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Review of International Best Practices of Programs to Promote Regional Innovation Systems

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Introduction

This paper has two main objectives. First, it aims at briefly reviewing the concept of Regional Innovation System (RIS) as it has been proposed in the literature, and especially in light of the use that this notion has often had for policy purposes. Second, it reviews considerable empirical evidence from developed and developing countries available in on-line databases, papers and project documents and reports, in order to start exploring some lessons learnt from experience, and their use for the design and implementation of future policy interventions.

The structure of the paper is the following. In section one we briefly review the literature on Regional Innovation System (RIS) and present our working definition. In section 2 we describe the sources of information used, while in section three we explain the methodology employed to scan the evidence. In section four we discuss the evidence and the insights that may be drawn for each type of intervention, while in section five we conclude with a preliminary synthesis of the lessons learnt.

1. Regional Innovation Systems: Theories and Positive and Normative Perspectives

A Positive Perspective

Since the early literature on National Innovation Systems (NIS)[1], the idea of applying a similar conceptual approach to smaller geographical levels was very tempting, and led to the proliferation of analyses on regional and local systems of innovation.[2]

Asheim and Gertler (2005) present a very useful discussion of the concept, where they claim that "…one cannot simply understand innovation properly if (one) does not appreciate the central role of spatial proximity and concentration" (Asheim and Gertler, 2005: 292). They use the concept of "tacit knowledge" (Polanyi, 1967) to support their argument, and note how: (i) tacit knowledge is difficult to exchange over long distances, (ii) socially organized learning processes are acquiring increasing importance, where innovation has come to be based on interactions and knowledge flows between firms, research organizations (e.g. universities), and public agencies (e.g. technology transfer centres, development agencies, etc.). A social process of joint innovation and knowledge production is increasingly at play, with place-specific and path-dependent characteristics. Such innovation and learning process is "social" as it exists between firms, agencies and organizations, and not within them, i.e. it is different from the innovation and learning occurring within firms. Although local firms cannot fully appropriate innovation, only local firms can enjoy its benefits.

This, together with widespread processes of "learning through interacting" (Lundvall, 1992) – with user-producer but also knowledge sharing among potential competitors and the interactions between entities that generate knowledge (researchers) and those that adopt knowledge (firms) - determines "stickiness" and geographical concentration of innovative activities.

Thus, regional systems of innovation – differently from clusters - put knowledge rather than the firm at the centre of the process, and consider shared practices, attitudes, expectations, norms and values which facilitate the flow and sharing of tacit and other forms of proprietary knowledge the cornerstone of the system of innovation (OECD, 2007).

Therefore, the rationale for a Regional Innovation System (RIS) stems from the existence of technological trajectories that are based on sticky knowledge and localized learning, and from the presence of knowledge creating organizations whose output can be exploited for economically useful purposes. Thus, a RIS can be thought of as **the institutional infrastructure supporting innovation and its diffusion within the production structure of a region** (Asheim and Gertler, 2005: 299)

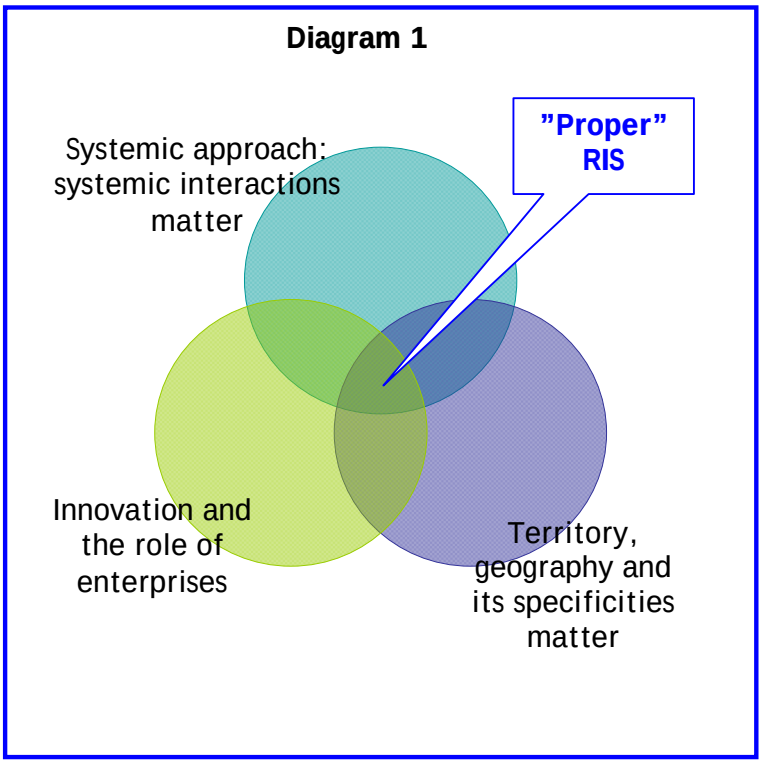
Various categorizations of RIS are available in the literature. One of them distinguishes among three types of RIS (Asheim, 1998): (i) territorially embedded RIS (e.g. networks of SMEs in industrial districts, like in Emilia Romagna), (ii) regionally networked innovation systems, where policy interventions lend these systems a more planned character (e.g. regional clusters of firms

[1] Freeman, 1987, 1995, Lundvall, 1992, Edquist, 1997 and 2005, Nelson, 1992.

[2] Cooke, 1992, 1993, 2001, Cooke and Morgan, 1998, Cooke et al., 1997, Asheim and Gertler, 2005, Iammarino, 2005.

surrounded by regional "supporting" institutional infrastructure, typically in Germany, Austria, and the Nordic countries); (iii) regionalised NIS, where exogenous actors and relationships play a larger role and they are functionally integrated into national or international IS (e.g. clustering of R&D laboratories of large firms or government research organizations in planned "Science Parks").

Diagram 1



Following this stream of literature, we may take a *positive* perspective to describe a RIS. Thus, we acknowledge that regions, especially when they have developed clusters and appropriate administrative machinery for supporting innovative enterprises, represent more meaningful communities of economic interest, define genuine flows of economic activities and can take advantage of true linkages and synergies among economic actors (Cooke, 2001).

Indeed, in order to define a RIS, we need to acknowledge its three main conceptual dimensions: the central role played by **innovation**, that is itself created and diffused within a **geographical**, **locally defined system**, where **firms** are essential actors of the system. A "proper" RIS results from the intersection of these three dimensions, and illustrates the object of analysis of this paper. The diagram 1 portrays this idea.

Thus, the systemic approach argues that the interactions among companies, research institutions, and local government actors are essential to generate innovation. During the innovation process economic actors do not act in isolation as they jointly contribute to the production, diffusion and use of knowledge. Innovation represents the true engine for structural change, with a direct influence on productivity improvements, and firms play a central role in both creating and diffusing innovation. The specific characteristics of a territory, its specific assets and networks, and not only the economies of scale allowed by geography, influence its innovation performance. It needs to be stressed that the process of creation and strengthening of a "proper" RIS does cancel previously existing arrangements (e.g. clusters, regions) but rather empowers them with additional elements and interactions.

Furthermore, the diagram illustrates the possibility that other types of intersections occur. For example, a systemic approach focused on innovation but without a geographical association would represent either a national, geographically loose system, or a system that could even work globally, like for example in a sector or within a multinational corporation (MNC). Or it could be a system geographically defined but without special emphasis on innovation, like a traditional industrial district.

Normative (Policy) Perspective

Can policies support and nurture, or even create, a Regional Innovation System? How can the concept briefly described above be translated into a policy approach?

Although governments and international organizations increasingly refer to RIS in their policies and programs, our review shows that **support to RIS** is sometimes mentioned as the direct target of a programme, but more often it **is the indirect objective of other programmes** targeting at least one of the three conceptual dimensions:

i. **Enterprise development.** Innovation and entrepreneurship are the core of competitiveness. There is plenty of programs targeting the productive sector, and most of the time they target enterprises even if their main scope is promoting S&T, or a specific territory. Thus, the productive sector is often considered as the final beneficiary of Science & Technology & Innovation (S&T&I) measures targeted to a specific region. Moreover technology transfer from research and dynamic venture capital industry play important roles to fuel company creation and growth. As a result these kind of programs set typically the following objectives: networking, training of human capital, diffusion of technology among enterprises, knowledge and technology transfer, R&D cooperation, direct and indirect support of business, support of start up, support innovation in selected manufacturing sectors.

ii. **Science and technology**. As technologies and new industries are becoming more sophisticated, collaborative research between academia and business is playing an ever growing role in the process of invention, innovation and commercialization. Programmes promoting S&T&I also indirectly target a RIS.

iii. **Regional development.** Local assets are essential to promote local development. Many of the programs analysed focus specifically on lagging regions (e.g. InnoRegio targeted for East Germany regions). Other programs choose regions through a bottom up selection, and help regions become creators of knowledge-related linkages and synergies among economic actors. A typical program of regional economic development focuses on assisting local authorities and agencies to adopt a more active and coordinated approach in order to strengthen the innovative abilities of local business and promote systematic learning; therefore they clearly aim at enhancing a RIS.

In terms of the concrete implementation practices, these policy streams usually share one or more of the following (indirect) objectives:

i. *engagement of actors*: here the commitment of public and private actors and stakeholders plays a central role. Crucial features are the degree of interaction and collaboration among local (cluster) participants and the existence of a formal agreements among local stakeholders;

ii. *collective services*: this concept comprises the provision of S&T services for enterprises, such as product process development, business advice, support to innovation management and advisory services to support the productive sector in the creation and diffusion of innovation;

iii. *large scale collaborative R&D*: these collaborative projects involve targeted research institutions for research projects in partnership with the enterprise sector, matching the specific needs of the private sector.

Most programs often utilize more than one policy tool to promote a region. Some of them even link all the mentioned intervention policies together, encompassing projects of collective research, technological services, sub-regional innovation stimulation and cooperation for clustering. This is the case, for example, of the Thematic Innovation Stimulation (VIS-TIS) Program in Belgium. Thus, not all programs explicitly target RIS development, but they contribute through different forms to the generation of a collaborative (systemic) environment among stakeholders at the local level.

On the basis of our sample, we could develop a categorization of programs supporting at least one (and possibly more than one) dimensions of a RIS. This is illustrated in Table 1 below, on the basis of the most prominent programmes we could find. It shows the breadth of policy approaches that are in fact used to promote a RIS.

Table 1 – Categorization of Programs to Promote a RIS

Final objective	Means through which it is possible to reach the final objective: Type of programs	Definition and Rationale
	Technology Transfer	Companies are not necessarily informed of or have access to the relevant research and technological knowledge. Moreover successful innovation requires knowledge from different fields, that a single enterprise cannot produce alone. Often innovation only takes place through an exchange of knowledge between users and producers.

Regional Innovation System		Hence technology transfer focuses on the process of intermediation and diffusion involving enterprises and research organizations
	Clusters	Innovative clusters have a strong territorial/regional identity and are mainly focused on innovation and development of specific sectors. Enterprises – and the linkages among them, and sometimes with other local organizations, - play a central role.
	University-Industry Linkages	U-I linkages base their rationale on the leading role of universities, research organizations, partnership in ST&I collaborative projects with enterprises for the development of pre-competitive research to be exploited by the productive sector.
	Programmes with a clear territorial focus	These programmes promote the interaction among different entities (Governments, both at national and local level, public organizations, research centres, and enterprises) that operate in a specific territorial context and in specific sector(s) often with main focus on S&T&I

Source: own elaboration

Although these programs have specific characteristics, they can easily overlap with other programs. This is indeed the inevitable consequence of the evidence of innovation that results from increasingly complex interactions at regional, national and world levels among individuals, firms and other knowledge institutions. Science and technology policies, enterprise policies and regional policies have clearly different original objectives and foci, but they may all foster the development of a RIS.

2. Sources of Information

Different information sources have been used for this review, and they include databases, papers and documents on projects to promote innovation, S&T, enterprise development, or territorial development, but all sharing a Regional Innovation System approach. They include:

- The European Commission **Inno-Policy Trendchart** (http://www.proinno-europe.eu/index.cfm?fuseaction=page.display&topicID=52&parentID=52). This database gives the number of policy measures per country and category and also provides a multi-criteria search function. The database embraces 39 countries in Europe, the Mediterranean region, North America and Asia. Policy tools include: strategy policy documents, cluster framework policies, policies promoting excellence, infrastructure to support research and business R&D (tax and loans), awareness creation on science and innovation, support to sectoral innovation in manufacturing and to innovation management.

- The Economic Commission for Latin America and the Caribbean (UN-ECLAC) **Science and Technology for Development** (CYTDES) project (available at: http://www.cepal.cl/iyd/ *info-instrumento*). This database describes the main features of S&T support measures for 45 countries in five continents. The programs are classified as follows: centres of excellence, research consortia, venture capital, technology funds, human capital training, incubators, S&T parks, national systems of researchers).

- **Erawatch** is a website (www.cordis.europa.eu/erawatch) managed by the European Commission's Directorate General for Research and the Joint Research Centre - Institute for Prospective Technological Studies (IPTS). The website collects data on national and regional research profiles, organizations, programs and documents.

- The **Inter-American Development Bank** (IADB) and The **World Bank** (WB) websites (respectively www.iadb.org and www.worldbank.org) under the link *projects* display a list of all the projects that have been implemented or are being implemented in Latin America and other developing countries. Our search focused on projects targeting RIS, sometimes indirectly through support to S&T, education, enterprise development. The information gathered concerns loan documents and other reports (e.g. monitoring, evaluation)

3. Our Sample of Programs Supporting Regional Innovation Systems

The programs analyzed have been chosen among a great variety of interventions. The selection criterion has been inspired by the RIS concept described above, and the sample selection has been random and guided by accessibility of information (Table 2). As a minimum necessary condition, the selected programs present at least one of these dimensions, but also tend to be related to the notion of RIS. The assessment has explored the intersection of two or more of the RIS dimensions in each programme (i.e. innovation, territory and systemic). This has been the logic driving our approach.

Table 2. Our Sample of RIS Programs

No.	Title of the program	Country	Prevailing stream of policy
	Technology transfer (TT)		
1	The India National Agricultural Innovation Project (NAIP)	India	S&T
2	Tekes Technology Programmes. This includes: RAPID (No 3) and NETS (No.34)	Finland	S&T
3	RAPID, Subprogram of Tekes Technology Progr. Grant and Loans	Finland	S&T
4	Centres of Expertise in Finland	Finland	S&T and RD
5	RIS +, Toscana	Italia	RD
6	Thematic Innovation Stimulation (VIS-TIS)	Belgium	S&T and RD
7	BioRegio	Germany	S&T and RD
8	Technological Modernization Program II	Argentina	S&T
9	Technological Modernization Program III (FONTAR)	Argentina	S&T
10	Competitividad del Cluster Provincia Santa Fe Argentina	Argentina	RD
11	Programa de desarrollo e Innovación Tecnológica PDIT	Chile	S&T and ED
12	Plastic and Rubber Training and Research Program	Colombia	S&T
13	Multimedia Super Corridor (MSC) Venture Corporation	Malaysia	S&T
14	Hard Disk Drive Cluster	Thailand	ED
15	Thailand Science Park (TSP)	Thailand	S&T
16	Programma Estatal de Ciencia y Tecnología del Estado de Jalisco	Mexico	S&T
	Territorial focus		
17	ASTER	Italy	RD
18	NRC Technology clusters	Canada	S&T and RD
19	GA-networking	Germany	RD
20	ARENA - Innovation in Networks Norway	Norway	RD and S&T
21	VINNVÄXT - Regional growth through dynamic innovation systems	Sweden	RD and S&T
22	Innovative Business Groupings Programme (AEI, Agrupac. Empresariales Innovadoras)	Spain	RD
23	Clusters de Santa Catarina, The textile and the ceramic cluster	Brazil	ED
	Cluster		
24	Yorkshire Forward Cluster Network	UK	ED and RD
25	InnoRegio	Germany	ED and RD
26	Industrial cluster Program METI	Japan	S&T and RD
27	Technological Districts	Italy	ED and RD
28	Tsukuba Research and Academic City (TRAC)	Japan	S&T
29	Desarrollo productivo y competitividad en Mendoza	Argentina	RD
30	Desarrollo de cadenas productivas para promoción de MIPYME export.s, Guanajuato	Mexico	ED
31	Centro de Innovación Mex. y Fondo Venture Capital para alta Tecnología, Guanajuato	Mexico	S&T
32	Cluster de TI en Recife, Porto Digital y inserción de grandes empresas	Brazil	S&T
	University-Industry (U-I) linkages		
33	Technopolis	Japan	S&T
34	MAGNET	Israel	S&T
35	NETS - Networks of the Future 2001-2005 Subprogram of Tekes	Finland	S&T
36	UY promoción de la innovación para la competitividad	Uruguay	S&T
37	Incentivos universidades-empresas Fundo Nac. de Desenv.Científico e Tecnol., FNDCT	Brazil	S&T and ED
38	Alianzas Estratégicas y Redes de innovación para la Competitividad (AERI´s)-	Mexico	ED

39	Uruguay Innova - within EC -Uruguay– National Indicative Program of Cooperation Developing countries	Uruguay	S&T

The review of the selected programs supporting (expressedly or implicitly) RIS, tries to single out examples of good, bad and best practices. The evidence on these programs was scanned with the use of the following Table 3, in order to capture and discuss the main features of each specific program.[3]

Table 3 Scanning the Evidence on RIS Support: Main Features of Each Program

Country	country/ies or region/s where the program is being implemented.
Title of the program	(often with an acronym)
Prevail. Policy stream	They include: (i) S&T, (ii) Regional development; and (iii) Enterprise development
Macro-category of policy tool	We used three macro-categories of policy tools: (i) engagement of actors, (ii) collective services; and (iii) large scale collaborative R&D (OECD, 2007)
Type of program	We tried to capture the prevailing feature of the program.
Implementing Agency	National/regional institution in charge of coordination and implementation
Keywords	It gives a first glance idea of the most notable features of the program.
Most notable feature	Brief summary of the program
Brief overview	The program's aims, its main strengths and weaknesses
Description	An accurate description of the program's nature, its main features and components. The program's structure, content and evolution, and whether/how it is embedded in a National Plan/Policy.
General objectives	Main goals of the program and its policy priorities
Specific sectors	The main economic sectors in which the program operates
Target group(s)	The beneficiaries, such as e.g. leading or lagging regions, hub areas; economic sectors, specific research institutions, (groups of) enterprises.
Mode of functioning and select. Of beneficiaries	Selection of the beneficiaries may be top down or bottom up.
Duration	Start and end of the program and if it follows a specific life-cycle.
Funding instruments	Direct (e.g. grants and loans) and indirect funding (e.g. tax incentives)
Eligible costs	E.g. labour costs, equipment, external expertise such as consultants, studies, etc..
Source of financing	Public, private or a combination of the two.
Overall budget	and specific contribution of each financing institution. Most programs are above €1 mill.
Results	Outputs of the program e.g. the number of involved enterprises, the inventions patented, or any other measurable outcome.
Evaluation	Few programs have been thoroughly evaluated. When available, main results of the evaluations (efficiency, effectiveness, impact) are presented
Links	Link to main web sites or relevant documents

4. The Evidence

We present the evidence for each type of program.

4.1. Technology transfer

This category of programs groups a wide variety of interventions, all sharing a central emphasis on the need to foster the process of transfer and diffusion of technology. In particular, these programs target technology absorption and innovation and aim at promoting the identification and introduction of new products, technology acquisition, partnerships, joint ventures, licensing/funding business premises, and business incubation.

Technology transfer programs also usually support large investments in R&D in research organizations and firms, especially SMEs. Very important to this purpose is the effort to bolster integration of value chain links, as well as the frequent use of public-private partnerships (PPP).

[3] The detailed results on each program can be found in the Annex:
http://host.uniroma3.it/docenti/pietrobelli/downloads.html

Selection of beneficiaries

Most (15 out of 16) TT programs identify the beneficiaries through a **bottom up** approach, with a competitive selection of the participants with the best potential impact given the level of public investment. Usually key selection criteria include: composition and extent of the co-operation of the target group, its financial capacity and complementarity with other projects of technological support to the region. In some cases a fundamental requirement is that SMEs are part of the grouping.

The advantage of this procedure is that during the programme implementation, it is possible to **delegate to a spontaneous (market) mechanism the selection of the most promising and competitive partners** for collaboration. This was the case of RAPID, Finland, where some companies developed their own projects and found partners quite independently: the majority of the projects were developed by research groups that saw a generic need in a given area and tried to generate industrial interest in it.

An indirect effect of this type of selection consists in forcing participants to implement a specific methodology. Thus, for example in BioRegio, Germany even the non-winning regions implemented the project concept, and this helped improve the performance of the biotechnology industry.

The small scale and narrow territorial focus of the RIS+ program in Tuscany (no.5) explain the **top down** selection approach.

Sectors

The method of selecting sectors notably varies: ex-ante selection tends to prevail when programs have a strong national strategic focus. This is the case of the ICIPC in Colombia, the NAIP in India, Jalisco cluster, Hard Disk Drive Cluster in Thailand, MSC in Malaysia, and BioRegio in Germany. The PDIT in Chile preferred a mixed approach, with part of the program itself consisting in identifying the key innovative areas to support.[4]

In turn, other programs preferred a horizontal approach attaching priority to selected functions, and leaving the choice of the sector to the beneficiary, and finally to the market. This is the case of RAPID, Finland, the VIS-TIS, Belgium, Thailand Science Park, TMPs, Argentina and the Centres of Excellence in Finland.

Most common type of measures

The most common type of measure contained in TT programs is the support to product development. Such programs aim at integrating the supply chain through the involvement of business organizations through (i) extensive utilization of IT support; (ii) application of prototyping techniques to support product development; (iii) consistent investments in training of human capital; (iv) strengthening of the institutional framework for competitiveness.

From these projects it appears that the creation of incentives for University-industry (U-I) collaboration represents a fundamental tool for effective TT, particularly at a regional level (on this see below).

[4] A large variety of sectors have been targeted in these TT programmes, including:

- agricultural innovation as for the India National Agricultural Innovation Project, the Cluster of Santa Fe, and the Chilean PDIT;
- biotechnology for the German Bio-regio and the TMPs in Argentina;
- cultural heritage for RIS+ in Tuscany;
- metal industry, ICT, digital technologies, for the Thematic Innovation Stimulation in Belgium, the *Programa de Modernizacion Tecnologica* in Argentina, the Centre of Expertise and RAPID in Finland;
- advanced materials for the Plastic and Rubber Training and Research centre in Colombia;
- ICT for Multimedia Super Corridor in Malaysia;
- Agro-Food, health, biotechnology, software, microchip & electronics, automotive parts, and textiles for the Thailand Science Park;
- IT, design, manufacture development, multimedia in the cluster of Jalisco.

#	Type of program	Prevailing stream of policy	Macro-category	Title of the program	Most notable features	Duration	Identif.of beneficiaries	Main actors involved	Budget	Strenghts and Weaknesses
1	TT	S&T	R&D/ EA	The India National Agricultural Innovation Project (NAIP), India	Focus on research projects in frontier agricultural science, strengthening of institutions' interactions.	2006-2012.	Bottom up	A consortium of stakeholders: research institutions and actors in rural areas	US $250 m: WB US$200 m as loan	
2	TT	S&T	CS/EA	Tekes Technology Programmes, Finland. Includes RAPID (#3) and NETS (#34)	Encourage innovation in the Finnish industry and services in areas defined on the basis of clear user need.	Since 1984	Bottom up		2007 budget: Eur 469 m	Success: More than 1,000 innovations in products, services and production processes. 700 patent applications, 1,000 research theses, 2,000 publications
3	TT	S&T	CS	RAPID, Subprogram of Tekes Technology Programmes (#2)	Improve product development process (link research to final markets)	1996-99	Bottom up	Research groups (mainly universities, i.e. Helsinki University of Technology).	Eur 27 m	Success: Economic targets fully reached (support of start up and innovative businesses). Largest investments by newly created companies in Advanced Engineering & Metalworking SMEs
4	TT	S&T (and RD)	CS/EA	Centres of Expertise in Finland	Attraction of investments and expertise for TT and research for high-tech industry, tourism, culture and environment.	Since 1994.	Bottom up	SMEs and micro-enterprises.	Eur 12.5 m per cluster for 2/3 years	Success: Active cooperation between universities, R&D institutions, companies and municipalities. Special focus on SMEs and micro-enterprises. Weaknesses: Lack of cooperation among CoEs continues to cause some overlapping of functions
5	TT	RD	CS/EA	RIS +, Toscana, Italy	TT from research centres to industry for high-tech opto-electronic products and innovative services in the field of cultural heritage and conservation	2000-02	Top down	Research centres conduct research and transfer results to industry	Eur 1 m.	Success: Good network approach among participants, creation of a cluster and a specific training course for technicians specialised in cultural heritage maintenance.
6	TT	S&T (and RD)	CS/EA	Thematic Innovation Stimulation (VIS-TIS), Belgium	Stimulate technology transfer between Flemish enterprises -in particular SMEs- and research institutions.	From 2002	Bottom up	Consortium of mainly Flemish companies	Eur 8 to 10 m. per project	Success: successful for sectors with a tradition of research cooperation. Weaknesses: Difficult for new sectors or without experience of cooperation in research
7	TT	S&T (and RD)	CS/EA	BioRegio, Germany	Concentrate research funds in a limited number of regions to support biotechnology	1995-2003	Bottom up	4 (out of 17) regions won the award	Eur 90 m for each winning region	Success: Big increase in creation of companies and thus, of jobs,and private sector co-funding. Very clear motivations and straightforward goals
8	TT	S&T	CS/ EA	Programa de modernizacion tecnológica II (FONTAR)	Foster TT and R&D cooperation. Within a comprehensive National Innovation System approach	1999-2006.	Bottom up.	Enterprises and collaborative R&D projects.	US$ 280 m. IADB share: US$ 140 m	Success: IADB's monitoring system acknowledged satisfactory results, but learning capability still needs improving. Firms getting non-reimbursable grants (ANR) increased their innovation intensity after the subsidy
9	TT	S&T	CS/ EA	Programa de modernizacion tecnológica III (FONTAR) Argentina	Foster TT and R&D cooperation. Additional focus on cluster development	2006-09	Bottom up	Enterprises and R&D organizations	US$ 510 m. IADB share US$ 280 m.	

Source: own elaboration. List of abbreviations: **Prevailing stream of policy:** *S&T: Science & Technology, RD: Regional Development, EnD: Enterprise Development. **Macro-category:** *EA: Engagement of actors, CS: Collective services, R&D: Large scale collaborative R&D.

#	Type of program	Prevailing stream of policy	Macro-category	Title of the program	Most notable features	Duration	Identif.of beneficiaries	Main actors involved	Budget	Success and Weaknesses
10	TT	RD	CS/ EA	Competitividad del Cluster Provincia Santa Fe, Argentina	Focus on agricoltural exports through regional governance mechanisms. Effort to extend successful approach around the municipality of Rafaela.	Since 2006.	Bottom up	Municipalities and private sector in Santa Fe	US$ 1.9 m	
11	TT	S&T (and EnD)	CS	Programa de desarrollo e Innovación Tecnológica PDIT, Chile	Identify and concentrate financial resources in key innovative sectors, within enterprises or PPP	2001-06	Combination of both	Enterprises and PPP	US$ 200: 50% from IADB, 50% from Central Bank of Chile	Success: Selectivity in S&T areas. Strong institutional framework. Creation spaces for inter-institutional interactions.
12	TT	S&T	CS	Instituto de Capacitación e investigación del Plástico y del Caucho Colombia	Provide technology solutions to the plastic and rubber industry through networking with local and foreign research organizations, and support to R&D, laboratory tests, training, consulting	Since 1993	Top down	Private firms, laboratories and Research organizations	N.A.	Success: Highly qualified personnel and modern infrastructure, active networking programs. Close relationships with founding members and foreign industrial associations. Substantial R&D results (nine patents)
13	TT	S&T	CS	Multimedia Super Corridor (MSC) Venture Corporation, Malaysia	Focus on ICT industry. MSC Venture Corporation committed to raise new funds and become an international venture capital company.	Since 1999	Bottom up	Enterprises and research organizations	In 1999 US$31.6 m.	Success: notably in network creation and strategic partnerships
14	TT	EnD	CS	Hard Disk Drive Cluster, Thailand	Innovation and capacity building to sustain Thailand's international competitiveness. Key role of intermediaries to foster information and knowledge sharing	2003-13	Bottom up	Researchers and their organizations, SMEs and large enterprises		Success: Smooth collaboration with intermediaries and stronger institutional capabilities in linking firms/individuals to other actors such as universities, government and R&D
15	TT	S&T	CS	Thailand Science Park (TSP)	TSP is a hub for R&D in S&T. Its mission is to promote innovation and R&D in the private sector and create R&D manpower	Since 2003	Bottom up	Researchers and their organizations, SMEs and large enterprises		Remarkable hub for R&D in S&T. Its missions are to promote innovation and R&D activities in the private sector and to develop a critical mass of R&D human resources for Thailand. Main activities are: Joint & Contract research
16	TT	S&T	CS	Programma Estatal de Ciencia y Tecnología del Estado de Jalisco	Encouraging cluster development through: training of human capital, incubation/acceleration, software/multimedia; and IT integrated supply chains	2001-06	Bottom up	local firms, Universities, reserach and training organizations, business associations	US$ 15 mill. (approx)	Strong contribution to the creation of a high-tech cluster in Jalisco - 31 design centres, 150 programming firms and 500 providers. Good training of human capital for MNCs. Some spin-offs from MNCs.

services, R&D: Large scale collaborative R&D. However seldom frontier R&D and patents

Macro category of Interventions

All the TT programs considered, except NAIP India, that supports research projects among firms and research organizations, intervene to promote collective service provision and sometimes actors' engagement.

Weaknesses

- The **poor definition of objectives** or the ambition of targeting all the objectives simultaneously, **without the necessary prioritization** is common to most programs, also in the more technologically advanced countries, and has sometimes represented a serious **obstacle** for the success of these programs. NAIP, India represented a counterexample, setting among the eligibility conditions a well defined and binding common plan of work.
- the NAIP program, India, suggests that in order to alleviate the **lack of linkages between the public and private sector** the implementation of **stakeholders' consortia** may help, with partnerships among the participants in using knowledge, setting priorities, experimenting and developing technology.
- Business-research organization collaborations are often hard to achieve. Appropriate incentives are often necessary (e.g. RAPID, BioRegio, TMPs, where collaboration was often mandatory);
- Difficulties in producing **innovation in completely new sectors** (e.g. VIS-TIS, Belgium).

Strengths/Results

- the CoEs, Finland and the PDIT, Chile programs underline the importance of **leveraging and integrating already existing S&T and financing instruments** (i.e. funds, programs, infrastructures) instead of creating completely new ones. This avoids waste of resources and duplications;
- good examples of **private sector involvement** are given by the RAPID and CoEs, Finland and the RIS+, Italy. In particular the RAPID program chose to match individual companies to specific projects, rather than matching them to the entire program. Generally the key success factor to create a real commitment from the private sector is the ability to offer concrete outputs for a specific market with specific technologies, as well as the presence of effective industrial associations capable of defining and expressing the private sector's collective interest;
- **Collaboration among programs stakeholders does not occur automatically** and cannot be left to their spontaneous initiatives. The CoEs program in Finland foresaw and fostered the creation of a "competence cluster" with the specific objective of intensifying the cooperation between centres of expertise and of enabling the more efficient use of national expertise scattered in different regions. In particular, in redesigning business processes towards more collaboration-oriented practices there have been some very interesting results. For example, in one case the networking and 'outsourcing' were taken to their extreme and only the innovation process was left within the original company; in the same line is the Hard Disk Drive Cluster, Thailand, that owes much of its success to the role of intermediaries in that they stimulate information and knowledge sharing, and build trust among participating firms/individuals within the clusters.
- **Adaptation of external technologies** has been remarkably useful in several instances, e.g. the ICPC, Colombia, searched for existing foreign technologies and adapted them to the needs of local enterprises thanks to a strong collaboration with foreign research institutions and industrial associations;
- **Venture capital** funding with focus on a specific sector has often played a strategic role. This is for example the rationale of MSC Venture Corporation, the premier venture capital firm in Malaysia, specialising in funding innovative companies in the ICT industry. Its parent company, Multimedia Development Corporation (MDC), develops and manages Malaysia's Multimedia Super Corridor (MSC). Together, they offer not only long-term financing but also strategic advice. Drawing on the MSC's global links, they have established international relationships and strategic alliances with numerous well-known venture capital companies in the world.
- **Provision of suitable research infrastructure** (research centres, technological hubs, etc.) to the business sector has often been very relevant. This is the case for example of the Thailand

Science Park, with its incubators providing space, shared equipment, business advice, and access to capital.

4.2. Programs with a Clear Focus on the Territory

General description and main common features

Although these programs have a clear territorial dimension, they often also encompass a systemic approach and a focus on innovation (see diagram 1). Typical features of this kind of programs are:

- **strong geographical focus** at a national or regional (local) level;
- **interaction** among research organizations and skilled local private and public actors (triple helix) to exploit the spillovers and networking advantages of a systemic approach;
- **institutionalization of linkages among participants,** especially useful when coordinating large amounts of resources and projects in different regions;
- **technology transfer** activities;

Selection of beneficiaries

Most of these programs select participants (enterprises, especially SMEs, or most frequently consortium of enterprises, industrial research laboratories, innovation centres/parks, representatives of municipalities and of the industrial sector, or regions) through a **bottom up** approach. Participants are usually asked to present a project proposal to participate in a competitive selection, that is then carried out by a steering committee of the agency in charge. This process requires a well-planned and authoritative evaluation process, and may bring the following benefits: higher quality of projects, funds are allocated to the projects which are judged to have the best potential for growth, initiatives tend to be regional and local. A good example of this approach is given by the ARENA program, Norway, that has a flexible selection procedure that foresees different entry steps.[5]

Less frequently programs adopt **a top down** selection mechanism. This is the case, for example, of the NCR Technology Cluster, Canada, and the METI in Japan, that foresee discussion with clusters' stakeholders and then informal assessments of potential complementarities with the NRC.

Sectors

Sectors tend to be specific to the territorial context where the program operates. In fact we have:

- advanced mechanics, environment, agro-food industry, building and construction; life sciences and health; organisational innovation and ICT for Aster, Italy;
- In Canada each region specializes in one sector;[6]
- Seafood, tourism, sea farming, gas, environment and energy, weight materials and ICT in the ARENA Innovation Norway program;
- biomaterial to applications and innovations, steel industry, fibre optic and health in the VINNVÄXT - Regional growth through dynamic innovation systems, in Sweden;
- Energy, ICT and biotechnology in the Innovative Business Groupings Programme (AEI) of Spain;
- Ceramic and textile industry in the Santa Catarina clusters in Brazil;

[5] *Entry A (Assessing own needs),* if the project idea is at an early stage, development beneficiaries are helped to conduct the preliminary study; *Entry B (Design of draft project)* when the idea shows already a development potential with documented interest of the relevant participants; *Entry C (approval/implementation of the project)*.

[6] IT and e-Business in New Brunswick; life sciences in Nova Scotia, nutrisciences and health in Prince Edward Island, Ocean Technologies in Newfoundland and Labrador, Fuel cell and hydrogen technologies in Vancouver, Nanotechnology in Edmonton, Plants for health and wellness in Saskatoon, Sustainable urban infrastructure in Regina, Biomedical technologies in Winnipeg, Photonics in Ottawa and Aluminium transformation in Saguenay.

N.	To P	Policy stream of policy	Macro-category	Title of the program	Most notable features	Duration	Identif.of beneficiaries	Main actors involved	Budget	Strenghts and Weaknesses
17	TF	RD	EA/CS	ASTER, Italy	Strengthening linkages between enterprises and research institutions to foster research and innovation.	From 2005	Bottom up	Mainly enterprises	Eur 383.7 m., of which Regional Gov.t Eur 158.2 m.	Success: Great success in creating linkages between industries (especially SMEs) and research. Substantial job creation.
18	TF	S&T (and RD)	EA/R&D	NRC Technology clusters, Canada	promote clustering and focus on science-based innovation	Since 2000	Top down	NRC receives five-years funding from Federal Government	approx.US$ 506 mill. invested by Jan.2000.	Weaknesses: Limited networking between NRC and other federal and provincial public entities
19	TF	RD	EC/CS	GA-networking, Germany	a negotiation tool between the Federal level and the lagging new Länder for funding. The program coordinates the financing for the different German regions.	Since 2005-ongoing	Bottom up	Representatives of the Laender institutions.	from Eur 0.3 to 0.5 m. per cluster network	Success: incorporates finance for cooperation and cluster management within the wider framework of funding agreements between the Länder and the Federal governments.
20	TF	RD (and S&T)	CS	ARENA - Innovation in Networks Norway	Strengthen linkages between public research and private industry especially for SMEs. Includes mobility and exchange of personnel	2002-10	Bottom up	targets enterprise groups in partnership with research organizations coordinated by NRC	approx.US$ 6 m. in 2004	Weaknesses: neglected need of a longer term perspective for cluster development, and acknowledge the level of social capital and innovation culture.
21	TF	RD (and S&T)	CS/EA	VINNVÄXT, Sweden	"triple helix" cooperation to develop innovation in selected winning regions. Long term perspective	2001-13	Bottom up	Mainly companies working with universities and other organizations	Eur 32.5 m.	Success: VINNVÄXT winners are performing well with good potential for future growth. Good collaboration among regional actors. Research useful for business sector.
22	TF	RD	AC/R&D	Innovative Business Groupings Programme (AEI), Spain	triple helix cooperation -expecially with SMEs- Generation of innovative clusters	Since 2007	Bottom up	Consortium of cluster stakeholders	Eur 1 m. per Region	Weaknesses: Modest cooperation within the "triple helix". The high number of proposal - many of which rejected - was not efficiently managed by the commission
23	TF	ED	EA	Santa Catarina Clusters, Brazil	Clusters with local, private and associational mode of governance (Cooke, 2003)		Bottom up			

Source: own elaboration. List of abbreviations: Prevailing stream of policy: *S&T: Science & Technology, RD: Regional Development, EnD: Enterprise Development. Macro-category: *EA: Engagement of actors, CS: Collective services, R&D: Large scale collaborative R&D

- the productive cluster in Mendoza is based on seven *productive "circuits"* that represent the province's most important economic activities, including industrial production, tourism, petrochemicals, farming, and farmer tourism.
- the GA networking does not focus on sectors but instead on the financial mechanism to support the wider framework for central-regional funding. It is then each region, within its specificities, that defines the areas of intervention.

Selection Process

The technology clusters in Canada adopt an **ex-ante selection** of intervention areas, consistent with the country's expressed priorities for innovation and S&T development. The same holds true for the Jalisco cluster, following the explicit government strategy to improve private companies' competitiveness and their integration in export chains. Most other programs prefer a **horizontal** approach. For example, the GA-Networking has the specific function of managing funding distribution, in order to prevent excessive competition between the Länder in the provision of the regional aid.

Most programs last 5 to 10 years. For example, in the Arena program, a project takes a year for the initial stage, before getting funded for a main project that typically lasts three years. A project may then apply for further funding for two additional years.

Most common types of intervention

This is the type of programs that, more than all the others, encompasses all the three RIS concepts (territory, systemic approach, and innovation). They typically include a collective engagement of actors, or alternatively a research project or collective services provision. Programs of this kind typically set specific **incentives to create structural relationships** (**"institutionalize")** among partners enhancing the generation of a credible and stable cooperation framework, often with the creation of a formal agreement. The main cross-cutting aims include: enabling knowledge providers to become more active partners of the business community, assisting the administrations and agencies involved to adopt a more active and coordinated approach for innovation, helping to promote systematic learning about innovative processes and the development of business communities.

The RIS is usually supported by these programs either focusing on research activities (e.g. VINNVÄXT, Sweden, AEI Spain, Jalisco Cluster) or on technology transfer (e.g. Arena, Norway, Santa Catarina, Brazil), or both (e.g. Aster, Italy; Technology Cluster Canada). Relevant activities to this aim often include: the strengthening of S&T infrastructure that needs to be useful not only for research institutions but also for the private business sector (i.e. laboratories, centres, technological parks); training of human capital through specific programs and grants for PhDs; the strengthening of the demand for industrial research through the establishment of research programs with universities.

Beneficiaries

Typically beneficiaries are groups of enterprises in partnership with research institutions and the administration of the regions. For example, in the GA-Networking, Germany, beneficiaries have to create a consortium that must include at least the three types of partners. The same applies to the Santa Catarina Brazilian cluster, where firms need mandatory membership of the industry association.

Weaknesses of these programs

- According to a project evaluation, Technology Clusters in Canada achieved an insufficient level of networking between the NRC and other federal and provincial public entities involved in business development.
- The Program of Knowledge Regions (AEI, Spain) appears to have achieved a scarce private sector involvement. Many participants suffered from failing to formulate complete and coherent research proposals with an adequate budget, causing a high share of refusals.

Strengths/Results

- The ASTER program in Italy focused on **promoting only additional innovation** activities. This was facilitated by the coherence pursued across the different levels of government, requiring participants be linked to the Emilia Romagna *Regional Programme for Industrial Research Innovation and Technology Transfer*;
- **Specialization** has often been a fundamental characteristic for a program to be effective (e.g. Technology Clusters in Canada). This was taken to almost an extreme, as the very same Government decided productive specialization through a top down approach, with each region targeting one specific sector. The GA-Networking program, Germany, has actually represented a negotiation tool for central-regional funding mechanism negotiations, with the target of enhancing specialization and avoiding duplications and useless competition between the regions.
- **Local private actors coordination** is essential and may be fostered by effective business associations (e.g. Santa Catarina, Brazil). In general, the cluster governance needs to be based on private-led actions to build inter-institutional cooperation as a governance mechanism (Cooke, 2003). In Santa Catarina, the private sector with its **business associations** (*sindicatos* and the Federation of Industries, local chambers of industry and commerce and their umbrella federation) have constantly adapted to the conditions of an open economy, reshaping the cluster actions according to the changes in the local and international context.
- **A longer term perspective is essential** when dealing with this type of programs. For example, the ARENA project in Norway chose to finance the planning and implementation of long-term projects that will be monitored through mid-term and ex-post evaluations.
- **A high share of co-financing by the private sector** is also desirable, and it was achieved by the ASTER program, Italy, given by the well-matching goals between research and business activities. The **density of networks** created by this program is remarkable.

4.3. Cluster programs

General description and main common features

Cluster program mainly refer to a group of enterprises of diverse sizes, sharing common complementary interests, and developing, on a voluntary basis, co-operative relationships. A cluster often includes also institutions, with which enterprises develop collaborations (Pietrobelli and Rabellotti, 2007).

This kind of programs usually put more emphasis on two of the three RIS elements, that is innovation and the territory. The manufacturing industry often represents the targeted sector of innovation programs within clusters. These programs typically focus on existing clusters with strong potential, and aim at improving the re-organization of production and interactions at the local level. Sometimes these programs also address the (indirect) target of fostering regional development and reducing regional imbalances.

Selection of beneficiaries

A variety of methods are used to select beneficiary clusters. Thus, for example, the BioRegio program adopts a self-selection bottom up approach through voluntary applications, whilst the Yorkshire Forward cluster network uses a combination of a top down and bottom up approach. In contrast, Technological Districts in Italy are selected with a top down process of strategic mapping. The METI project, Japan, also uses a top-down approach.

Conditions required for selection include the presentation of a well structured project, the coherence of the project with the strategic aims of national and regional S&T policy, the collaboration among different stakeholders from both public and private sectors, with often a leadership of industrial actors.

N.	To P	Policy stream of policy	Macro-category	Title of the program	Most notable features	Duration	Identif.of beneficiaries	Main actors involved	Budget	Strenghts and Weaknesses
24	CL	ED (RD)	CS/EA	Yorkshire Forward Cluster Network, UK	Targets development of the region through funding innovation in enterprises. Key business sectors are defined ex-ante, cooperation is mandatory	2005/2015	Bottom up and top down	Enterprises	Budget 2006/07: £354 mill.	Success: the program fully reached the targets set for economic activities (support of start up, etc)
25	CL	ED (RD)	CS/EA	InnoRegio, Germany	Targets innovation networks and clusters in lagging new Länder in Eastern Germany with support of EU structural funds. SME focus	Since 1999-ongoing	Bottom up	Länder SMEs and R&D institutions	Total annual budget Eur 110 mill.	Weaknesses: - modest coordination of research support activities; - scarce transfer of knowledge among economic actors. - modest "innovation" creation in the business sector
26	CL	S&T (RD)	CS/EA	Industrial cluster Program METI, Japan	Program aims at supporting endogenous development through horizontal networks (e.g. University-industry, industry-industry and cross-industrial collaborations in specific regions)	Since 2001	Top down	Business managers, engineers, researchers	From 2006 US$ 5 billions.	Success: Improved information flow - also on policy measures and support -, better technical support to SMEs. Weaknesses: weak collaboration with industry support organizations
27	CL	ED (RD)	CS/EA	Technological Districts, Italy	Focus on network building and engagement of SMEs in collaborative projects	Since 2004 .	Top down	Regions, SMEs	EUR 600 mill.	Success: Campania and Emilia Romagna more successful. Lombardy and Veneto also developed their law to support industrial districts. Weakness: Scarce diffusion of the program
28	CL	S&T	CS	Tsukuba Research and Academic City (TRAC), Japan	The oldest Science park in Japan, to address problem of Tokyo serious urban congestion in the 1960s	Since 1965	Top down and bottom up	Research institutions and enterprises.		Success. creation of new research jobs. TT between academia-industry not so successful, required additional incentives to enhance cooperation with private sector
29	TF	RD	EA	Desarrollo productivo y competitividad en Mendoza Argentina	Targets training of HR, public infrastructure, credit for technology cluster support	Since 2005	Bottom up	Consortium of cluster stakeholders	Step 1: US$ 116 mill.; Step 2: US$ 83 mill.	
30	CL	ED	CS	Programa de desarrollo de cadenas productivas para la promoción de MIPYME exportadoras en Guanajuato, Mexico	Targets productive and export development					
31	CL/TT	S&T	CS	Centro de Innovación Mexicano y Fondo Venture Capital para alta Tecnología en Guanajuato, México		Since 2008	Top down and bottom up	Enterprises, local stakeholders, research institutions	MVCF: US$ 20m	
32	CL	S&T	CS	Cluster de TIC en Recife, Porto Digital	Porto Digital created by public initiative - a cluster with focus on software development and ICT	Since 1999-ongoing		Enterprises, local stakeholders and research institutions	R$ 33 million	

Source: own elaboration. List of abbreviations: Prevailing stream of policy: *S&T: Science & Technology, RD: Regional Development, ED: Enterprise Development. Macro-category: *EA: Engagement of actors, CS: Collective services, R&D: Large scale collaborative R&D

Most common types of intervention

All of these program are classifiable mainly as collective services provision and offer S&T and advisory service to support the creation and diffusion of innovation for the productive sector. To a lesser extent they also include engagement of actors initiatives.

Strengths/results

- **Due consideration of time and of the lengthy process of cluster strengthening** is necessary. The METI program in Japan rightly adopted this approach, and was also helped by monitoring and evaluation activities to adapt the approach over time.
- **Private-public partnerships and mutual involvement are crucial** for the success of this kind of interventions. The example of Porto Digital (PD) in Recife is illustrative in this regard. Porto Digital was created by a public initiative of the *Secretaría Estadual de Ciencia, Tecnología e Meio Ambiente (SECTMA)* with close collaboration with the private sector. A cluster with specific focus on software development and ICT was created, having also a broader objective of enhancing social inclusion and urban restructuring (Bercovich and Suassuna, 2008).
- **Business incubation** is a tool that has proved useful in some experiences. In Porto Digital it represented the most important factor for success. The *Núcleo de Gestão do Porto Digital* (NGPD) has been in charge of the management of the initiative and of the public policy within IT sector, and at the same time has acted as a service centre and a networking hub for the cluster's stakeholders. NGPD has also worked on technical cooperation and technology transfer agreements, and encourages integration between companies.
- The presence of multinational corporations (MNCs) may foster cluster development. This proved true in the Jalisco cluster, Mexico, where MNCs face harsh competition in a market that requires highly trained human capital, and they got involved in a long term strategy of human resources development within the cluster.

4.4. University-Industry linkages

This type of programs are usually characterized by the presence of two of the three RIS elements (diagram No.1): a systemic approach and a strong focus on innovation. Moreover:

- incentives to boots linkages between research organization and firms through large scale collaborative R&D are often present;
- development of the research infrastructure, a highly qualified workforce and an innovative culture are of crucial importance.

Objectives/sectors

The objectives of this kind of programs vary considerably according to the country/region priorities, and they usually focus on cutting edge technologies or technologies with a potential contribution to structural change. Project documents typically mention: export diversification, competitiveness of the industrial sector, creation of a S&T industrial complex, improvement of the telecommunication sector.

The sectors involved include as varied sectors as optical packaging, nanotechnology, chemistry, wireless communication, ICT, Detection Technologies, biomedicine, bio-fuel, health, environment, security and space, food and agriculture for the Magnet program in Israel, electronics, electromechanical engineering, new materials, design and fashion, computer software, and biotechnology for the Technopolis program, Japan, chemicals, public administration, electronics, communications equipment, firm-related services for the FNDCT, Brazil, future wireless systems' architecture, implementation technologies and applications, broadband network technologies for NETS in Finland, and health, science, environment and phytosanitary for Uruguay Innova.

N.	To P	Policy stream of policy	Macro-category	Title of the program	Most notable features	Duration	Identif.of beneficiaries	Main actors involved	Budget	Strenghts and Weaknesses
33	UIL	S&T		Technopolis program in Japan	Favours contact between research and production. Government fosters attractiveness of the region to high-tech industries	Since 1983		Community, enterprises, academia		
34	UIL	S&T	R&D	MAGNET, Israel	Pre-competitive U-I cooperation program	Since 1994	Bottom up	Consortium	Annual US$ 60 mill.	Successes: Very efficient with a small staff. Effective speed from R&D to markets
35	UIL	S&T	R&D	NETS - Networks of the Future, Subprogram of Tekes, Finland	Boosts linkages between research institutions and companies - esp. in telecomms.	2001-2005	Bottom up	Finnish companies, universities and research institutes	Eur 260 m. - Tekes funding 103 m.	Success: Successful in research but less so at industry level. It privileged SMEs
36	UIL	S&T	R&D/CS	UY promoción de la innovación para la competitividad, Uruguay	Export diversification by supporting: the institutional framework, training of HR, TT and private sector innovation, R&D and mobility of researchers	2007-12	Bottom up	Rural community, business sector, research institutions	WB:US$ 26 mill.; Uruguay Gov.t US$ 5 mill.	
37	UIL	S&T (ED)	R&D	Incentivos Universidades-Empresas Fundo Nacional de Desenvolvimento Científico e Tecnológico (FNDCT, Brazil)	No reimbursable research support funds for joint research projects	Since 1999	Bottom up	Cooperatives, private/public firms with Universities	Public sector: US$ 158 m; private sector: US$ 130 m	Success: Evaluation by the IADB-OVE reports positive impacts on private R&D expenditures of beneficiary firms
38	UIL	EnD	EA	Alianzas Estratégicas y Redes de innovación para la Competitividad (AERI´s), Mexico	Aims at strengthening networking between industries and institutions to enhance the competitiveness the Mexican economy	Since 2007	Bottom up	Enterprises, research institutions, service providers	2007: US$ 3 m., 2008: US$ 4.7m	Success: Demand largely from SMEs.
39	UIL	S&T	CS	*Uruguay Innova* , within EC-Uruguay cooperation – National Indicative Program	Focus on R&D&I to improve exports and economic diversification	2007-2013	Bottom up	Research institutions, researchers and enterprises.	Eur 16 m for 2007-2009	

Source: own elaboration. List of abbreviations: Prevailing stream of policy: *S&T: Science & Technology, RD: Regional Development, EnD: Enterprise Development. Macro-category: *EA: Engagement of actors, CS: Collective services, R&D: Large scale

Common features

U-I linkages programs may support competitive or pre-competitive research by providing resources targeted to R&D. A necessary element is the presence of partnerships and collaborations between industrial firms and research organizations. All these programs regard large scale collaborative R&D. In fact, operational tools typically include measures to increase the stock of advanced human capital, technology transfer programs for the productive sector; and measures to promote technology diffusion.

Beneficiaries may include a consortium of commercial companies together with academic and research organizations (e.g. Magnet program, Israel)

Weaknesses

A weakness that is sometimes noticed is the limited effectiveness of research activities for the business sector. Thus, for example an internal evaluation of the NETS program in Finland documents great success in research activities, but much less in business-related areas.

Strengths/results

- Advanced technologies have been successfully developed in areas where **time-to-market**, and the generation of **new products and service prototypes** are especially necessary.
- The **large number of staff is not always a necessary condition for success**, as suggested by the Magnet program in Israel, that successfully dealt with a variety of programmes and projects with only a small staff. A key element for success is the synergetic collaboration between industrial companies and academic research groups.
- **Support from supranational research institutions** represents an important resource for TT and exchange of researchers (e.g. Uruguay Innova within EC-Uruguay cooperation)
- The **infrastructure for research** is also important to promote research-business interactions, as shown by the Technopolis programme in Japan.

5. Understanding the best practices. What do we learn?

Evaluations as a tool to understand and learn

Evaluations are the most useful tool to assess whether or not a policy or a programme has been successful. Indeed, they provide useful guidance on how the design and implementation of the different programs could be improved and replicated. There may be ex-ante, on-going or mid term, and final/ex-post evaluations. The evaluation methods also vary according, among other things, to the program framework and its rationale. Thus:

- if the program refers to a national **S&T policy** that sets priorities and targets specific drivers or economic outcomes (e.g. number job created/safeguarded, amount of investment of new created companies, number of business assisted to improve their performance, turnover and export levels), an ex-post evaluation illustrates to which extent they have been achieved;
- if the program is targeted to **specific sectors,** an evaluation may help to understand which types of measures are most suitable for specific sectors of intervention;
- finally, evaluations give an overall prospect of the performance of the measure in relation to its general objectives. In some of the cases analyzed we noticed for example a good performance in promoting innovation but few linkages between academia and industry, or otherwise good research results but scarce implementation of these in the private industry sector.

However, the main problem to our aims is that **evaluations are seldom available**, and if they are, they are **often short and not enough deep and structured** to allow a real assessment of the efficiency and effectiveness of the measure. Moreover, they hardly contain an analysis of the impact of the program, and they are rarely performed by independent evaluators. However, in absence of proper evaluations, additional sources may help in drawing some insights and learning from the different cases. Very important inputs in this regard are:

- the framework in which the program is applied,
- the program implementation and the analysis of the instruments entailed,
- the contextual factors that affect the program design and execution,
- the assessment of the so-called "innovation drivers" that according to the OECD (2001) definition are human resources, knowledge building and knowledge sharing and entrepreneurship – themselves intermediate inputs of a local innovation system.

Insights from the Programs Analysed and General Lessons Learned

1. **Clarity of motivation for the intervention** (at national as well as regional level). It has been observed that very often the targets of the program are not precisely defined.

Example: in the *Technology Modernization Program II in Argentina*, like in many other programmes, both the general and specific objectives made reference only to the generic concepts of firm efficiency and competitiveness. The clear and specific definition of the targeted goals is the necessary starting point of a well performing program, as it helps defining the funding levels and methods, the steps of the programme, the mode of selecting the beneficiaries, and so on.

2. **Specialization** of the program both in the definition of the **areas of intervention** and/or **of the specific functions addressed**.

Example: the Technology and Innovation Development Program in Chile and the BioRegion in Germany identified key technology sectors (e.g. IT, biotechnology, sustainable production and quality, and biotechnology). They both appear to have enjoyed great success, partly due to the clarity of motivation for intervention and to the straightforward definition of objectives.
Example: the CoEs in Finland set priority drivers, and the GA-Networking program in Germany had a specific functional role to serve as a negotiation tool for central-regional funding mechanism negotiations. This enabled reduction of duplications and of excessive competition between regions.

3. **Setting objectives consistent with the time frame of the program**. All the short term objectives should be conceptualized as operational tools *functional* to reach the long term objectives. In principle, the main advantage of implementing long term programs is that setting on-going relationship among the actors is eased. The evidence of such relationship beyond the funding period can be considered a sign of success (sustainability and impact).

Example: the *CoEs in Finland* is an example of a fixed term (6 years) government program, started in 1994 and replicated later. The present programs started in 2007 and it is supposed to end by 2013. Quantifiable targets to be reached by 2013 are set (e.g. share of joint project funding, share in all projects of nationally and internationally competed funding, creation of new expertise-intensive jobs and businesses, growth of exports). Together with these long-term purposes, the program defines short-term specific objectives, such as the number of innovations created, of new products, services, businesses, and the task division between regions to form internationally competitive centres of expertise.
Example: The *Promoting Innovation to Enhance Competitiveness* in Uruguay is a national program financed by the World Bank, with a long-term objective of export diversification through investments in new technologies, and consistent short-term targets like training of human capital, fostering new collaborations between the productive sector and knowledge institutions, and the support of a S&T Observatory.

4. **Public support** is of crucial importance as it plays several essential roles in the creation and strengthening of a RIS: (i) it finances and helps establish public goods that would not be provided otherwise (e.g. organizations such as agencies, specific S&T funds, research centres and laboratories that are directly involved in the knowledge generation and diffusion); (ii) it enhances a flexible and appropriate governance of the system setting the guidelines for the linkages and coordination between private and public organizations involved in the program (coordination failures often represented a major limitation in several programs analyzed); (iii) public commitment raises the credibility for the different stakeholders.

5. Importance of a **"triple helix" of university, industry and government**. This concept highlights the interaction among local institutions and private actors to create a favourable environment for the region's development and for the diffusion of knowledge. Continuous flow of ideas and knowledge are enhanced. A strong system of this sort may help avoid problems of adverse selection, moral hazard and duplications.

Example: the *GA-Networking* program in Germany highlights the role of institutions as intermediaries to guarantee flexibility, coherence and functionality of the system. Each Länder identifies the most prominent network as part of its regional funding strategy within the GA program. Thus regions, that have normally better information on the regional economic situation, collaborate with national institutions to identify the beneficiaries of the financing.

Example: The *ARENA* program in Norway is another remarkable example of good interaction and networking within a triple helix approach. The program is based on the recognition of a need to create and strengthen interaction among firms –particularly SMEs that constitute the core of Norwegian regional development- , knowledge providers and the public sector. This is enhanced through specific measures, including the mobility and exchange of personnel between companies and knowledge institutions.

Example: in *Porto Digital, Pernambuco,* the *Núcleo de Gestão do Porto Digital* (NGPD) was created to create, coordinate, and implement cluster programs. Its function has been especially notable for its ability to network institutions both at the local and the national level, and start creating a "system".

6. **Private sector engagement** in programs' design and implementation is a fundamental element of a successful RIS promotion programme. This engagement is crucial to ensure long-lasting partnerships and the necessary resilience towards unexpected market changes. The use of a bottom up selection procedure often allows the private sector to express its priorities and participate effectively. Incentive mechanisms are very necessary in this regard.

Examples: Many programs such *as Yorkshire Forward*, the *Thematic Innovation Stimulation*, introduced periodic training activities to stimulate innovation and collective research programs targeted at companies in a certain area.

The *CoEs* in Finland, for example, follows a model of management led by sub-regional councils that, among the other functions, serve as interface with the private sector as well as with the various levels of government to promote coherence. In fact private sector involvement –including co-financing – was a key success factor of CoEs.

The Regional Network for Industrial Research, Innovation and Technology Transfer in Emilia-Romagna (*ASTER*), whose specific mission is to strengthen linkages between enterprises and research institutions in the field of research and innovation, achieved a large degree of private sector participation. The institutional/legal framework played an important role, with the Law no.7 and its implementing programme PRRIITT (Regional Programme for Industrial Research Innovation and Technology Transfer), issued in 2002 that formalized the objective of networking of institutions and enterprises, and put ASTER in charge of coordinating the private sector's partners involvement.

In the *Santa Catarina Clusters* the involvement of the private sector in the textile cluster has been remarkable, and mainly through the action of the industry association (*sindicato patronal*) and its mandatory membership.

The *MAGNET Programme* in Israel has had a very effective method to involve the private sector in pre-competitive R&D. Specific Consortia have been created. These Consortia are based on active cooperation of *industry business*, *engineers* and academic *researchers* that cooperate to develop basic innovative technologies for new product lines. The innovations developed may be exploited also by members of the same industrial sector organized in "users associations".

7. **Coherence and utilization of local assets and measures**. Programs need to be coherent and possibly linked with the already existing measures, centres and institutions, thus avoiding duplications and overlapping.

Examples: According to a recent evaluation report, the *Technology and Innovation Development Program (PDTI)* in Chile succeeded in utilising already existing financing instruments instead of

proposing completely new ones. The *Yorkshire Forward Cluster Network* program also managed tyo integrate various programs.

Example: in the Guanajuato Cluster in Mexico, the program *Centro de Innovación Mexicano y Fondo Venture Capital para la alta Tecnología en Guanajuato* (launched in 2008) continues and is consistent with an earlier program called "*Programa de desarrollo de cadenas productivas para la promoción de MIPYME exportadoras en Guanajuato*" and financed by the FOMIN/MIF for 3 years. This first programme aimed at developing production capabilities and efficiency in order to enhance export levels through sustainable production chains. It was followed by another programme more focused on innovation and high-technology.

8. **Cluster intermediaries** may play the useful role of stimulating information and knowledge sharing, and building trust among participating firms/individuals within the RIS.

Example: the Hard Disk Drive Cluster in Thailand, with the International Disk Drive Equipment and Materials Association (IDEMA), and with the Board of Investment (BOI), focusing on complementary long-term issues, like capability development and human resources. In contrast, the *Technology Clusters of Canada* demonstrated insufficient networking capability between the National Research Council and other federal and provincial public entities involved in trade and investment sectors;

9. **Entering into new sectors or strengthening existing traditional ones?** Entering into new sectors and new areas of business poses completely different challenges from strengthening existing sectors. Some evidence suggests that perhaps a catching up is easier also for RIS than a world leader strategy, as technologies are already available internationally and need to be adapted locally.

Examples: The *PDTI* proved successful in diffusing biotechnology and ICT in Chile, exploiting international best practices. The *Plastic and Rubber Training and Research program* (ICIPC) in Colombia helped create high technological capacity in these sectors by searching for existing foreign technologies and adapting them to the needs of local enterprises. Other less successful examples of investments in new economic sectors are the *NETS* program in Finland and the *Thematic Innovation Stimulation* of Belgium, where there have been some difficulties in promoting sectors new to the country.

10. **Importance of R&D cooperation**. The existence of prestigious research organizations in the region collaborating with the private sector enhances the probability of success of the initiative to promote a RIS.

Examples: in *Porto Digital,* Brazil, the Informatics and computer-science department of the Universidade Federal de Pernambuco (UFPE), with its excellent reputation has often been considered a good partner by local companies. This proved true also for the *Technopolis* program in Japan.

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