NEW WAYS TO MAKE TECHNOLOGY PARKS MORE RELEVANT

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High technology policy has become a central feature of many national and regional strategies for encouraging industrial development. One of the more high profile instruments for implementing high technology policy supported by governments and regional authorities has been the technology park - a refinement of the familiar industrial park concept. The global recession, coupled with the failure of high technology policies in many countries, has now meant that technology parks are coming under closer scrutiny. The failure of Australia's high technology recovery has also meant that its technology parks are being subjected to increasing demands for accountability. There is a need to consider how to make technology parks more relevant in an environment which is beginning to see the limitations of past high technology policy. This paper reviews recent literature on technology parks with a special emphasis on Australian experience. It is argued that the suggestions often put forward for making technology parks more relevant need not be associated with 'objective' measurements of commercial success. The problems are more fundamental and the solutions should be inherently linked to the nature of policy-making itself. The paper argues for a strategy for relevance which depends on: recognising high technology for what it is; replacing the linear model of innovation as a rationale for policy; avoiding the dichotomy of sunset and sunrise industries, and establishing new criteria for assessing technology parks.

Keywords: Australia, high technology, science parks, technology parks, technology policy.

INTRODUCTION

Throughout the 1980s it was widely accepted that high technology was a vital component of future wealth generation and competitiveness. Consequently, high technology policy became a central feature of national and regional government strategies for industrial development. While the enthusiasm for high technology development was almost unbounded in many cases, the objectives of many high technology policies have often been less than clearly articulated.

High technology is difficult to define, It can be seen as the application of the most advanced scientific techniques to the industrial production process, but this is only one of its many interpretations.[1] It is often inferred to have an association with electronics, computers or telecommunications. The term can refer to industries,

technologies, individual firms, products and processes. It is synonymous with 'new, advanced, emerging, knowledge-based, science-based or technology-intensive, industry'.[2] Politicians have been notorious for defining high technology very loosely in order to gain political advantage.[3] Other commentators have emphasised different aspects of high technology. For example, Macdonald emphasises the diversity in high technology industry and the important role of information,

In reality, high technology industry is not a single entity, but a wide variety of industries composed of tiny firms and multinationals, firms exploiting different technologies in different ways for different purposes, firms whose characteristics and requirements are apt to change rapidly... The intangible capital which high technology firms manipulate so well is information. Indeed, this ability is perhaps the only characteristic common to all high technology firms.[4]

Not only is high technology poorly defined, but there is also a less than precise view of what high technology policy is designed to achieve. For example, some of the claims made for high technology include the generation of employment, the revitalisation of depressed industrial regions, and the creation of new firms and industries. Given the breadth of these claims for high technology, it is not surprising that governments during the 1980s saw high technology as an economic saviour. Complexity was ignored by policy-makers in favour of simplicity and the promised political benefits of high technology. One particular manifestation of this drive for simplicity in high technology policy was the technology park. In many respects technology parks represented the 'town planning' or 'developers' view of high technology.

This paper reviews recent literature on technology parks with a special emphasis on Australian experience. It is argued that the suggestions often put forward for making technology parks more relevant need not be associated with 'objective' measurements of commercial success. The problems are more fundamental and the solutions should be inherently linked to the nature of policy-making itself. The paper argues for a strategy for relevance which depends on: recognising high technology for what it is; replacing the linear model of innovation as a rationale for policy; and avoiding the dichotomy of sunset and sunrise industries.

TECHNOLOGY PARKS IN AN INTERNATIONAL CONTEXT

The technology park can be seen as a refinement and specialisation of the familiar industrial park, which provides a planned and optimal environment for industrial firms. As industrial development changed over the past thirty years, the technology (industrial) park became a vehicle for attracting high technology development. The technology park has become a popular instrument of high technology policy in many countries.

Depending on the country, the name can encompass developments such as research park, science park, business park and high technology park. In the United Kingdom, for example, the term commonly used is 'science park' and these are generally regarded as having a close association with a university or academic institution.[5] In Australia, the term 'technology park' is more common. The technology park is supposed to provide the right sort of conditions to promote the growth

of high technology firms and industry, such as proximity to a university and a campus-like environment. Often, production activities are excluded from the park and there is an emphasis on research or 'knowledge-based' activity. The aims of science/technology parks in different countries are remarkably similar. For instance, some of the most commonly cited aims of science parks in the UK are:

- facilitation of research and development (R&D) links and technology transfer between the academic institution and the park tenants;
- the formation, attraction and growth of new firms;
- the promotion of 'high technology', leading edge technology', or R&D based technological activity;
- employment creation;
- regeneration of the local economy;
- a commercial return on investment.[6]

These aims often have been founded on the belief 'that universities constitute a significant underutilised source of technological innovation'.[7] Hence, the location of a park near a university is thought to be desirable because of the access to information. Likewise, the experiences of California's Silicon Valley and Boston's Route 128 have guided park developers in the belief that labour supply is a critical factor influencing high technology growth. Technology parks are also believed to facilitate the genesis of new venture companies and Silicon Valley is often cited as a model for this.[8]

During the 1980s, there was a growth period for science and technology parks in many countries. For example, the UK has some 39 projects which can be classified as science parks[9]. France has 40 parks (or technopoles) and Germany has over 120 innovation centres/technology parks/science parks which have been founded in the past 10 years.[10] In the United States there are over 300 university related research parks.[11] Interest in science and technology parks has remained high to the point where a recent UK newspaper editorial observed 'almost every self-respecting university now has a science park. So too does an increasing number of polytechnics, although some prefer the more down-to earth title of technopark'.[12]

However, the enthusiasm for technology parks has given way to a measure of scepticism in recent years. The failure of high technology policy to deliver the perceived benefits of employment generation and the creation of new industries, coupled with the global recession, which has adversely affected many high technology firms (especially in computing), has brought about some major reassessments. It is far from universally agreed that science and technology parks are delivering what they were supposed to when they were established.

First, the prospect of a science/technology park generating close links with a university is now considered to be doubtful. In Europe, for example, university-tenant firm linkages have not developed as expected.[13] Van Dierdonck *et al.* have observed that:

> In sum, the information networks relevant to science park tenants can certainly not be limited to the science park environment itself... For the majority of

science parks, it is rather difficult to speak of external economies of scale. At best one can hope that they will evolve over a longer period of time. Thus, the advantages offered by the 'rich business environment on the park' may well be an illusion.[14]

Second, the formation of new venture companies in science/technology parks does not seem to be as great as expected. A survey of new firms on science parks in the UK found that these firms were not involved in the cutting edge of technological innovation, but involved in new applications of existing technology.[15] Likewise, the potential of new venture spin-offs arising from university research also seems to be limited.[16]

Finally, the contribution of science parks to industrial regeneration through employment creation or the growth of new industries has also been brought into question. For example, the contribution of science parks to employment is not as great as first predicted in the early 1980s. In 1990, for example, total employment in UK science parks was less than 15,000.[17] The concerns which have been raised overseas are also relevant to Australia.

AUSTRALIA'S TECHNOLOGY PARKS

Australia's experience with technology parks dates from the early 1980s and follows that of other countries such as the UK and Germany. The initiative taken by the state governments of South Australia and Western Australia to set up technology parks proved to be the first of a number of similar and related attempts by the federal government and other state governments, universities and local authorities to promote high technology. Adelaide's first technology park was launched in November 1981 and opened a couple of years later. The technology park in Perth opened in 1985. Other developments quickly followed.

There are now well over 20 technology park developments in Australia - some of which receive public funding – and numerous other commercial developments (e.g., business parks) which have been more than happy to borrow the term 'high technology' as part of their advertising.[18]

Despite the burgeoning of high technology policy and the increase in number of technology parks during the early 1980s, Australia's indigenous high technology firms and industries have not fared well. The recession has severely affected the profitability of many indigenous high technology firms and the potential of high technology industry now seems less evident than it was a few years ago. As a result, public investment in science and technology is being subjected to increasing demands for accountability.[19] It is therefore not surprising to see technology parks being more closely scrutinised in terms of return on investment and relevance to policy goals. Australia's latest large-scale technology park type project, the multifunction polis (MFP) has come under considerable criticism.[20]

As in other countries, the initial enthusiasm for technology parks in Australia has waned somewhat, but there is still interest from some quarters, especially state governments and educational institutions. One example is a proposal for an 'advanced technology park' in Redfern, Sydney, which is being supported by the Uni-

versity of New South Wales, the University of Technology, Sydney, and the University of Sydney.[21] This proposal has attracted community opposition on a variety of grounds, including ownership of intellectual property and environmental concerns.

Growing concerns about the negative effects of high technology development and the effectiveness of technology parks do not appear to be of great importance to planner or sponsors of technology parks in Australia. [22] There have been hardly any comprehensive studies of science/technology parks in Australia of the type carried out overseas. Likewise, assessments of the contribution of high technology to the Australian economy have been limited. This makes policy analysis and assessment difficult. However, a study conducted by the former Commonwealth Department of Industry, Technology and Commerce (DITAC) in 1989 reviewed Australian technology park experience at that time and so provides one perspective on what has been achieved.[23] While stressing that it was too early to make judgements of the Australian situation (since many of the parks were established only during the mid-1980s), the DITAC report indicated that the contribution of technology parks to the growth of technology intensive business was modest.

> The complexity and difficulty of encouraging the growth of technology-intensive businesses suggests that undue emphasis may have been given to technology parks as the primary mechanism for encouraging their growth. A technology park may create an 'illusion of progress' that a high technology complex is being created and that from a regional perspective, progress is being made. From a national viewpoint, this may not be the case.[24]

This view is supported by the fact that in 1989, Australia's most established park, Technology Park Adelaide, employed only 750 people.[25] This is even more striking if it is noted that Technology Park Adelaide firms constituted 0.5 per cent of all firms in the South Australian manufacturing sector and received 9 per cent of total Government support provided to all South Australian firms.[26]

In terms of interaction with universities, the DITAC study noted

> With the possible exception of a few university sponsored technology parks and centres, the level of interaction between the firms within parks and research institutions generally is much lower than expected. This is surprising in that fostering of such interactions is an objective held by most sponsors... Even for university sponsored parks there is limited interaction, especially between large firms and the university's researchers.[27]

It is evident that Australian technology parks have fared no better in achieving objectives than some of their counterparts overseas, especially in achieving employment growth and links with higher education institutions.[28] Some Australian parks have experienced very slow growth.[29] Some state governments, notably Western Australia and Victoria, have shifted their focus by now promoting the idea of technology precincts as an additional concept to bolster slowly developing technology parks. The managements of Technology Park Adelaide and the Western Australian Technology Park have reported success in developing the parks.[30] Other researchers have pointed to the less than desirable performance of Technology Park Adelaide.[31] One review of the Western Australian Technology Park found that the

park had not really fostered interchange between academia and industry.[32]

The lack of empirical studies and conflicting interpretations of evidence has meant that detailed assessment of policy in Australia has not been undertaken. However, this does not answer the question why governments, universities and regional authorities have stuck so tenaciously to the belief that technology parks and high technology would deliver economic benefits despite growing evidence of difficulties in achieving goals and objectives. The answers may lie in the nature of policy itself.

THE NATURE OF POLICY: WORDS THAT SUCCEED AND POLICIES THAT FAIL

'Suppose', said Gold, 'it's a bad policy. Suppose I make a mistake'.

'In government', Ralph answered, 'there's no such thing as a mistake, since nobody really knows what's going to happen. After all, Bruce, nothing succeeds as planned. I wouldn't be worth my salt if I didn't know that'.

'Suppose my policy fails?'

'Then it fails. Nobody's perfect.'

'And there's no harm done', said Ralph. 'It's happened before. But there was no harm done'.

'No harm done?'

'We're still here, aren't we?' said Ralph.[33]

It is naive to think that policy is "a proposed cure for problems that have been identified through some independent or detached view of reality".[34] This is the rational policy model in which reality is given, a rational explanation of the problem is developed, and a solution (policy) is designed to solve the problem. It is too simplistic.[35]

It can be argued that "there is no reason to believe that the point of many policies is really to solve problems... public policy operates as much to shape society around certain values as it serves to solve specific problems".[36] As a result, in many policy areas it is better to have the failure of policy based on widely held beliefs and theories than it is to achieve success at the cost of important social values.

So it is with high technology policy and technology parks. The parks are designed to overcome certain social problems such as low and lagging levels of industrial development, unemployment and declining incomes. High technology policy provides the 'explanation' of the problem. In the case of technology parks, the Silicon Valley myth has played an influential role in informing policy.[37] The myth is a set of beliefs about the origins of high technology in Silicon Valley and associated entrepreneurialism and innovation. It says that if the conditions present in Silicon Valley were to be replicated, then high technology growth would occur. These conditions relate to things such as a pristine environment, attractive living conditions, access to a university, recreational facilities and transport. The structural form of technology parks has been associated with the belief that innovation

flows from the laboratory benches of universities. There is a reliance on the linear model of innovation which explains why technology parks (even more aptly named science parks in the UK and research parks in the US) are located near or on university campuses.[38]

The fact that the explanation for something can recreate the thing itself establishes numerous ways to account for the failure of public policy. By appealing to the complexity of the problem, policy-makers can say that the reasons for the problem become part of the solution. Technology parks are a classic example. The circumstances which led to the creation of 'ideal' high technology centres such as Silicon Valley and Boston's Route 128 are complex but can be simplified to include the catalyst of a technology park, its location near a university, its campus-like environment, and so on. The park becomes a ' self-fulfilling prophecy' in that for it to meet its objectives it must 'create' the conditions for success which were its justification in the first place. So the failure or slow growth of a technology park can be taken as proof that the variables identified as originally lacking in a region (e.g., the park, the interaction with the local university, etc.) were indeed 'real'. This logic justifies the introduction of even more technology parks or the fine-tuning of existing variables. This seems to have been the Australian policy experience in this area.

At this point identifying the success of technology parks becomes difficult. At one level there is the test of the market. A technology park which goes broke can be said to have failed. One that is not going broke demonstrates that the underlying policy assumptions were correct, even if that may not be true or able to be tested. Technology park supporters are particularly good at reasserting the correctness of the underlying policy assumptions. This usually takes the form of glossy brochures and other means of 'defining' success.[39] Given these features of policy, we might be forgiven for thinking that policy analysis of technology parks could lead to useful improvements. The answer is yes, but only up to a point.

POLICY ANALYSIS OF TECHNOLOGY PARKS

Lamberton, drawing on the work of Enos, points out that care must be taken to distinguish between articulated and 'real' policy analysis.[40] In the first case, stated or articulated policies are checked against evidence of performance, even though there may be many reasons for deviation. These stated policies are themselves "validated by the achievement of a consensus by government, industry and academic researchers".[41] The problem with this type of analysis is that it is very difficult to determine just what has happened in a particular situation because there are many different reasons for deviation.

When applied to technology parks, articulated policy analysis relies on the simplicity of the Silicon Valley myth to complete a circular argument. In Australia, an apparent consensus was formed in the early 1980s when it was widely accepted that the conditions of Silicon Valley could be replicated, by means of technology parks.[42] The persistence of the policy problem (evident in low levels of high technology development) was sufficient justification for the establishment of even more technology parks. For example, improbable 'high tech' locations such as Caboolture

in Queensland and the Redfern Railway Yards in Sydney are now targeting tech-
nology parks.[43] More recent manifestations of this type of policy analysis are based
on reassertions of the success of technology park ventures overseas. Their success
is meant to justify the correctness of the original policy decisions to establish tech-
nology parks. However, Massey, Quintas and Wield's sobering thoughts should be
noted by policy-makers.

> [There is] the idea that because a particular set of characteristics 'worked' in
> Stanford and Silicon Valley their reproduction elsewhere will reproduce also
> their results. This is a fallacy. In part it is so because, even were the local-level
> conditions to be reproduced (which is itself unlikely), the wider situation has
> changed. Some areas are now already established and the dynamics of location
> have consequently shifted.[44]

The second approach in policy analysis, instead of focusing on articulated policy,
is based on observing behaviour and then determining what 'real' policy could
have created this behaviour. The problem is that 'real' policy analysis has diffi-
culty discriminating between accounts which are equally consistent with the evi-
dence.[45] This means that different 'realities' exist. Hence, it is not uncommon in
research about technology parks to discover completely different perceptions be-
tween a park's management and park tenants about the success of a park and in-
deed what actually is happening in the park.[46] Fortunately, the very existence of
these different realities allows for a refreshing reassessment of ways to make tech-
nology parks more relevant. The simplicity and constraints of the Silicon Valley
myth are sidestepped by opening up the issue to more searching analysis.[47]

MAKING TECHNOLOGY PARKS MORE RELEVANT

Attempts to make technology parks themselves more relevant could be regarded as
piecemeal. There is little consistency in the many studies that have investigated the
reasons for the success or failure of technology parks. The matter is more deep-
seated in that more fundamental changes need to be adopted in high technology
policy itself. The argument is that making a strategy for greater relevance will
depend on:

- recognising high technology for what it is;
- replacing the linear model of innovation as a guiding rationale for technology
  parks;
- avoiding the pointless dichotomy between sunset and sunrise industries; and
- establishing new criteria for assessing technology parks.[48]

Recognising high technology for what it is

High technology firms require vast amounts of information and this is most often
obtained through informal and personal information networks.[49] It is not just any
information which is required. "Of most value in high technology industries, though,
is a blend, an integration of technical and commercial innovation, one that places

technology in the context of the market so that what is sold can be made and what is made can be sold.[50] If the creation, acquisition and handling of information is important in high technology, then managers of technology parks and indeed policy-makers need to be fully aware of this and reconsider what they are doing.

The belief that high technology can attain most of its information requirements from the local area (particularly the affiliated university) seems to be misplaced.[51] The implication is that technology parks need to foster information networks on a global rather than a regional scale. Technology park management will need to play a greater role in facilitating these networks by seeking top quality advice for rapidly growing firms or specifically assisting technology transfer between firms and universities.[52] Indeed, recognition of the limitation of science/technology parks with respect to information provision could well encourage park sponsors (e.g., universities) to explore mechanisms other than the park to promote high technology development. Other vehicles include research consortia, joint ventures, collaborative R&D programmes and contract research. The presence of a technology park, especially if it has financial difficulties, could preclude the consideration of other valuable approaches to technology and information transfer. Building on existing regional business strengths could be a starting point.

At the level of park activity and organisation, a survey of fifteen UK science parks pointed to a number of successful criteria and problem areas.[53] From this alternative reality, it is possible to see some new opportunities for technology parks.

The key criteria of successful parks identified in the survey were as follows:
- they have been long established and been able to develop gradually;
- they have built on existing links with industry and have not sought to use the science park to establish links;
- they have been able to sell the kudos of association with a university of international pre-eminence (Cambridge Science Park is a good example of this);
- they have been able to attract firms from overseas rather than just local or university-based firms;
- they provide a working environment totally unlike any available elsewhere in the region; and
- they are not dependent on the presumed technological strengths of a particular university. (Science parks at some technological universities in the UK have been outstanding disasters).

In terms of looking to pitfalls, the survey points to these problem areas:
- over investment in prestigious building could cause problems, especially during a recession, as rents will need to drop to attract tenants;
- proximity to a university could be a disadvantage, especially if the university takes a direct interest in the management of the park;
- information flow from a university to companies on the park is often much less than initially anticipated;
- science parks are expensive to run and experience shows they are of low profitability;

- scientific and technical information (that residing in universities) may not be the most important information resource for small high technology companies;
- conflicting government and regional policies for industrial development could confound and conflict with the park's own strategy .

Replacing the linear model of innovation

The linear model of innovation which implicitly supports the location and logic of science and technology parks needs to be replaced. Its fundamental premise that innovation occurs in a neat progression from basic science to applied science, and from research and development to commercialisation is now widely discredited.[54] Quintas *et al.* have noted that

> Far more complex models [than the linear model] involving feedback loops and a process of non-sequential interaction between the functional elements of research, marketing, development, design, production engineering, production and so on have been found to more accurately reflect the successful innovation process.[55]

As a result of this dependence on the linear model, technology parks may introduce artificial barriers which separate parts of the innovative process. Instead of bringing people closer together, divisions can be opened up, especially within universities (as has been observed for science parks in the UK).[56] Reassessing the linear model of innovation as a guide to technology park practice has a number of implications. First, the geographic proximity of the university becomes less important. Hence, a technology park should cultivate broader information networks and begin to supplement those it has established around academic science and technology. This could well involve opportunities for the business and the humanities faculties of universities in seeking a greater role in the park.[57] The 'science' or 'technology' park might well be replaced by the 'business' or 'enterprise' park.[58] Second, management will need to be more flexible about the sorts of activities permitted on technology parks. The requirement to separate artificially manufacturing from research activities in technology parks would then be seen as a possible hindrance to innovation. More flexibility in defining permissible activities on parks will be required. This could well entail moving away from the university environment. The image of a technology park housing elite research personnel would also need to change if it is accepted that shop-floor workers have a legitimate role to play in innovation and technology transfer.[59] Third, the role of universities in supporting technology parks may need to be reconsidered. It may be that universities should concentrate more on what they do well and question "whether transforming a perhaps first-rate academic into a second-rate business man is desirable in terms of the national interest".[60]

From the alternative reality created by replacing the linear model of innovation, possibilities of making technology parks more relevant can range from the radical to the incremental. At the radical end of the spectrum, it is possible to conceive of new ways of structuring innovation. For example, in the UK, the Greater London Enterprise Board established a series of Technology Networks during the 1980s

which had the aim of tapping the technical resources in polytechnics. The focus was not only on commercial goals, but also on social goals (e.g., technologies for the handicapped). There are a number of implications for technology parks. First, it would probably mean raising the level of direct public support for projects undertaken in the park. Projects which were undertaken would rely on 'human centred' technology, building on human skill rather than replacing it.[61] The prospect of generating employment may be greater (admittedly on a smaller scale) from such 'human-centered' projects than from high technology in general. Second, the types of people involved in radically-focussed technology parks would be varied. Insistence on high qualifications and a rigid view of what research is would have to be relaxed. Park management would need to rethink its image of high technology and be more willing to accept the involvement of unconventional organisations, such as unions, community groups and welfare agencies. These are precisely the sort of factors which would conflict with many of the beliefs about high technology held so strongly by park sponsors, such as universities and regional authorities.

While this alternative approach recognises that social factors indeed shape the innovative process (and not the logic of the linear model), such approaches suffer because "those who control technology do not share the humanistic values of the reformers".[62] The apparently rational alternative may be irrelevant to those in positions of control in technology parks. For these reasons, the success of technology parks in solving the problems of depressed areas may be clearly limited from the outset.[63] Given the current recession and the relatively weak bargaining position held by unions in those industries where the unions could influence technological change, there seems little prospect of radical alternatives being considered seriously.[64] Any change would need to be accompanied by a shift in community perception of the role of high technology in society.

At the incremental end of the spectrum, modification of the linear model of, innovation as adopted by technology parks would require a reassessment of the status and location of a technology park. The technology park would no longer need to have a close affiliation with a single university, but would probably cultivate linkages with several institutions. Likewise, the emphasis on affiliating with a university would not be as great. Other possibilities arise. Linkages with existing large firms, industries or public institutions (e.g., hospital or libraries) be a possibility. More diverse forms of activity and information networks could be associated with technology parks. This will require the adoption of more flexible approaches by management.

If innovation is not likely to flow in the prescribed pattern from the university, it may well mean that it could flow from other sources, such as production, design, marketing or the shop-floor. The elitist image of technology parks may need to be replaced by a system that places a greater emphasis on worker participation and training, especially in the innovative process. Also affected will be the design of work within technology parks and the status accorded to it.[65] Of course, both the radical and incremental possibilities fly in the face of the Silicon Valley myth and the inherent values built into technology parks. Replacing the linear model of innovation in the context of technology parks really means rethinking the rationale of

technology parks and at the very least recognising that they have a less than central role to play in the process of innovation, let alone economic development.[65]

Avoiding the sunrise and sunset industries dichotomy

Continuing to think of high technology as sunrise industries and technology parks as being the mechanism for their generation is something which will need to be reconsidered by policy-makers. The undue focus on, say, computers or telecommunications ignores the important role that these technologies have for other industries. Likewise, the sunrise/sunset dichotomy places an emphasis on products rather than on changes within the production process.[67] Technology parks, therefore, may have a role to play in introducing new technologies into existing (sunset) industries. For many regional economies, this role for the park may be more significant than attempting to generate new industries or firms. The demonstration effect of new technology may be more effective than the 'flagship' role played by technology parks, especially when there is little comparative advantage for a region to boast of for a technology park. Avoiding the sunset/sunrise dichotomy will require park managements to pay more attention to global information networks while at the same time addressing how effective technology transfer can take place at the regional level.

One of the most important attributes of high technology firms is the way they handle information. Technology parks, by emphasising the sunrise/sunset dichotomy, are not a very effective mechanism for allowing other sectors of the economy to learn how to use information better. They can achieve this refocussing by looking to how high technology and other information sources can revitalise existing industrial strengths of a region. Quite often important attributes of a region are ignored simply because it is defined as 'sunrise'. Innovation is far more complex than that. Recent attempts in Europe to establish advance telecommunications links between the 150 science parks in the European Community could go some way to implementing this demonstration effect.[68] However, even the impact of advanced telecommunications and information technology on the innovation process is itself poorly understood.[69] This raises broader issues. As Lamberton has pointed out, the policy process of setting priorities for technology development falls within the scope of information policy.[70] The challenge to technology park managers and policy-makers is to lift technology parks and high technology policy out of the realm of real estate and discredited theories of innovation into the real world of information and the practicalities of business.

New criteria for assessing technology parks

Any strategy to make technology parks more relevant will need to recognise the essential political environment that gave rise to them. During the early 1980s there was considerable emphasis on the promise of high technology. Economic circumstances have changed; technological opportunities have moved on, and the experience of hindsight has shown that new assessment criteria are needed. The problem is that the various interests involved in sponsoring technology have often expected

different outcomes. For instance, universities may look to spin-off companies and regional authorities may focus on jobs. Experience has shown that the traditional commercial criteria of occupancy, rate of return on investment, can be only partial indicators. The ability to spawn a new Silicon Valley can no longer be a criterion The misreading of a particular phase of American industrial history has led to other countries following a particular path, hoping that technology parks would provide a 'quick fix' [71]. Employment generation is also faulted as an indicator: high technology does not hold that sort of promise. The prospect of academic spin-off companies is also doubtful; the importance of university linkages to high technology firms has been over emphasised in the past.

More informed policy evaluation in the future will depend on collecting meaningful data on investment, company formation, employment and technology transfer, as well as on the political will to analyse economic decisions accurately.[72] At present, the self referencing nature of the policy process, especially as it relates to technology parks, prevents this from happening. More applicable criteria will emphasise recognising high technology for what it is and the extent to which information is utilised in other parts of the economy .

CONCLUDING REMARKS

If policy-makers are to give serious consideration to making technology parks more relevant, much more thought will need to be given to high technology policy and what it means to analyse policy in this area. The importance of high technology to the Australian economy is too significant to continue to rely on the exhortation of simplistic models, myths or beliefs about technology parks and the development of high technology industry. This approach leaves us with little option beyond a series of fine adjustments to an ill-conceived system. There is a need for an alternative framework for looking at high technology and one useful general perspective is to see high technology as an information intensive activity. This framework does not (yet) have the glamour of high technology policy, but it does have the potential of perhaps paying some dividends. Such a framework would emphasise information networks, the non-linearity of innovation and the diversity and novelty of information that lies outside the bounds of science and technology. This, of course, is not to say that all technology parks are totally useless or that science and technology makes no contribution to innovation. Rather, the message is that some parks will pay their way and have beneficial effects, but the perceived benefits of others are unlikely to be realised.

At a more practical level, removing the burden of the linear model of innovation as a major influence on policy will go a long way towards introducing new mechanisms for promoting innovation. It may well be that with more progressive policies, technology parks be seen less as instruments of high technology policy and more as a form of property development. For the time being, the dictates of high technology policy may be the most difficult obstacle preventing policy-makers from seeing technology parks from a more realistic perspective .

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