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ISI

Efficient Technological Linkages between Academic Institutions and Industry

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The Role of EC Investment in Promoting R&D Capability
and Technological Innovation in Eastern European Countries:
Scientific Goals and Financial Instruments

1. Philosophies underlying technology transfer activities

Western countries have developed different strategies and policies to establish efficient linkages between academic research and industrial application. In a perfect market economy we expect natural intensive linkages between these two systems, mainly generated by the mobility of researchers. In reality, however, we observe barriers of various kinds (institutional, motivational, financial). Thus the real situation quite frequently makes industrialists, researchers and politicians complain that the existing linkages are suboptimal, and that they should be organized more systematically and efficiently. Public actions are requested, which should contribute to achieving different goals, in particular:

- to create economic wealth from research, an argument put forward by those responsible for funding or performing research at universities and public laboratories;

- to generate and maintain a productive, flexible, creative and highly qualified technology and competence base which can be effectively used by industrial companies. Such arguments are heard quite often from those responsible for the competitiveness of companies and regions,

- to provide a solid and secured access to new commercially promising technologies, this position is heard quite often from representatives from smaller countries or smaller firms.

Arguments of this kind have led public sector actors - at all levels from municipalities to the CEC - to initiate and support linkage structures and organizations of various kinds.

A closer look at the variety of goals and rationale of such public actions reveals

(1) that the goals are often not explicitly stated or operationalized, and as a consequence, such programmes are very difficult, if not impossible, to evaluate.

(2) Public actions are not consistent with major policy goals (especially with those of science policy or of industrial policy)

(3) The main rationale for specific forms of public action is often reference to actions abroad ("the USA, or France, or the UK, have it; so it must be efficient").

As a result, policies to facilitate the linkages between academic research and industrial applications have been implemented in all industrialized countries. They differ in goals, rationale,

scope, and form as well as in the instruments applied and the actors involved.

If one tries to compare the underlying conceptual models of public policies in this field, different approaches become apparent. This becomes evident if one looks at three fundamental aspects where alternative orientations have resulted in the implementation of structures and organizations with different degrees of efficiency.

A **first dimension of conceptual orientation** is based in the different forms of knowledge and know-how which have to be transferred from academic institutions to industrial companies.

At the beginning of the seventies, technology transfer agents and public policies addressed above all the **results** emerging from public research centres, which were mainly manifested in the form of research documents (research reports, books and articles) and property rights on inventions. Large databanks on research documents (in the USA), licence agencies (such as the NRDC in the UK or ANVAR in France), and research/industry liaison units were set up with the help of national governments.

In recent years, the focus of public policies, in particular in some smaller countries and in Germany, has shifted towards the utilization of the technological **competences and capabilities** of the researchers and engineers.

Document related technology transfer activities are less **efficient** than competence related activities, because they are associated with much higher transaction costs on the side of the user, i.e. cost of

- searching an appropriate supplier or broker of technology
- specifying the problem and the task of the supplier or broker of technology, i.e. the costs associated with problem diagnosis
- assessing the cost/benefit ratio of using a (specific) supplier or broker of technology
- providing specific information to the supplier or broker of technology
- controlling quality and confidentiality of the supplier or broker of technology
- translating the availibility of new technology into company action.

A **second conceptual distinction** relates to the "value" ascribed to the differences between supply push and demand pull. The rationale for supply oriented technology transfer activities is focussed on the results of public R&D, especially with respect to their direct applicability in industry. An extreme interpretation, which can be found among the advocates of the French concept of "valorization", compares publicly funded R&D results to a gold mine, which can be exploited by "explor-

ing", "digging", "transporting to the surface", "extracting" and "processing"; a process which is seen to be associated with high profit expectations. With this concept in mind, to "waste" something of high value by not realizing its price on the market should not be acceptable to society and the state, as all the costs have been borne by the taxpayer. As a consequence, the emphasis is on a supplier guided identification, assessment, and marketing of "promising" research results, and on their transformation and adaptation to meet industrial needs. In essence, this concept is **a supply push concept.**

Alternative approaches, which are more common in other countries, focus on **demand pull** or on the mobility of researchers and engineers. Examples of demand pull policies include incentive schemes that facilitate a firm's acquisition of knowledge and know-how from any suitable external source (e.g. not only research centres, but also engineering companies) and in any appropriate form (e.g. not only research results, but also through "people transfer" and competent go-between services). Different degrees of mobility reflect differences in career prospects and wages as well as differences in cultural attitudes to work.

Preferences of public policies towards supply or demand-oriented concepts depend on

- the share of R&D carried out in the public domain, and especially the size of the funds spent on the development of large-scale technological systems (in the areas of nuclear power, aerospace, etc.) and on military research, and
- the level of mobility of researchers from public research establishments to industrial companies.

Demand led activities are more **efficient** than supply push activities, because they involve lower transformation costs, i.e. cost of adapting technological solutions to the specific needs and capabilities of the company, and also they allow the acquisition of technological resources from any possible source, also from other companies.

A **third conceptual distinction** is of an "instrumental" nature. Policies to facilitate technology transfer between public research establishments and industry are often based on one of two organizational models. These can be labelled

- the model of "**bridging**" public research and industry and
- the model of building an "**interface**" between public research and industry.

According to the "bridge" model, an emphasis on technology transfer leads to the pursuit of common goals for basic and applied research in **one** organization. Examples of this model are aca-

Personnel:	
employees	6,000
of which	
- are employed with a lmited work contract	2,000
- hold a university degree	1,500
- are doctoral students or student assistants	1,200

Table 2: **Personnel of FhG**

Finances (in mDM)	
total budget	750
of which	
- is spent on contract research which is paid for	600
- by basic funding from the government	180
- by contracts from industry	180
- by contracts from public bodies	200
- by public investment grants and other income	40

Table 3: **Financial Structure of FhG**

FhG is a fairly dynamic organization:

- There are high annual growth rates for its budget and personnel: between 10 and 20 per cent over the last 10 years.
- It is the springboard for an industrial career for many engineers: about 50 per cent of them leave after a couple of years to take over responsibilities in industry.
- The average fluctuation rate of researchers is 8 to 10 per cent p.a. As a consequence, two thirds of all researchers are under 40.

The following picture shows the position of a typical Fraunhofer-Institute (FhI) in the process of technological development. The type of work an FhI can engage in, its role and its mode of financing changes during the different phases of a cycle of technological development (as illustrated in table 4), lasting on average ten years:

(1) exploratory R&D: basic funding

(2) know-how accumulation: publicly funded R&D projects

(3) know-how transfer: R&D contracts with industrial clients

(2) FhIs act as partners in an R&D consortium with industry. Their opportunities have increased in recent years, as public R&D promotion has shifted from funding R&D projects in individual companies to the funding of collaborative R&D projects.

(3) Industrial companies detach researchers to FhIs, not only with the financial support of a corresponding federal programme, but also at their own cost.

(4) Each FhI has a supervisory board, which annually monitors its work and results. Representatives from industry play the major role on these boards.

(5) Researchers at an FhI often view their employment at FhG as being transitory, their next phase being planned as a career in industry. Compared with other research organizations in Germany, FhIs contribute a respectable number of spin-off companies to manufacturing industry.

5. Comparison

Within the last decade, most West-European countries have developed a differentiated system of public measures to increase the utilization of publicly funded or generated research results and of technological competence accumulated in public research establishments. On the one hand, these activities consist of bringing the forms and contents of public R&D promotion measures more into line with later utilization in industry. On the other hand, accompanying measures attempt to reduce and/or remove weaknesses and bottlenecks in the technological transformation process. In detail, these measures have the following main strategic orientations:

- to increase the transparency of available research results and the capabilities of researchers, and to facilitate access to them,

- to transform and adapt available results and capabilities in order to improve their "applicability",

- to strengthen the capacity of potential users to specify, assess, and absorb available results and research capabilities,

- to develop both non-commercial and profit-making services, acting at the interface between academic institutions and industry.

The two organizations presented try to develop links to academic institutions and to industry, partly in similar, partly in different ways:

- The "individualistic" approach of Steinbeis develops and supports a market for small scale know-how transfer projects, performed mainly by or under the responsibility of individual lecturers. Public Services, which would be performed anyway, are "valorized". In other words, an additional value is created, which can be "appropriated" by the "valorizors", and this also contributes to regional development and to the quality of academic teaching. Conflicts with commercial consultants are avoided if project size can be kept small.

- The "institutional" approach of Fraunhofer develops and supports a market for contract R&D, performed by institutes attached to Technical Universities. These institutes rely to a much lesser degree (than Steinbeis) on university resources, at least in financial terms. Links to Universities are essential.

- Both organizations transfer the knowledge and know-how accumulated not only via joint projects, but also intensively via mobility to industrial users.

- Neither Steinbeis nor Fraunhofer place emphasis on general transfer via technical documents, either as an input from the academic institutions, or as an output of their own work. However, both see the development and selling of technological competence as a crucial element of their respective organizations.

Neither interface organization has all the characteristics of private organizations, but their commercial orientation and their business like structures and procedures have been continuously developed. Both perform certain roles in the formulation and implementation of public innovation policies, which gives them the image of public organizations.

The description of their internal mechanisms and structures, as they appear today, would be not only incomplete but heavily biased without mentioning that the present profile of the two organizations, above all the Fraunhofer-Gesellschaft, has not been the result of a master plan, designed by intelligent policy makers. Rather, the historical development of the two organizations has been mainly a trial-and-error-process, combined with the taking up of occasional (political) chances.