

CRITICAL SUCCESS FACTORS OF TECHNOLOGY PARKS IN AUSTRALIA

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Abstract: Given the potential importance of technology parks, their complexity in terms of the scope of required investment and the growing interest of governments to use them as tools for creating sustainable development there is a pressing need for a better understanding of the critical success factors of these entities. However, Briggs and Watt (2001) argued that the goal of many technology parks and the factors driving innovation success are still a mystery. In addition, it is argued that the problem with analyzing technology parks and cluster building is that recent studies analyze “the most celebrated case studies... to ‘explain’ their success” (Holbrook and Wolfe, 2002). This study uses intensive interviewing of technology parks’ managers and managers of tenant firms in the technology park to explore critical success factors of four of Australia’s technology parks. The study identified the following critical success factors: a culture of risk-taking “entrepreneurism”, an autonomous park management that is independent of university officials and government bureaucrats, an enabling environment, a critical mass of companies that allows for synergies within the technology park, the presence of internationally renowned innovative companies, and finally a shared vision among the technology park stakeholders.

1 INTRODUCTION

Technology parks and incubation programs provide a mechanism to promote and stimulate commercial and industrial innovation, encourage re-industrialization and ensure sustainable regional development. The UNESCO defines Science and Technology Parks (STPs) as “economic and technological development complexes that aim at fostering knowledge-based economies by bringing together scientific research, business and governmental organizations in one physical location, and supporting interrelationships between these groups.” In addition to providing space for knowledge-based products, science and technology parks can house centres for scientific research, technological innovation and incubation, training, forecasting, as well as facilities for fairs, exhibitions and market development. They are formally linked (and usually physically close) to centres of technological excellence, universities and/or research centres.

In a technology park knowledge can be diffused through formal and informal interpersonal or employee-related contacts amongst the firms (which

may result from direct face-to-face interaction or more indirectly from the research ambience generated by, for example, a nearby leading firm), or knowledge may be dispersed through relationships with local universities or other institutions of higher learning and/or research (Wolfe and Gertler, 2003). Indeed universities and colleges often play the role of an “anchor” and are a catalyst to high-technology company spinoffs (Berry, 1998).

However, technology parks and incubation programs are not always successful (Sun, Ni and Leung, 2007). For example, Colombo and Delmastro (2002) pointed out that “in spite of the diffusion of science parks in Europe, whether they have been successful or not in supporting new technology-based firms still is unclear”. Some even concluded that technology parks in specific context might be a “technology fantasy” (Bakouros, Mardas, and Varsakelis, 2002). In addition, it is argued that the problem with analyzing technology parks and cluster building is that recent studies analyze “the most celebrated case studies... to ‘explain’ their success” (Holbrook and Wolfe, 2002).

Using intensive interviewing (Kvale, 1996; Reinharz, 1992) of four Australian technology parks’ managers and managers of tenant firms this

paper presents a framework of critical success factors for technology parks in Australia. The model has practical implications for technology parks.

2 SUCCESS FACTORS OF TECHNOLOGY PARKS

The American National Business Incubation Association (NBIA) estimates that there are more than 1000 business incubators in North America, up from only 12 in 1980; and the number at present exceeds 4000 worldwide (Sun, Ni and Leung, 2007). Numerous science park and incubation programmes are very successful in fostering growth of emerging entrepreneurs, creating new job opportunities, and speeding up development of regional economy (Lee and Yang, 2000; Walcott, 2003; Phan, Siegel and Wright, 2005). Successful examples exist in Italy (Colombo and Delmastro, 2002), China (Sutherland, 2005; Lai, and Shyu, 2005), Poland (Matusiak, 2003), Singapore (Koh, Koh, and Tschang, 2005), Korea (Lee, 2003), Nigeria (Adegbte, 2001), and Brazil (Lalkaka, 2003) to name some; this is of course in addition to the North American and UK parks that have been world class exemplars in developing such incubation programmes to enhance the growth of regional economies and foster new firm development.

However, technology parks and incubation programmes are not always successful. Evidence on the effectiveness of incubation programs is not conclusive. For example, Colombo and Delmastro (2002) indicated that "in spite of the diffusion of science parks in Europe, whether they have been successful or not in supporting new technology-based firms still is unclear". Other researchers even argued that technology parks in some context may be a "technology fantasy" (Bakouros, Mardas, and Varsakelis, 2002). There is little systematic research and empirical study on the relationship between critical success factors and the performance of incubation programme. How to improve the technology parks success rate and rate of the technological incubated entrepreneurs has become a critical issue.

While there is a considerable amount of research on the performance of incubation programmes (Mian, 1996, 1997; Sherman, 1999; Lindelof, Lofsten, 2002; Siegel, Westhead, and Wright, 2003; Bigliardi, et. al., 2005), few studies have examined related performance driven factors especially in Australia. For example, Smilor and Gill (1986) identified ten critical success factors from the incubator perspective, and four from the tenant

company perspective. Factors found described the static configuration of incubation programmes, such as "facilities, budgets, organizational charts, geographic location, institutional link and so on". Autto and Klofsten (1998) identified configuration parameters including proximity to major universities, or technology sites, availability of on-site manufacturing facilities, competent science park management, accessibility of venture capital funding, and prudent tenant selection criteria. There are also process oriented factors which refer to active hands-on support arrangements that assist start ups companies during the early phases of their life cycle. Phan, Siegel and Wirhgt (2005) suggested that research should be analyzed at four levels; the incubator level, the incubatee level, the entrepreneur level, and the system level. They also advocate connecting the four levels together for a comprehensive examination of success criteria. While this brief literature review is both important and helpful, it is used only in developing the research questions.

3 METHODOLOGY

The research design employed in this study follows the fundamental prescription of Glaser and Strauss (1967) called "grounded theory." In this prescription, the researcher establishes a specific area of study and a general theoretical framework without specifying hypotheses a priori. Instead, these are allowed to flow from the phenomenon being studied. The researcher conducted semi-structured intensive interviews of both technology parks managers, business development managers and marketing managers and managers of tenant firms in the technology parks. In total 30 interviews were conducted. While an interview is a direct conversation (Lofland and Loffland 1984; 1995); intensive interviewing permits an in-depth exploration of a particular topic or experience and thus, is a useful method for interpretive inquiry.

The in-depth nature of an interview fosters eliciting each participant's interpretation of his or her experience. The interviewer seeks to understand the topic and the interview participant has the relevant experiences to shed light on it (Fontana and Frey 1994; Seidman 1997). Therefore, the interviewer's questions ask the participant to describe and reflect upon his or her experiences in ways that seldom occur in everyday life. The interviewer is there to listen, to observe with sensitivity, and to encourage the person to respond. Hence, in this conversation the participant does most

of the talking.

The interviews consisted of open discussion around a few general discussion points provided by the interviewer. The same set of discussion points was used with both the technology park managers and managers of tenant firms.

The processes of tape-recording, transcribing, and analyzing interviews are ongoing. Document collection and analysis allowed the researcher to understand the official history or background of the studied institutions.

The data were analyzed in two basic, interrelated phases. As the data were collected, the researcher was looking for themes and factors of success. From these readings, the researcher constructed analytic memos consisting of hunches, questions, topics, and themes. This preliminary analysis, involving careful listening and reading guided by the research question, guided both the interviewing and the collection of documents. The researcher used the themes generated by the analytic memos to block and label the transcribed interviews. Below are the discussion points:

1. How would you define success of a technology park? What makes one technology park more successful than another?
2. What factors influenced the success or failure of the technology park? What are the barriers to success? What are the enablers?

Hypotheses with regard to the determinants of success have been developed from the interviews and will be empirically tested by using a survey instrument. This paper contains the findings from the interviews.

3.1 Profile of the Participants

There are four technology parks participating in this study. One is located in New South Wales and is considered to be the largest technology park in Australia with more than ninety tenant firms inhabiting the park. The second is located in Victoria and is seen to be as one of the smallest technology parks in Australia with only numerous tenant firms. The other two parks were located in South Australia and one of them is the oldest technology park in Australia. In terms of management structures the parks varied in terms of reporting and management. Two parks reported to local government agencies, one reported to an Australian university and another had an independent form of a private company.

2.2 Key Informants

The researcher interviewed general managers, business development managers and marketing managers of the technology parks. In addition, interviews were conducted with managers of tenant firms located in the parks. First the managers were contacted via phone and provided with a brief description of the study's rationale and objectives. The manager was assured that his/her identity and the identity of his organization were to remain confidential and that no one will have direct contact with the data collected except for the researcher.

4 DEFINING TECHNOLOGY PARK SUCCESS

It is extremely difficult to quantify the financial and economic impact of a technology park, primarily because there is no established definition of success or a standard way to examine a company's effect on an economy (Drescher, 2001). Studies that have attempted to determine success or failure of technology parks tend to focus on two areas: benefits received by the park or the community and benefits received by businesses locating in the park. An even greater challenge, is defining success in a way that allows comparisons across different technology parks.

The interviews showed that the success of a technology park depends primarily on the body or the institution that is managing the park. That is the driving force behind the establishment and management of the technology park. In general the participants agreed that universities focused on research, students training and creating IP whereas government bodies focused on technology transfer, job creation and economic development. In reality, though, the participants agreed that universities had little understanding of market mechanisms such the commercialization of IP and concept development and testing while government bodies usually treated technology parks as mere real estate developments. This caused a distorted view of success. Once there was a shift to autonomous, private firm-like management the way success of the technology park was viewed changed to reflect the different stakeholders of the park itself.

While the participants agreed on the five major indicators of technology park success they placed different weights on them. This reflected the different stakeholders involved in the technology park and their differing interests. Following are the five indicators:

4.1 Technology Parks' Innovation and its Ability to Create IP

One of the numerous and major roles a technology park plays is creating linkage between universities, research centres, research and development departments in companies and technologically based start ups. These linkages work on different levels: first, they allow start ups to have access to established laboratories and research bases that are otherwise expensive to build or rent. Secondly, they allow university students to have access to companies for training and an opportunity to pursue projects that can create IP. Thirdly, when a critical mass of companies exists in the technology park synergies exist and more IP is created. The bottom line here is the number of IPs created per year. Although this is important it is only one dimension of parks' success.

4.2 The Ability of the Technology Park to Attract Funding

Participants agreed that the ability of the technology park to attract funding was detrimental to its success. The funds that are collected are usually used for diverse purposes. Some of the purposes mentioned by participants included: intellectual property enhancement and "freedom to practice" analysis, prototype development and testing, market research and commercial assessment, feasibility studies for production, determination of regulatory and reimbursement pathways and finally preliminary business plans. One park manager explained that:

our focus is to provide the critical support needed to advance technologies and generate public interest in the technology so the companies can attract additional funding and market interest.

4.3 The Ability of the Technology to Create Value through Real Estate Development

Technology parks are essentially a property-based development with a high-quality, physical environment in a park-like setting. They take advantage of proximity to sources of significant intellectual capital, conducive infrastructure and policy environment, and supports technology-based firms and state institutes in a managed area, thus facilitates interaction, technology development and economic growth.

All participants agreed that technology park success can be measured by its ability to create and

develop real estate value. From the technology parks' management view this is important because real estate development is one of the factors that prospective tenants consider when choosing a park. A manager of a technology park explains:

Aesthetics and beauty is a very important aspect. We have created natural spaces overlooking water front and developed a conference centre, fully serviced apartments that can be rented for variable periods of time. We are also attracting supporting services such as cafes and the likes.

From the tenants' view it is important that apartments and other services are available so that it becomes easier to accommodate their employees and visitors.

4.4 Number of Jobs created within the Immediate Community and the Country

This is a straight forward measure of the technology park success. However, it also reflected the ability of the technology park management to effectively link the different stakeholders together. That is the ability of the technology park management to link universities and local labour market with tenant firms. One technology park manager explains:

We have developed a mechanism by which we can link job seekers with the companies within the park. But the more important aspect is that of university students training which can be replaced by a formal job opportunity. The relationship between universities and the parks tenant firms is assumed to exist and function smoothly. However, this is not the case. Universities are sometimes distant and may not be able to gain access for training in the parks tenant firms. In our capacity as park management we bring the different parties together and make sure that they see what is in it for them.

4.5 Technology Transferred

Technology transfer can take place in different ways. The usual is that through the mingling of different tenant firms within the park. Technology park management arranges regular meeting to hook up employees and managers of tenant firms together. In these informal meeting managers and employees from different firms but related or close industry can share experiences, discuss common obstacles and problems. This may lead to sharing of knowledge and technology. In many cases synergies are created and companies can benefit through the buying of services or product from other tenant firms in the park.

One technology park manager explains:

We set up regular activities every month. We do it in way that it is informal and apart in time. The idea is to put everybody in an environment where they can have a chat, discuss their work, goals problems and so on.

The second way a technology park assists in transferring technology is through the provision of jobs and training for students and young graduates and highly skilled employees. Employees may have the opportunity to work with leading Australian or foreign firms for short projects or even have long term contracts which injects them with new knowledge, technology and managerial skills. When these employees leave the tenant firm, and join the workforce in the market they participate directly or indirectly in transferring this knowledge, technology and management styles.

Of course this is a two way process in which the knowledge may be transferred from the local workforce to the foreign companies. One manager comments:

Foreign companies are attracted to this park because this city has been traditionally known to host [certain industry-name removed]. Proximity to the sea has always attracted [name of industry] industry to this city which meant that with time we have created a pool of skilled labour in this realm.

5 SUCCESS FACTORS

The interviews revealed a variety of factors that influence the success of the technology parks. The researcher was able to triangulate perspectives and to develop a more robust assessment of each technology park by comparing different perspectives across technology parks' management and tenant firms' management. However, differences in perceptions of success naturally translated into differences in perceived determinants of success. Cross-case comparison was the most useful tool in the researcher's induction of the determinants of success. At a basic level, it was found that successful technology parks were characterized by: 1. an autonomous park management that is independent of both university officials and government bureaucrats, 2. a risk taking "entrepreneurial" culture, 3. an enabling environment, 4. a critical mass of companies that allows for synergies to arise within the technology park, 5. the presence of internationally renowned innovative companies and finally, 5. the presence of supporting services such

as lawyers, accountants and real estate development agencies.

5.1 A Culture of Risk Taking "Entrepreneurism"

One of the major roles of a technology park is that of linking research, technology, capital and know-how to leverage entrepreneurial talent, accelerate the development of new technology-based firms, and speed up the commercialization of technology. Most managers interviewed believed that innovation required a risk taking culture that is rarely existent in universities or local/regional government institutions. One researcher/technology park manager commented:

the university [name of university removed] does not understand what we do. They perceive what we do as risky. When they undertake their risk assessment every year they put us at the top of the list. I think they are worried about the resources and grants and how they are being used. This is why universities should not manage the park!

Another explained:

Universities; like any other government institution are mainly concerned with efficiencies and playing it safe. If they are not sure of the outcomes then they are not willing to take a risk. However, private firms are more likely to undertake risk.

Another researcher further elaborated that:

We do not advocate taking risk. It is risk that is managed professionally by the people who truly understand its nature!

Furthermore, despite universities interest in generating income from patents and attracting funds the main focus of universities remained knowledge creation and dissemination. One manager/researcher explained that:

Before the technology park became independent, some university deans who were brilliant researchers worked at the technology park as associated deans. Their compensation came from the university and were paid no extra money from the technology park. Now, in exchange for each new patent they came up with the university paid them 1 dollar. That is one dollar for each patent created! This just an example on how universities lack of understanding of importance of motivating researchers to create patents that can be commercialized and make huge amount of money. How can we motivate researchers under these conditions to excel.

Government entities on the other hand tended to view technology parks as no more than real estate development. This was the case in the four technology parks surveyed. One technology park manager argued:

A very important distinction between the present management and the previous one (the present being market oriented and autonomous and the previous being the local government) is that the previous management treated the technology park as a pure real estate development. This meant that they were not concerned with the impact of the technology park on the economy, creating IP and knowledge, creating linkages between universities, research facilities and private companies whether start ups or international firms. The difference is enormous!

5.2 An Autonomous Park Management

In order to create a risk taking environment where participants have the freedom to try and fail managers agreed that technology parks' management should be independent from both the university and local/regional government bureaucrats. One manager commented:

Since the new management took lead of the technology park from the regional government things have changed dramatically. We operate on commercial basis just like any other firm in the market.

Another manager/researcher argued that:

At the technology park level, universities and government agencies do not usually have the capability to assess the clear risks and potential benefits of financing the creation and expansion of a technology-based enterprise. They inherently lack the knowledge to make a rigorous appraisal for a technology project. Because we understand the nature of what we do we can employ the right people and therefore can manage the risk effectively and efficiently.

This is not to say that the technology parks are totally independent from the university or the regional government. In some cases universities undertook administrative support in the form of developing contracts and other HRM activities. This allowed the technology park management to focus on what is important. In addition universities are represented on the board of directors of the technology park so that the relationship is continued and an understanding of university interest is kept in consideration. One researcher argues that:

Technology based ventures often have social and environmental implications. They are inherently more risky than others and the management of risks calls for assessment techniques and vision.

5.3 An Enabling Environment

Most of the study participants agreed that an enabling environment in which the technology park operates can be detrimental to its success. According to the participants of the study there are numerous enablers to the success of a technology park which may include: the presence of knowledge workers and skilled labor in the immediate environment of the technology park, the availability of the right communication energy and real estate infrastructure, the availability of IP offices within the technology parks.

With regards to skilled labor it is important that a pool of workers exists in the immediate environment and outer environment of the technology park. This does not seem to be a problem for any of the technology parks involved in the study despite the fact that Australia faces an extreme shortage in skilled labor. One technology park manager explains:

This city has been a traditional location for ship builders in Australia. This meant a pool of skilled labor in this industry and related industries which helped us a lot in attracting the kind of companies that we have in the park.

In other parks the labor consisted mainly of researchers who were attracted by universities and research companies that are themselves tenants in the park. One technology park manager comments:

We rely heavily on researchers from the university [this university is linked formally to park]. We also rely on postgraduate research students who undertake their research under the university but at the same time use research facilities and labs in tenant companies. This provides us with a big pool of knowledge workers.

With regards to the right infrastructure, it is important that the necessary infrastructure such as communication and energy are made available to tenant companies. Technology parks involved used provided developed infrastructure that was used to attract leading research and foreign companies to the park. One technology park business development manager explained that:

We have managed a major Australian communication firm to base its broad band internet services in the park. In exchange we promised them to the official provider for the park and its tenant

firms. Indeed we gave them big fish! Foreign companies whose work required a high quality communication infrastructure and what can be better than a facility that is in the same vicinity of the firm (that is in the park).

5.4 A Critical Mass of Leading Foreign Companies

Participants agreed that a critical mass of companies in general and foreign companies specifically affords park and the region a sought-after labor pool that is both broad and deep. This enables the region to draw more high-quality employers and companies that not only provide jobs but also increase the sophistication and expertise of the region's workforce through their research, use of technology, investment in employees and high standards. It also provides an environment in which company researchers, knowledge workers, and university professors can interact around ideas, creativity and entrepreneurship, thereby creating more knowledge, more innovation, and economic growth.

Another reason why the presence of internationally renowned firms is important is that these firms usually have established markets overseas. One park manager commented:

The Australian market is limited in size, there is a shortage of skilled labor and more than 90% of Australian companies are SMEs. All of these factors create a challenge. The presence of leading foreign companies guarantees that they will have their own established markets and will not rely totally on the Australian market. They bring in their capital, technology and managerial knowledge. At times they may even bring in their own employees. This is not always the case however. To a certain extent it depends on the nature of the technology park and the rationale behind its establishment. For example, one of the smallest technology parks, which was not located in a major city and was located rurally was focused on agricultural businesses and research. Here it was obvious how the nature of the Australian market, labor market reflected on the technology park. Australia faces a huge shortage in skilled labor in general and in agriculture specifically. This meant that Australian agricultural businesses used capital investment and highly developed technology and the use of highly productive workforce to compensate for this shortage. The technology park itself was composed of mainly Australian SMEs that specialized in agriculture. However, the technology park did attract world class researchers from all around the world in order to solve the shortage problem.

5.5 A Shared Vision

Due to the nature of a technology park and the fact that numerous parties are involved in its creation and development; it is important that these parties have an agreement and understanding of what the technology park should do both in the short and long run. The aim is to link the strategies of the universities and the tenant firms with the city's/region's own self-vision of the future of the city/ region where the technology park resided. One manager argued that:

To seek a shared vision among senior stakeholders of what success in [city name] would look like in 3 years time and to begin the process of developing a strategy to achieve that vision.

Another manager noted that:

the direct involvement of senior stakeholders in generating the strategy, created an impetus towards implementation of results that may have been lacking in a more extended but lower level process. In a way the process provided insights for all into how foresight approaches can be usefully adapted to a specific policy context to set in motion dynamic networking processes so vital for the regional innovation system.

6 CONCLUSIONS

The study used intensive interviewing of technology parks' managers and managers of tenant firms in the technology park to explore critical success factors of four of Australia's technology parks. The study found general agreement on success dimensions but differences on the weights placed on these dimensions depending on the different stakeholders involved in the technology park. The study found that an autonomous, private firm like management of the technology park is more likely to reach a better success considering the multiple stakeholders involved in the technology park. This is in contrast to the situation when universities managed technology parks here they focused solely on research and IP creation and government entities where the technology park was treated as a mere real estate development. This is evident by the fact that all four technology parks involved shifted from university and/or government control into an autonomous management that is independent from both the universities and the government.

The study found the following to be critical success factors of technology parks in Australia:

1. A culture of risk-taking “entrepreneurism”: a technology park that has a culture of risk taking and entrepreneurship is more likely to succeed and produce more innovation and technology.
2. An autonomous park management that is independent of both university officials and government bureaucrats; a technology park that is managed by an independent private firm-like management is more likely to adopt a risk taking culture and therefore produce more innovation and commercial results.
3. An enabling environment, a critical mass of companies that allows for synergies within the technology park, the presence of internationally renowned innovative companies, and finally a shared vision among the technology park stakeholders.
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7 RECOMMENDATIONS

Based on the previous conclusions the study makes the following recommendations:

1. To be able to succeed technology parks management should nurture a culture of risk taking and freedom to fail. Innovation and success involves risk taking that is usually lacking in universities and government institutions. The nature of technology parks requires such risk taking, but it is calculated risk. That is risk under professional management.
2. Technology park management should be autonomous from both universities and the government. It should either be totally independent or has a very high degree of autonomy. A culture of risk taking that was described in the previous point can only be achieved if the technology park has a high degree of autonomy.
3. Technology parks should provide and strive to build an enabling environment that attracts prospective tenants to the park. Communication infrastructure, real estate development of the park, proximity services can all add value to the park and can be detrimental to the decision of entry of prospective tenants.
4. Technology parks should try and build a critical mass of tenants firms which may help in creating synergies between these firms and therefore add value. Technology parks' management can adopt specific and targeted entry policy for prospective tenants that allows the technology park to choose tenants that will add to the value of the technology park stock of firms. Further, leading foreign firm

should be targeted since they bring in technology, capital and new managerial ways.

5. Technology park management should aim to build a consensus or at least an understanding among the park stakeholders so that the benefits and value are maximized and all interests are served. Successful technology parks' management should make regular meeting and gatherings among tents of the park, government officials, and the community to open communication channels. This process serves to build relationships at the grass root levels and helps create a comprehensive and sustainable development on the long run where technology parks become a major player in this process.

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