Success Factors for Science Parks
in the Developed World and Emerging Economies

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Executive Summary

Research published in 2005 contrasting STP successes and failures in the USA, Canada and Mexico[1] have highlighted some common essential ingredients for success and the nature of the success that can be expected in different regional environments. The International experience of the authors from working in the UK, Russia and South Africa suggest additional criteria need to be added to be able to predict the likely outcome from establishing an STP, particularly in the emerging economies of the world.

Note: In this paper the term STP is taken to include both full Science Parks and significant Technology Incubators.

Background

According to research by Mian et al[1] the success of a Science and Technology Park (STP) and the contribution that it can make to its regional economy are not the same. An STP is more likely to be successful if it is founded in a region that has:

- A large, metropolitan, diverse and well established developed economy;
- A strong research base;
- A culture of entrepreneurship;
- Stakeholders including a University or research centre that are actively engaged in championing and delivering resources to establish the STP; and,
- Pro-active and entrepreneurial management

However, an STP in a large metropolitan area is less likely to be one of the major drivers of change towards a more knowledge intensive economy but nevertheless can enhance the process.

In North America, the greatest contrasts between success, failure and contribution to economic improvement lie between the USA and Mexico. Although objective analysis suggests that only 25% of US STPs are successful and have been material in bringing about economic change, about 50% have been successful.

By contrast, in Mexico, there have been few notable successes to date. This is attributed to inconsistent and inadequate public sector support for both the STPs' built infrastructure and the provision of appropriate business support infrastructures including seed funds and venture capital.

South Africa, Russia and the UK

While the Mian success factors seem to predict success and outcome expectations for North America, practitioner experience suggests that they would only provide a partial indicator in other economies, particularly other emerging economies. By taking experience from South Africa and Russia two further key success factors are postulated. Reference to the UK is added to check their relevance to another developed economy.

South Africa

As in many emerging countries, there have been efforts in the 1980's and 1990's to establish 'technoparks', some linked to universities and other independently. These projects either failed to attract the intended occupants or degenerated into normal business parks offering only real estate services to the residents. With hindsight, it is clear that such developments did not fully understand the critical elements to nurture an STP with its associated value-addition activities by the park management.

In 1994, South Africa underwent a peaceful but dramatic political and social change. From a country ruled by a minority, with a strong resource-based industry and R&D focused on internal self-sufficiency needs such as energy, defence and agriculture, the transition to democracy dramatically changed the business arena. In the isolationist and sanctions era, South Africa did not respond to world trends of increasing the country's knowledge economy contribution. In this context, internal competition between larger corporates dominated the local scene, and a large proportion of the population was excluded from business roles. However, the country had a solid business culture, good infrastructure and banking systems and legislation covering intellectual property.

It was within this context that the Gauteng Province launched a project to stimulate knowledge intensive business growth based on a Science Park model. With the previous history of such ventures, reference only to international role models and long distances to developed countries with deep STP experience, the identification of 'key success factors' on which to plan this new activity was critical. In this context, the 'refined Cabral-Dahab Science Park Management Paradigm[(2)] was a valuable guide, and provided an agenda for studying selected successful parks. These factors are summarised in Table 1 below.

Table 1: The Cabral Dahab Science Park Management Paradigm[(2)] - Refined

A science park must:

1. Have access to qualified research and development personnel in the areas of knowledge in which the park has its identity.
2. Be able to a market its high valued products and services.
3. Have the capability to provide marketing expertise and managerial skills to firms, particularly SMEs, lacking such a resource.
4. Be inserted in a society that allows for the protection of product or process secrets, via patents, security or any other means.
5. Be able to select or reject which firms enter the park. The firm's business plan is expected to be coherent with the science park identity.
6. Have a clear identity, quite often expressed symbolically, as the park's name choice, its logo or the management discourse.
7. Have a management with established or recognised expertise in financial matters, and which has presented long term economic development plans.
8. Have the backing of powerful, dynamic and stable economic actors, such as a funding agency, political institution or local university.
9. Include in its management an active person of vision, with power of decision and with high and visible profile, who is perceived by relevant actors in society as embodying the interface between academia and industry, long-term plans and good management - Mr./Ms. Science Park.
10. Include a prominent percentage of consultancy firms, as well as technical service firms, including laboratories and quality control firms.

Such factors provided a 'necessary' checklist on the development strategy, although experience showed they were not sufficient for this project. The further factors identified by Mian et al [(1)] introduce important additional elements which later operational experience have confirmed, e.g. Gauteng represents a large metropolitan, with a diverse well established economy, representing some 36% of the South African GDP in a small geographic area. This positions many of the emerging

businesses (including SMEs) in Gauteng with a sizeable local market as well as a 'launch pad into African and other markets'. However, while some of the other factors can be addressed by judicious location selection and stimulation of key relationships e.g. with universities and research centres, there are others which present more fundamental barriers due to history and business culture.

In the case of The Innovation Hub (TIH), in parallel with the development of the main site, the activities were started in pilot mode, where business incubation was a priority, which gave opportunities to understand some of the dynamics of the interrelationships of the various components of the triple helix, viz. government, business and academia/research. Significantly, the context of a resource-based economy, based on dominantly imported technology, and the need to transition from an isolated economy to the rapid globalisation and emphasis on knowledge-based business required adaptations. This early phase of TIH emphasised the important role of 'neutral' or independent agencies such as STP's in contributing or facilitating to improving the interfaces between the role players. Thus it was realised, as is now common practice[3], that STP's have a role beyond their physical boundaries and this must be catered for in the development strategy. This role has evolved to the point where TIH could initiate a pilot programme based on the Finnish 'Centres of Expertise' model, where business and research consortia define key development projects. Additionally, an extended community ("INNOV8") provides a forum for knowledge based businesses, the R&D institutions and government agencies opportunity to interact on a regular basis, and create as 'voice' for the smaller emerging companies. As one of the major gaps lies in 'business-ready' high-tech skills, the CoachLab programme provides a win-win engagement with business and universities which has lead to other interactions. All these activities place strong emphasis on engaging previously disadvantaged entrepreneurs and graduates to improve their competitiveness.

In many of the STP evaluations, the 'natural flow' and technology transfer from academic and research institutions to the business world are identified as key factors. In South Africa, the Department of Science and Technology in its R&D Strategy of 2002 described the situation as an 'innovation or commercialisation chasm'. Many factors can contribute, from low levels of entrepreneurship in the knowledge-workers, the lack of business experience amongst many of the previously disadvantaged people endeavouring to start businesses, the lack of technology transfer or technology commercialisation in academic and research staff evaluation measures, through to gaps in support policies for business. Likewise, the process of technology transfer has as much to do with the sources of knowledge and with the business culture of the recipients. Thus STP's, to meet their objectives in such circumstances, will need to be pro-active and active participants in facilitating change in their national system of innovation.

As is commonly an issue, the availability of experienced investors capable of managing the risks related to emerging knowledge-based companies is a critical factor. While an STP can create a visible presence for these companies and a good basis for deal flow, the transition from private equity funding to true venture funding in emerging countries can remain a challenge.

Postulated additional success factor No 1: The nature of the business, and research cultures and experience can have a profound effect on the rate of developments of technology-based firms (TBF's), both individually and as a sector. Emerging economies that recognise this early in the development and build ameliorating features into their STP environments are more likely to have successful STP's.

Russia

To exemplify a second additional success factor we can turn to the Russian experience in the 1990s[4].

The basic Mian model is less successful in explaining the success and outcomes of STPs in Russia during the late 1990s and beyond, although it does go part of the way. In the early 1990s when the STP movement began in Russia with the Tomsk Technopark, there was strong stakeholder support, a desire to embrace the market economy and entrepreneurship and the excellent knowledge base of the Universities, Technical Institutions and the Academy of Sciences. In its early years Tomsk

TechnoPark flourished under a highly entrepreneurial management team. Indeed, such was the capability of this management team that the TechnoPark itself became a significant wealth generator, but did so more by export of timber and import of tea from India and other basic commodities than by exploiting the local extensive and capable knowledge base. The TechnoPark collapsed financially in the mid 1990s through the juxtaposition of two events:

- First they overextended themselves with imported goods on consignment and;
- The federal government ran into budgetary problems and stopped paying wages and salaries, often for months at a time, to large numbers of staff in the myriad of institutions in and around Tomsk.

The combination of large stocks of imported goods and a vanishing home market led to the collapse. The TechnoPark has since been restarted on more conventional STP lines.

However, by number, the greatest density of TechnoParks in Russia sprang up in and around Moscow and St Petersburg based on the many excellent universities and research institutes that exist there. These projects had the benefit of lying within the most dynamic and extensive parts of the Russian economy with their historically better lines of communication and greater access to resources of all kinds. So this would seem to fulfil the Mian condition of a large, diverse local economy. Furthermore, there can be no doubting the excellence of the research base. The entrepreneurial energy of the staff of these Institutes was also immense as the real value of their salaries dropped substantially and their consequent motivation to develop additional income from their knowledge and skills rapidly rose.

However, the economy of Russia, while still large had changed dramatically. The long established supply chains and technology transfer activities that had been driven by the USSR budget machine wound down. Each organisation now stood alone with no guaranteed orders placed by central planners. While this was a very significant stimulus to entrepreneurial activity it also created many unforeseen outcomes that would hinder the development of TBFs.

Limited National Market

A quick check on the typical occupiers of STPs will show that in most parts of the world by far the majority of these companies sell their technology products and services to other businesses. They are B2B businesses. Certainly there are also business to consumer (B2C) businesses but they tend to be much smaller in number.

In Russia the opportunity for new TBFs to sell to large enterprises in Russia was radically diminished for many years after the centrally planned economy was disassembled. The managers of the larger enterprises no longer had dedicated budgets for innovation and many saw a once in a lifetime opportunity to sequester the plant and equipment of the businesses they ran and transfer them, through "privatisations", to themselves. During the 1990s it was exceptional to find such managers particularly interested in productivity enhancing new technology, and if they did they tended to prefer to pay a much higher price for a well known "western" technology as opposed to something that had been developed by an academic based in a local STP, however eminent the founder.

Consequently, many of the TBFs setting up in the early Russian STPs based their start up strategy on selling directly to international markets. However, the individuals lacked experience in international trade so they had little understanding of the product quality and service support implications of their chosen strategy. Furthermore, there was virtually no risk capital or credit available to them to undertake the investment they needed to enter overseas markets. Therefore, the only mechanism open to them was to find joint-venture partners in other countries that could undertake the marketing on their behalf.

The Russian government started to establish seed funds and databases of technology to stimulate the interaction of their TBFs with counterparts in other parts of the world. It did stimulate a few joint

ventures, but it was a very small number in relation to both the vast knowledge base of Russia and the number of technologies being promoted by small Russian TBFs. A brief case study of a Russian TBF based on the Zelenograd TechnoPark on the edge of Moscow is given in the box below which exemplifies many of the practical problems these businesses faced.

The AFM Company at Zelenograd Technology Park

Zelenograd is the microelectronics capital of Russia and at its peak was researching, developing and manufacturing sensitive microelectronic products for much of Russia's defence industry. The Zelenograd TechnoPark was established in the early 1990s to help academics and other technical staff to create spin out businesses based on their knowledge.

A young researcher (we will call him Yuri, although that is not his real name) whose skills lay in surface microscopy designed and built an atomic force microscope (AFM). It was by the then prevailing world standards a fairly basic piece of equipment but it worked well enabling users to "see" the surface of materials down to its molecular or atomic structure. The initial business model of the founder was to sell this equipment as a teaching machine to other Russian institutions, but he soon realised that the capital budgets of even the most favoured Universities such as Moscow State University had been so heavily decimated that he would have to rethink his business strategy.

Through his attendance at international conferences, Yuri realised that he had a very large cost advantage over equipment made in the developed western world economies. He estimated that he could make and sell his AFM for $8,000 while competitors were about 3 to 5 times this price. It was at this time that the University of Warwick Science Park (UWSP) was working with a number of Russian Science Parks through a programme financed by EBRD, and Zelenograd was amongst the Parks being supported.

Yuri's business was selected as one of several to receive special assistance to help in accessing international markets. A second-generation prototype was imported to the UK and a marketing plan was agreed between Yuri and UWSP. It was decided to test both the teaching market in the UK for direct sales and the opportunity for attracting one of the 3 or 4 European manufacturers as a potential distributor.

Everything started well. A number of interested buyers attended an event at which Yuri came over to demonstrate his equipment and two sales to universities resulted some months later. Also discussions went forward with one European manufacturer who seemed keen to take an exclusive worldwide license.

Then, the problems began:

- Unless Yuri was driving the equipment, it often proved difficult to use. This gave problems in demonstrating it to new potential customers in Yuri's absence, even though Yuri had trained technically competent individuals in the UK.
- The customers found that getting hold of Yuri in Russia to be talked through equipment set up and operational matters was tiresomely slow. For many understandable reasons in the Russia of those times, Yuri's hours in the office were random. But European customers do not find this behaviour acceptable and it was damaging his business' reputation.
- Then, as discussions with the potential European manufacturer progressed they asked about the supply of one of the main consumable items of his AFM a component called the cantilever that senses the atomic forces at the surface that it is scanning. This turned out to be absolutely critical. Offline from the meeting UWSP established that the cantilevers were not made in Zelenograd but were purchased from a US business that also made AFMs. While the US firm were prepared to sell cantilevers to Yuri in his capacity as a researcher, they made it absolutely clear to UWSP they would not entertain the sales to his or any other company that were including their components in commercial microscopes. Nor were they interested in investigating the possibility of taking a licensing to sell his equipment. Yuri wanted to keep going - he believed he could continue to secure enough cantilevers, through networks of scientific colleagues. However, UWSP had to point out that he would be infringing the patent rights of the US Company and this was a matter that UWSP could have no hand in it.

The combination of these problems meant that Yuri's business could not trade and so he withdrew back to his lab, his international business prospects thwarted.

The good news is that some 10 years later UWSP heard that Yuri was selling a new AFM, this time in Korea.

The case study story of the Zelongrad TBF is atypical in that they actually managed some international sales, but is very typical in the scant regard such businesses had towards customer service, product quality and intellectual property. In the home market of the centrally planned USSR in which the founders of Russia's new TBFs had grown up these were not features that counted for much. As a consequence of many thwarted attempts to secure access to international markets most Russian TBFs turned their attention towards consumer products and ironically the more basic the product the more likely they were to succeed - provided the founders had good commercial acumen. The wholesaling of western made wool carpets, sales of a tap-mounted basic water filtration device and mail order of imported children's clothing all produced good financial returns to the academic founders of TechnoPark based businesses. Clearly these businesses had little to do with the scientific training and qualifications of their founders.

There were some exceptions of TBFs that were founded, traded successfully and grew. For example a small start up on a Moscow TechnoPark hit on the idea of increasing the communication capacity of Russia's extensive telegraph network. They developed a modem that allowed the capacity of these lines to be increased many times over making them useful for both voice and data transmission. The Moscow TBF was the first into this market and maintained their lead by getting their designs manufactured in Taiwan thereby vastly improving the quality and reliability of their equipment. This was not advanced technology, but was a clever adaptation of modem technology that recognised that Russia's telecommunications industry was short of capacity at a time that demand was rising rapidly. The telecoms industry was amongst the first of the knowledge based sectors in Russia to receive heavy attention from western businesses that quickly lead to significant investment in Russia. The small TechnoPark modem business became a very successful B2B business. It was one of the few with a

real technology based innovation that had a home market to turn to. The only general category of TBF prevalent in Russian TechnoParks that found some home market were IT software and services businesses who started to sell to the burgeoning number of import based SMEs springing up in Moscow area. While a few businesses developed highly innovative software, in the main their sales were the reselling "Western" products. The TechnoPark at Moscow State University is noteworthy in having more of this type of business trading successfully than elsewhere with a higher proportion having at least one innovative product they had developed themselves.

Postulated additional success factors No 2: There must be a national market accessible by TBFs for an STP to have any realistic chance to bring about economic change to a more knowledge based economy.

The UK

The model generated by Mian[(1)] et al works tolerably well for the UK which is a well developed and diverse economy. Careful use of the success factors suggests that well-run and adequately resourced STPs, with heavily engaged stakeholders in regions remote from London have had the largest impact on their local economy in addition to being successful. Arguably, London does not need STPs as means of raising its economy. Biased as its economy is towards financial services, London's economy already has by far the highest Gross Value Headed per head of anywhere in the UK and is amongst the highest as a city region of anywhere in the world. There also exists in and around London the highest level of R&D expenditure in the UK per head of population, and the highest level of entrepreneurship. Arguably London could be considered a "without walls STP", where the knowledge based business entrepreneurs and the financial networks quickly find each other, ensure that the businesses are well funded and good management is identified. Certainly this type of behaviour seems to happen far more often in London without the help of an STP than it does in the UK regions where there are many good and active STPs.

However, whether a firm is London based or not there is a frustrating national business culture exhibited by all too many UK entrepreneurs that leads them to limit the growth of their business well before its potential has been realised. This is a stark contrast to the behaviour of successful US high-tech businesses. This business cultural phenomenon affects the scale of the economic impact of that UK STPs can achieve. As in the South African situation the importance of understanding business culture as a key success factor, therefore becomes very important. In Cambridge where seed Venture Capital is most prevalent in the UK (London apart), and has been stimulated in no small part by the St John's Innovation Centre, a highly proactive STP in that locality, the larger number businesses with third party equity holders is starting to increase the number of businesses that seek higher growth profiles. Over the last decade it has become noticeable that several of the more successful UK STPs have become directly involved in helping their clients to secure seed capital in the form of equity at the start up or very early stage as a mechanism for broadening the ownership base from the outset. The anticipation is that over time these owners will be motivated to bring about the changes that the business needs to maintain growth long after the original founder might have been satisfied to level off.

Conclusions

While the Mian model for assessing the likely impact and success of an STP is a valuable starting point it is insufficient, particularly in emerging economies. It is proposed that two additional factors need to be added:

(a) The nature of the business culture, particularly in relation to features such as IP protection, quality standards etc., but also covering other business cultural norms endemic to a nation or region e.g. a low propensity for technology diffusion from the knowledge base to businesses (South Africa), that can hold back the development of TBF formation or the unwillingness of

businesses founders to aspire to achieve the full growth potential of their business (UK) must also be considered; and

(b) The presence of national markets readily accessible to TBFs, in economies that are in transition or developing.

It is the thesis of this paper that STPs that are able to understand and ameliorate the types of issues raised by these additional factors while also exhibiting the essential Mian characteristics will be more likely to deliver significant economic outcomes than those that do not.

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