



NATIONAL TECHNICAL UNIVERSITY
OF ATHENS

Laboratory of Industrial & Energy Economics

Department of Chemical Engineering – Division II

INNOVATION NETWORKS.
Policy initiatives in Greece¹.

Ioanna Kastelli*

Aggelos Tsakanikas*

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*Research Associates NTUA/LIEE.

Introduction

For the last two decades, there has been a continuous introduction of new elements in the Greek institutional set-up and public policy.

Policy initiatives became more specific regarding technological development. For a long period, interest was focused on the linear relation of R&D and innovative activity that would upgrade competitiveness of the Greek industrial system. During the last five years we observe a more systematic approach for issues related to industrial and technological development. Emphasis is given through specific policy initiatives to the promotion of interaction and diffusion. It can be argued that the European Union's policy objectives shaped to a large extent the priorities of the Greek industrial and S&T policy (directly and/or indirectly).

This paper studies the science and technology policy in Greece, with special concern on regulations promoting or interfering with the phenomenon of networking. The first section gives a brief overview of the Greek S&T system pointing out some specific issues that relate to interaction among actors. The second section presents policy initiatives promoting networking. The focus is not only in policy measures that explicitly promote interaction but also in those that indirectly have effects on the creation of linkages in the Greek industrial system. The third section suggests a classification of the policy initiatives according to the type of intervention.

1. Brief overview of the Greek S&T system

The experience of the last 20 years in the Greek science and technology policy points out the growing concern regarding the technological development and the introduction of new elements in the Greek institutional set-up that may encourage economic actors to improve their technological and organisational capabilities. Policy initiatives during this period have been shaped to a large extent by the orientation of the European Union's S&T policy.

Industrial and technology policy has first introduced measures for R&D support due to the weak level of business expenditure on R&D (firms perform only 20% of the Gross Expenditure on R&D). Elements of innovation and technology diffusion policy were introduced later and this was partly a consequence of the negotiations with the Commission for the 2nd Community Support Framework (Tsipouri, Rossi, 1999).

As it is increasingly recognised, innovation relies to interactive processes and knowledge flows. One of the main problems in the Greek S&T system has been the limited linkages between economic actors and the weak infrastructure for diffusion of information and knowledge. Interaction among firms as well as between firms and the scientific community are weak (Deniozos, 1996). This can be observed in the structure of GERD inflows and outflows (table 1), according to which private firms financed only 1,4% and 0,5% of respectively the Universities and Public Research Institutes (PRIs) expenditure on R&D. In the same time infrastructure for scientific and technological services, networks of information and databases are at an early stage of development.

Table 1

Structure of GERD inflows and outflows (%) in 1993						
From \ To	PRIs	Universities	Public Firms	Private Firms	Non-profit organisations	% on total GERD
Central government budget	63,6	15,7	5,0	4,6	27,0	28,1
Universities	-	43,4	-	-	-	17,7
Structural Funds	17,7	13,1	15,0	13,7	34,0	14,9
Own funds of Universities/PRIs	3,5	5,9	-	-	26,6	3,7
Public firms	0,8	2,4	65,7	0,1	2,5	3,5
Private firms	0,5	1,4	4,7	67,5	7,0	16,7
Non-profit organisations	-	-	-	-	-	-
EU Framework Programmes	13,0	17,7	7,6	12,4	0,4	14,5
International Organisations	0,8	-	-	-	-	0,3
Other foreign sources	0,1	0,3	2,0	1,7	2,6	0,7
Total	100,0	99,9	100,0	100,0	100,1	100,1

The breakdown of R&D expenditures by source of financing and performing sector shows the relative small contribution of the business sector in funding R&D. At the same time table 1 reveals the significant contribution of government in R&D funding as well as of sources from abroad, which mainly consist of EU Framework Programmes, Structural Funds and other foreign sources.

The major steps of S&T policy in Greece over the last 20 years show an evolution towards a more European consistent framework of policy tools. Policy makers in this context seem gradually to recognise the importance of linkages and knowledge flows in strengthening the innovative performance of the Greek industrial system. In this respect promotion of R&D collaboration has been introduced recently as a mean for developing interaction among different types of organisations (Universities, firms, research institutes etc.), aiming to underpin innovative processes. However, although policy initiatives for supporting R&D collaboration show a certain interest for this type of research activities, it doesn't appear that public and private actors have integrated the involvement in R&D collaborations in their technology strategy. On the contrary, they do not seem to disassociate their R&D activity from public support (Kastelli, 2000).

2. Programmes promoting networking

Signs of a sluggish change are observed in the Greek industrial policy after the mid- '90s. The policy shift has been mainly inspired from the EU policy and has been reflected in specific initiatives for the improvement of industrial competitiveness and the development of the scientific and technological base. Most of the policy initiatives have been promoted in the context of the Community Support Framework (CSF) I and II. The Greek Government with the financial support of the European Union launched the Operational Programmes for Industry (EPV I & II) and the Operational Programmes for Research and Technology (EPET I & II), both being under the responsibility of the

Ministry of Development. They have set the general orientations of the public intervention for industrial development and the development of the research and technology infrastructure and included specific actions. The section below describes specific policy initiatives that promote networking.

A strategy for networks

In the middle of '90s the Ministry of Development has funded a project named "The Future of the Greek Industry", aiming at the establishment of a Public Industrial Strategy. The main concern in this context, has been the promotion of networking in Greece as a means for improving industrial competitiveness. The project included a number of case studies on existing or potential clusters in 19 industrial sectors.

Some interesting points of these studies are presented below:

- The project has been implemented in a normative framework considering that the challenge for achieving industrial competitiveness is related to the development of networks. The main policy objective was to set the framework of public intervention for networks but in the same time to promote sustainability of networks in the absence of public support.
- Local or regional clusters of firms have been studied in order to reveal the existence or possibility of inter-firm and inter-sectoral relationships.
- Local concentration of sectors is characterised by dualism. Firms with competitive advantage co-exist with low performance firms.
- Firms being part of a network present a heterogeneous behaviour. In most of the cases collective action was resumed in common requirements from the Government.

No evaluation has been carried out regarding any implementation of the above strategy for networks.

Specific action for SMEs: promotion of firms collaboration

EPV II, which is under the responsibility of the General Secretariat of Industry of the Ministry of Development and covered the period 1994-1999, was analysed in 6 sub programmes aiming to establish coordinated policy initiatives for improvement of industrial competitiveness. One of the key actions falling in sub programme 4, concerned the promotion of collaboration in SMEs. This action was mainly inspired from the project "The Future of the Greek Industry" described above. The specific initiative aimed at strengthening SMEs through the promotion, creation and development of different formes of collaboration such as joint ventures, networks, mergers. The policy objective was to help SMEs to overcome size limitations by exploiting synergies.

Initiatives in the context of S&T policy

The Greek Government launched two Programmes aiming at the establishment of a

support framework for S&T policy, Operational Programme for Research and Technology I & II (EPET I & II). They have set the policy objectives that should guide all specific initiatives referring to technological development. The Programmes were under the responsibility of the General Secretariat of Research and Technology (GSRT in the Ministry of Development). The duration of the programmes was respectively 1989-1993 and 1994-1999.

The objectives of EPET I set the context for the establishment of linkages and more specifically were:

- a. the linkage of productive and research activities through
 - the development of units for industrial research, technology transfer and the offer of specific services to the firms,
 - the development of technological parks for the exploitation of the research output coming from the Universities and public research laboratories.
- b. the transfer and diffusion of R&D information by
 - creating libraries and databases,
 - developing a national network of documentation and diffusion of information and linking it with international networks
 - training.
- c. the development of research laboratories in sectors related to the socio-economic development.
- d. the human resources development.

In 1994 EPET II was launched, aiming to:

- a. promote the cooperation between research laboratories and productive units in projects of high economic interest such as environmental technologies, bio-sciences, information technologies, new materials, study of socio-economic and cultural issues.
- b. give incentives for transfer of technology through:
 - license and technical assistance,
 - networks of technology transfer,
 - covering business risk deriving from the adoption of new technologies.
- c. promote innovative activities.
- d. promote and strengthen the mechanisms for exploiting research output such as:
 - technology incubators,
 - technological parks,
 - venture capital firms,
 - centres for diffusion of information and know-how.

- e. strengthen the adoption and assimilation of new technologies (e.g. Information and Communication Technologies).
- f. develop Greek human resources according to the existing needs for training.

Another Programme falling under the responsibility of the GSRT as well, was STRIDE HELLAS, integrated in the European initiative STRIDE (Science and Technology for Regional Innovation and Development) for the development of the less developed regions of the European Union (duration 1991-1993).

Its objectives were:

- a. the linkage of productive and research activities,
- b. the development of interrelations between national organisations and European and international networks,
- c. the development of R&D infrastructures.

One of the main concerns of this Programme was the promotion of cooperation between different organisations.

In the section below we will describe specific initiatives that derived from EPET I & II.

Programmes promoting collaboration

Programme for Developing Industrial Research (PAVE): The programme aimed to foster industrial research, innovation and industrial design. Participation in PAVE didn't require partnership but proposals submitted by consortia were positively assessed.

The **Programme of Co-financing (SYN):** SYN aimed at the cooperation of Universities and Research Laboratories with industries/users in order to encourage the linkage of research activities with industrial applications. Participation in this programme required a 30% financial contribution from the industrial partner in order to ensure the link between research outcome and industrial needs.

Both programmes have been introduced independently but integrated in EPET after 1990. As stated before, PAVE implicitly promoted R&D cooperation whereas SYN aimed directly to the cooperation of Academic or Research Institutions with firms. After 1992, the number of PAVE projects without any type of partnership decreased significantly (LOGOTECH, 1999). On the contrary a significant increase in subcontracting agreements is observed and a steady proportion of projects with partnership (ibid). Academic Institutions represented the main proportion of sub-contractors in PAVE projects. However, the efficiency of PAVE in improving linkages among actors is contested. Many of the projects were not really adapted to firms' needs. In general, a difficulty characterised the implementation of many projects, regarding the transformation of R&D results in commercial applications. Additionally, a significant part of cooperations didn't have any continuation (ibid).

SYN appears to be a programme for Academic Institutions as they have the most active participation. Among the users of SYN projects, industrial firms represent 47% and

Public Authorities 29% (ibid). However closer investigation of project deliverables has shown that many of them are studies and results that could not be exploited by the users (ibid).

The programme of **Research Joint Ventures for Improvement of Competitiveness** (EKBAN): Recently, cooperative R&D is promoted by EKVAN funded by EPET II. The supported technological areas follow the priorities of the EU Framework Programmes, offering wide opportunities in the areas of environmental research, bioscience, agricultural research, information technologies, new materials, culture and management (Tsipouri, Rossi, 1999). In 1994 the contribution of firms in the accepted projects covered 48% of the total budget (GSRT, 1995). Evaluation of this programme has not been carried out yet.

The above national initiatives differ from the European Framework Programmes supporting cooperative R&D in that they do not set the condition for pre-competitive research. The outcome of the research activity may be a product or process innovation. Thus the conjunction with competition issues was not considered in the same perspective as at the level of the European policy.

Another scheme to promote R&D cooperation is the Programme “**International Cooperation for Research and Technology**”. It promotes international networks for information and knowledge flows among different countries. Support is provided for consortia of Private and Public Research Institutes, Universities and firms to implement joint research activities.

Programmes promoting knowledge flows.

The **Programme for Target Research Fellowships** (YPER) and the **Programme for Advancing Human Capital** (PENED): Both programmes aimed at creating a pool of highly educated persons who have actually dealt with production problems. At the same time it was expected that the programmes would highlight, especially for firms, the importance of applied research and innovation (Katsoulakos et al., 1996). Projects funded under these initiatives should focus in specific industrial needs exploiting in the same time human potential from the academic domain.

The **Programme “Human Networks of Knowledge Promotion”**: The focus of the programme is in creating closer interaction and networking between researchers and managers in companies in order to diminish intellectual isolation, improve technology transfer and offer scope for interdisciplinarity (Tsipouri, Rossi, 1999). Support is provided for travel expenses, organization of workshops, information material etc.

The **Programme for Best Practice Bench-marking** (PAFOS): This programme is for the determination and assimilation of standard practices of new technologies, focusing in topics of technological modernization. PAFOS encourages collaboration between at least one firm and one consultant in technology transfer, supporting the identification and absorption of new technologies.

The **Performance Financing Programme** (XAT): The programme aims to distribute the risk of innovation financing amongst three parties i.e the technology supplier, the technology user and the financial institution.

The **Technology Brokerage Programme** (Technomesiteia): Conceived in 1995 to enhance technology flows from foreign to Greek actors, it supported activities like technology audits in the companies users of new technologies, market research about suitable available technologies, organization and carrying out negotiations between suppliers and users of technology etc.)

Industrial clustering for knowledge flows is promoted in the context of the key action **“Technology Parks”**, which aims at enhancing interaction between firms and between firms and Research Institutes. In the same line, GSRT has launched a financial scheme to support the development of **Liaison Offices** in Universities, which promote the exploitation of scientific research.

Foundation of intermediary organisations linking research to industrial activities

In the mid '80s GSRT and EOMMEX established the **Industrial Research and Technological Development Companies** (EBETA) as joint ventures between the State, Universities and firms. The policy objective behind this decision was to develop links between academic research and the needs of industrial firms. EBETA were established in six specific industrial sectors namely textile, food, ceramics, metallurgical, aquaculture and maritime industries (the sectors were chosen because of their importance in the Greek industrial system). EBETA were considered as valuable intermediate organisations that would contribute to the development of applied industrial research, provide technological assistance and specialised services to productive units and promote diffusion of information among firms and firms – Universities.

Assessment of their role (LOGOTECH, 1997) points out that although originally their clientele was determined to be SMEs, finally most interest for their services came from medium and large firms. It seems that SME had neither the financial resources nor the technical background that could exploit the possibilities offered by these organisations. While the most important effect from the presence of these organisations might well be their assistance in diffusing information within industry and in stimulating firms to specify their needs that could be funded from European or national programmes, their overall effectiveness has been controversial. The problems in their functioning result from²:

- i) a fuzzy institutional status,
- ii) an ill-defined context of responsibilities,
- iii) a weak relationship with firms of the respective sector due to difficulties in defining the needs of their clients, in finding the potential users of their services as well as difficulties due to the limp attitude of the firms regarding cooperation.
- iv) a weak presence of linking mechanisms that would help to exploit the outcome of their technological activity.
- v) their size, operational and organisational structure and strategic planning has

² “Assessment of sectoral corporations for industrial research and technological development”, report to the Ministry of Development, February 1997.

not been helpful in absorbing and diffusing know-how and information.

Another action that implicitly encourages the creation of links among economic actors is the foundation of the **Business Innovation Centres** (BIC). They constitute a national innovation network, which has as a main objective to create an environment, especially for SMEs that might enable them to develop technologically. BIC provide a wide range of services with the general scope of reducing significantly the rate of failure among new business (Katsoulacos et al., 1996). These services include training in management, conception of the business plan, technological consultancy, search for partners, marketing consultancy, access to seed and venture capital.

Networking in specific research areas

In the context of S&T policy, there has been an effort to strengthen R&D activities and enhance technological infrastructure in specific research areas. Initiatives with such sectoral focus are:

- Sectoral Programme in Agricultural Biotechnology,
- Coordinated Programme for Management of Industrial Waste,
- Programme for Research and Development in Transportations,
- Programme for the Development of Microelectronics and Micromechanics.

The programmes above foster interaction between users and producers or technology suppliers and users as well as the linkage of academic research to specific industrial needs.

The development of physical networks facilitating interaction between different actors

ICT technologies facilitate innovation processes and learning as it is considered an important infrastructure for intra- and inter-firm information flows (OECD, 2000).

The implementation of the Government's strategy regarding Information Society issues largely depends on funding initiatives in the context of the 3rd CSF. The growing importance of ICTs has been considered by the Greek Government in the context of the new **Operational Programme for Information Society**. A particular emphasis is given to the importance of the introduction of new technologies and e-business practices in the Greek firms. In this context, the new initiative of "**E-Business Forum**" has been launched by the Ministry of Development. This forum aims at the creation of a public discussion in which participate all social and economic actors that are concerned of the subject in some way. The main issue of this discussion is the overview of the present situation regarding e-business in Greece and the suggestion of specific actions that will enable the development of new ways of doing business.

One specific action, which is included in the OP for Information Society is the programme "**Go Digital**", which aims at enhancing ICT infrastructure of small firms (up to 10 employees) by funding their access to the internet and exploitation of internet services.

3. Policy initiatives and actors' behaviour: some empirical evidence

It is interesting to present at this point, some empirical evidence regarding cooperative R&D funded from Greek national sources. Information on this topic has been obtained in the context of the "STEP TO RJVs" project³. A Greek national database was created, including joint **research** activities, with at least one participant from the private sector, which were initiated during the period 1985-1996 and funded by national programmes⁴. The 154 projects included in the database are undertaken by networks of firms, Universities and/or Research Institutes created on a project-based venture. Table 1 presents their distribution in the various National Programmes.

Table 1: Research partnerships distribution

Type of Programme	Number of RJVs	%
EPET I	10	10%
EPET II	48	32%
STRIDE HELLAS	48	31%
PAVE	2	1%
Other Programmes	18	18%
Unavailable type of Programme	28	8%

The technological areas that have been mostly promoted through the National Programmes (especially EPET I & II) were very similar with the areas promoted in the context of the European Framework Programmes. 35% of the subsidised projects were in information technologies, 16% in education and materials respectively, 15% in environmental protection and 12% in biotechnology. This indicates that new technologies were of high priority. However, it should be mentioned that those technological areas that were promoted in priority during the last 10 years, were selected with a bottom-up procedure, according to the technological area distribution of the proposals.

The size of the consortium is an important aspect of the networking phenomenon. Gelsing (1992) defines networks as "**three or more** firms that cooperate in order to gain strength of numbers, solve problems, enter new markets, or develop and produce goods". Only 17% of our data involve cooperation between just two organizations. On the contrary, almost half of the projects (47%) had up to 4 participants and in general the vast majority of them (more than 80%) have had seven or even fewer participants indicating a tendency for small-sized networks. The duration of all these efforts does not exceed the upper limit of 3 years for 90% of the cases.

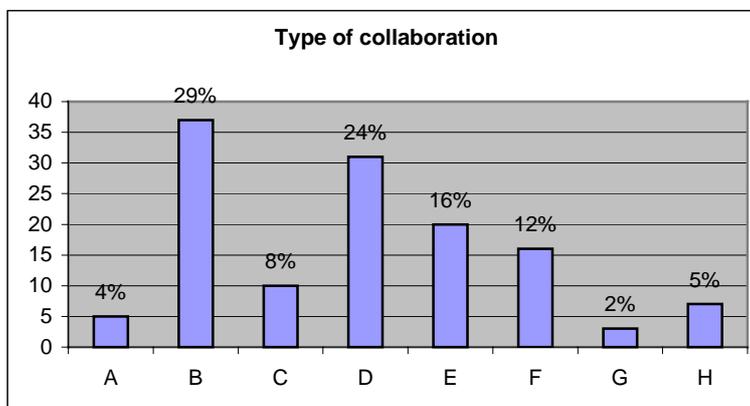
The distribution of the different types of collaboration according to the participating

³ The STEP TO RJVs project has been funded by the TSER Programme of the EC and coordinated by Yannis Caloghirou. The project was undertaken by 7 research partners, namely NTUA/LIEE (coordinating team), IDATE (France), FEEM (Italy), U:Carlos III Madrid (Spain), SSE (Sweden), PREST (UK), SIRN (UK).

⁴ The basic source of information for the construction of this database was the National Documentation Centre, where are recorded all funded projects in Greece. The database includes 154 funded RJVs with at least one firm in the consortium.

organisations is presented in Figure 1.

Figure 1



A: Firm-Firm collaboration, B: Firm-University collaboration, C: Firm-University-Other, D: Firm-University-Research Center, E: Firm-University-Research Center-Other, F: Firm-Research Center, G: Firm-Research Center-Other, H: Firm-Other. (Data available for 128/154 projects).

The most frequent type of collaboration is between firms and Universities (24%). 75.9% of the projects include at least one University and/or Research Center.

Taking into consideration that expenditure on R&D is low in comparison with other countries and that the most active entities in National Programmes were Universities and Research Centers⁵, it is correct to consider that national subsidies for cooperative R&D supported basic research in those cases where lack of financial resources is observed. The National Programmes (especially PAVE, SYN, EPET, EKBAN) in addition to the European Framework Programmes, constituted for Public Institutions an important source of funding R&D activity.

There are 210 Greek firms that have at least once participated in a collaboration funded by a National Programme. However when we examine their activeness, we find out that the vast majority of them (73%) has participated only once. The most active organization in terms of memberships is a University: Aristotle University of Thessalonica is the top position with 56 participations (more than 1/3 of the projects). In fact a total 11 Universities or Research Centers follow next before the first firm appears on the relevant list. It is Knowledge S.A, which is located in Patras, and its primary activity is Computer Services, that has participated in 9 projects. Only 16 firms have had more than 3 participations.

A regional characteristic seems also to hold true. Firms located near the region of Thessalonica collaborate with each other and especially with the Aristotle University of Salonica. The same goes for the region of Patras, where the most active firm in our

⁵ "STEP TO RJVs Databank – Greek National RJV database: descriptive statistics": working paper by Aggelos Tsakanikas. The projects included to the STEP TO RJVs Databank were selected according to specific criteria and do not cover all funded RJVs.

database, Knowledge SA, collaborates with the local University and the local Technological Park. Their links with other agents from Athens and especially the National Technical University –the leading and most famous university of Greece- are much looser than those established in their area. A strong linkage exists also between the Foundation for Research and Technology (FORTH) in Crete, and almost all firms in the sector of Computer services and Electronics. FORTH is one of the two main national research centres in Greece and the only one located in the periphery. It consists of seven Institutes (one of them being the Institute of Computer Science) located in the cities of Heraklion, Rethymno, and Patras.

A sectoral network of firms in the Chemical industry and especially in the sub-sector of refining oil is also identified. The 3 out of 4 Greek refineries (2 public and 1 private) seem to collaborate often, along with two other Research Institutes (the Chemical Process Engineering Research Institute in Salonica and the Institute of Chemical Engineering and High Temperature Processes in Patras).

Although there have been efforts from the national policy side, at least influenced by the European S&T policy, private actors have shown poor interest in cooperative R&D. Most actors that undertook cooperative R&D (about 70%) participated only once in RJVs⁶, which shows poor dynamic.

The study of funded cooperative R&D (from European or National Programmes) gives some evidence on the attitude and behaviour of Greek economic actors with regards to networking and cooperation. The survey carried out in 80 Greek firms⁷ showed that the objectives of the private actors for undertaking cooperative R&D seem to be oriented towards technological development. The most important objectives for Greek firms were to keep up with major technological development and to have access to complementary resources and skills. The benefits from undertaking R&D through cooperation showed the importance of acquisition / creation of new knowledge and the improvement of technological and organisational capabilities. Cooperative R&D in Greece seems to respond to a catching-up intention from the side of the private actors, especially when taking into consideration the weak technology base of the Greek firms. However, according to the survey results, Greek firms would not have undertaken the specific R&D projects without public funding (71% of the cases). This finding is two-fold; it underlines the positive effect of public funding on promoting R&D activity but in the same time taking into consideration the low level of business expenditure on R&D, it reveals the strong dependency of firms' technological activities on subsidies.

4. Discussion

⁶ “STEP TO RJVs Databank – Greek National RJV database”.

⁷ In the context of the STEP TO RJVs project, a survey has been carried out in seven European countries, fielding a questionnaire to a survey sample of firms that have participated in a mixture of EU Framework Programmes, EUREKA and National Programmes. In Greece, 80 questionnaires were collected, covering 124 projects, and represented a response rate of 57,9%. The information obtained included general information on the company, information about the objectives of the company in participating in R&D cooperation(s), the obtained benefits and the problems that the company faced during the cooperation(s).

The introduction of new elements in the Greek Science and Technology policy has followed the general orientations of the EU policy but until now have failed to establish an authentic set of coherent actions aiming at strengthening interactive processes and establishing intense linkages among economic actors.

Private actors seem to recognise the benefits from networking and interaction but are strongly depended on public support. However, the success of any policy initiatives depends on actors' intention to disassociate their R&D activities from public funding.

Policy initiatives promoting linkages among economic actors are a tool to prompt industry to undertake R&D activities. It is quite unclear if this goal is reached. Even if Greek firms and other organisations seem to respond to policy initiatives, there is no important evidence that this trend is self-sustained as the strong dependency of firms' technological activities on subsidies, still remains. Besides, any policy effort to have a permanent impact in improving Greek industry's competitiveness needs to be integrated in a set of policy actions that support economic development.

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Angle of intervention	Action for SMEs	PAVE	SYN	EKVAN	Int. Coop. R&D	YPER	PENED	Human Networks	PAFOS	XAT	TECHNO MESITEIA	Techn. Parks
Awareness of the network possibility		X						X				
Search for partners											X	
Building trust and a shared knowledge base								X				X
Organizing the network											X	X
Ensuring providing complementary resources		X	X			X	X		X	X		
Active cooperation	X		X	X	X							

Angle of intervention	Liaison Offices	EBETA	Innovation Centres	Sectoral Programmes	Go Digital
Awareness of the network possibility		X	X		
Search for partners	X		X		X
Building trust and a shared knowledge base	X				
Organizing the network					X
Ensuring providing complementary resources	X	X		X	X
Active cooperation					