정책/ISSUES

Technopoles: a policy concept at the end of its life cycle?

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1. Introduction

In the 1990s, technopoles, a land and property - led technology policy concept which aims at spatially slustering high - tech firms and R&D organisations, have been very popular among both local, regional and national policy - makers to boost regional economic growth. No matter how they are called, be it sciences parks, high - tech centres, incubator centries, technology parks, technoparks or science cities, they have given hopes to policy - makers in many countries to boost regional technology transfer, innovativeness and hence competitiveness. Now at the end of the century, the concept seems to have reaches some point of saturation, particurarly in industrialised countries such as the USA, Western Europe and Japan.

Many detailed stusies have been done both on technopoles in individual countries such as the USA(Luger & Goldstein 1991), Japan(Boss 1998; Funaba et al. 1998) and Germany(Sternberg et al. 1996) and on technopoles in an international comparative perspective in order to find some lessons that could be learned from successes and failures(Castells & Hall 1994). By analysing technopole policies in Japan, Germany and South Korea, this paper will focus on the following three questions. First, at what stage are technopoles in these countries in their life cycle? Secondly, what is the position of technopoles in these countries in the wider context of regional innovation policies? Thirdly, what can bo done to overcome the main weakness of technopoles, that is their lacking ability to foster regional technology transfer and networking?

In order to be able to answer these questions, at first the concept of technopoles will be explained in Section 2 of this paper. In Section 3, technopole policy in Japan, Germany and South Korea will be presented. The technopole concept will be put in a broader regional innovation policy context in Section 4, before answers will be given to the above - mentioned questions in the concluding Section 5.

2. Technopoles: explaining the concept

Accoring to Castells & Hall(1994), technopoles are cities, suburbs, or even rural areas whose existence is dominated by the presence of high technology in the from of research, development, manufacturing or some combination of all three. They may be planned or unplanned, privately fianced, publicly financed or set up by public - private - partnerships. They come in several varieties and have many different names, as will become clear in Section 3. The French word 'technopole' is used to describe them all generically. Technopoles are located all over the world, but mostly in North America, Europe, and East Asia. The most famous technopole, Silicon Valley, came into existence a few decades ago in what was then basically a rural area. Others, such as Route 128 in Greater Boston, are found in the suburbs of huge metrpolitan areas. Successful technopoles are characterised by synergy between industry, academia and government. Although any region can have higher education institutes(HEI), public research establishments(PRE), high - tech firms, or even all three at once, that alone not guarantee the special kind of relationship that generates synergy.

The success of unplanned technopoles, such as Sillcon Valley and Los Angeles, inspired other countries to deliberately create their own(Castells & Hall 1994). This paper will focus on these technopoles as planned policy concepts. In fact, many scholars regard just planned concepts as technopoles. Lagendijk & Charles(1998:16), for instance, define technopoles as " a land and property - based form of technology policy, geared towards the establishment of a spatial agglomeration of hi - tech businesses and organisations". The first examples of these planned technopoles are, among others, Sophia - Antipolis in France, Taedok Science Town in South Korea, Tsukuba Science City in Japan and Akademgorodok in the former Soviet Union(Castells & Hall 1994). There are large variations between the characteristics and scopes of technopoles between different countries. In Erope, for instance, where technopoles were established in two waves(1969 - 1973 and 1983 - 1993)(Komninos 1997), large attraction - led technopoles aiming at attrating inward investment of high - tech companies and R&D departments of multinationals can be found in France and Spain. In countries such as the UK, Germany, the Netherlands and Belgium, on the other hand, "technopoles" are nothing more than small incubator - led parks aiming at boosting spin -

offs from HEIs and PREs and other small high - tech firms.

Broadly speaking, technopoles aim at achieving three goals. First, the most obvious goal is to foster economic development. High tech and innovation - led growth is regared as absolutely necessary for maintainng and increasing competitveness lf firms, regions and nations (Malecki 1997).

Secondly, in some countries, particularly those with over - populated and congested urban areas, building an out - of - the - way technopole in the countryside is often seen as a way to reduce regional economic inequalities. This line of reasoninh was behind the creation of Tsukuba in Japan,Taedok in South Korea and technopoles in France,where economic planners hoped to draw research and development out of the over - burdened capital cities by relocating their natinal research facilities and universities to new sites in the country and by luring firms with incentives to follow them there. This kind of 'dirigiste' or mission - oriented regional policy is bassed on the growth pole concept and can only be found in countries with powerful central goverments(Cooks & Morgan 1994).

Thirdly, technopoles aim at creating synergy between HEIs, PREs and firms in order to foster technology trasfer, innovation and hence competitveness. In the end, this should lead to creating an environment geared toward innovation. Capital and resources are natually drawn to such a "milieu of innovation", rather than having to be relocated through central planning(Castells & Hall 1994). Synergy is crucial in the long - run. Even technopoles based on branch plants, controlled from distant locations, should have synergy, as source of innovation, as their long - term objective.

Although creating synergy and fostering technology transfer and networking both between firms and between firms and HEIs and PREs in the region is an important goal of technopoles, the failure to achieve this goal is at the same time one of their largest weaknesses. The main reasons for this lack of technology transfer and networking are the following. First, because technopoles are a property - based initiative, a great deal of their management is property related and puts much emphasis on marketing and image instead of promoting networking on the spot(Lagendijk & Charles 1998). Secondly, since the technology - push philosophy(linear model of innovation) prevails at many technopoles, they often lack explicit technology transfer instruments. Thirdly, in some larger technopoles in peripheral areas, externally controlled branch plants dominate, which have few links with local suppliers and lack the R&D base necessary for collaboration with local HEIs and PREs. According to Castells & Hall(1994), it is not sufficient to simply provide the networks in a physical sense at technopoles, it is also necessary to take definite steps to open up the social networks and break down barriers to networking.

The second main problem, particularly with technopoles planned by central government, is that technopole plans are often over - ambitious and focus on a too broad range of technologies and industries. Planners often forget that different technopole policies are appropriate to different levels of regional development(Castells & Hall 1994). At lower development levels, relatively modest technology parks will be perfectly appropriate. Particularly in the latter case, it is necessary to concentrate on one or two target areas or niches that are best adapted to local needs and facilities such as regional HEIs, PREs, industrial traditions, entrepreneurial capacities and political leadership in the region.

3. Technopoles in Japan, Germany and South Korea

The Japanese government already established Tsukuba Science City in 1970. In Tsukuba Science City, which is located 70 kilometres north - east of Tokyo, four universities, 33 national and 150 corporate laboratories are employing over 12,000 researchers(Bass 1998). The actual technopolis programme in Japan, about which much has been written(Funaba et al. 1998; Sternberg 1995; OECD 1996; Castells & Hall 1994; Bass 1998), started more than a decade later in 1983. Inspired by visits of Silicon Valley and Cambridge(Great Britain), the central government started the programme in order to support both national industrial growth and the economic development of peripheral regions. These aims corresponded with the demands of large high - tech companies, which were looking for low - cost peripheral locations for their production facilities(Sternberg 1995). The division of labour between central government and prefectural governments concerning the current 26 technopoles, is as follow (Sternberg 1995). The prefectures plan and establish physical and institutional infrastructure, whereas central government specifies eligibility criteria, provides financial support for the institutional infrastructure and financial incentives for companies which want to invest on the technopole.

After Tsukuba and the technopoles, the research parks can be considered as the next generation of property - led innovation policy measures(Bass 1998). Compared with technopoles, research parks are smaller, more focused on R&D and technology transfer and less on production facilities. All 126 research parks in Japan have a so - called 'centre facility', which is a "complex of research and development and entrepreneurial support facilities and services, typically managed by a publicprivate organization"(Bass 1998:396).

Although quantitative studies on the technopoles are positive about the effects of technopoles on regional economic development(Sternberg 1995; OECD 1996), more qualitative studies mention several problems, such as the lack of networking and technology transfer and the "brainless" and vulnerable character of many technopoles due to the over - representation of branch plants(Funaba et al. 1998). Scholars also disagree on the extent to which the technopolis programme contributed to the emergence of regionally embedded innovation policies and bottom - up planning. Whereas the OECD(1996) and Funaba et. al.(1998) are positive on this issue. Bass(1998:400) states that central government still plays a dominant role in innovation policies: "in the case of Japanese RHT〔regional high technology〕development ... decentralization should not be interpreted as a move towards American style federalism or bottom - up planning, but rather as a change from direct implementation by the national government, as in Tsukuba, to implementation by subsidy administration and other forms of administrative guidance". Although Funaba et al. (1998) observe an increasing role of prefectures in planning and building technopoles, they spot at the same time an interprefectural technopole - induced competition for industrial and research satellites and hence a shifting of local spending from other public purposes, such as environmental and quality - of - life issues, to industrial complex building.

In Germany, technology and incubator centres("Technologie - und Gruenderzentren") are popular instruments in local economic development policies(Sternberg et al. 1996). The size and scope of these centres, which can be considered as buildings which provide young technology - oriented firms with office space and other services for a limited time period, differ considerably from the Japanese and Korean technopoles. At the beginning of the 1980s the first centre was opened in Berlin after which the number of centres has been soaring to the current 122 or so. In contrast to Japan and South Korea, the German central government has little involvement in planning. implementation or financing of the centres. In most cases they are set up and financed by local and regional authorities.

The technology and incubator centres in Germany have set themselves three goals, namely stimulation of start - ups, creation of qualified jobs and initiating and intensifying knowledge and technology transfer. Sternberg et al.(1996), who have carried out the first comprehensive evaluation of the impact of 108 of the totality of 122 German centres, surveying more than 1,000 companies, conclude that technology centres are successful with regard to their first and second goal: the stimulation of technology - oriented start - ups and the creation of qualified jobs. However, they only have limited quantitative effects on local labour markets. The centres do not play a large role in initiating and intensifying knowledge and technology transfer. This transfer would also take place without technology and incubator centres. Only in peripheral and many regions in eastern Germany technology and incubator centres can fulfil a role as knowledge and technology transfer organisation. The most successful centres in Germany, such as the centres in Dortmund and Karlsruhe, are located close to a university which is strong in technical subjects both in teaching and research and are led by a pro - active management team which advises the tenants with regard to financial and management issues and actively supports inter - firm co - operation in the centre. In the future, though, it will be increasingly difficult to find enough technology - oriented start - ups to fill the centres, as the potential for these kinds of start - ups is limited.

Although still considerably smaller than technopoles such as Tsubuka in Japan or Taedok in South Korea, Science City Ulm in Baden - Wuerttemberg is the only initiative in Germany that shows some similarities to large - scale technopoles. In contrast to the above - mentioned technopoles, Science City Ulm, which was founded in 1990, cannot be considered as a top - down guided political concept, but rather as the initiative of three parties: the Baden - Wuerttemberg - based Daimler - Benz concern, the regional government of Baden - Wuerttemberg and the young university of Ulm(Boucke et al. 1994).

Science City Ulm consists of some technical departments of the university of Ulm, parts of Ulm polytechnic, six applied research institutes, Ulm Science Park, where R&D - departments of medium - sized enterprises and research institutes of Daimler - Benz can be found, the 'Technologiefabrik' Ulm(a technology - oriented incubator centre), and some intermediary agencies. Boucke et al. (1994) criticise the dominant role of Daimler - Benz in the Science City and the lack of a central office that directs outsiders to relevant institutes.

In the 1970s an important measure both to achieve structural industrial transformation and a more balanced regional growth in South Korea was the establishment of Taedok Science Town by the central government. This archetype of central planning policy is located in the neighbourhood of the city of Taejon, 170 kilometres south of Seoul. Taedok Science Town, modelled after the research triangle of North Carolina, now has 23 PREs, 21 private R&D centres and three universities which employ in total 15,000 people(Oh & Kang 1997:128). Although the Science Town led to an increase in business services in Taejon, no significant linkages with industries in the region and few spin - offs(857 jobs in ten years time) have been established(Oh & Kang 1997; Wessel 1997). The latter is illustrated by Taejon's below average employment in high - tech industry(Wessel 1997). In addition, despite the very high quality of the research carried out in Taedok, there seems to be little collaboration between Taedok's various institutions(Castells & Hall 1994).

Only recently six so - called technoparks, which can be regarded as the second generation of technopoles in South Korea, have been selected by the central government for long - term financial support(Yang 1998). The most important reason for the relatively late launch of the technoparks, considering that Taedok Science Town was set up in the early 1970s, is that the Ministry of Commerce, Industry and Energy did not manage to get broad enough political support for it. Therefore a technopark act could not be set up, as it happened in Japan in the 1980s. The recently selected technoparks are located in Inchon, Ansan, Chonan, Kwangju, Taegu and Kyongsan. At first the central government just wanted to select two technoparks, but due to strong lobbying by the provincial governors and also to Kim Dae - Jung who wanted to have an extra technopark in his home region, Cholla, the government extended the number to six.

In contrast to Germany and many other countries in Western Europe where science parks are chiefly concentrated on promoting technology - oriented business start - ups, the Korean parks are of larger scale and are also focusing on R&D and production facilities of large companies, particularly branch plants of chaebol. They are characterised by a large variety of participants(province, local authorities, universities), a university campus location and often include technology business incubator centres, pilot plants and small business support centres.

Wessel(1997) and Yang(1998) are sceptical about the development chances of the technoparks in South Korea. First, Taedok Science Town has shown how long it takes and how much central government support is needed to come to limited successes concerning spin - offs and networking with the local economy. Secondly, the plans for the technoparks are too homogenous and too little geared towards specific endogenous potentials in the regions. Thirdly, the university professors involved in technoparks are too much focused on attracting state R&D funds for their own research projects instead of co - operating with small and medium - sized enterprises(SMEs). Last but not least, the current financial and economic crisis will force many partners involved in the technoparks to scale down their plans or even to fully withdraw, which might lead to the degeneration of technoparks into near - campus industrial zones or office parks, particularly in peripheral regions. One of the main advantages of the technopark programme, however, is that it has been boosting the role of provinces in innovation policies. Due to both financial(25% of the budget of the parks are paid by provinces) and planning involvement, provinces start to realise that they can play an increasing role in setting up innovation policies.

In sum, technopoles are different concepts in different countries. In contrast to the small - scale, locally and regionally devised and implemented technology and incubator centres in Germany, Japanese and South Korean technopoles are large - scale facilities to attract R&D laboratories and branch plants, devised and to a large extent financed by central government. In Germany and Japan, where technopoles have been set up much earlier than in South Korea, the concept seems to be at the end of its life cycle, whereas South Korea has just started to establish six new technoparks. However, no matter what shape they have or in what stage technopoles are in their life cycle, one of the largest problems this concept is faced with is that it does not succeed in supporting technology transfer and networking in regions to a satisfying extent. According to Lagendijk & Charles(1998:19), "the most important question ... is whether other instruments, not based on property or on attracting investments to particular places might be more effective to facilitate technology transfer". These other instruments will be described in the next section, where technopoles will be put in the wider context of regional innovation policies.

4. The position of technopoles in wider regional innovation policies

In industrialised countries technopoles are not the only policy concept to support the innovativeness and competitiveness of regional economies. Partly encouraged by the unplanned technopoles found in the USA and the thick institutional set - ups found in successful regional economies in Europe, such as Baden - Wuerttemberg in

Germany and Emilia - Romagna in Italy, many regions in industrialised countries have been setting up a broad range of innovation policies since the second half of the 1980s(Sabel 1996). The central aim of these regional innovation policies is to support regional endogenous potential by encouraging the diffusion of new technologies in general and the diffusion of new technologies from HEIs and PREs to SMEs in particular, but also between SMEs and large enterprises(vertical co - operation) and between SMEs themselves(horizontal co - operation). Besides the above - described technopoles, these policies consist of technological financial aid schemes and intermediary institutions between HEIs and PREs and SMEs, also called innovation support agencies. The latter are considered as the core of regional innovation policies(Lagendijk & Charles 1998; Pyke 1994). This increasing importance of regions for innovation policy can be considered as the outcome of a convergence of regional and technology policy in Western Europe since the early 1980s(Rothwell & Dodgson 1992). These two policy fields converged since their aim became partly the same, namely supporting the innovative capabilities and thus competitiveness of SMEs.

Some forms of regional innovation policies and more in particular innovation support agencies can be found both in Japan, Germany and South Korea.

In Japan, the dense network of 172 Regional Research and Technology Centres, the traditional Kohsetsushi Centres, is an important part of regional innovation policy(Shapira 1992). The first of these centres were established at the beginning of this century. The centres, which are mainly financed by local and regional authorities, are specialised in those technology fields that are over - represented in the regional economy. They support local SMEs concerning applied R&D, quality assurance, training, and technical and business consultancy and disseminate information on new technologies by organising seminars, research meetings, by disseminating a newsletter and reports and by offering a technological library. The centres have on average 40 employees. The consultants, who are normally engineers in their forties with work experience and a good reputation in local industry, mainly react to demands of SMEs and also visit firms in the region. Due to their age and experience and the low staff turn - over, consultants have built up stable and long - term relationships with regional firms. Although no systematical evaluation has been carried out until now, Shapira(1992) had the impression that most firms are satisfied with the services they receive from the centres. The 460,000 advices annually given and the 24,000 firm visits per year show the large reach of the centres. The main reasons for the firms' satisfaction are seen in the low charges and the geographical and social proximity of the centres. At the same time, however, the centres have been criticised for their relatively old and low qualified staff and their focus on low - tech, traditional technologies(Shapira 1992). Recently Kohsetsushi centres have got a prominent role in the 'centre facilities' of Japan's research parks(Bass 1998), which is a good example of the integration of technology transfer agencies in technopoles.

The regionalisation of technology policy soared in federal Germany, where regions have much financial and political clout, after Baden - Wuerttemberg successfully started regional technology consultancy centres in the 1980s (Hassink 1996). In fact, technology transfer is seen as the core of Baden - Wuerttemberg's technology policy and the Steinbeis Foundation as the main technology transfer organisation. This Foundation, which was founded in 1971, runs a dense network of no less than 238 Transfer Centres promoting technology transfer between polytechnics and SMEs(Beise et al. 1995; Pyke 1994). The lion's share of these centres are located at polytechnics and are specialised in specific technology fields, varying from, for instance, biotechnology to management consultancy. The main activities of the centres are general consultancy services, technology and marketing consultancy, R&D, and further training(workshops, seminars, conferences). Total staff of the Steinbeis Foundation increased from 830 in 1983 to 3,572 in 1997, whereas income grew from DM 4.9 million to DM 125.7 million(STW 1998). About 95% of the Foundation's income is earned by its own activities, although the state of Baden - Wuerttemberg is paying the salaries of many of the centre directors, as they are often at the same time professors at polytechnics. Although the Steinbeis Foundation has not been evaluated yet, the Foundation considers its work to be clearly successful, referring to its spectacular growth figures and small amount of state support, Recent, more general studies on technology transfer and SMEs in Baden - Wuerttemberg, however, reveal the limited relevance of HEIs, PREs and particularly technology transfer agencies as external technology sources for SMEs(Beise et al. 1995; Toedtling 1998).

Despite the political decentralisation in South Korea in 1995, the central government still seems to be the major player when it comes to innovation support agencies. In fact, it has been very active in funding several innovation support agencies aimed at supporting SMEs since 1995. In that year it launched, in addition to the older network of Small & Medium Industry Promotion Corporation(SMIPC), a network of 11 regional offices of the Small & Medium Business Administration(SMBA). Moreover, a country - wide network of 27 sectorally specialised Regional Research Centres(RRCs), which are based at universities, was established. Of the main innovation support agencies, regional authorities are only limitedly involved in the RRCs(they finance about 15% of the RRCs' budget). The other agencies

are either central government agencies(SMBA) or non - profit agencies which are fully supported by the central government(SMIPC). The strong influence of the central government and the strong vertical ties with upper - tier authorities seem to contribute to a fragemented and overlapping innovation support infrastructure, which lacks horizontal co - ordination(Kim 1995). This problem has also been observed in Japan(Bass 1998:393). Innovation support agencies and technopoles are normally separated concepts in South Korea. However, in some newly planned technopoles, such as Kyongbuk Technopark, new small business support centres will be established, whereas in others, such as Kyonggi Science Park in Suwon, existing innovation support agencies in the region will move to the park in order to enable SMEs in the region to do under - one - roof one - stop shopping.

To conclude, technopoles should clearly be understood as part of a larger array of regional innovation policy initiatives. The position of technopoles in these wider regional innovation policies, however, differs from country to country, depending on the relative importance of technopoles compared with the other elements of these policies, that is technological financial aid schemes and the innovation support infrastructure. In Japan and South Korea, where we can find large - scale technopoles devised and partly financed by central government, technopoles seem to have a more prominent position in regional innovation policies than in Germany and many other countries in Europe. In Europe, technopoles are not frequently mentioned either in support programmes of the European Union or in the theoretical development concepts which have been currently developed by Western European scholars(Cooke et al. 1998; Morgan 1997). Technopoles, however, can and should be integrated in these policy programmes and development concepts. However, no matter what position technopoles have in wider regional policies, in all industrialised countries the dispersed networks of demand - oriented innovation support agencies(software) and the spatially constrained, property - led, supply - oriented technopoles(hardware) seem to be quite separated from each other.

After having described recent developments in technopoles and regional innovation policies and support systems, now answers will be given to the questions that were asked in the introduction.

First, at what stage are technopoles in Japan, Germany and South Korea in their life cycle?

In the most advanced industrialised countries, such as the USA, Germany and to some extent Japan, the technopole concept seems to have reached some form of saturation. In these countries, therefore, technopoles are certainly in the maturity or even declining phase of their life cycle. With regard to science parks in the USA, Luger & Goldstein (1991) detected some degree of saturation already in 1991, as they stated that any new research park will have more difficulties, especially if it is not linked to a HEI/PRE and/or located in peripheral areas. Similar conclusions were drawn by Sternberg et al.(1996) with regard to Germany. In a European context Komninos(1997:193) clearly sees technopoles at the end of their life cycle, particularly if they are put in the wilder range of innovation support initiatives: "... the spread of new effective tools for technology transfer, based on networks, institutions and services, questions the established character of technopolitan development. The novel feature of these tools is that they operate without property or spatially - polarised dimensions".

In newly industrialising countries which are just in the phase of establishing technopoles, such as South Korea, the concept is in the introduction or growth phase of the life cycle of a policy concept. Since each country is at a different development stage, technopoles will accordingly be at different positions in their policy life cycle: at the end of their life cycle in Japan and Germany, at earlier stages in South Korea. The latter, therefore, can learn from the mistakes industrialised countries have made when they set up the concept.

Secondly, what is the position of technopoles in Japan, Germany and South Korea in the wider context of regional innovation policies?

In South Korea and to a lesser extent Japan, countries with powerful central governments and a 'dirigiste' or mission - oriented regional policy based on the growth pole concept, large - scale technopoles tend to have a more prominent role in regional innovation policies than in Germany, which has a federal political system characterised by regionally embedded networking kind of innovation policies.

Thirdly, what can be done to overcome the main weakness of technopoles, that is their lacking ability to foster regional technology transfer and networking?

The main problem of many technopoles is the lack of regional technology transfer and networking that take place both between firms and between firms and HEIs and PREs in the region. To solve this problem, technopoles need to be integrated in wider regional innovation policies and strategies. These strategies should be based on thorough and in - depth studies of the strengths, weaknesses, opportunities and threats of the regional economy and firms' production environment. Only if the establishment of technopoles is based on these kinds of studies, they are able to focus both on the demand for technologies among local firms and on niches in the regional production structure. In this way the development of supply - oriented technopoles based on the linear model of innovation can be avoided. In order to set up such innovation strategies regional policy - makers could learn from three sources. First, they could benefit from recent experiences made by European regions that have been supported by European programmes (Regional Technology Plans(RTP)/ Regional Innovation and Technology Transfer Strategies and Infrastructures (RITTS)) to devise such strategies(Nauwelaers et al. 1996). Secondly, they could learn from Japanese regions that have recently experimented with regional co - ordination efforts in the field of regional high technology policies to combat the fragmentation caused by vertical administration(Bass 1998). Thirdly, they could use recently launched theoretical development concepts on regional innovation systems(Cooke et al. 1998; Toedtling 1998) and the learning region(Morgan 1997).

In addition to its role of boosting technology transfer and networking in the region, there are two other advantages of coherent regional innovation strategies. First, over - ambitious technopole planning focused on a too broad array of technologies can be avoided with the help of regional innovation strategies. Secondly, regional innovation strategies help to place technopoles in the proper regional innovation policy context and by doing that they help to co - ordinate all innovation - oriented measures relevant to the region, which might be devised both at local, regional, national and supranational leave. This will help to avoid overlap and duplication of policy measures and thus to foster transparency and efficiency of the innovation support system.

To develop technopoles and to reap benefits from them for the regional economy is a long - term process, certainly longer than the political election cycle. Regional innovation strategies can help regions to yield benefits of technopoles sooner than without them.

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