

## **TECHNOLOGY WATCH: AN EMPIRICAL ANALYSIS OF THE TECHNOLOGY SUPPLY AND DEMAND IN EUROPE, IN RELATION TO TECHNOLOGY AND ORGANISATIONAL CHARACTERISTICS**

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### **ABSTRACT**

*Technology transfer* is the key mechanism for *technological innovation* which is of critical importance for the survival and growth of both small businesses (demand) and technology developers (supply). Central administration at regional, national and European level, devise technology development programmes aiming at both the research and the industry. Yet, the selection of technology sectors identified for funding by Central Administration is based on a "top-down" approach, while privately funded technology transfer agreements are driven directly by the needs of small and medium sized (SME) businesses ("bottom-up"). The scope of this paper is to identify what are the main characteristics of *technology supply and demand* in Europe in terms of technology sector, type of organisations involved and geographical distribution. To do so an empirical *technology watch* is conducted on a large sample, over 18000 of technology profiles (*technology offers* and *requests*) collected from the technology portfolio of the *Innovation Relay Centres (IRC)* in Europe, during the last 8 years. The analysis of the above data can indicate interesting trends in the technological capacity and needs of European SMEs, and, beyond its usefulness as a competitive intelligence tool for individual SMEs, it can provide information on the technological awareness of businesses overall and distinguishing sectors with high performance and future growth capabilities, for both the (technology) demand and supply side.

**Key words:** technology watch, technology supply and demand, technology transfer, small and medium sized enterprises' competitive intelligence tools, Europe

### **INTRODUCTION**

Technology Watch is a technique to recognize the main technological advances as they appear on the market, in order to detect opportunities and threats in a timely fashion (Davidson, 2001). It is one of several market intelligence tools utilised by companies, together with patent search, market survey, competition analysis, etc., aiming at a better mapping of the external environment of a company, while technology and

innovation audit are conducted so as to provide a better insight to a company's internal capabilities and skills.

The above mentioned techniques comprise a portfolio of innovation management tools and mechanisms available to companies – and small and medium sized enterprises (SMEs) in particular - in order to formulate their (inward and/or outward) technology transfer strategy and improve their competitiveness. Technology transfer in broader terms is the exchange of know-how between organisations through licensing or marketing agreements, joint ventures, co-development arrangements, training, etc. (Cohen *et al*, 2002).

During the last 12 years (1996-2008), Innovation Relay Centre (IRC) Network<sup>1</sup> (an initiative of the Innovation Programme launched by EC) has mediated in the achievement of more than 4000 transnational technology transfer agreements through three major brokerage tools: an internet distribution system of technology offers and requests, organisation of brokerage events (partenariats) and organisation of company missions.

The collection and analysis of the IRC network technology portfolio (technology offers and requests) distributed throughout Europe in the last 8 years of operation of the IRCnet provides on its own a unique technology watch tool that identifies the technology supply and demand in Europe, as this is generated by the technology providers and users themselves. The technology portfolio of offers and requests can be analysed per country of origin, technological sector, cooperation type sought, initiator (organisation type) and year.

The analysis of the above data can indicate interesting trends in the technological capacity and needs of European SMEs, and, beyond its usefulness as a competitive intelligence tool for individual SMEs, it can provide information on the technological awareness of businesses overall and distinguishing sectors with high performance and future growth capabilities, for both the (technology) demand and supply side.

At the same time, the technology supply (company and RTO capabilities) and demand (company needs) in Europe is contrasted for comparison and discussion with the technology sector oriented funding policies of the European Commission, implemented through its multi-annual Framework Programme (FP) for Research and Technological Development<sup>2</sup>.

## **METHODOLOGY, DEFINITIONS AND DATA COLLECTION**

The most direct way to assess the technological needs and capabilities of technology provider and user organisations (SMEs and Research and Technology centres – RTOs) is to ask them. However, such as venture would require a vast mobilization of resources, a dedicated questionnaire (not too heavy in order to respect the participant's time, nor too light in order to collect substantial information) and meticulous methodology to discount non reliable entries. The current empirical approach takes advantage of already expressed demand and supply of technology – in the form of technology

requests and offers – issued by enterprises and Research centres, not to satisfy the requirements of a survey but to identify business partners all over Europe.

This data collection has been made possible thanks to data available from one of the largest technology brokerage networks in Europe, the Innovation Relay Centre network (IRCnet). For the last 12 years IRCnet experts have been assisting firms and researchers to seek for business partners by providing match-making services. Technology providers (high tech SMEs and RTOs) have been assisted to submit their technology profiles (technology offers), professionally drafted so as to target better the demand side. Technology seekers (mainly SMEs) have been helped to identify suitable technological solutions to their problems by compiling technology requests, targeting the supply side. Over 200 brokerage organisations in Europe have been collectively working to disseminate this technology portfolio to as many recipients as possible, in order to achieve transnational technology transfer agreements, thus satisfying one of the EU innovation policy targets.

About 14000 technology offers and 4000 technology requests (submitted in the last 8 years) have been the sources of the present study. Each profile (offer or request) is structured so as to provide clear information on the technology on offer or demand, the organisation that submitted the profile and the potential partner sought, the technology and market sectors concerned, as well as the type of business cooperation the issuing organisation is willing to discuss with the potential partners. Each profile is described by an extended free text and is also classified using codification system agreed by all IRCs to allow for a unified and compatible information management system.

All technology profiles have been proof-read and quality controlled (by the experts of the IRCs and the IRC Secretariat) prior to submission and dissemination, thus allowing for a completely reliable, accurate and valid data set and avoiding problems of data reliability assessment that always exist in general surveys. (Alwin, 1989).

By monitoring of the technology portfolio of the IRCnet over the years, one may detect trends in technology and market sectors and compare them with national and European policy tools (funding mechanisms) developed by the EU to address the transnational technological cooperation, exploitation of research results and innovation issues. Such an approach is, practically, a technology watch exercise, which together with patent analysis and other market intelligence surveys contributes to Innovation Management, not only at a company level but at sector and policy-making levels too (EU, 2004 report on Innovation Management Techniques). The data required for this study have been collected from the IRCnet Secretariat and the Community Research and Development Information Service (CORDIS) – <http://europa.cordis.eu>.

## **RESULTS**

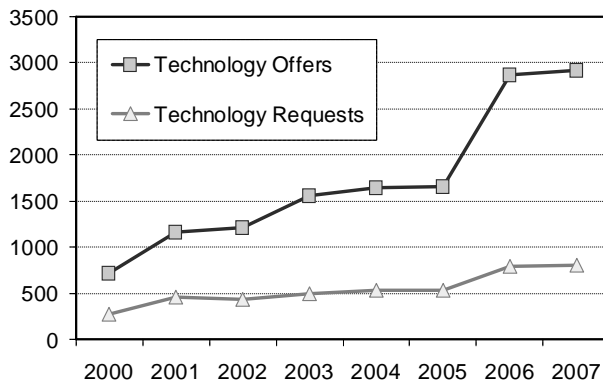
**The Technology Transfer (TT) Portfolio (offers and requests).** Over 14000 technology offers and 4000 requests have been distributed in Europe in the period 2000-2007. Over 50% of the activity comes from companies and RTOs in Spain, UK,

Germany, Italy and France. 75% of the activity stems from the EU15, while the new EU members (enlargement countries) account for the 17% of the activity. Associated countries (Chile, Iceland, Israel, Norway, Switzerland and Turkey) have contributed the remaining 8% of the technology portfolio. For the creation of this portfolio over 1000 technology consultants have been employed, providing their services in over 200 regions in Europe.

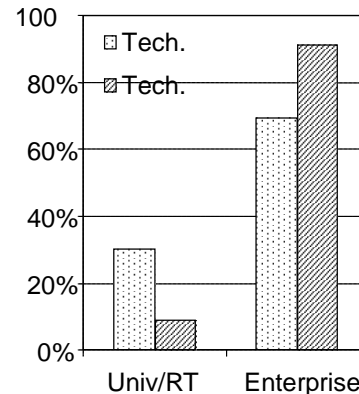
The TT portfolio (offers and requests) has been increased over 3 times since 2000 (from about 1000 contributions per year in 2000 to over 3000 in 2007) indicating an improvement of the productivity of the IRC network and its visibility in the technology market. The number of submitted offers is steadily triple the number of the submitted requests. The trend described above is also shown in Figure 1.

The majority of the offers (10000 or 70%) are submitted by enterprises and the remaining 4000 (30%) are submitted by Universities and Research centres. On the other hand the majority of requests are placed by private enterprises (3600, or 90%), and only 400 (10%) are placed by research and academic institutions (Figure 2).

**Figure 1**  
The Technology Portfolio (Technology Offers and Requests) Distributed in Europe (Including Associated Countries) by the IRCnet 2000-2007 (left)



**Figure 2**  
Distribution of Offers and Requests Per Issuing Organisation Type (right)



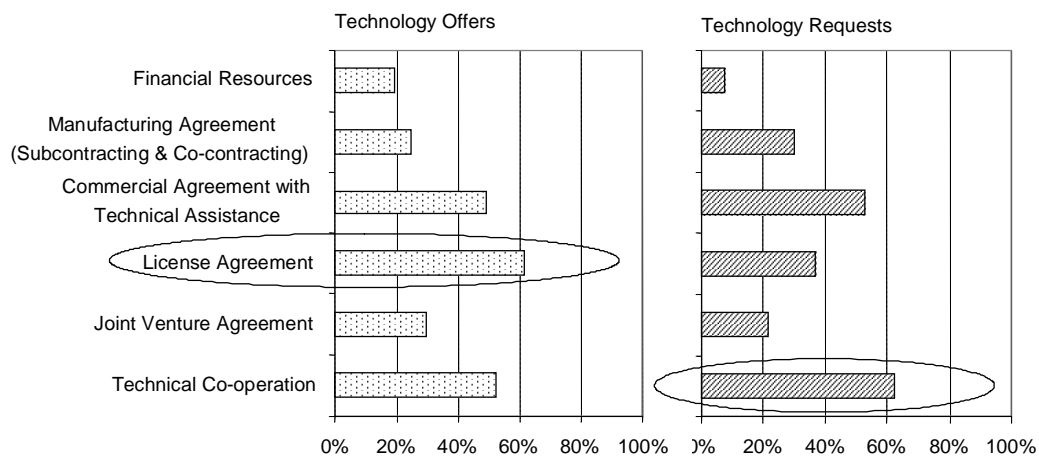
**Type of collaboration.** Each technology profile may propose more than one types of business cooperation (technical cooperation, licensing, joint venture, etc.). Technology providers prefer licensing agreement (62%) followed by commercial cooperation with technical assistance (52%), while technology seekers (end-users) prefer technical co-operation (63%) followed by commercial agreement (53%).

Table 1 (and Figure 3) presents the types of collaboration proposed by the issuing organisations in the IRCnet TT portfolio of offers and requests in the period 2000-2007.

**Table 1**  
**Collaboration Sought**

	Offers (14000) ↓	Requests (4000) ↓	Grand total
Technical Co-operation	7187	2706	9893
Joint Venture Agreement	4110	945	5055
License Agreement	8483	1600	10083
Commercial Agreement with Technical Assistance	6776	2281	9057
Manufacturing Agreement (Subcontracting)	3385	1299	4684
Financial Resources	2679	328	3007

**Figure 3**  
**Collaboration Type Sought in the Technology Offers and Requests (2000-2007)**



**Sectors concerned.** Each profile may concern more than one sector. Sectors are specified in each technology profile following the Venture economic industry codes and technology codes developed by the IRCnet. For the purpose of this analysis they have been regrouped in six major sector categories.

**Table 2(a&b)**  
**Distribution of Technology Offers and Requests Per sector and Technology Provider Type**

A. Sector	Offers by RTOs/Univ	Offers by Enterprises
Electronics, it and telecoms	1578	3231
Industrial manufacturing, materials and transport	2246	5861
Energy & Environment	961	2609
Biological Sciences	1412	1765
Agro & Marine resources & industry	650	1365
Social and economics concerns	134	301

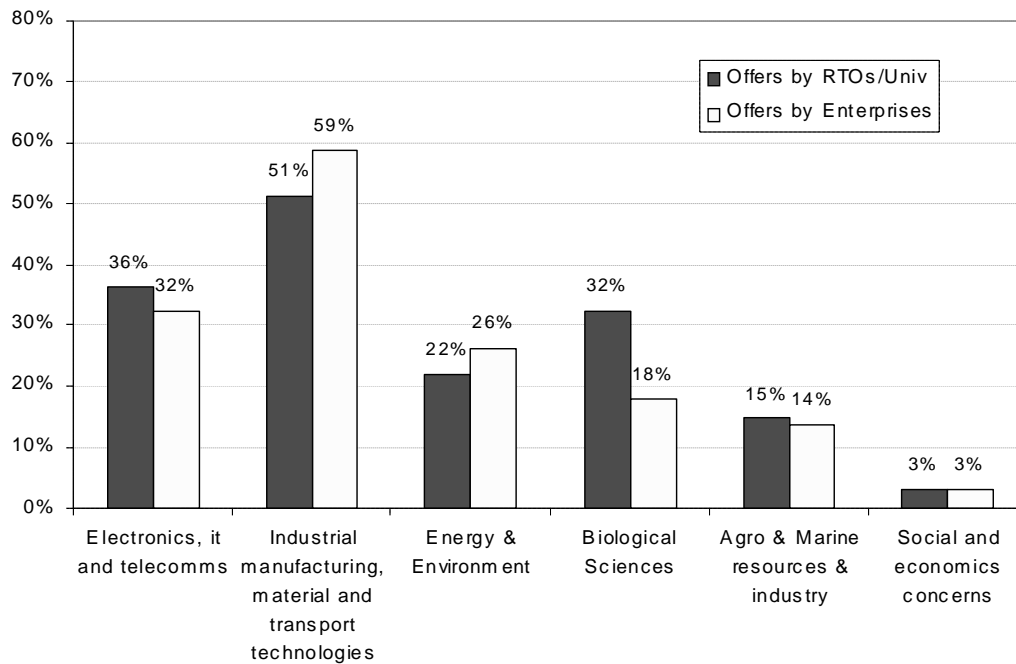
Most of technology providers (whether they are research organisation or companies) produce technologies addressing the sector of Industrial manufacturing, materials and transport, followed by Electronics, IT and Telecoms. Research and academic units exhibit significant activity in the Bio-science sector too.

B. Sector	Requests by RTOs/Univ		Requests by Enterprises	
Electronics, it and telecoms	182	49%	811	21%
Industrial manufacturing, materials and transport	260	70%	2829	75%
Energy & Environment	146	39%	959	25%
Biological Sciences	76	20%	497	13%
Agro & Marine resources & industry	66	18%	791	21%
Social and economics concerns	19	5%	38	1%

Technology requests are mainly submitted by enterprises. Most of technology requests submitted by RTOs and universities are practically concealed partner searches for collaborative research proposals (funded by the EU). The highest demand in expertise and know-how is in the sector of industrial manufacturing and materials (75% of industrial requests).

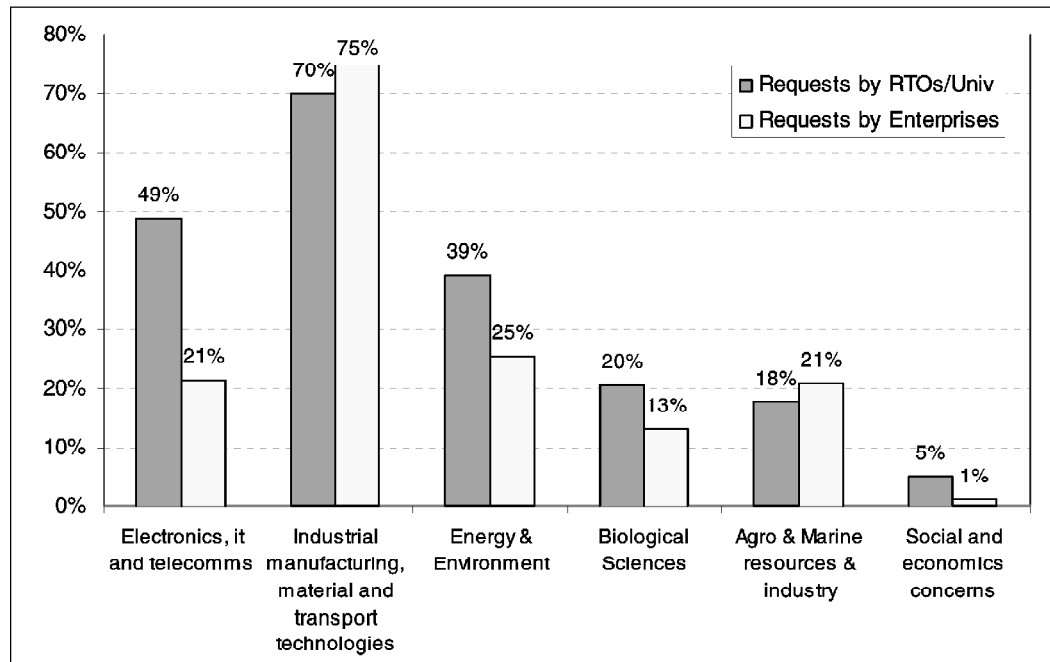
The technology supply and demand for both Enterprises and RTOs/Universities can be better visualized in the following charts (Figures 4 and 5):

**Figure 4**  
Sector Distribution of Technological Capabilities on Offer by Research Units and Enterprises



The pattern is similar for both research and industrial worlds with the exception of Bio-sciences where new technology is on offer mainly by Universities rather than from Industry.

Figure 5  
Sector Distribution of Technologies on Request (Demand) by Enterprises



Technological demand by RTOs and Universities concern mainly concealed partner searches for EU funded research proposals.

Figure 5 reveals that industrial and materials technologies are of primary concern by enterprises, followed by energy and environmental technologies, with electronics, IT and communications in the third place of interest. It is obvious that IT technologies are now available either "in-house" or "at the shelf", and enterprises are not in need of brokerage services to find solutions.

The above presented data identify quite clearly what European industry, and SMEs in particular, are in search or capable to offer, in what can be defined as "new technologies."

**Technology development public funding.** Since the early 80s, the European Commission has invested a large amount of resources in Research and Technological Development (RTD). It has established a Framework Programme which currently runs its seventh phase (FP7). Following continuous foresight, experts' advice and RTD players' opinion, collected through studies, surveys, debates and deliberations with national and European authorities, the EU selects thematic priorities and decides on the funding level of each priority. In the last 18 years the EU funding of the key thematic priorities has evolved in a manner displayed in Table 3, introducing some new topics and rearranging some of the thematic priorities. This information is

collected from the Community Research and Development Information Service (CORDIS) and is available to everyone through its public website.

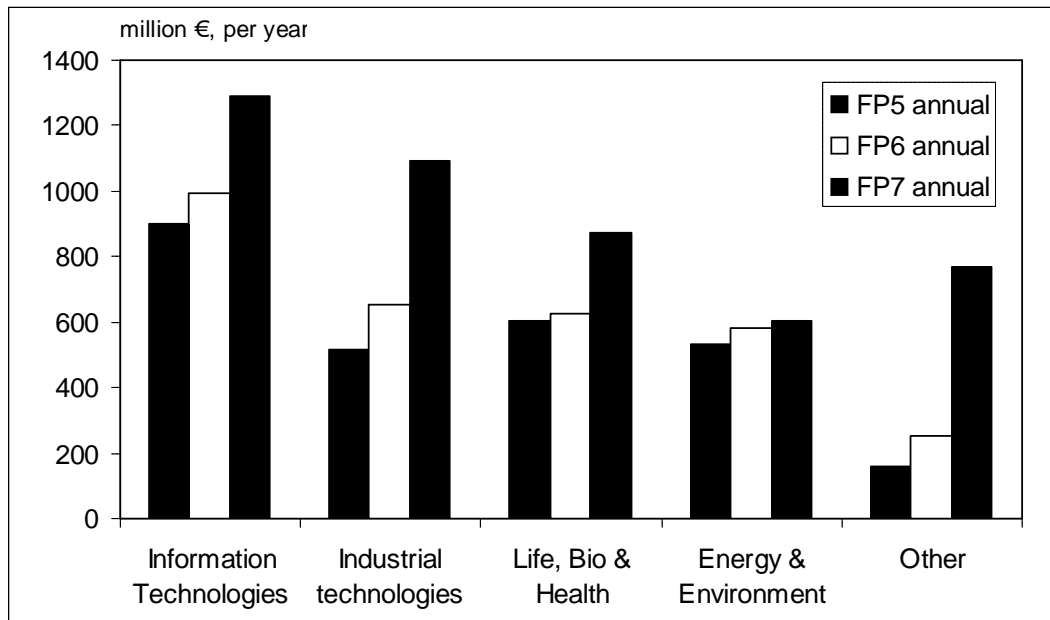
National authorities usually follow the European trend-line introducing national funding schemes with some differentiation in order to satisfy local and regional priorities.

**Table 3**  
**EU Funding Per Thematic Priority (Framework Programme for RTD) in Million Euro**

<i>FP programme</i>	<i>FP5(98-02)</i>	<i>FP5/year</i>	<i>FP6(02-06)</i>	<i>FP6/year</i>	<i>FP7(06-13)</i>	<i>FP7/year</i>
Life & Health	2413	603	2514	629	6100	871
ICT	3600	900	3984	996	9050	1293
Growth/NMP	2075	519	2610	653	3475	496
Transport (incl. Aero)					4160	594
Energy	1042	261	2329	582	2350	336
Environment	1083	271			1890	270
Security & Safety					2830	404
Total RTD	10843	2711	12438	3110	32413	4630

The above thematic priorities have been regrouped so as to be compared with the IRCnet sectors presented above. This regrouping has allowed for graphical a comparison given in Figure 6. It is obvious that Information and Communication Technologies (ICT) remains according to the funding authorities the major area for

**Figure 6**  
**EU Funding for RTD within the Last 3 Framework Programmes: Thematic Distribution and Development in Time (Annual Rates Per Framework Programme)**





support and investment by the governments, followed by the thematic priority of industrial technologies.

## **DISCUSSION & CONCLUSIONS**

A collection of 18000 technology profiles with offers and requests issued by SMEs and RTOs has been utilised to analyze and assess the technology supply & demand trends in Europe. Naturally, technology providers tend to promote their know-how in a more pronounced manner than technology seekers their technology needs, resulting in a offers-requests ratio of 3, 5:1.

Requests are placed mainly by SMEs (90% of the requests are submitted by enterprises), while offers from both SMEs (70% of the offers) and RTOs (30% of the offers). Technology requests submitted by RTOs and Universities, most of the times concern concealed partner searches for joint RTD proposal.

Licensing agreement is the most favourable type of business collaboration among technology providers, while technology recipients prefer "one-off" technical cooperation.

Offers submitted by RTOs and Universities address needs of the following sectors: Industrial manufacturing and materials (51% of RTO Offers), Informatics and Communications (36% of RTO offers) and Health and Bio (32% of RTO offers) with the other sectors to follow. On the other hand, offers submitted by enterprises address needs of Industrial manufacturing (59%), ICT (32%) and Energy and Environment (26%) with the remaining sectors to follow. This pattern of technology Supply differs to the one of the Demand side, in which enterprise requests (needs) concern predominately Industrial manufacturing and materials technologies (~75% of the submitted enterprise requests), followed by requests on energy and environmental technologies (25%), leaving far behind in terms of concern the ICT and the Health & Bio sectors (the latter being a sector that attracts vast internal investment in large companies, which usually do not rely on technology transfer for product development). On the other hand ICT technologies are by now "commodities" available "on the shelf", and companies do not rely on brokers and RTD market search to locate them.

The above findings portray quite accurately the technological concerns of European SMEs and one would expect that funding policies (from national and international bodies) would reflect these trends. However, the major funding tool for research and Technological Development in Europe, the Framework Programme (FP) for RTD, established by the EC and operating in the last 20 years, seem to address better the public research world and its priorities, rather than the private enterprise thematic priorities, which are defined by both technology providers and technology seeking enterprises. In contrast to the sectors of higher concern in both the demand and supply sides, FP7 funding is consistently directed primarily to Informatics and Communications and then to Industrial technologies and Bio-technologies, in a rather balanced manner (Figure 6). It is evident from the above that RTD funding is research

and policy driven rather than market driven, despite the strong political commitment in strengthening the SME backbone of the European Economy. This could be possibly due to the fact that funding policies have not been thoroughly reconsidered in the last 15 years, as they also serve research personnel employment targets, established lobbies within the funding authorities, foresight studies and the inertia of large institutions and organisations.

Broad and large-scale technology watch exercises like the one presented in this paper may provide a good basis for the re-design of RTD funding policies in Europe and serve better the SME needs and priorities in the Union.

### ACKNOWLEDGEMENTS

The authors wish to thank IRCnet Secretariat for providing some of the data employed in this analysis.

### NOTES

1. IRC network comprises over 200 organisations all over Europe, structured in 71 consortia, created to facilitate transnational transfer of technologies between companies (and research and technology organisations). To do so, IRCs offer a broad range of standardized innovation, brokerage and consultancy services. The whole activity is moderated by the Commission through a Secretariat structure.
2. See information on EU research at: <http://europe.eu.int/comm/research>; information for the Seventh Framework programme: [http://europa.eu.int/comm/research/future/index\\_en.cfm](http://europa.eu.int/comm/research/future/index_en.cfm).

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