under way have led to vocal demands for closer university-industry interface, both to offer training and in support of higher rates of knowledge-intensive start-ups.

Whereas the region (country of Småland) is entrepreneurial, academic traditions are weak and, because of neglect, Jönköping missed out on opportunities to be selected as the location of a new university when new institutions were planned in the 1960s and 1970s. A gradual reassessment of the situation led to a widely-shared conviction among the main regional players that an institution for higher education and research was indeed needed. In contrast to the common striving for traditional generalist university institutions, the regional actors early opted for the establishment of a more specialised institution which would be able to develop a sharp profile mirroring the special values and assets of the region. An unexpected opportunity arose in the mid-1990s when the centre and right-wing government of the time opted to create two non-government owned *university foundations* in Sweden, to be less bounded by public laws and more prone to experimentation and specialisation. The selection eventually came down to Chalmers Institute of Technology and Jönköping University.

A few years after the university foundation had been set up, Science Park Jönköping was established as a non-profit association and a collaborative platform for the creation and growth of new enterprises. The responsible parties included the university as well as each of the municipalities of the wider county. In effect, the general assembly was more interested in diffusion than intensive firm development in the park itself. The municipalities were basically moving to raise their own performances, and were less engaged in exercising strong influence on the central unit. Meanwhile, novel strategies of the young SME-conscious university and the science park were developed in tandem. For in-

stance, as the university pioneered the development of entrepreneurship research, Science Park Jönköping developed its own platform for the experimentation and creation of new enterprises by students. As the university developed a vast network of companies mentoring its students through their educational programmes⁵, the Science Park was able to exploit the engagement of the individual municipalities of the region and develop new structures for local engagement in processes of firm creation and competence upgrading.

The reach of the Science Park in supporting entrepreneurship and business renewal in the region more broadly, was extended through the adoption of a science park system. This consists of several nodes in the county where each can be characterised as a micro-version of the Science Park. The objective is to extend the accessibility of essential infrastructure in the form of:

- ⇒ *venue* (i.e., a knowledge-intensive meeting place where a critical mass of mechanisms in support of the development and exchange is able to evolve),
- ⇒ *services* (value creating services to stimulate start up, development, and growth of new companies and business areas) and
- ⇒ *knowledge* (links to university, research institutes, and other sources of knowledge).

Further, all specialities cannot be found within a single physical location. The extended geographical system offers possibilities for bringing together multiple regional initiatives in novel ways that allow for capturing of economies of scale at the level of the network as a whole.

Reflecting the philosophy of the key actors and the objectives of the main activities, the structure of Science Park Jönköping was designed to differentiate between, while also linking, three distinct phases of company development: i) the Business Lab; ii) the Business Incubator, and; iii) the Business Growth part. These three fit respectively the themes *start-up*, *development*, and *growth*. Special attention has been paid to the operations of the Business Lab, which operates as an "open-source" environment where ideas originating from students/researchers, as well as from the surrounding business environment, are allowed to be tested⁶. The university pays the rent of the lab, and some university training courses are offered there. Through appropriate linkages with the Business Incubator, a high "deal flow" of ideas and a progression in multiple forms of "learning environment have been engineered", even if only a fraction of the firms started in the Business Lab can be housed in the Business Incubator. In Business Growth, the Science Park houses companies originating from academia as well as from established businesses and R&D-units.

The main components of the student entrepreneurship system are: (i) a 5-week course in "Entrepreneurship & Business Creation", which is mandatory in the first year for all students in undergraduate programmes in business administration and engineering and; (ii) a support system run by the Business Lab of the Science Park where any student, or more commonly, a team of stu-

dents that have an idea can freely enter and get advice and support. Because the university is closely aligned with private companies in several ways, students are used to working together with companies. As a result, they can relate their studies more effectively to the business community, gain more practical entrepreneurship training which can be used in another context or they may exploit the possibility to start a new company backed by the business support of the Science Park through the Business Lab.

The way this environment was shaped from the outset and has continued to interact with the university, students are inspired to visit the Science Park and are encouraged to start new companies in parallel with their studies. The various educational programmes of the university offer an understanding of entrepreneurship, but these activities only have limited scope and thus allow students to divert plenty of time and effort from other studies and learning exercises. The day the inspiration for getting to know more about a concrete opportunity arises, students become aware of the entrepreneurial avenue as an option, and also of a physical site

and professional hub at which they can visit and feel welcome.

As a result, the number of companies started in the business lab, mostly by students, has grown rapidly to reach over 70 in 2006. Whereas the majority are started by business and engineering students, interest is noticeable among health and teaching students as well, where levels of entrepreneurship are overall extremely low in the Swedish university system. Not only do students of Jönköping University thus start firms to a higher degree than elsewhere, but the student support system is highly cost-effective in financial terms. The cost per firm started is estimated at approximately €5000, an order of magnitude significantly lower than the cost in "Entrepreneurship Schools" at other universities. Survival rates are also reasonably high, although distinctly lower than at some much higher-investing institutions such as Chalmers⁷. On the other hand, benefits accrue not only because some companies survive and grow, but also because entrepreneurs bring their experience with them to other new ventures, and also other professional careers.

Box 2: Main methods for a Science Park to improve the competence base of human resources in SMEs

(n.a = not applicable)

| Method | Creation of new firms | Supporting local clusters | The Science Park system in the region |
|---|-----------------------|---------------------------|---------------------------------------|
| 1. Visiting expos/trade fairs | | X | X |
| 2. In-house training courses | | | |
| 3. External courses | X | X | X |
| 4. Work rotation | n.a. | | |
| 5. Study visits outside firm's location | | X | X |
| 6. Delegation of work tasks | X | X | |
| 7. Financing professional literature for reading after working hours | | X | |
| 8. Permitting/Encouraging reading of professional literature during working hours | n a | n a | n a |
| 9. Personal development meetings | | X | X |
| 10. Regular meetings with employees incl. elements of education | | | |
| 11. Recruitment of new competence for the firm | X | X | |
| 12. Tutor/mentor for newly-employed | X | X | |
| 13. Senior tutor/mentor for already employed | n a | | |
| 14. Cooperation with external competence | X | X | X |
| 15. Linking competence development to salary by e.g. a bonus system | n a | n a | n a |
| 16. Project work | | X | X |
| 17. Participation in networks | X | X | X |
| 18. Study visits at the same location | | | X |
| 19. Temporary work in another firm | | X | |

Due to its unique set-up, combined with the special features of the region, Science Park Jönköping is unusually well-positioned to play a constructive role in meeting the needs for upskilling among SMEs, as discussed in the preceding sections. The region is not only “SME-intensive”, but the share of firms in manufacturing is exceptionally high (accounting for 60 per cent of employment in some municipalities), whereas supportive business services are weakly supplied. The new firms created in the park tend to be oriented towards professional services, and are marketing and selling their competencies to other SMEs in the region (as well as nationally). Service firms in particular complement the traditional manufacturing SMEs and may help to support specialisation through more effective carving out of core competencies in their customer firms. An example is a firm started by a media and communications student in the Science Park which took on an assignment in media training for the management group of a medium-sized manufacturing company that sells its products on a world wide market. Other examples are spin-off firms in the Science Park working with project management, product design and the development of ICT-services that strengthen information logistics and knowledge management in client companies.

By developing a forum for match-making, linking established business and the aspirations of new knowledge-based firms, Science Park Jönköping positions itself to cherish complementary processes of firm formation and continuous and mutually-rewarding skill upgrading in existing SMEs. Complemented by other collaboration with the university, such as mentorship programmes, the Science Park moves to encourage and train firms to articulate their specific skills needs. The Science Park moves to make the supply of skills more prone to be driven by the demand for value-enhancing services in individual businesses.

As complementary mechanisms for exercising this task, Science Park Jönköping has exploited three channels. As depicted in Figure 5, these are: (i) The creation of new companies and the development of skills for Science Park firms, mostly with SMEs in the region as their prime customers; (ii) the support of local clusters by developing programmes for SMEs together with Science Park firms, and; (iii) the collaboration between actors in the region that work according to the Science Park idea in a system, the Science Park system.

Through the creation of new enterprises, new knowledge is put to action. By selling their new technology and services, the new firms diffuse their knowledge to more established businesses. By getting access to a wider supply of complementary services through the interface with a “trusted” intermediary organisation and arena for exchange, these firms also gain the confidence of increasing their specialisation, focusing harder on developing skills that are central to their key business in parallel with developing an increased reliance on the external services. Through these processes, both of which allow firms to adopt new knowledge and technology, existing firms and industries gain opportunities to become more competitive on the global market. Also,

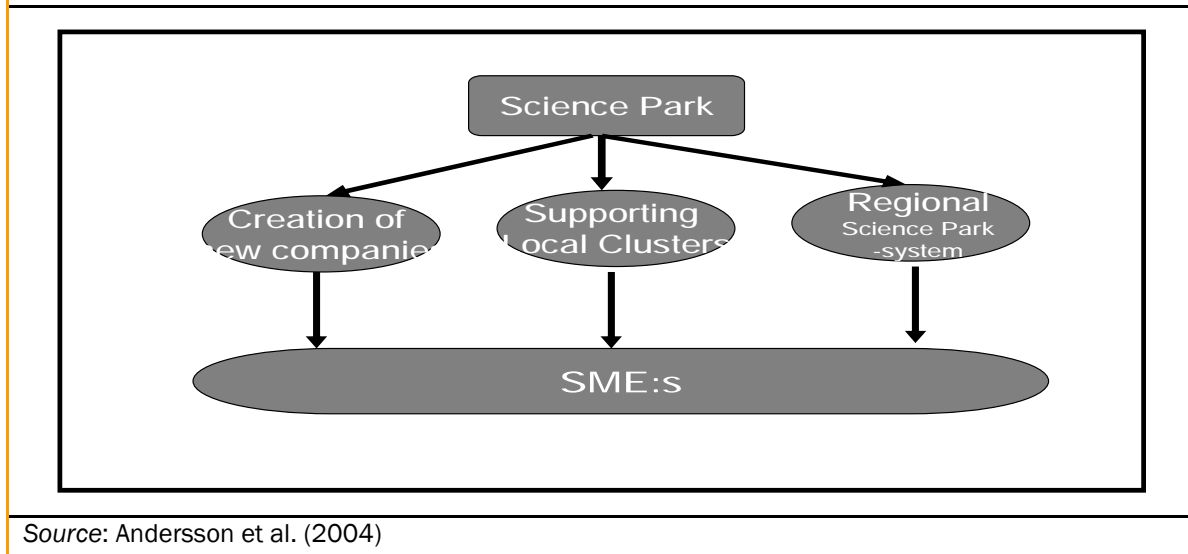
through the creation of and activities developed by new companies, learning processes are shared between actors in the Science Park and the SMEs of the wider surrounding region.

To what extent can the Science Park support the development of “relevant” skills within the new companies? For nascent firms (whether housed in the Business Incubator or not) as well as for growing companies, an extensive range of services is provided, related to training. The training is hands-on, based on the need of the specific company, and often organised in a setting where three or more companies cooperate. An example is a two-day strategic sales-training programme which is hosted by the Science Park each year. The basic methods and instruments are communicated to all companies participating but applied to different problems. Business coaches from different areas of expertise are coordinated and combined for the purpose of analysing and adjusting the existing models so that they can meet the specific needs of each individual company in a “task force” manner. Another example is arranging a joint “kick-off” for the companies that are too small to arrange such a meeting on their own. A law firm has, for instance, allocated one employee, one day every second week, for free counselling for Science Park firms. If the firms require more expertise in intellectual property rights the office of a national patent firm with five employees, located in the Science Park, can provide support. Also, the former owner of the local law office is employed by Science Park Jönköping as a senior consultant for science park firms. As a special consideration, at least one of the available business coaches needs to have relevant expertise in intellectual property rights.

Science Park Jönköping also attempts to identify and strengthen emerging clusters. In the local community, the Science Park firms working within the area of robust electronics and embedded systems together with other firms form a cluster with skills upgrading high on the agenda⁸. Learning processes are based on exposure to specific problems confronting individual companies and how they can be resolved in the specific situation, followed by exercises of comparison and generalised conclusions. By bringing together a group of companies representing a certain area of expertise, various new solutions can be identified and compared. Processes are engineered to trigger mutual exchanges and learning experiences. Many of the ideas that are rejected, i.e. not applied to the specific problem/need at hand, are in effect reintroduced and applied in another context.

Based on the experience of Science Park Jönköping, Box 2 summarises a number of measures that a science park can adopt to improve the competence and human resource base of SMEs, applying the methods shown in Box 1 and distinguishing between the three enumerated modes. While the “X” markings are, of course, judgemental, their sheer number illustrates the need for a science park to develop a comprehensive strategy for what it can and cannot do, in support of communication, planning, implementation and, not least, the creation of synergies between the different aspects of its operations.

Figure 5: Science Park support model - three modes of strengthening local SMEs



As the strategy of Science Park Jönköping has evolved over the years, efforts have been made to strike a combination between flexibility/adaptation on the one hand, and preserving a clear and effective structure on the other. A key aspect has been the continuous effort of the park to keep its main collaborative actors, including the university and the businesses, on “speaking terms” with each other, within the realm of a market-oriented view of entrepreneurship and skills upgrading. In many respects, the role of Science Park Jönköping is that of a broker. As such, it must acknowledge and seriously consider the cultural differences between e.g. academia and business, but identify the points of mutual benefit and build upon them, thus building trust between different parties. This includes creating a climate in which lack of time to handle administrative hurdles or participating in discussions for discussion’s own sake is appreciated, where business failures are accepted, and where the virtues of both uncompromising competition and fruitful collaboration between companies are stimulated.

On a more operational level, the inclusion of several kinds of activities in its agenda creates a challenge for Science Park Jönköping to measure the effectiveness of disparate kinds of efforts, and to guard incentives structures that can allow for an orderly cherishing of good results in each of them. From the start, Science Park Jönköping adopted a *balanced scorecard reporting model* of activities. In 2003, as a commercial business intelligence system was implemented, the burden of collecting extensive data was rationalised, in part through a software system that systemised the daily interactions and information developed between business coaches and companies.

Whereas Science Park Jönköping made great strides in many respects, there are also outstanding challenges. The entrepreneurial spirit has not embraced all parts of the university. To date, students in potentially important growth areas such as health and education have played a minor role in the set-up of new firms. This comes as

no surprise, as these sectors are dominated by public interests in Sweden (and in Europe more broadly), feature mainly female students (which have generally been less prone to start their own company), and also because the processes leading to entrepreneurship in these areas may take on special features due to special restrictions. Another weakness is that although the growth part has come to host a good number of established companies, the provision of relevant professional business services allowing this category of knowledge-intensive firms to grow vigorously has lagged. This, again, is not surprising given the fundamental priorities and objectives of the key stakeholders. Revising the fundamental ownership and governance structure of the Science Park so as to make it more conducive to the development of a dynamic internal environment for growth, bringing in financial and other complementary kinds of expertise from other regions without degrading the local entrepreneurial climate, represents a priority for reform in this particular case.

Concluding remarks

This study has described and examined challenges confronting SMEs with regard to the upgrading of skills, potential high-growth entrepreneurship, and the role of universities and science parks in responding to resulting opportunities. Measures bridging the supply of general training by universities and the demand for idiosyncratic skills on the part of SMEs should be paralleled by those that can allow for an effective mobilisation by firms of external professional service providers. Science parks and incubators can play a crucial role in fostering an effective combination of measures, including a constructive interface between academia and business.

Sweden, being a country with high R&D-intensity, strongly internationalised big business and extensive research in universities, displays examples of novel approaches to foster competence upgrading and enhanced competitiveness in its greatly important population of SMEs, including in traditional industries and in some of the (relatively speaking) peripheral regions of the country. Reviewing the experience of Science Park Jönköping in cooperation

with Jönköping University, the paper presents observations how capabilities and effective matching roles may be nurtured through methods that enable high adaptation to unique local features.

Although the precise design of measures will depend on specific circumstances, in regard to SME development, we have seen that science parks and incubators may operate so as to:

1. Increase early exposure of SMEs to the demands of markets. Strengthening a more customer-oriented development process from early on is instrumental, especially for technology-based start-ups.
2. Operate so as to effectively support stronger and more beneficial cooperation between the university on the one hand and companies on the other. Culture, incentives and agendas on the two sides differ for natural reasons and the Science Park may fill the gap as a broker that can help make the two sides realise mutual benefits in exchanges.
3. Link up with other nodes and local learning centres in a wider region so as to enhance the accessibility of skills upgrading for SMEs.
4. Exploit advantages of geographical proximity between individuals, companies and universities, capture synergy effects between the supply of academic skills and the demand for skills upgrading in SMEs.
5. Devise an interface with respects to measures bridging the supply of training by universities and the demand for idiosyncratic skills on the part of SMEs, in parallel with fostering conditions that can allow for strengthening professional business services. Progress in these two respects can be mutually enforcing.
6. Build a network of experts that can provide business development services to the companies that the science park is serving. The science park can develop expertise on *managing* this network for the purpose of supporting business development by more professional servicing of company needs. A science park should not strive for providing the full scale of business development services in-house.

The case of Jönköping is atypical in several respects. High ambitions to support business links are found in many places. Many science parks, in Sweden and elsewhere, have been able to channel much greater flows of funding to start-ups. Noteworthy for Jönköping is how much has been achieved with very little external funding and little reliance on economies to scale at firm level. Another aspect which should be greatly relevant from the African viewpoint is the combination of focus on start-ups and competence upgrading among SMEs, the geographical scope of the scheme as the Science Park organises a wider nexus of learning nodes in the wider surrounding region, and the adoption of a consistent systemic approach in support of SME-development and entrepreneurship. In these respects, Science Park Jönköping further combines its own focus with that on entrepreneurship in education at Jönköping University.

The two are not in conflict but specialise in a mutually compatible and complementary manner.

The key to achieving consistency may be found in context-specific factors, such as the prevalence of SME culture in the region, and the profiling of entrepreneurship at Jönköping University. In a more general sense, fundamental success factors include the ability of the university and the science park to identify a mutual win-win situation from developing an active interface between them. The prevailing attitudes, as well as the presence of objectives and activities on both sides that could draw benefits from the start-up of new firms by the students and the development of long-term relations with the SME-sector, embracing both training and the strengthening of professional business services, have been helpful in the present case.

In the next phase, weaknesses of the governance structure of the science park need to be addressed. A fundamental measure, mutually identified by the university and the park management as a priority for reform, is the need of separating the science park system from the central park unit. This emanates from the fundamental importance of mustering a more intensive engagement by a narrowly defined set of stakeholders, which is more local in nature but which extends to include not only the academia and the local policy sphere, but also experienced and established leading business interests. International experience from successful science parks provides ample evidence of the crucial importance of engaging real business insight in the management of science parks. In this sense, the interface between the university, the science park and society needs to adapt and evolve. This is also needed if the previously public-sector dominated domains are to open up to entrepreneurial opportunities. The latter in addition, however, requires the adoption of new means to introduce the part of the schools that so far were organised primarily towards the public sector, notably health and education, to the fabric of the science park, while adding new required elements so as to allow for a boosting of successful entrepreneurship activities in these areas as well.

Most fundamentally, the success as well as the still outstanding challenges of Science Park Jönköping centre on the opportunities, mechanisms and the abilities to shape long-term collaboration, teambuilding, communicating and implementing its strategies in ways that allowed it to address outstanding coordination problems among its main counterparts and to interact with them in such a way as to add value for all the relevant key actors.

A foundation of trust needs to be created which is consolidated through frequent meetings in an informal setting. A science park should participate in creating these types of arenas and networks, but engage the university and business representatives in the process. A science park must structure its operations, while at the same time adapt to continuously evolving wider environmental conditions, thus adopting a strategy of emerging development over time.

tion processes, and; iii) the boundary between the local environment and outer structures, in the form of national innovation systems or international networks and markets. Science parks can put their member firms on a larger map through, amongst other things, media coverage and branding.

The scope of the activities that fit within the agenda of science parks requires consideration (Ferguson, 1995; Formica and Sanz, 2003). Should science parks and incubators serve the firms in the park/incubator as well as firms that they have helped create², or should they also serve “firms at large” in their local environment? There is no universal answer. In fact, the proper strategy will depend on what needs are most urgent, whether other players and functions operate in the field, and what competencies are available. But even under circumstances when the proper answer is the restricted one, a science park could serve as a “test-bed”/lab for developing programmes to identify and articulate needs, programmes, etc., which can eventually be applied to larger groups of firms.

By supporting the creation of new firms, the science park/incubator contributes to its local community by the fact that these firms “sell” skills upgrading by their work in SMEs. By providing local SMEs with services/functions, knowledge that originates from the university is packaged and distributed to companies through these start-ups, providing new competence and solutions in response to a specific task or problem.

It is worth reflecting on possible processes through which so-called “regional clustering processes” may be catalysed, as illustrated in Figure 4. The *engineered clustering process* is generally top-down. However, both policymakers and private individuals may be active, and the approach needs to include the exploitation of existing social capital to anchor networks. Alternatively, *organic processes of clustering* are bottom-up. Multiple actors in inter-firm collaboration may trigger the organic formation of clusters. These initially display spontaneous developments towards the establishment of link-

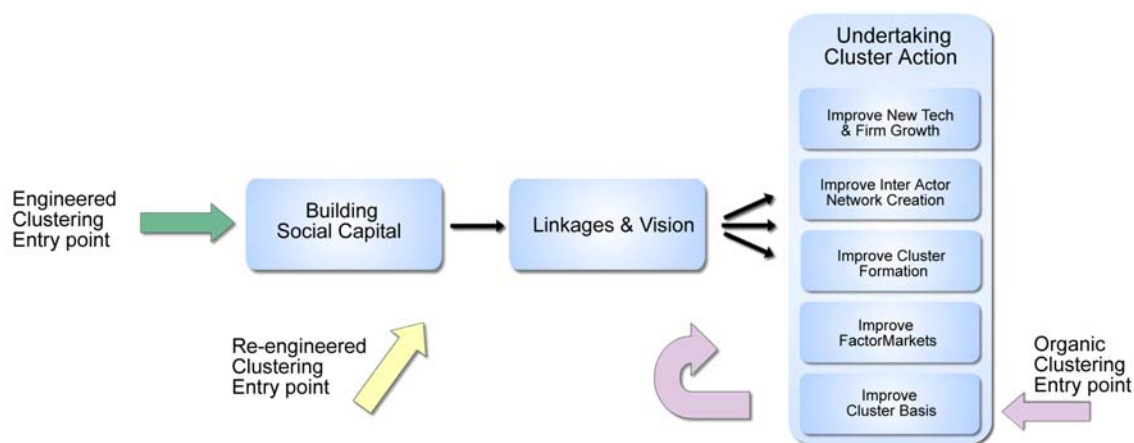
ages and joint strategies (Nauwelaers, 2003). From such a platform, a more structured exchange in response to joint opportunities may result. A third process is that of *re-engineered clustering* which, in effect, is a hybrid of the previous two. Existing relations are hindered from progressing for some reason. Key linkages are broken, or imbalanced, or other factors are blocking constructive interface. In this case, linkages and relations may be improved by the breaking of adverse rigidities, or through the communication of a new vision or strategy for joint initiatives. International organisations often try to *re-engineer* regions in developing countries by supporting historically vivid traditional clusters.

Irrespective of the entry point, the general phases of establishing potentially beneficial linkages are basically the same. In a stylised sense, they amount to: i) building of social capital and the creation of trust; ii) defining strategic linkages; iii) defining a strategy and vision, and; iv) bringing interlinked actors together in process of knowledge-generation and business formation. To the extent that a science park attains a key role in supporting the creation new knowledge-intensive firms, it may serve as the natural platform for bridging the gap in competence upgrading between the university and local SMEs. In order to make a real difference, however, it needs to operate “in tandem” with both sides.

Broadly speaking, three kinds of outstanding tasks can be identified: i) programmes are needed to enhance the capacity of SMEs to identify and articulate their specific skills needs; ii) measures are warranted to package and aggregate these needs, and to mobilise the supply side to respond, which is a task requiring cooperation between institutions that are close to SMEs and universities, public research labs, etc., and; iii) broader, community-wide programmes, possibly with a cluster-based element, to establish synergy between skills upgrading internal to firms and the strengthening of the supply of skills offered by external professional services providers.

Success in addressing these issues requires specific competencies. These include an ability to operate bottom-up in

Figure 4. Clustering processes and entry points



Source: Andersson et al. (2004)

bringing together and establishing trust and belief in mutual purpose among relevant local actors. In this context, science parks and incubators potentially stand to play an important role. Science parks are, according to the IASP-definition, professional organisations that, among other things, stimulate and manage the flow of knowledge and technology amongst universities, R&D institutions, companies and markets, and provide value-added services. Thus, taking an active role in i), ii) and iii) above is, or at least should be, part of the “core business” of a science park.

In many cases, however, science parks perform weakly in developing those links that are key to their ability to play a constructive role vis-à-vis private business, applying both to their internal structure and their external interface. Local context and governance play a decisive role, including formal as well as informal institutional frameworks. A perception of trade-offs often complicate relations, e.g., a feared conflict on the part of many universities between being perceived as “an entrepreneurial university” and having a high intellectual eminence. Career paths also seem to deviate rather than run in parallel (Delmar et al., 2005). Further, conflicts in objectives with regard to most sources of funding complicate the process of identifying relevant core business. Universities are in general funded by the government while science parks tend to be funded by public authorities mandated to support science-industry linkages, regional authorities and business interests. The match is seldom a happy one which may result in formal or informal resistance from a range of actors, in effect stressing the old linear model, favouring push of science and research output and punishing those institutions and individuals that are open to two-way communication with real-world business interest, notably on the SME-side.

The way that regional authorities and the other actors engaged in science parks confront these challenges influences the way in which outcomes are likely to move in terms of boundary-crossing, commercialisation and growth. The ability of a science park and its management to stimulate opportunities for exchange often hinges on the openness of the other actors to “coming to the table”, and for the various actors to join forces in creating room for adjustment to fit the specific regional setup. Existing businesses tend not to champion sound conditions for newcomers when their own interests are at stake. On the other hand, the already established industrial strongholds must serve as a breeding ground for new enterprises. Fruitful tracks can be catalysed through the interface between the competence needs of business and the supply of knowledge that spring out of research and universities. Still, although less so than in the African context, in Sweden and other European countries alike, public funding for research and innovation continues to be marked by a “supply side” doctrine that leaves a combination of public officials and traditionalists with critical influence on what can and should be done. These actors seldom have a good understanding of what it takes to generate new industries and businesses, or what is required for adaptation of regulations and programmes to special local conditions.

The question thus arises who can play the role of catalyst for change. We argue that policymakers and other stakeholders concerned with enterprise and regional development alike should view science and technology parks as potential partners and actors to be engaged in efforts to build the “right” context for cultivating aspiring entrepreneurs. A requirement, however, is that their agendas should start out with the ability to engineer, and to practice, a clear-cut process of business incubation and competence upgrading in what should be destined for a population of knowledge-based enterprises in their specific region. For this to be possible, the quality of the interplay between university and industry is a major factor. In this perspective, within the science park or incubator, a primary role ought to be conferred to invention teams, where researchers, business strategists, sales forces, and patent experts are brought together and devote time to customers in order to really come to grips with the kinds of concrete problems and needs that must be addressed in their particular context³.

For science parks and incubators to be effective, they need to apply, or be subjected to, proper measurement of relevant performances. In reality, many parks are governed with a view to objectives such as maximising rented space or income from rents, which may well run contrary to their objective to nurture new business with growth potential. Even the assessment undertaken by the European Union in the early years of the new millennium applied a range of such obscure and misleading indicators. For science parks to fulfil their real missions, they need to be judged on the basis of meaningful performances. This has to do with how many companies are created and developed within their premises, which does represent a common measurement today, but also their ability to spur value-creating exchanges between universities, research institutes and SMEs - an exchange that requires hands-on methodology, professional approaches to linking academia and business, and to be truly relevant to real-world business development processes (Deiaco et al., 2002; Andersson et al., 2005b).

5 The Case of Jönköping

In this section, we highlight the experience of one particular science park and its connections to the neighbouring university and business sector. This case, which is that of Jönköping Science Park, is unique in several respects. Several factors stand out, such as the uniquely high propensity of students at Jönköping University to start their own business, which they mostly do through the institutional interface established between the university and the Science Park in the form of the business lab of the latter. Another unique feature has to do with the intertwined connections of the two institutions with industry, and notably the communities of SMEs which occupy the surrounding region. Another feature, of relevance for lessons for African countries, is that the surrounding region is dominated by SMEs operating chiefly in traditional industries, and which are more reliant on soft (non-R&D) sources of innovation, rather than the science base or high-tech R&D. Having said this, achieving industrial sophistication, and high-quality

Endnotes

1. Such resistance is not unique to university. In various spheres of society, specific privileges for incumbent actors in effect counteract and impede linkages to, e.g., customers or industry. In the health sector, traditional professional responsibilities coupled with sensitive integrity and security aspects, commonly account for resistance to organisational change and the adoption of new work practices.
2. In general, an incubator (within a science park) houses only a fraction of spin-off that has been supported by the activities of the park/incubator.
3. By reviewing operating experiences in the United States, China, Brazil, Korea, the United Kingdom, Sweden, Finland and other selected countries, Rustam Lalkaka argues that "Success in the Olympiad of venture creation ...depends essentially on five inter-linked rings: Public policy, private partnerships, knowledge affiliations, professional networking and community involvement". See Lalkaka, R., "Best Practices" in Business Incubation: Lessons (yet to be) Learned", in: Formica, P. and Sanz, L. (Editors), *Frontiers of Entrepreneurship and Innovation. Readings in Science Park Policies and Practice*, IASP, Malaga, 2003.
4. The county has the largest percentage of private sector employment in Sweden, particularly in SMEs Sweden in a general sense has a small share of the work force in SMEs and low rates of entrepreneurship. As of 2004, the country holds the 30th place in the ranking of 34 countries in the yearly Global Entrepreneurship Monitor (www.gemconsortium.org), and has been ranked at places 5-7 from the bottom during the 5 years the study has been conducted.
5. Practically all programme students in business and engineering at Jönköping University have a host company during their first two years of study. Presently, there are about 850 host companies following more than 2000 students through their programme studies.
6. Ideas emerging in the intersection between university, students, researchers and local companies can be upgraded in the unique setting of the "Business Lab". The core of the Business Lab is about providing hands-on value-creating business development ideas and to match new ideas with combinations of entrepreneurial teams, generally with a multidisciplinary background. Out of some 80 projects which exploited the Science Park Business Lab in 2004, 35 are viewed as potentially promising new enterprises.
7. The Royal Swedish Academy of Engineering Sciences, and its national student council, organized a seminar in March 2007 comparing the strategies of the wider approach to entrepreneurship practiced at Jönköping with the "intensive" approach of Chalmers. See also Reitberger and Wahlbin (2007).
8. Electronics (broadly defined) offers an example of the role of Science Park Jönköping in developing local clusters. Some of these firms have worked extensively with SMEs in the region, providing both new technology and skills. In Science Park Jönköping, 27 per cent of companies operate in electronics.

References

- Amin, A. and Cohendet, P. (1999), "Learning and Adaptation in Decentralised Business Networks", *Environment and Planning D: Society and Space* 17, 87-104.
- Andersson, I., Andersson, T., and Mossberg, A. (2007), *Competence Development for Growth - International Outlook and Analysis*, NUTEK, Stockholm.
- Andersson, T., Schwaag-Serger, S., Sörvik, J., and Wise Hansson, E. (2004), *The Cluster Policies Whitebook*, IKED, Malmö.
- Andersson, T. (2005), "The Paradox of the Swedish Innovation System: Leader in Europe?", in *Le Système Français d'Innovation dans l'Économie Mondiale, Enjeux et Priorités*, Laredo, P. and Sachwald, F. (eds.), IFRI, Paris, 81-100.
- Andersson, T. (2006), "Coping Skills", in *What's Next? Strategic Views on Foreign Direct Investment*, ISA published in Co-operation with UNCTAD and WAIPA, Jönköping.
- Arvantis, S. and Woerter, M., (2006), *Firms' Strategies for Knowledge and Technology Transfer with public Research Organisations and Their Impact on Firms' Performance*, KOF Institute for Business Cycle Research, ETH Zurich.
- Balmaceda, F. (2006), "Task-Specific Training and Job Design", *Centro de Economía Aplicada (CEA)*, Universidad de Chile, Santiago.
- Barro, R. och Lee, J.W. (1996), "International Measures, of Schooling Years and Schooling Quality", *American Economic Review Papers and Proceedings* 86, 218-23.
- Becker, G. S. (1993), *Human Capital; A Theoretical and Empirical Analysis, with Special Reference to Education*, 3d edition, University of Chicago Press, Chicago.
- Black, S.E. and Lynch, L.M. (2000), "What's Driving the New Economy: the Benefits of Work-Place Innovation", *NBER Working Paper* 7479.

- Clark, B. R. (1998), *Creating Entrepreneurial Universities - Organizational Pathways of Transformation*, Pergamon, Oxford.
- Deiaco, E, Giertz, E, Reitberger, G, Rogberg, A, (2002), "Teknikparkens roll i det svenska innovationssystemet - historien om kommersialisering av forskningsresultat (eds.), 3, VINNOVA.
- Delmar, F., Wennberg, K., Wiklund, J., and Sjöberg, K. (2005), "Self-employment among the Swedish Science and Technology Labor Force", The evolution of the firms between 1990 and 2000, ITPS, Stockholm.
- Etzkowitz, H., Leydesdorff, L. (2000), "The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations", *Research Policy*, 29, 109-23.
- Jovanovic, B. and Nyarko, Y. (1996), "Learning by Doing and the Choice of Technology", *Econometrica* 64, 1299-310.
- Ferguson, R. (1995), "Panacea or Let down - Science Park in the literature", The Small Business Research Group, Swedish University of Agricultural Sciences, Department of Economics, Teknikbrotstiftelsen i Stockholm, Stockholm.
- Formica, P. and Sanz, L. (2003), "Frontiers of Entrepreneurship and Innovation, *Readings in Science Park Policies and Practice*, HU-160.
- Gibbons, R. and Waldman, M. (2005), "Task-Specific Human Capital", *American Economic Review*, Papers and Proceedings, May.
- Hamel, G. and Prahalad, C. K. (1994), *Competing for the Future*, Harvard Business School Press, Cambridge.
- Harrison, B. and Glasmeier, A. (1997), "Response: Why Business Alone Won't Redevelop the Inner City: a Friendly Critique of Michael Porter's Approach to Urban Revitalization", *Economic Development Quarterly* 11(1), 28-38.
- Hay, D.B., Butt, F., and Kirby, D.A. (2002), Academics as Entrepreneurs in a UK University, in Williams, G. (ed.), *The Enterprising University: Reform, Excellence, and Equity*, Open University Press, Buckingham.
- Lavrow M. and Sample, S. (2000), *Business Incubation: Trend or Fad? - Incubating the Start-up Company to the Venture Capital Stage: Theory and Practice*, University of Ottawa, Ottawa.
- Leroy, F. (2002), "Lang Leren(d) Leven; Van Employability naar Enjoyability (Long-Life Learning; from Employability to Enjoyability)", *Over Werk, Tijdschrift van het Steunpunt WAV*, Leuven, 44-56.
- Martin, B. R. (2003), "The changing social contract for science and the evolution of the university", in Geuna, A., Salter, A. J. and Steinmueller, W. E. (eds.), *Science and Innovation: Rethinking the rationales for funding and governance*, Edward Elgar, Cheltenham.
- Martin, R. and Sunley, P. (2001), "Deconstructing Clusters: Chaotic Concept or Policy Panacea?", Revised Version of a Paper Presented at the Regional Studies Association Conference on *Regionalising the Knowledge Economy*, London.
- Nauwelaers, C. (2003), "Innovative Hot Spots in Europe: Policies to Promote Trans-Border Clusters of Creative Activity", Background Paper on Cluster Policies, European Commission, *European Trend Chart on Innovation*, Luxembourg.
- OECD (2001), *the New Economy - Beyond the Hype*, Paris.
- OECD (2003), *Science, Technology and Industry Scoreboard*, Paris.
- OECD (2005a), *Innovation Policies, Innovation in the Business Sector*, Paris.
- OECD (2005b), *SME and Entrepreneurship Outlook*, Paris.
- Peneder, M. (2002), Structural Change and Aggregate Growth, in *Structural Change and Economic Growth: Reconsidering the Austrian Old-Structures/High-Performance Paradox*, Chapter 5, WIFO, Vienna.
- Piva, M. and Vivarelli, M. (2007), "Corporate Skills as an Ex-Ante Incentive to R&D Investment", *IZA Discussion Paper* 2562, Bonn.
- Polanyi, M. (1962). *Personal knowledge: Towards a post-critical philosophy* (2nd ed.), University of Chicago Press, Chicago.
- Prahalad, C. K. and Ramaswamy, V. (2000), "Co-opting Customer Competence", *Harvard Business Review*, 78, 1, 79-88.
- Reitberger, G. and Wahlbin, C. (2007), "Tillväxt genom akademiskt företagande" (Growth by Academic Entrepreneurship), forthcoming in Giertz, E. (ed.). "Då förändras näringslivet" (Then Industry Will Change), Studentlitteratur, Lund.
- Storey, L. (1998), "Functional Analysis and Occupational Standards: their Role in Curriculum Development", *Nurse Education Today*, 18:1, 3-11.
- World Bank (2004), *World Development Indicators*, Washington.
- Wright, M. (2004), *Spin-outs from Universities: Strategy, Financing and Monitoring*, University of Nottingham, Nottingham.