CHAPTER 10

After Technopoles
Diffused Strategies for Innovation and Technology Transfer

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Introduction

Science and technology parks (technopoles) are recognised as important institutions and infrastructures for industrial innovation and technology transfer, providing an interface between universities, R&D and production activities. However, after two waves of technopolitan development in Europe (1969–73 and 1983–93), major disadvantages in this technology transfer mechanism have become apparent. The chapter starts with a critique of the innovation and technology transfer concepts which are associated with technopoles and science parks, characterised by highly-localised and low-institutionalised technology transfer. The second section comments on some recent developments in the technology transfer policy of the European Commission, including the Strategic Programme for Innovation and Technology Transfer (SPRINT), the Regional Innovation and Technology Transfer Strategies scheme (RITTS), the Regional Technology Plans Pilot-Action (RTP) and the Fourth Framework Programme for R&D. Based on these experiences, the final sections discuss new tools for research-industry linkages and technology transfer which diffuse innovations through network structures and decentralised institutions. The recognition of the effectiveness of such tools and instruments for innovation support is gradually changing the nature and direction of technopolitan development.

Technopoles and Innovation Support

More than 25 years of technopolitan development in Europe have contributed to the creation of a phenomenon with substantial dimensions and expectations. The first phase of science and technology park development occurred at the beginning of the 1970s (1969–73), and it was rather experimental. It concerned a small number of cases, the science parks of Cambridge and Heriot-Watt in Britain, Haasrode in Belgium and Sophia Antipolis in France. These pilot projects appeared as spontaneous initiatives of the universities and private economic groups and searched for focal links between the universities and industries (Monck *et al.* 1988; Muller 1985). A second phase started at the beginning of the 1980s, during which the phenomenon received quite important dimensions with the creation of more than 100 parks in all European countries. These parks are connected to the wider political and economic framework of productive restructuring, the disintegration of productive activities, the rise of small businesses and the new demands for R&D, innovation and producer services. Since then, the co-ordinated efforts of the public and private sectors for new types of economic activity based on research and technology sustain the science park movement as an important institution supporting innovation and industrial competitiviness.

Science and technology parks vary significantly from one part of Europe to another. In the UK, Germany, Holland, Belgium and Greece a model of small 'incubator-led' parks predominates. These parks support new technology-based firms, on the levels of production, product development and finance. On the contrary, in France and Spain technology parks (technopoles) are larger and seek to change the entire local productive system, where they are located, through the attraction of large high-tech companies and multi-national R&D departments. This 'attraction-led' model acts as a catalyser in order to appeal to, and house, innovative firms in particular areas. In both cases, science and technology parks appear as zones/clusters of innovation and co-operation among R&D, industry and education. Networking and technology exchange link research institutions, innovative companies, new start-ups and supplier firms.

In most of the technopoles created during this period, the same components are more or less present (see Dunford 1992; Komninos 1992):

- a university-production co-operation, which creates a technology and innovation environment open to firms
- an infrastructure which transfers technology and business services to SMEs or larger firms
- a number of innovative firms, which creates a pole for innovation capable of diffusing technology and know-how to the wider productive system around the park.

Innovation and technology transfer activities constitute the nucleus of science parks; around it is set the population of the parks, consisting of R&D institutions, small and larger firms, infrastructure and supporting services. Technology transfer is realised through different forms of institutional agreements and management practices, including (see Dalton 1992; Komninos 1992):

- Agreements between firms and the universities. Generally they assure (1) the opening up of university infrastructures and research facilities to companies, (2)the flow of information and expertise through common projects, personnel transfer and day to day contacts, and (3) the support of the new ventures of scientists who wish to exploit commercially their research.

- Finance for start-ups of technology-based firms. In the absence of affluent seed capital financing, many parks have themselves organised seed and venture capital funds. The purpose is to support new start-ups, which constitute an important channel for technology transfer and innovation.
- Networking between firms. Strategic alliances in the fields of producer-supplier relationships, marketing-diffusion relationships, common R&D or product design projects and new joint ventures, resolve the usual difficulties that small firms face in production and marketing.
- Housing of innovative firms. An important part of the global activity of science parks is to provide new types of buildings and spaces characterised by flexibility and high quality. Such infrastructures attract the well-qualified employees of high-tech firms and promote parks as centres of innovative activity and business excellence.

Various claims are frequently made for the benefits and positive effects of science parks, including new firm formation, encouraging university-industry links, new employment and high-technology enterprise. However, in many cases the technological dimension and the technology transfer mechanisms of the parks were proved inefficient, technology transfer was neglected while other forms of entrepreneurial activity were favoured (see Massey, Quintas and Wield 1992; Massey and Wield 1992). Three situations, inherent to the constituting concepts of science parks, have contributed to such distortion.

First is the emphasis on the property dimension of the parks. Science parks were conceived as:

> a property based initiative which has formal operational links with a university or other Higher Education Institution as major centre of research; it is designed to encourage the formation and growth of knowledge based businesses and other organisations normally resident on site; and it has a management function which is actively engaged in the transfer of technology and business skills to the organisations on site (Dalton 1987, p.i)

A great deal of the science park management is related to property; to sell land, to build and to fill up incubators. In larger parks, where the stake of property is more important, property management caused a neglect of technology resources and job creation. As J. Hennebery (1992) points-out, one might be tempted to evaluate the impact of science parks in narrow cost-per-job terms by comparing the scale of public investment with the number of jobs created in 'academic' businesses.

A second reason is the emphasis on marketing and image strategies developed by the management in order to attract tenants. It was observed that an important motif for the location of firms was the high-tech image of the parks, which attracts tenants independently from the real technological potential (Monck *et al.* 1988). In many cases, marketing and promotion strategies prevailed, although the local business environment was very poor in innovative activities and the potential for the attraction of tenants very low (Technopolis International 1992, Komninos 1993).

A third reason is the low institutional links of parks with higher education and research institutions. Relatively few science parks have been developed by universities and many parks have been developed without functional relationship to academic and research institutions. This restrains considerably the supply of technologies and innovation services they are supposed to provide. An assessment of science parks role in the diffusion of technological knowledge (see Van Dierdonck *et al.* 1991; Van Dierdonck and Huysman 1992) notes the moderate technological environment that many parks offer.

These orientations of science parks towards physical accommodation and the attraction of innovative firms have diverted their function and tend to transform them from technology-supporting mechanisms to property-intensive developments. The spatial and marketing issues prevailed, while technology transfer, innovation and re-engineering of corporate practices were frequently neglected. Furthermore, the emphasis on space and physical infrastructures created a disproportion between the investments needed for the development of the parks and their real added-value in the innovation and modernisation processes.

A renewed interest for technology and innovation issues is needed if science and technology parks wish to achieve their policy objectives and remain important elements in the regional innovation infrastructures. Some new directions and solutions to this problem have been elaborated in the European Commission's innovation and technology transfer policies.

Technology Transfer, Innovation Support and EC Policies

During the 1980s and early 1990s, European Commission policies and programmes on technology transfer opened new ways of thinking about innovation support systems and shaped a number of infrastructures and services for such purpose. Most important have been contributions from the Strategic Programme for Innovation and Technology Transfer (SPRINT), the Regional Innovation and Technology Transfer Strategies and Infrastructures (RITTS), the pilot-action of Regional Technology Plans (TRP), and, recently, the Fourth Community Framework Programme for Research and Technological Development. These programmes have accumulated important experiences in technological co-operation and created generic tools for technology transfer and innovation diffusion.

SPRINT has been the main European Community programme for technology transfer during 1984–88 and 1989–93. It had three objectives:

- to facilitate the diffusion of new technologies to firms (support of specific projects for technology transfer, support for innovation financing by smaller firms, and inter-firm co-operation)
- to strengthen the European innovation and technology support services (support for science parks, innovation services, networks of technology and innovation specialists)
- to improve the awareness and understanding of innovation (creation of the European Innovation Monitoring System, support for the exchange of knowledge and experiences between the Member States).

Two major concepts were developed in the programme. First, the identification of *technology transfer routes* open to SMEs. Three basic technology transfer routes were identified: (1) the research to industry route, which can provide firms with sophisticated new knowledge, (2) the inter-firm technology transfer route, based on sub- and co-contracting relationships and (3) the technology licensing and related contractual forms of technology transfer (CEC 1994b). A second important concept was the building of *trans-European networks* for co-operation and application of new technologies in sectors and regions where they are yet to be utilised. These networks aimed at promoting inter-firm co-operation and helping SMEs from different countries to trade technology, carry out joint R&D, market complementary innovative products or to engage co-operation in the fields of technology and innovation. Since 1994, SPRINT was incorporated in the Fourth Framework Programme for R&D, as part of Third Activity devoted to the dissemination and exploitation of R&D results, technological development and demonstration.

Under the SPRINT Programme was developed the Consultancy Scheme for Regional Innovation and Technology Transfer Strategies and Infrastructures (RITTS). The scheme was aimed at regional governments and associated regional development organisations wishing to improve or change the focus of infrastructures and services for innovation and technology transfer. It covered a wide part of the Community, not just objective 1 or 2 regions, and it had a trans-national dimension in order to encourage the spread of best practices. Overall, 23 projects for regional innovation and technology transfer were supported. On the methodological level, the scheme was divided into three stages. The first stage was concerned with drawing up an inventory to define infrastructure support elements, business needs for R&D and types of possible public intervention; the second stage was concerned with the examination by a steering Committee of the strengths and weaknesses of the regional economy and the definition of a development plan; the third stage consisted of the implementation of the plan and follow-up mechanisms.

Complementary to RITTS were the Regional Technology Plans, a new pilot policy of the Commission to enhance the synergy between Technological Development Policy and Cohesion Policy. Regional Technology Plans were developed in the framework of the Structural Funds and were jointly managed by DG XVI (Regional Policy) and DG XIII (Telecommunications, Information Market and Exploitation of Research). They have launched in Leipzig-Halle-Dessau (Germany), Limburg (Netherlands), Lorraine (France) and Wales (UK). More recently four less-favoured regions have joined the programme: Abruzzo (Italy), Castilla y Leon (Spain), Kentriki Makedonia (Greece) and Norte (Portugal). Typical deliverables of a RTP include: the definition of a plan for technological development based on the consensus of the main actors in the public and private sector, which is to be implemented through the second Community Support Framework, Community initiatives and other investments from the public and the private sector; the organisation of a system for continuous monitoring and evaluation of technology issues and the needs of regional firms; the participation of the involved region in the network of Community's regions developing RTPs and building competitive advantages on technology and innovation. The management of each programme is based upon two local bodies: a Steering Committee and a Management Unit. The Steering Committee, composed of representatives from the public and private sectors, the Universities and other research institutions, oversees the whole operation and guarantees a regional consensus among the actors involved. The Management Unit assures the day-to-day work of the programme, launches the necessary studies and supports, scientifically and technically, the orientations from the Steering Committee (CEC 1994a; Landabasso 1995).

Major objectives of both the TRPs and RITTS (actually included in the INNOVATION Programme) are to encourage the endogenous technological development of the European regions, to improve the capability of local and regional actors to design policies which correspond to the real needs of the productive sector and the strengths of the local scientific community, and to support local consensus among the public authorities, the private sector and the universities about the character of technological development of the region.

An important push to technology transfer actually came from the Fourth R&D Framework Programme, which defines a number of priorities on the levels of technologies and the diffusion of innovation (CEC 1993b). The programme is divided in four activities which concern specific RTD projects, international co-operation, dissemination of RTD results and training and mobility of researchers. Major objectives shaping the programme are: the promotion of technologies having wide applications into a large number of industrial activities, and the promotion of dissemination and diffusion of R&D results.

The first activity of the programme, which covers 87.3% of the budget, is concerned with the development of generic technologies. Major applications include: information and communications technologies (28.2% of the activity's budget), energy technologies (18.5%), industrial technologies (16%), bio-medicine

Table 10.1 Technology orientations in the first activity of the fourth R&D framework programme

1. Information and Communication Technologies
    - Information technologies
    - Advanced communication technologies
    - Telematic applications of common interest
    - Technologies for integrated information and communication systems
2. Industrial Technologies
    - Design, engineering, production systems and human management
    - Materials and material-related technologies
    - Advanced propulsion technologies
    - Standards, measurement and testing
3. Environment
    - Natural environment, environmental quality and global change
    - Environment-related technologies
    - Earth observation and the application of space technologies
4. Life Sciences and Technologies
    - Biotechnology
    - Biomedicine and health
    - Applications of life science
5. Energy
    - Clean and efficient energy technologies
    - Nuclear safety
    - Controlled thermonuclear fusion
6. Research for a European Transport Policy
    - Strategic research for a multi-nodal trans-European network
    - Optimisation of networks
7. Socio-economic Research
    - Evaluation of science and technology policy options
    - Research on education and training
    - Research on integration in Europe and social exclusion phenomena

Source: Eurotechnology, No 41, January 1994 and biotechnologies (13.1%) and environmental protection technologies (9%). These choices reflect the technological needs of EU industries and services and link directly the Fourth Framework Programme to the European policy for industrial competitiviness (CEC 1993b).

However, the main challenge for translating RTD results into industrial innovation lies on dissemination and technology transfer. The programme includes three separate activities concerning the diffusion of RTD:

- the Second Activity for international co-operation, with 4% of the programme's budget
- the Third Activity which builds upon VALUE and SPRINT experiences and concerns the dissemination and exploitation of research results, with 2.5% of the budget
- the Fourth Activity for the stimulation of training and mobility of researchers, with 6.2% of the budget (CEC 1993b).

New Interfaces Between R&D and Production

The concepts and experiences acquired in the framework of SPRINT, RITTS, RTPs and the Fourth R&D Programme renew the discussion on technology transfer, research and industry co-operation and innovation support systems. These programmes have contributed in the development of new tools for the diffusion of R&D. Typical schemes are the observatories, the technology co-operation networks, the structures for the provision of advanced technological services and the institutions for innovation financing. Such tools may be incorporated in various technology transfer institutions to extend and change the character of the technology transfer infrastructure – science and technology parks included. In all cases, the central issue is the direct connection of innovation support initiatives to corporate strategies, the technology needs of SMEs and the competitiveness of local and regional productive systems.

Observatories and Technology Information

The key issue in technological development is to raise the awareness of the agents involved in productive practices and policy-making on R&D, innovation, technological capabilities and solutions. Different structures may be useful to this purpose: observatories, information centres, telematic networks, data-bases, etc.

Such information mechanisms rely on a double interface:

- A structure for the selection of information on technology issues that interest companies and, usually, SMEs; it covers both the supply of technological services by institutions of research and brokerage agencies as well as the demand for technologies and specific technological services.

- A structure for the diffusion of information to producers, public administration and the research community, covering a wide range of issues related to the specific problems of SMEs and the policies and programmes for technological development. This may include formal and informal procedures of communication, meetings and other forms of information exchange. Furthermore, the development of multi-media technologies and powerful bases for data storage and process permit the building of user-friendly interfaces for on-line communication and information.

Two good examples are EIMS and patent information. The European Innovation Monitoring System (EIMS) searches to establish a knowledge base and to develop research capabilities on innovation. It encourages the exchange of knowledge and experience between the Member States and the European Commission concerning innovation policies and innovation support measures through the development of a network linking experts and research teams performing applied innovation research and surveys at a European level, the systematic diffusion of results, studies and surveys performed in the EU and the establishment of a permanent Community-wide data-collection for monitoring the innovation capabilities and performance of industries and regions.

Complementary are the data bases on patent information. About a million patent documents are published every year in the 100 nations that have signed the Paris Convention for the Protection of Intellectual Property of 1883, which is the cornerstone of the modern patent system. Patent information may have a double role. On the one hand to provide inside information on existing competition, markets that might be exploited, starting points for R&D and informed reviews to the state-of-the-art in specific technologies. On the other hand it may provide solutions to specific problems and save development costs from duplication of research (see Derwent 1986).

Technology Transfer Networks

Technology transfer networks may be considered a major instrument for technology transfer. Technology networks are built upon supplier-producer relations, regional agglomerations of firms, international strategic alliances in new technologies, consortia for technological co-operation and specialists for long-term co-operation. The concept of network refers to a decomposable system in which the system is more than the sum of its interacting components; in other words there is synergy and multiplication effects from the interaction of the networks' members (see Cooke and Morgan 1991; Freeman 1990). Major issues for the technology networks concern focus, membership and the services (see also, Bianchi and Bellini 1991; De Bresson and Amesse 1991).

Concerning the focus, technology networks can be built on three different bases: to be focused on a sector-focus, on a technology, or on a combination of both.

- Sector-focused networks are very common and the narrow specialisation of industrial branches makes co-operation easier across wide geographic areas. Such networks may include firms, sectoral technical organisations and specialised research institutions.
- Technology-focused networks tend to be closer to the state-of-the-art in the area of expertise, but the lack of natural affiliation to particular industries makes the partnership more difficult. A useful base for technology-focused networks may be the Fourth Community R&D Framework Programme and the technological components of the first activity since it offers a typology of generic technologies and provides links to working groups, experts, research teams and industrial applications.
- Mixed-focus networks combine the benefits of the previous types, the facility for industrial application and awareness of the state-of-the-art of specific technologies.

For the membership, two different forms of technology co-operation may be distinguished: technology exchange, where technologies pass from one member of the network to another, and technology exploitation, where technological knowledge developed by research teams of the network is transferred to firms. So, with respect to the objectives for technological co-operation, the networks may include, firms, private consultants (including technology brokers, management consultants, consulting engineers, industrial property consultants, patent attorneys), research and technical organisations (contract research organisations and sectoral technical centres) and public and non-profit organisations, such as regional development organisations, chambers of commerce and industry.

Technology networks are able to offer a wide portfolio of services. Apart from information transfer, key services include technology transfer, skills transfer and specialist support (see Table 10.2).

The choices made on the focus, the membership, and the services, set the initial framework for the global management of the network: the internal co-operation and alliance, the leadership, the procedures and rules of management, the conflict and under-performance resolve, the creation of new markets based on synergy and the long term perspectives.

Provision of Advanced Technological Services

A wide range of technology applications and services is increasingly demanded by SMEs which cannot provide them internally, and which are not easily available on the market (see Britton 1989). Such services concern primary production and

Table 10.2 Services provided by technology networks

Technology transfer	*Skills transfer*	*Specialist support*
Technology brokerage	Training and education	Financial advise, market research
Licensing in, licensing out	Recruitment, Skill search	Technology application and management
R&D and technology audits	University – industry liaison	Demonstration
Research for products and processes	Location of R&D resources	Product evaluation, patent intellectual property advise

Source: CEC 1994b

research services, like certification, product development, multi-media applications, CAD-CAM applications, software and computational tools, and various types of laboratory analysis – including destructive and non-destructive quality analysis, chemical analysis, laser and optoelectronics applications, mineral exploration analysis and hydrogeology surveys and analysis.

Most demanded are the services related to:

- Quality certification, which is increasingly important for the competitive presence of products in the European and international markets
- Business services such as the technological evaluation of new products and firms (analysis of technology-based inventions, analysis of technical feasibility, market analysis), the protection of intellectual property (patents, model protection, registration of trademark, licensing, royalties), the design of development plans (business plan preparation, build and testing of prototypes, user questionnaires and product improvement) and marketing (choice of marketing route, establish a new venture/ find a partner licensing, design of marketing strategy)
- Multi-media and telecommunication services for product promotion and consulting for the suitability of multi-media for different applications and platforms. On the other hand, small systems of distributed informatics ensure that texts and voices may travel along the telephone lines and links may be established to data banks, to specific services available on a national and international scale and to local agencies through the installation of electronic mail services.

These services are linked to technologies which have become very important in contemporary production and product and management technologies like automation, quality control, energy saving, environmental protection and information technologies for business purposes. They have a direct impact on upgrading the technological level of productive processes necessary to improve competitiveness.

They are provided by different types of organisations, mainly in the public and semi-public sector, whose portfolio of services is concentrated upon SMEs' technology needs.

Innovation Financing

The creation of tools for innovation financing stems from the need to encourage new business start-ups. Technology-based and innovative SMEs have been misunderstood by bankers and financiers. Their characteristics differ markedly from those of more traditional businesses and this has led to a serious gap between businesses and financing institutions (CEC 1995).

When it comes to providing start-up and initial expansion financing for small-scale projects, the more conventional financing tools are ill-suited to companies' needs or are only partially able to satisfy them. There are, however, some tools specifically designed towards providing equity capital, which increases the chances of long-term survival. Their formation include (see CEC 1993a):

- To create the fund on an equity basis, probably in co-operation with existing financial institutions or banks. Alternatively, it is possible to create a separate finance line into an established venture capital fund.
- To set an appraising unit for innovative projects. What is needed is a methodology for evaluating the risks and the technical feasibility of proposals with respect to the market environment in which the new products will operate. Such appraisal may also consider the management, marketing and technical skills of the business and make use of external technology and marketing experts.
- To inform SMEs on the financial capabilities of the scheme and the comparative advantages *vis-à-vis* traditional financing tools.
- To design exit routes, always in co-operation with the financial institution or bank involved, for withdrawal from the individual project (financial route, industrial route, selling of the stake to the investee company, etc.).

Experiences and know-how on the functioning of such funds have been accumulated in the European Seed Capital Fund Network (ESCFN). It is a pilot scheme of the European Commission having, as it's overall objective, the fostering enterprise creation (and employment) in the Community by strengthening the financing opportunities available to new businesses. ESCFN supports a number of newly-created funds – provided that they agree to make their investment in start-up or early stage businesses. Some funds, if located in specific areas, may also benefit from a contribution to the funds available for investment.

Post-Technopolitan Command Centres

The experiences acquired by the technology transfer and innovation programmes of the EC, and the tools designed in this framework, show alternative routes which enrich and transform science and technology parks.

Science and technology parks have been started by universities wishing to valorise their research through the proximity and provision of physical accommodation to technology-based firms. The activity of high-tech firms, as well as of the start-ups in new industrial activities, have produced needs for new types of spaces – the chief characteristics of which were flexibility, quality and information technology infrastructure. In turn, the agglomeration of high-tech companies in science parks created poles of technological capability and diffused innovation around their location.

However, 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. Instead, they are based on institutions, networks and information technology infrastructure. A new post-technopolitan profile is emerging, in which the functions of science and technology parks are diffused in many parts of the local productive system and the spatial aspects of technopoles become less important.

Indicative of such trends is that more and more technology transfer initiatives, based on technology networks, observatories and centres for advanced technological services, are developed out of science and technology parks. This multiplication of technology transfer initiatives involves a great number of social actors at the local, regional, national, sector and associative levels. The consciousness of the role of innovation in the defence of jobs and income has increased the demand for technology intermediaries to be included in local and regional development programmes. On the other hand, new tools for technology transfer and information diffusion are created by many universities (industrial liaison offices, career advisory units, technology information centres) without any formal reference to technopolitan structures. They take the form of networks and institutions supporting the university-industry co-operation and are placed under the usual university administration and decision-making.

From the multiplication and spread of non-spatial tools for university-industry co-operation, new technopolitan designs are emerging (see Komninos, Mercier and Tosi 1995). Already the technology transfer environment has deepened (see Miege 1992), leaving the isolated technology park as a memory at the outskirts of the city, as the unique technology intermediary. In the new innovation environment, composed by many players and dispersed initiatives, the real issue is the establishment of networks and 'command centres' in order to assure co-ordination, focus for the various initiatives and to avoid duplication and waste of effort. What is needed is co-ordination and guidance of the different agencies providing technology and markets information, technology inter-mediation, advanced technology services and innovation financing.

The nodal, property, and marketing-led technopoles are transforming and inserting into a multi-centre and multi-level research-production interface. The strengths of this post-technopolitan interface lay in the multiplicity of the tools for technology transfer it encloses, which do not rely on heavy and costly infrastructure or on the size of cluster of innovative firms. Networks and information channels do not presuppose the spatial proximity of the participating members and open their linking capacity over large geographical scales. Technology transfer institutions, technology networks and appropriate information technology infrastructure are appropriate answers to inefficiencies of the established technopolitan agglomerations and their built-in spatial constraints.

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Innovation, Networks and Learning Regions?

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