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Ethnographic research and network analysis in monitoring regional programmes

by

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Abstract
By applying ethnographic research to social network analysis, the paper addresses the issue of monitoring and evaluating "policy experiments" promoted through the EU Regional Programme of Innovative Actions (RPIA) directed at supporting innovation by fostering interfirm cooperation networks in SME production systems. The research relies on a complex-systems approach and specifically on the notion of generative relationships. The case study refers to Tuscany's RPIA implemented in 2001-2004. We focus on (1) analysis and monitoring of cooperation networks, (2) assessing the "emergent" structural effects of an innovation policy fostering cooperation networks; (3) analysing the multi-level impact of policy measures.

Keywords

Innovation policy and cooperation networks, generative relationships, regional development, SMEs production systems, complex systems

1. Introduction: Context and objectives of the analysis

In the course of the last ten years, innovation has gained increasing importance in the context of European development policies (European Commission, 1995). In order to attain the 2000 Lisbon objectives – recalled in the 2005 Bruxelles Council − the European Union is betting on innovation as a tool to increase Europe's possibilities for growth and social cohesion. The Commission is also showing increasing awareness that a peculiar kind of production structure − composed of small and medium enterprises systems − is a resource for Europe which should be enhanced through ad-hoc incentives and tools in order to support its systemic development (Audretsch, 2002; European Commission, 2003; European Council, 2000).

So far, several European regions − using available EU funds such as those assigned to the Ris, Ritts and Ris+ programmes − have promoted policies for innovation (surveyed in the papers by Nauwaelaers and Wintjes, 2003; Bachtler e Brown, 2004; Landabaso and Mouton, 2005; Rossi, 2005). The view of innovation that underpins European innovation policies has been thoroughly discussed by Mytelka and Smith (2002) who discuss the main changes of the Commission's policy choices over time. The formation of the European Community was becoming an increasingly complex process that called for new tools for intervention, not only in the field of innovation policies. This explains why, starting from 1994, the European Commission envisaged that, in the overall allottment of Structural Funds, up to 1% of the budget should be destined for experimenting new ways of community structural intervention. But, so far, little attention has been paid to the innovative character of such policy experiments, their effects, and the need for proper analytical tools in monitoring those experiments[1]. The paper addresses these issues by focusing on policy experiments promoted in the Regional Programme of Innovative Actions (RPIA). In particular we focus on an in depth empirical analysis of the "Technological Innovation in Tuscany" programme (henceforth RPIA-ITT), implemented in the period 2001-2004. This programme was aimed at stimulating technological innovation processes in the regional economy through the creation of networks of cooperation − among small and large firms, research centres, universities, local public institutions, centres for innovation, business services providers, training agencies and financing institutions − with the purpose to integrate competences and to test new methodologies for the diffusion of innovation.

Our research is not concerned with the analysis of the technological innovativeness of the project proposals themselves (this was evaluated during the proposals' selection stage). Instead, we intend to analyze, in a complex system perspective, the overall impact of this experiment in innovation policy. Ethnographic research and social network analysis helped us suggest improvements to the design and management of a regional programme of innovative actions with respect to three main issues: (1) analysis and monitoring of the role of the various actors involved in the innovation process and in the creation of cooperation networks; (2) assessing what we identify as "emergent" structural effects of a policy whose objective is to foster cooperation networks; (3) analyzing the impact of policy measures by considering the interweave − through time − of linked policies. The description emerging from this analysis will provide the basis for a further stage of our investigation in modeling

[1] In her concluding address to the Annual Congress of Associazione Italiana di Valutazione, Stame (2005) pointed out that this issue is the main challenge facing evaluation policies in Europe, as opposed to the pragmatic tradition typical of US evaluation.

innovation policies, that will be implemented in the agent-artifact innovation modeling environment developed by ISCOM researchers[2].

As a preliminary step in our analysis, in Section 2 we compare the notions of "network" and "innovation" to which the programme's designers referred, with the notion of "generative relationship" in innovation processes (Lane and Maxfiled, 1997) that we have adopted in analysing and modelling the RPIA-ITT. The ethnographic perspective – that we outline in Section 2 − provides a powerful tool in order to identify the relevant data and analyze both the multi-level, multi-temporal interaction streams fostered by policy incentives, and the emergent structural effects of the policy. Section 3 presents the main features of the RPIA-ITT programme and of the projects that were submitted for funding. An analysis of the many networks of relationships underpinning the programme is discussed in Section 4. Section 5 presents some concluding remarks on the potentialities and limitations of experiments in regional policy of the type considered.

2. Cooperation networks and generative relationships: ambiguity of a concept and emergent phenomena at programme level

2.1. Cooperation networks and innovation

In the analysis of the RPIA-ITT programme, we must first of all identify what the policymakers meant by cooperation network. In general, the idea of "network" is ambiguous since, on the one hand, it can apply to a wide range of different situations while, on the other, the normative interpretation of what may constitute a cooperation network could influence the effectiveness of a policy measure.

The specific procedure described in the RPIA-ITT's call for tender document provided a straightforward way to identify the "nodes" of the cooperation network and the relationships relevant to the programme, since expected applicants had to formalize their cooperation through the creation of Temporary Associations of Firms or Temporary Associations of Aim, whose members (the nodes) would be organizations (manufacturing firms, universities, service centres) committing to jointly carry out an innovative project. Although this definition might appear very operational, when we analyze "networks" three main issues must be tackled with regard the identification of (1) the relevant nodes and their processes of change, (2) multiple linkages among nodes affecting the network structure, (3) the relevant data, and (4) the time horizon.

First, when we consider the organizations as the relevant "nodes" we have to distinguish who were the actors involved in innovation processes: they might be the people in charge of the organizations that were formally defined as cooperating, or the people responsible for managing the project, or the members of the working groups who cooperated in network activities within the individual organizations[3]. Such actors "cooperate" (this defines the connections among them) in an activity (an "innovation project") producing a prototype or a new procedure. Although the RPIA-ITT's focus was on "supporting innovation by creating partnership networks", the procedure followed in the course of the programme seemed to lose that focus, by collapsing a

[2] Iscom is the acronym of the EU project "The Information Society as a Complex System "EU-IST-2001-35505, information on the project may be found on line at http://www.iscom.unimore.it.

[3] When a multilevel organization is involved, such as a University or a big research institution, it appears evident that the relevant node in charge of signing the temporary contract (relevant for the application procedure) is in general at a higher level than the actors who will conduct the partnership in the project (such as a research team in a University Department or a research branch).

cooperation network into the physical artifact it might produce as a result of cooperation. “Cooperation network” and “project” are not synonymous, nor can one be reduced to the other: they require two mutually intertwined levels of analysis, concerning, respectively, the cooperating actors and the activities in which they cooperate. We believe that it would be more fitting to the programme’s aim to represent the activity of the network with respect to the process of interaction that enabled such a product to be obtained. This way, it would be possible to highlight also changes in network composition, in terms of partners involved and their competences, due to the RPIA-ITT or affecting the networks formed during its implementation.

Secondly, the relationships that underpin the innovative activities of each network cannot easily be reduced to the sole relationships unfolding within the individual cooperation networks. The interactions that need to be examined are direct interactions among the participants in the programme, crossing the various projects and action lines, as well as those that link the participants through common involvement in other activities (for example, other regional research projects or other European programmes). As we shall see, if we consider different types of relationships we obtain different results in terms of network structure and intensity of the centrality measures: a well-known result from the study of networks of social relationships when one considers how the multiplicity of levels of interaction influences the cohesion factors of a network (Powell, 1990; Padgett e Ansell, 1993; Breiger et al. 2003; Lane 2005).

Third, the hypothesis that there is a “network of networks” needs proper data to be assessed. In the innovation field, with respect to the first four Framework Programmes (FPs), this hypothesis has been recently discussed by Barber *et al.* (2005) in a complex network perspective. Dealing with a large data set, Barber and co-authors present some broad results on some general properties of the emerging network of networks (such as scale properties, diameters of clusters) based on an intersection graphs analysis. Their conclusion is that in order to draw policy implications on network properties of the FPs it is necessary to consider the characteristics of the participants: this requires a huge amount of work on 35,000 records to be checked manually, still under way. In their conclusions, Barber and colleagues highlight a critical point in the modeling of such networks: we need to know more on the characteristics of nodes and their relationships. In our investigation however we can rely on a very accurate description of the nodes: the overall size of our case study is small enough to allow a manageable collection of the proper data − identified through ethnographic research.

Last, since attention is focused on processes and innovation, even the time span for observation should be carefully defined, because innovation policy effects can hardly be measured in the accountability time span admitted by the EU procedures.

2.2. Networks and generative relationships

When analyzing the RPIA-ITT we confronted the notion of “cooperation network fostering innovation” with “generative relationships” as described in Lane and Maxfield (1997), who define as “generative” those relationships capable of inducing changes in the way in which the actors involved in the relationship view their world and act within it, also giving rise to innovations having, in general, the character of new entities (as, for example, new agents or new artifacts or even new institutions).

Lane and Maxfield see generative relationships as resulting from interactions between agents (firms, but also individual departments or persons inside and outside the firms) and artifacts. The multiplicity of levels at which interactions between agents and

artifacts occur (inside and outside the firm) does not necessarily result in the creation of a generative relationship or its maintenance: for it might be the case that within a firm there exist certain departments that, in interacting with other agents and artifacts, fuel generative relationships, whereas other departments obstruct the generative nature of those relationships. In this perspective, the changes produced by the generative relationships cannot be predicted from knowledge of the characteristics of the agents involved in the relationship. Interpreting the result of that process therefore requires knowledge of the structure and history of the technical, economic, social and institutional relationships between the agents in question.

In Lane and Maxfield's analysis (1997), new generative relationships induce changes in the attributions the agents assign to themselves, to other agents and to artifacts. These changes are often cumulative in nature and, in turn, pave the way for new generative relationships: a boot-strap dynamic that characterizes structural change in the space of agents and artifacts. The generative potential of a relationship is affected by certain conditions that we shall briefly rehearse, since this has provided a guide in the analysis of the RPIA-ITT. First, the heterogeneity of the agents favours the combination of differences in terms of competences, attributions or access to particular agents or artifacts, and may thus contribute to generating new competences as the result of that relationship. A second condition is that those involved in the relationship orient their activity in a common direction in the space of agents and artifacts, i.e. there must be some artifact or some agent on which they mutually focus their activity. But the agents must also try to develop a recurrent pattern of interactions, something which depends on the attributions assigned by each one to the identity of the other[4]. Finally, interactions involving discussion of problems and entities of common interest may turn out to be more incisive if the agents are able to interact in such a way that enables them to work together in a non-conventional way. And the possibilities that emerge from their joint activity will in general be wider when their relationships interweave with a network of other relationships.

Lane and Maxfield (1997) emphasize how the agents involved in generative relationships need to continuously monitor the conditions in which the interactions take place, in order to be able to interpret the changes that are the very result of those relationships. Such monitoring provides cues for identifying how to fuel and maintain generative relationships. As soon as agents discover that changes are taking place in the sphere of attributions (assigned to them or to other agents and artifacts), they might also try to discover where these changes come from by examining the various relationships in which they are involved and to identify the ways to fuel those specific relationships that, in turn, can generate changes.

If we consider the generativeness of relationships as a reference for the analysis of innovation, we must also bear in mind that innovation processes give rise to transformations in the structure of the space of agents and artifacts. This implies that, in analysing a policy for innovation that will stimulate the innovation process through the creation of cooperation networks, we must examine not only transformations in the "space of artifacts" (in the limited sense of "results of the innovation processes") but also the corresponding transformations in the "space of agents" (that is to say, changes in agents' attributions and in the structure of the interactions among the economic agents). These combined changes should be addressed in order to monitor the effects of incentives aiming at supporting innovation by the creation of partnerships.

[4] In this context, mutual trust is not a precondition — indeed, it may be a result of the interaction streams through which the agents realize that they can benefit from the relationship that is being generated.

This theory of innovation requires to reveal the emergent properties of interaction streams that cannot be analyzed in terms of the usual data related to innovation activities, such as patent data, or R&D expenditure, or the number of agreements signed up by research institutions; nor they can be summarized by the usual impact factors, such as the number of seminars organized, number of people trained (as suggested by EU guidelines). New analytical tools in such complex analysis might be found in ethnographic research (Agar, 2004), that allows explorations of the process trough which interaction streams emerge and have effect.

2.3. Integrating ethnography and social network analysis

The interpretation of a new social phenomenon − such as experiments in innovation policy fostering social interactions − can be built in a coherent (and verifiable) interpretative framework on the basis of hypotheses that are not formulated a priori and then tested, rather they are selected and redefined *en course*, in an iterative procedure which, at every stage, builds on results accrued from many sources ("rich points" and "massive overdetermination", as Agar, 1996, says). This ethnographic perspective provided us with insights with respect to three main issues: first, we singled out the types of organizations that might act as "facilitators" for generative relationships in the networks; secondly, we explored the systemic nature of the emergent structural effects of the policy considered; third, we highlighted to what extent the RPIA-ITT programme allowed some cooperation networks, crossing different projects, to become relevant as a "system of innovation", that might become a lever for further innovation upsurge.

The relevant data in such analysis cannot be completely identified a priori just by reading the programme's call for tender or the EU guidelines that shaped that tender, nor just extracted by the application forms or the projects' documents. The identification and collection of relevant data was part of our ethnographic research through which we examined in depth the process of creation of cooperation networks, their degree of formalization and the nature of the ties between the participants (nature of these ties, history of how they emerged and changed in time, between which actors − individuals or organizations − and for which common activities).

Having collected the available documentation produced by the projects and by the programme's administrators, we began by interviewing representatives of eight cooperation networks, four of which had received funding (one for each action line envisaged by the programme) and three of which had not (and obtained different scores in the pre-programme selection). The comparative analysis enabled us to focus on the factors that favoured the creation of successful networks and the criteria for defining the success of the network[5]. In mapping out the background against which specific programming decisions were made, we enjoyed the cooperation of three managers of the Tuscany Region, two of whom were responsible for drafting the RPIA programme (but were no longer working in that capacity during the management of programme), while the third interviewee was the manager in charge of running the programme. After this first stage, the study was extended to two small firms involved in funded projects and to a second group of organizations that had been identified, through our analysis of relationship networks (described in Section 4), as being the most central nodes in the RPIA-ITT relationship network: these were service providers, universities and a few

[5] Given the resources available, it was not possible to extend the comparative analysis to actor networks that, although initiating an innovation process, did not apply for funding within the RPIA-ITT programme.

particularly active service centres. For each of the organizations thus identified, we interviewed the person who, according to RPIA documentation, was in charge of the project, or another person suggested by the former. The interviews were structured around a set of open questions dealing with some general topics − questions of descriptive, structural and contrast nature, aiming to outline the context in which the interviewees operate (Spradley, 1979) − and a very detailed series of research topics specific for each type of actor that was interviewed[6].

Ethnographic interviews grounded both our selection of the relevant information to be included in the data set and hypotheses to be investigated with social network analysis.

We constructed and reclassified a data set for the nodes (36 projects submitted; 409 organizations involved in those projects, their representatives; the modules of activities in each project) and relationships relevant to our investigation. For each of the participant organizations we took into account the presence of "multilevel" organizations: this explains why we counted a higher number of participants than the Tuscany Region did in their calculations. For university participants, we classified as nodes not the university institution but each department involved in the project (we found no cases in which more than one research team from the same university department was involved). In the case of Scuola Superiore S. Anna in Pisa we considered individual departments only in the construction of the modules-partners networks (explained in section 4.2) while in all other cases S.Anna was considered as a single participant; this choice was motivated by the presence, within each project, of numerous S.Anna research units coordinated by the same person. In the case of Consorzio CEO we considered the various research groups as a single actor. Consorzio Con.Cer.Tex was instead divided into two different actors, in order to highlight that only one of the partners was particularly active in more than one project.

The data, drawn from several official sources, were manually checked by confronting them with information from interviews and rearranged in a database. The complete list is described in Appendix 1. Several properties of the nodes have been included in the analysis and will be discussed in sections 3 and 4. The information for constructing the database was drawn from the following documents: the official call for tender of the RPIA programme by Tuscany Region, the 36 "synthetic application forms" and funding plans presented by the networks applying for funding, on the basis of which the projects were evaluated; the report assessing the projects presented; the database prepared by the evaluators of the RPIA-ITT who collected some summary information on the projects; the "executive projects" presented by the 14 funded projects at the start of the work; the "concluding reports" presented by the 14 funded projects on conclusion of the work; the funding plans approved; the funding data regarding the "certified expenses of the programme"; the guidelines sent by the Tuscany Region to those responsible for the RPIA-ITT projects for drafting the final report; the EU CORDIS project website (for EU projects), institutional websites, and websites of individual organization.

In order to analyze who were the actors involved in the projects and what were the characteristics of the cooperation networks, initially we followed the lines provided by the RPIA-ITT procedures, i.e. the analysis of the projects as separate entities to be

[6] For the interviews with the two partner firms, we studied in depth the information enabling us to describe their competence networks, that allow them to innovate and produce, and their role in the project. For the interviews with the regional managers we focused on their activity in the programme's design.

discussed with respect to each of the 4 action lines envisaged in the programme. Complementary use of ethnographic research and social network analysis changed our perspective by highlighting − by means of summary indicators and graphs − the emergent structure of the programme and the generativeness of the relationships among the actors involved in innovation policy, which were not immediately visible from an examination of the data provided by the individual projects. With Pajek (de Nooy, Mrvar and Batagelj, 2005) we performed a two-levels analysis: one concerning each project (where we examined the relationships between participants in the various work modules of the project), the other concerning the programme as a whole. Networks visualization (see review by Freeman, 2000) and network statistics have provided a powerful support for the emergent working hypotheses in analyzing the RPIA-ITT policy experiment.

3 The RPIA-ITT programme and the projects presented

3.1. The Programme: an overview

The RPIA-ITT programme was developed in a period of three and a half years, from May 2001 (when funds were requested from the European Commission) to December 2004 (when the final documentation describing the performance of the programme was presented to the Commission). The programme budget totalled 6 million euros, with minimum 15% cofinancing by private subjects. The 36 proposals presented in reply to the call for tender published by the Tuscany Region involved 409 organizations, with total 528 "presences" (58 organizations were present in more than one project, for a total 177 "presences"). Of the 36 projects that were put forward, 3 did not meet the call for tender's basic requirements. Of the remaining 33, 13 scored less than 60/100, the minimum needed for approval for funding.

Experience in the context of RITTS (*Regional Innovation and Technology Transfer Strategies*) and in activities developed in the High Technology Virtual Network project led the Region put out a tender for innovative projects witihin four action lines. The first two aimed to "favour technology transfer and diffusion of innovation" in a geographical area (Western Tuscany) and in a range of technological applications (fashion) featuring lower growth capacity. The other two were targeted to technological development and industrial applications of, respectively, optoelectronic technologies and biotechnologies. The RPIA-ITT's tender document specified that the available resources should be shared among the four action lines in a substantially uniform way, with no single action line subject to any restriction. Although the initial distribution of the 36 projects presented was, overall, balanced between the four action lines (though relatively fewer projects were submitted under action lines 2 and 4), the final distribution of the resources assigned to the individual lines was strongly influenced by the very low scores obtained by the projects in action line 4, and by the comparatively higher scores of the projects in action lines 1 and 2. In view of the gap between the score of the "approved" the "not approved" projects (the latter having a mean score of 45.7/100) we decided to extend the analysis to all the projects, with the purpose to identify the reasons for such low assessment, aiming at identifying tools and formulating recommendations that would help improve in future the quality of the proposals made by the local actors.

The projects presented in action lines 1 and 4 have the largest mean size: 14 participants[7]. In general, the mean size is comparatively greater for the approved and, in particular, for the funded projects — which is consistent with the selection criterion that assigned an increasing score (up to a maximum of 15%) as the number of small and medium firms taking part to network increased.

Some of the actors involved in the RPIA-ITT programme had taken part to a series of talks set up by the regional administration when the programme was in its draft stage. The final text of the programme explicitely listed the 16 actors who had been involved in these talks (which we called the "negotiation" stage) and had shown an interest in presenting proposals for cooperation networks that would implement the pilot projects. Indeed, the brief duration of the validity of tender might not have been sufficient to produce a number of proposals suited to the programme's objectives. The involvement of several actors in the negotiation stage therefore allowed the participants to come up with suitable proposals and identify potential partners in very short time. The maximum number of partner organizations in one single project which took part in the negotiation stage is four. On average, the number of partners participating in the negotiation stage was larger for the approved projects and even larger for the funded projects. The information activity conducted by the regional officers was, therefore, essential for the potential participants to be able to devise higher-profile projects with the most appropriate partnerships.

Before examining the structure of the RPIA-ITT in detail, let us summarize some characteristics of the organizations taking part in the programme.

3.2 Characteristics of participants

The call for tender of the RPIA-ITT requested the minimum configuration of the cooperation network to comprise at least 4 firms, 1 research institution (universities or public research centres) and 1 public, private or mixed company[8] having among its statutary aims the provision of services to firms. The size in terms of employees and annual turnover data show that, overall, small firms constituted a significant share of the actors taking part in the programme: a little more than one third of the 409 participants were manufacturing firms, mostly of small or medium size (with less than 250 employees). Half of the 80 manufacturing firms that were involved in funded projects employed 30 people or less. One objective set by the RPIA-ITT had thus been achieved.

In the funded projects, there was a slightly greater share of manufacturing firms, organizations providing services to firms and associative organizations. The activities in support of innovation, technology transfer and R&D received a relatively greater share of the resources of the funded projects.

Although it was not compulsory for the participants to be located within the regional territory, the call for tender stated that it was desirable for Tuscany-based organizations to be involved. This was achieved: only 10% of the organizations taking part in the 36 candidate projects had headquarters outside Tuscany, and only 3.8% of the resources was assigned to them.

Of the 409 organizations in the 36 projects that applied for funding under RPIA-ITT, 58 were present in more than one project. Although there is no significant correlation between the number of projects in which an organization is present and

[7] The project involving the largest network numbered 24 partners.

[8] Classified in the NACE's sectors of the economy J, K and O (restricted to division 91).

projects funded, some among these 58 organizations were very active in the programme: suffice it to note that the first 10 organizations involved in more than one project were to perform activities corresponding to one quarter of the financial resources of the entire programme. On average, each of the 36 project submitted for funding had one partner in common with 7 other projects, with a peak in one project having one partner in common with 15 others. In the set of funded projects the mean figure was relatively higher, and it is to be noted that the projects submitted under action line 3 (optoelectronics) were those that had a number of partners in common with the greatest number of projects (a mean of 8.6 projects).

In order to identify which organizations had similar behaviour in applying to the various action lines of the RPIA-ITT, we adopted an algorithm of cluster analysis to the set of 409 organizations, operating on the total number of projects in which the organization was present and the number of projects in each of the 4 action lines[9]. With this analysis we identified six highly significant clusters: four of these (A-D) correspond to the four RPIA-ITT action lines, they comprise 361 organizations involved in a single project and 34 organizations involved in two projects, mostly under the same action line; cluster E includes 16 organizations involved in two or three projects, mostly under RPIA-ITT action line 3 (optoelectronics)[10]; cluster F includes 8 organizations involved in more than five projects, the most active participants in the RPIA-ITT[11]; in addition, four of the eight participants to cluster F − CEO, CNR-IFAC, El.En., INOA − are leading actors in the field of optoelectronics. These two clusters show that optoelectronic technologies were at the core of the whole programme. The organizations operating in this sector − which is characterized by technological convergence in a vast range of applications − found many opportunities for funding in the context of RPIA-ITT, by submitting projects not only under action line 3, but also under the other action lines (they submitted projects ranging from cutting marble in the quarry to the traceability of genotypes along the oil-wine filière).

Overall, 19 of the 24 organizations in clusters E and F were involved in funded projects − that is, 9.4% of all the participants to funded projects − performing activities in the RPIA for nearly 3.2 million euros, around 50% of the entire financial resources of the programme. These organizations, for their economic and technological importance in the programme, deserve an in-depth analysis, in order to explore their role as "bridging nodes" among the different projects. This will be dealt with in section 4.

4. Networks of relationships within and between RPIA projects

4.1 Two-level networks

Although the RPIA-ITT was aimed at the creation of innovative cooperation networks, the regional administration's first approach to evaluating the effects of the various proposals presented was to frame them within the four action lines the region had set in the call for tender. To some extent this was quite reasonable, since three of the four action lines were identifying separate technological fields. Both ethnographic

[9] Clusters processed with S-Plus®, S-statistics = 0.83. We thank Jose Lobo for this elaboration.

[10] Four of these (a data firm and three research firms) were involved in projects that were subsequently not funded.

[11] This group comprises some organizations that presented two or three projects within action line 3 in support of optoelectronic technology (CEO, CNR-IFAC, El.En, Eurobic, INOA), two actors whose participation was "spread" among projects within various action lines (CGS and CPR), and one actor (S.Anna) that submitted projects mainly within action line 1.

interviews and cluster analysis shifted our perspective: on those results we grounded our hypothesis that the effectiveness of the policy under consideration had to be considered with regard not only to the individual projects in the four action lines, but also to the overall potential changes that it activates through the mobilization of relationships among the actors participating to more than one project. It should be noted that the perspective stressing individual projects as if they were acting in isolation was not specific of the Tuscany regional administration. It is the one pursued by the EU guidelines focusing on the "results impact factors" of the projects funded (number of patents, number of partners, number of workshop, of publications, of the share of resources spent according the executive budget plan, and so on). Although those data might be useful in cross-programme comparisons, for example at EU level, from this information we could hardly answer some crucial issue for this kind of policy measure: which kind of cooperation network (in terms of participants' competences) and in which conditions might be more active in mobilizing innovation processes? Among the organizations that mobilized in response to the programme, which ones were the most active in formulating proposals for innovative projects? and which ones were most successful in obtaining funding? Answers to these questions have been found by analyzing interrelationships within and between the cooperation network associated with the individual projects.

To explore these aspects we constructed two sets of bipartite networks: one related to the individual funded projects, assessing the module-partners network, and another relating to the projects-partners network for the 36 projects and the associated 409 partners. These two sets of bipartite networks will be discussed by focusing on three aspects: first, the configuration of the relationships between organizations participating within each project; second, the emerging structure of the programme; third, the organizations functioning as "bridging nodes" or "connectors" between the participants in the programme.

4.2. The structure of the funded projects: the module-partner networks within the projects

According to the application forms, the activity of each project had to be described with respect to work modules. The funded projects had, on average, slightly more than 7 modules per project (slightly more than the non-funded projects) with an average of 3 participants per module. Since the participants were involved in more than one activity in the project, the total number of presences in the modules provides us with an indication of the interweave of collaborations within the project. Within the cooperation networks, the partners were generally not engaged with the same intensity: on the one hand, this seems reasonable because it is often necessary to implement a project with a central core of coordinating actors and a team of participants who collaborate on specific activities; on the other hand, this might also suggest that the number of participants was increased with the aim of achieving a higher score in the assessment, but without any corresponding engagement by those participating in the project.

In order to retrace the process of construction of the cooperation network and the different roles of the participants, we analyzed − for the 14 funded projects − the information available on the type of activity and the time spent in the project. For each project we constructed three types of module-partner networks, enabling a comparison of the configuration of the network at three distinct moments: presentation of the request (application form), beginning of the work (executive plan), report on the results

achieved (final report). The heterogeneity among the 14 project networks can largely be accounted for by the way the documentation was produced: although the data presented in the application stage (and thus included in the application forms subjected to ex ante evaluation) provided detailed specification of the activities of the project and the partners who would be involved, they did not always provide complete indications on the roles of the different actors within the various work modules. An example of the visualization of the three networks of partner-module relationships is given in Figure 1, referring to one of the projects which had a more complete and precise description. The number and quantitative importance of the partners can be seen quite clearly when ties in the network are weighted with respect to engagement in terms of person-month. However, the qualitative importance of the various partners can be gauged only through careful analysis of the individual projects.

INSERT Figure 1. Network of participant organizations and work modules.
Figure 1 caption: Using one of the funded projects as an example, these networks capture the organization of the project in terms of the contribution of each participant to which work modules, at three different moments in the history of the project

Since the number of cases is too small in order to highlight a significant typology, we shall confine ourselves here to a few methodological remarks.

A first remark concerns the concentration of the activities and the total and mean person-months committed to the projects. With regard to information available on 13 networks some actors could be defined as "more active than others". In 2 projects out of 13[12], activity is concentrated among a restricted number of actors (engaged for more than 60% of the total person-time). In general, the intensity of the participants' engagement in the project should be considered in addition to the mere counting of the participants.

A second remark highlights the need for visualization of module-partners networks. It could provide an effective tool to describe — in the stage of ex ante evaluation — the characteristics of the network and of the articulation of the project, thus complementing the qualitative analysis of the proposals. This might also be a powerful tool for updating, in itinere, the changes in partners' roles and interactions. Visualization of such networks might be effective for reconstructing a process that cannot be described with the administrative data of expenditure accounting (as usually recommended in the EU monitoring and evaluation guidelines), and that was difficult to summarize on the basis of the extremely heterogeneous data contained in projects' final reports. In this perspective, visualization becomes a lever in order to obtain proper descriptions of the participants, (their characteristics, their role in the network) both those that were initially involved in the network (formally constituted to bid for funding) and those who (after the project's approval) were involved at a later time.

4.3. The emergent structure of the programme

In analyzing the project-participants network we highlighted the characteristics of the projects and the participants. The projects were distinguished in four "approval" categories (funded, approved but not funded, not approved, not evaluated) and according to the for RPIA-ITT's action line within which they were presented. Regarding the participants, we evidentiated their sector of economic activity (reclassified by assigning the NACE 1991 codes), whether the participant was also

[12] Data were not available for one cooperation network .

proponent of the project, and whether the participant had been involved in the negotiation stage. Figure 2 shows the bipartite network of the 36 projects and the relationships between the projects through the 58 "connecting" actors. The 361 actors participating to only one project have been omitted from visualization in order to make cross-project links more visible.

INSERT Figure 2. An overview of RPIA applicants and key organizations.
Figure 2 caption: The 36 projects that applied for funding under the RPIA-ITT programme and the 58 organizations that were involved as partners in more than one candidate project

INSERT Figure 3. Key organizations involved in the progamme.
Figure 3 caption: The 58 organizations that were involved as partners in more than one candidate project

The graph in Figure 2 shows two projects isolated from the others (since the participants were not present in other projects) and projects with a greater or lesser number of links with others. Before examining some summary indicators describing these links, we shall consider the project-partner relationships, shown in Figure 3, displaying only the relationships between the 58 actors present in more than one of the 36 projects. Here, the graph traces the relationships that serve as a backdrop to the whole programme and that have at their centre a core of actors with a great number of links. A better interpretation of these relationships emerges from the analysis of the centrality indexes listed in Appendix 2[13]: the Scuola Superiore S. Anna of Pisa is at the centre of the general network of the programme with the highest value for all the centrality indexes computed for the network, because of the numerous activities involving its various research groups, present in 15 of the 36 candidate projects[14]. Overall, the organizations that have the largest number of links are those belonging to clusters E and F, whose importance in the programme has been remarked on above (the value of the closeness centrality index varies in a fairly narrow range, between 0.58 and 0.50). The modest value of the betweenness centrality index proves that the nodes in the RPIA-ITT network are connected through many different routes.

Let us now turn to the network of 36 projects reported in Figure 4[15]. Also with respect to these projects, the centrality indexes, listed in Appendix 2, help us to interpret the graph, which highlights the transversal links between the four action lines. The graph makes plain that the presence, among the participants in the project, of

[13] Centrality measures refer to Freeman (1978). Degree centrality measures the number of linkages of each vertex with all the others. In the measurement of closeness centrality the central nodes of the network are those having minimum (geodetic) distance from all the other nodes. The normalized index of Sabidussi assigns maximum centrality equal to 1 when the distance is minimum. To calculate this index the network must be connected, therefore the index value was calculated on 34 of the 36 projects. The index of betweenness centrality measures to what extent a node is central qua element of linkage between two nodes (interrelationship).

[14] If we consider the degree of centrality calculated on the set of the 404 participants, we observe that the position of the S. Anna and of the first ten participants in the list (see the table in Appendix 2) obviously remains predominant.

[15] The analysis of the network of relationships between projects based on the co-presence of persons in charge of the projects did not show further links between the participant organizations, activated by indirect links between their contact persons. This analysis was nevertheless relevant for supporting our reclassification of organizations nodes, such as in the S.Anna or CEO cases, which we briefly remarked on in section 2.4.

organizations that had taken part to the negotiation stage was not always a success factor for the approval of the project, even though funding was granted to all the projects that had 3 or 4 partners that had been involved in the concertation stage.

INSERT Figure 4. Connections between the 36 candidate projects.
Figure 4 caption: Network of relationships among the 36 candidate projects, where a link among two projects indicates that one or more organizations were involved in both.

An initial hypothesis drawn from the ethnographic interviews was that a higher degree of connectivity of a project had acted in favour of its approval, but when the analysis was extended to all the candidate projects we observed that many non-funded projects were closely linked with funded ones. Attention should therefore be shifted to the presence of certain particularly active organizations, which helps us understand the connections between the projects. Some of these organizations had an "excessive" presence that was investigated more carefully by examining other innovation-supporting programmes to which RPIA participants had been jointly involved. This analysis was performed on the basis of the data reported in the application forms of the projects, and for each of these we traced, where possible, the type of "extra-RPIA" activity performed by RPIA actors[16]. We found that 98 RPIA actors had already collaborated with each other, before and outside the RPIA-ITT programme, to 111 non-RPIA projects. These were mainly European projects (67) and projects sponsored by the Tuscany Region (21), the remaining projects were funded by the Italian Ministries (of research, of industry, agriculture, by the National Council of Research). For these organizations we calculated the betweenness centrality index with respect to the network of relationships among RPIA actors linked through participation in non-RPIA projects (see the data reported in Appendix 4). Only in one case the index calculated on the non-RPIA network is much higher, signalling the case of an organization generally very active in other programmes of technology transfer, but relatively less active in the RPIA-ITT[17].

We now turn to the funded projects alone, shown in Figure 5 in the same position they occupy in Figure 4. The map of links among these projects highlights two important facts: first, the core of projects linked by the joint participation of more than one organization shows that projects proposed in the context of different action lines were in fact all related to the technological area of optoelectronics; secondly, one project had strong centrality in terms of direct links with other projects, a datum also confirmed by the analysis of the centrality indices reported in Appendix 3.

INSERT Figure 5. Connections between the 14 funded projects.
Figure 5 caption: Network of relationships among the 14 funded projects, where a link among two projects indicates that one or more organizations were involved in both.

[16] The data on the joint participation to non-RPIA projects on the part of RPIA participants were collected starting from the information provided on the RPIA application forms, concerning each participant's previous research activity. This information was cross-checked and integrated using information available from the EU CORDIS project website (for EU projects), from other institutional websites, and from the websites of individual organizations. Although accurate, this manually assembled database is by no means exhaustive.

[17] Such links do not describe specific collaborations, rather they highlight these organizations' involvement in the search for sources of funding for innovation activities.

4.4 "Bridging" nodes

From the bipartite network − the 36 projects that applied for funding and the 58 organizations that were involved as partners in more than one candidate project − we extracted sub-networks based on the type of economic activity performed by the partners, with the aim of pointing out which type of organization presented more linkages across projects and if the co-presence of actors performing the same category of activity enhanced opportunities for being funded. The economic activity of the participants was aggregated in nine categories, and the graphs are shown in Appendix 5. These graphs highlight two types of sub-networks: those richer in links between organizations of the same type and those where similar organizations have few links with one another. Networks of the first type are those regarding research and development organizations, business services and university departments. Networks of the second type are those regarding firms (manufacturing and computer), public bodies, membership organizations and a other organizations (mainly in the telecommunications sector). Apart from the CNR-IFAC case, many links within the same type of organization do not necessarily imply a greater success in getting funds[18].

The general result of this elaboration is biased by the call for tender's constraint on having a mix of different types of actor in the cooperation network. Nevertheless, from the graphs it emerges that the cluster of research centres involved with optoelectronic technologies stands out for participation in funded projects. This is a network of public research centres, with specific competences in the field of optoelectronic technologies, which aspires to become a structured network for promoting the applications of these technologies in fields ranging from surgery to manufacturing and telecommunications − a wealth of prestigious scientific competences that were effectively mobilized by the RPIA programme and were able to set up links with other research centres, also in the academic world, both in Italy and abroad.

Through the ethnographic interviews we explored the role of heterogeneous competences in the process of formation of cooperation networks[19]. A common claim in the interviews was the importance of involving in the partnership network a multiplicity of actors with different functions and competences, an element necessary to foster the emergence of generative relationships.

Among the participants involved in the RPIA-ITT programme, some service providers have been essential in order to involve actors having specific competences, enabling the management (and performance) of the projects presented for funding in accordance with the RPIA-ITT's call for tender. In many instances, moreover, they displayed a good ability to develop new projects starting from their experience − accrued with the regional programme resources − and to involve a greater number of actors, in addition to those already involved in the cooperation networks set up for the RPIA-ITT programme. The group of service providers involved in the programme consisted of various categories of actors, having different structural characteristics, different behaviours and different objectives. However, a common element is that these organizations deal with interventions in the field of training, certification and technology transfer, a set of activities that allows them to weave a close fabric of

[18] The university subnetwork confirms the strong presence of S. Anna (often involved also in non-funded projects) and evidentiates its links with other research groups of departments of the University of Pisa.

[19] Indexing of the 25 ethnographic transcriptions has been undertaken, by using Atlas.ti, as a complementary research project performed by Margherita Russo (with the assistance of Simone Mazzacani). For sake of brevity we shall not quote the extracts of the interviews, which is usual procedure in ethnographic research.

relationships with both manufacturing firms and other local actors (such as trade associations, local administrations). Such relationships are exploited in order to identify local needs and promote interventions to foster the development of the local territory. The capability of the service providers to monitor the funding opportunities, as well as their ability to manage the relevant administrative-accounting procedures, are a crucial feature for the possibility to promote and manage innovation projects.

With regard to the relationships between university research teams and manufacturing companies, the interviews showed that the RPIA-ITT programme marked an important opportunity. Participation in the programme enabled many of the university departments and research centres that we interviewed to come into contact with small and medium enterprises, with whom they might not have worked otherwise. Some firms were more receptive to and more interested in proposals that might improve the production process, and, in general, in the introduction of technological and management innovations in the firm. Interaction with these firms was, in general, quite easy, also thanks to their ability to appreciate the impact of innovation on their production process. From the manufacturing companies' point of view, the willingness to collaborate on specific projects was strengthened by the experience of participating in the projects of the RPIA-ITT.

The possibility to bridge the world of applied research with those firms that are less responsive to outside collaborations was enhanced by the intermediation of the service providers, whose action was effective especially with those firms that were willing to follow the example of the more active firms, and to participate to the projects once a core of participants had been established. Involvement by the service providers was indispensable for small manufacturing companies whose activity is entirely focused on the production function, and who are unlikely to respond to stimuli from the "outside" (e.g. from academia and from industrial research).

In general, interactions among actors with complementary competences has played a role in enhancing positive feedbacks (a results first highlighted by Richardson 1972). Nevertheless, from the interviews it emerged that the ability of some actors in dealing with EU bureaucracy (from the application stage to the accountability procedures) might have a perverse effect on the structure of the cooperation network. Moreover, some service providers involved in the cooperation networks did not perform any activities but were clearly involved just to increase the number of participants and consequently obtain a higher proportional score in evaluation. We did not accurately quantify the burden of these participants, but approximately they accounted for no more than 5 per cent of the all budget (of the funded projects), which is less than we expected, but that should be reduced in future policy action lines[20].

5. Concluding remarks

Our detailed analysis of the procedures of the RPIA-ITT programme allows us to formulate concluding remarks that can be generalized to most innovation policies that support cooperation networks among different kinds of organizations. To discuss the most appropriate policy instruments and the most effective procedures, we shall concentrate in particular on four main issues: first, the criteria for assessing the efficient use of resources in EU bottom-up policies; second, creation of a cooperation network within the constraints of a EU call for tender; third, timing of the innovation processes,

[20] Estimated weight draws on the cross check of the participation of a partner in the module partner-network and the description of the activity performed by the cooperation network.

in innovation policy measures; fourth "central" actors in a network that would foster the innovation processes by fuelling generative relationships.

5.1 Efficiency and accountability

The analysis of the RPIA-ITT leaves unsolved a basic problem that, for sake of brevity, has not been dealt with in this paper, but that we recall since, in actual fact, it influences the effectiveness of this experiment in innovation policy measures. The RPIA-ITT can be placed in the context of bottom-up experimentation desired by the Commission and supported through the allocation of an amount (though small) of Structural Funds. The margins of this experimentation were downsized in the last programming period, not only because the share of funds assigned was reduced, but also because the very terms of the experimentation were subject to accounting rules that often hampered the explorative possibilities that might have been provided by the policy measures carried out at regional level. Reducing good government and efficiency to a mere matter of expenditure checks has the ultimate effect of disincentivating those who desire to be involved in an innovation process (private firms and regional administrations) but given the small amount of resources in question are hindered from mobilizing part of them by having to account for every penny[21].

5.2 Networks and projects constrained by the terms of the tender

In the analysis of a policy like RPIA-ITT, cooperation networks and pilot projects are two levels of analysis interwoven with each other, which concern the organizations that cooperate and the activities in which they cooperate; we have stressed that networks and projects are not synonymous, nor can the one be reduced to the other. The formal constitution of a temporary consortium among partners is the key element for the project's implementation. If the network is the metaphor we use to describe the links among the various actors and if our interest focuses on recurring links, we must therefore bear in mind that the creation of a network takes time, and that the timing and the outcome of such a process cannot be neatly inscribed within the terms specified by the tender. Network setup is different from the creation of a prototype, a product, or the dissemination of the results. The interviews show that, in assembling the network of partners necessary for presenting a programme, the promoters of the project referred to relational networks that were already active and to proposals that, to some extent, had already taken shape in previous research and experiment activities — even though the programme was an opportunity to activate new relationships. But the expectation of the participants is that those networks may not necessarily be the ones that will successfully exploit the results of the project.

The point to be generally discussed concerns the role played by the cooperation networks in favouring the innovation processes in support of local development. If we suppose that the innovation processes are "stimulated" by exploiting existing relationships and by supporting and consolidating broader or "generative" relationships among subjects that are not accustomed to entering into relationship with each other (e.g. small firms and universities), then attention must all be focused on how one contributes to creating new networks of relationships or to consolidating the innovative projects that emerge from the already active relationships. In many instances in the interviews we observed that new networks were created by grafting them on to existing relational networks: this is a fairly predictable result, but its importance for local

[21] The issue of experiments in European policies is discussed by Stame (2005).

development is that it was not known, ex ante, which concrete relationships would be activated thereafter, and with what potential and effective outcomes.

The network, then, must also be part of the ex post assessment of the results. In order for the stimulus provided through the programme to be effective, must the network be stable? And what happens if some new partner joins the formal network? The ambiguousness of the idea of network envisaged by the programme lead to descriptions of the networks to be almost completely omitted from the executive plans and the final reports – because the networks' discussion was confined to what was admissible, that is, to what was specified in the project applications, then formalized in Temporary Associations of Aim. In analysing the RPIA-ITT's documentation enclosed with each project at every stage (from the application forms to the final reports), we found very scant attention to the process of creating a network of cooperation among the actors, a process concerning which no kind of information was requested. Even the guidelines set up by the administration on the basis of the EU general guidelines for similar programmes, contained no hints on network formation.

Even a cursory glance at the representation of the module-partner networks of the 14 funded projects (such as Figure 1 above) shows that the projects represented themselves in a heterogeneous way and in a number of cases they failed to describe what a partner did in the network, or forgot to report the partner's activities in the final report. If we had not conducted the interviews we might have ascribed such omissions to errors in filling up the forms or to the scant importance given by a the people in charge of the projects to such information. But the ethnographic interviews witnessed a very close attention to the process of constructing the cooperation networks, both before submitting the application and in the course of the project. This suggests that, in spite of certain negative aspects connected with the terms of the tender and the taxing accounting procedures, those who successfully obtained funding were able to exploit the opportunities offered by the network's enlargement and strengthening.

5.3 Timing: of policies, projects, and innovation processes

It is widely recognized that the time frames of innovation processes cannot be foreseen, even in cases where innovations have already been acknowledged as valid, even from the commercial point of view (Rosenberg, 1996; Lane and Maxfield, 2005). With this in mind, it becomes necessary to take account of two aspects connected with each other.

The first concerns the results exploitation plan: exploitation is itself a process that cannot always be implented (and is often not even clearly identified) in the limited time available for the policy intervention (which in the RPIA-ITT was a scant 13 months).

The second aspect has to do with the time span to which the assessment of the effects of a programme refers. In order to assess the generative capacity of the relationships activated in the course of the funded projects and the new relationships emerging thanks to the activities performed in the projects, the results described in the concluding reports should be updated at least after six to twelve months from the conclusion of the project. Only in this way can one gauge to what extent the funded projects led to other projects (of individual actors in the network or of the network as a whole) or benefitted from the simultaneous implementation of other projects (by individual actors in the network or by the network as a whole).

5.4 Central actors vs. network of actors: monitoring emergent phenomena

From the analysis of the programme it emerged that some actors were "central" in presenting projects and implementing funded proposals: ten per cent of the participants controlled almost half of the financial resources of the entire programme, but were also able, through multiple direct and indirect links, to mobilize some four hundred other actors, many of whom had no previous experience of contact with research centres or universities. In a local production system characterized by some tens of thousands of manufacturing firms this might appear a very modest result, but we should also recall that the resources available for the "pilot" projects were themselves modest.

We suggest that, starting out from the "pilot" character of those projects and the experimental nature of the programme, it might be possible to initiate a new stage that takes advantage of this experience, implanting within the local system the knowledge of the several ways in which generative relationships can be created, and the same time contributing to reduce the difficulties inherent in the joint action among organizations that often function in conditions that are hardly commensurable.

In general, in order to construct and maintain the generative nature of the relationships it is necessary to find the most suitable incentives for stimulating the reciprocity of views of the participants, that must have the time and space to work together, since this will facilitate their understanding of the respective competences and identities. In this sense the RPIA-ITT provided an opportunity for interaction among people with different competences and for experimenting with the creation of relationships capable of sparking innovation processes.

The RPIA-ITT experiment showed how some organizations are able to build bridges between different experiences, needs and competences. These organizations often engage in a wide range of activities — from research to training to consultancy — that brings them close to very different contexts — from academic research to the specific production technology — from which they learn several languages. Their "multivocality" makes them essential actors if the networks are to be created, to be modelled (expanded or narrowed down) and to function around specific project proposals; above all, if the intention is to act on a local production system characterized by small firms concentrating on the production function alone. This is the area of intervention in which it might be possible to strengthen interactions between the regional policymaker and the service providers, with the aim of bringing small firms closer to "unusual" networks of relationships (with universities and research centres, but also with firms operating in other sectors) which may enlarge the competences they can access directly and indirectly. Such interaction between policymaker and "territory" (the locus of relationships among firms, institutions, associations and social parties) demands careful monitoring of the needs for public intervention and of the generative potentials that can be activated by certain relationships: a monitoring that should become common practice for the regional administration.

What kind of "practice" may turn out to be most effective? What we are thinking about is a practice of the kind advocated by Hirschman (1968, 1995 rev.) with his "hiding hand" principle, which he claimed was most effective in the implementation of development projects. A practice with intends to relieve actors from the difficulties connected with confronting change, which is the essence of innovation itself, by concentrating the actors' resources on the changes that consolidate – even in the absence of public incentives – their capacity to initiate further changes in the future.

In this paper we argue that innovation policies directed at the creation of cooperation networks – such as those discussed in this paper – should be evaluated also

for the systemic effects that they produce. In this perspective, it becomes necessary to build into policies the timing of the expected results and ways of checking, in the course of the programme, the processes of interaction among the involved actors. These interactions change the involved actors themselves: new actors are attracted to the innovation processes, the space of interactions of the initially involved actors changes. Rather than assigning more resources to the monitoring of these policies, new ways to monitor and evaluate these policies should be seeked. The flows of resources that, in the last two decades, have been directed to supporting innovation have been matched by a flow of expenditure for analyses and evaluation of policies that so far have not sparked a debate on the effectiveness of these tools (which are compulsory in every community funded measure and tend to document only what is known). It would be better to invest a smaller amount of resources to monitor the way in which funds have been spent and more on brain intensive practices to understand what novelty is emerging from policy.

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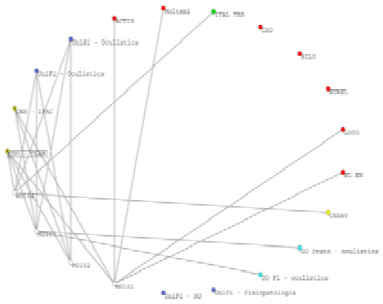
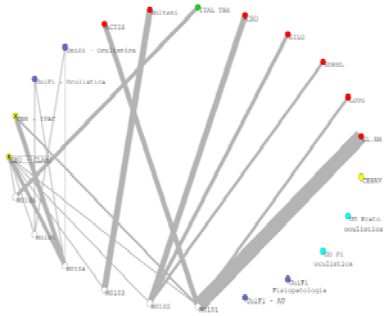
List of figures and appendices

Figure 1. Network of participant organizations and work modules.

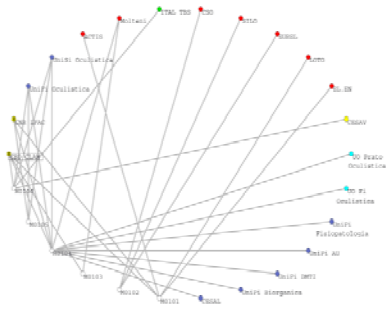
a. data from synthetic application forms



b. data from executive report

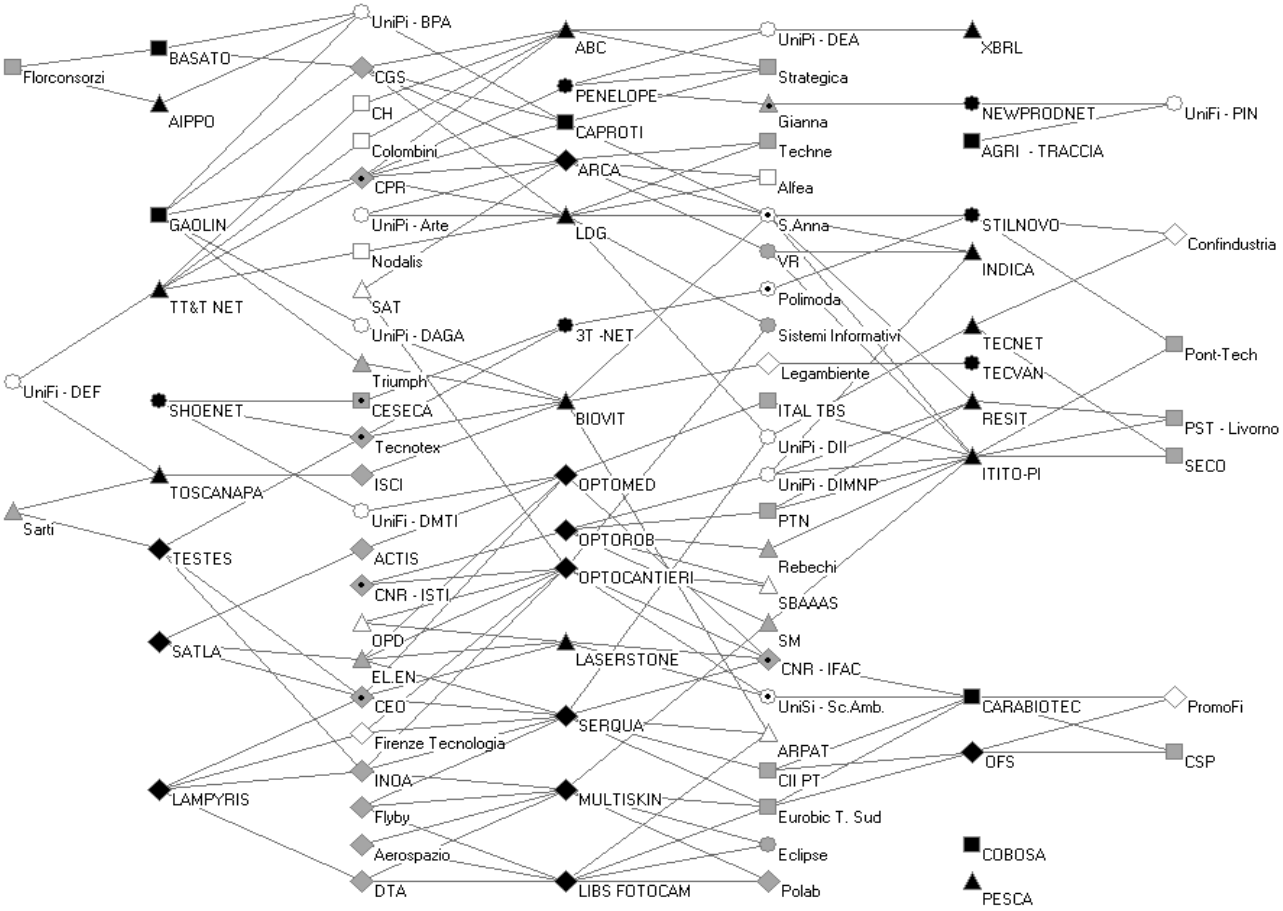


c. data from concluding reports



In network b (produced on the basis of the information contained in the "executive report")
lines are proportional to the person-months that each organization committed to the project

Figure 2. An overview of RPIA-ITT applicants and key organizations.



Key

Projects

The 4 "actions" of the programme

- ▲ Action 1 "western Tuscany": 13 applications
- ● Action 2 "the fashion district": 6 applications
- ◆ Action 3 "optoelectronics": 11 applications
- ■ Action 4 "biotechnologies": 6 applications

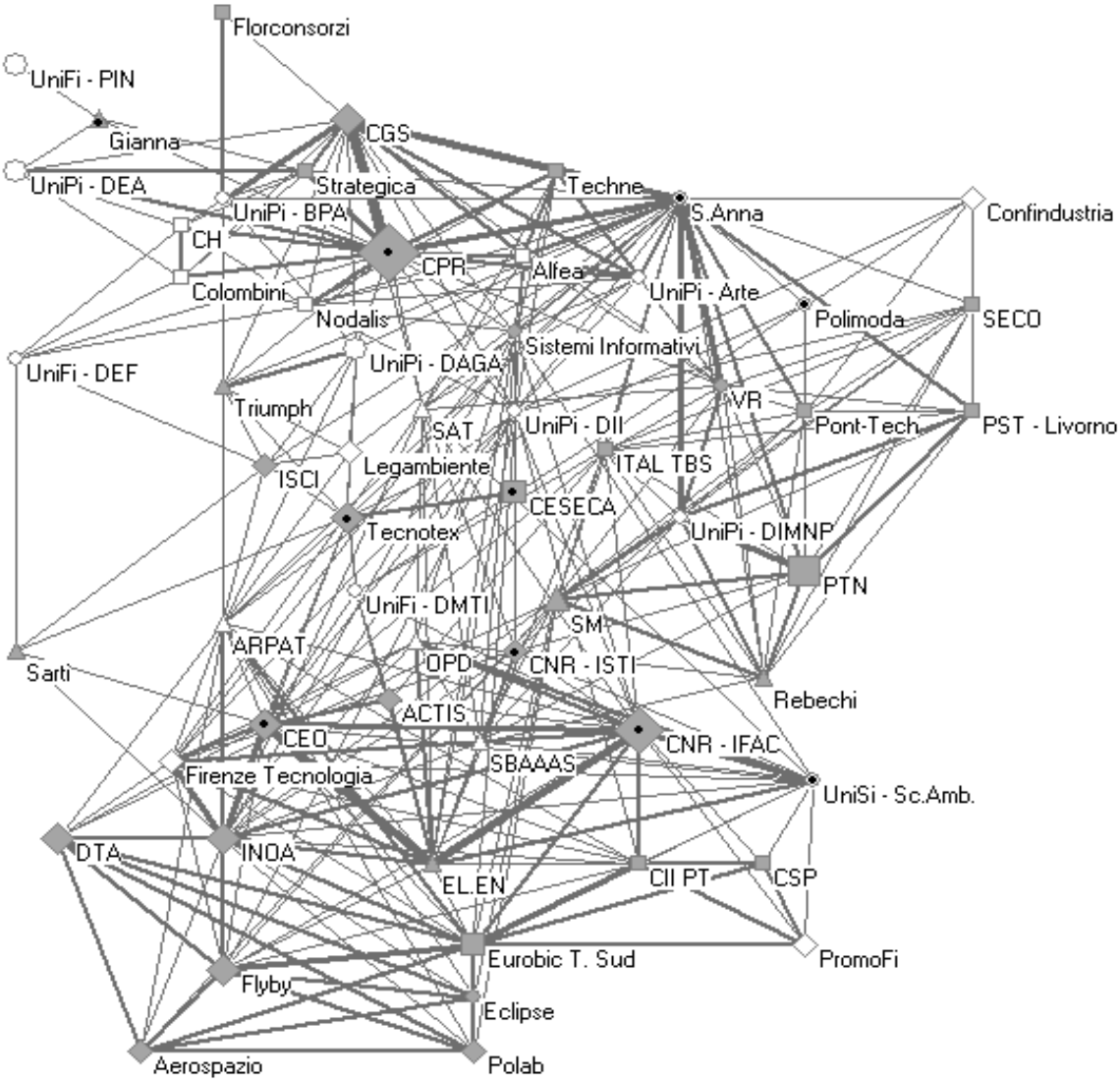
Participants

Sector of economic activity of the 58 organizations that were involved in more than one candidate project

- ▲ Manufacturing (Ateco 1991: 15-36)
- ● Computer and related activities (Ateco 1991: 72)
- ◆ Research and development (Ateco 1991: 73)
- ■ Business services (Ateco 1991: 74)
- △ Public administrations
- ○ Education (Ateco 1991: 80)
- ◇ Activities of membership organizations (Ateco 1991: 91)
- □ Other (excluding agriculture hunting and forestery)

· the organization was involved in the negotiation stage

Figure 3. Key organizations involved in the progamme.



Key

Sector of economic activity of the 58 organizations that were involved in more than one candidate project

- ▲ Manufacturing (Ateco 1991: 15-36)
- ● Computer and related activities (Ateco 1991: 72)
- ◆ Research and development (Ateco 1991: 73)
- ■ Business services (Ateco 1991: 74)
- △ Public administrations
- ○ Education (Ateco 1991: 80)
- ◇ Activities of membership organizations (Ateco 1991: 91)
- □ Other (excluding agriculture hunting and forestery)

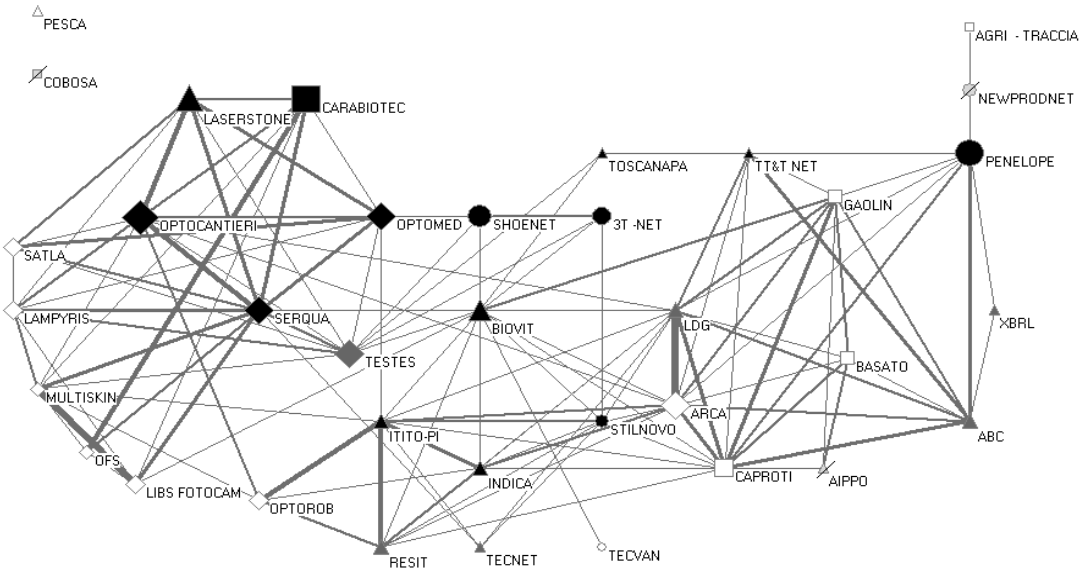
Links between vertices: number of joint projects

- 1
- 2
- 3
- 4

· the organization was involved in the negotiation stage

Vertex size is proportional to the number of projects for which the organization acted as proponent [min 0, max 3]

Figure 4. Connections between the 36 candidate projects.



Key

The 4 "actions" of the programme:

Action 1 "western Tuscany" Action 2 "the fashion district" Action 3 "optoelectronics" Action 4 "biotechnologies"

Vertex size is proportional to the number of partner organizations that had been involved in the negotiation stage [min 0, max 4]

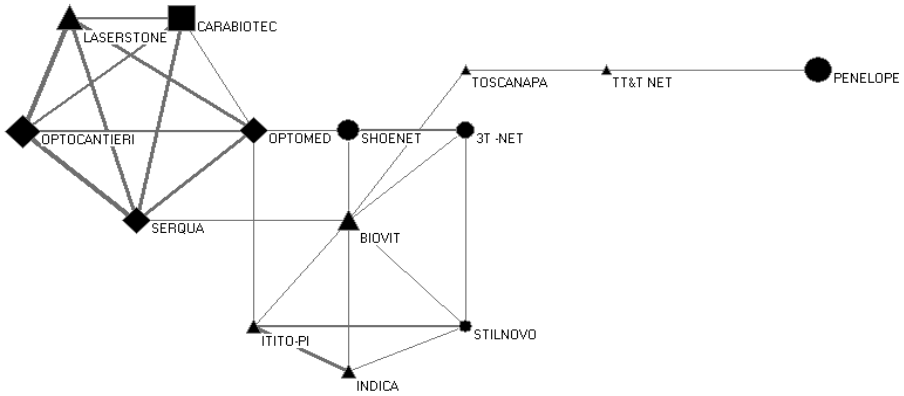
Evaluation score obtained by the 36 projects:

Funded proposals: 14 Approved, but not funded, proposals: 6 Non-approved proposals: 13 Incomplete applications (not scored): 3

Links between vertices: number of joint participants

1 2 3 4

Figure 5. Connections between the 14 funded projects.



Key

The 4 "actions" of the programme:

Action 1 "western Tuscany" Action 2 "the fashion district" Action 3 "optoelectronics" Action 4 "biotechnologies"

Vertex size is proportional to the number of partner organizations that had been involved in the negotiation stage [min 0, max 4]

Evaluation score obtained by the 36 projects:

Funded proposals: 14 Approved, but not funded, proposals: 6 Non-approved proposals: 13 Incomplete applications (not scored): 3

Links between vertices: number of joint participants

1 2 3 4

Appendix 1 - List of reclassified variables included in the data set[22].

v1 Project code (id. number assigned before evaluation)
v2 Project acronym
v3 Name of participant organization
v4 Code assigned to the organization in the context of the project
v5 Participant (shortened name)
v6 Type of organization according to the synthetic application form (Firm or Consortium of Firms; Service provider; University; Public research centre; Private research centre; Training agency; Local administration)
v7 Type of organization according to the financial plan (University; SME; Service Centre; Large company; Local Administration; Training Center)
v8 Type of organization (public; private; private organization participated by a public institution; mixed public-private partnership)
v9 Contact person for the project (name)
v10 Legal representative of the organization (name)
v11 Participant organization's role in the network (proponent; partner; subcontractor; new partner, i.e. not included in Temporay Association of Firms/Temporary Association of Aim; non-admissible partner)
v12 Activity performed in the context of project 1 provision of technology; support for innovation and technology transfer; research & development; public relations; final user
v13 Activity performed in the context of project 2 provision of technology; support for innovation and technology transfer; research & development; public relations; final user
v14 Activity performed in the context of project 3 provision of technology; support for innovation and technology transfer; research & development; public relations; final user
v15 Sector of activity declared by the organization (ATECO91 classification)
v16 Legal status (S.p.a.; S.r.l.; S.n.c.; Sas; S. coop a rl; S.c.p.a.; S.s.; Onlus)
Type of organization (Public Administration; Public Research Centre; Public Economic Organization; Association; Consortium; Consortium participated by public institution; Other; S.C.r.l.)
v17 More detailed description of the activity performed by the organization (text)
v18 Number of employees ([0], [1-5], [6-10], [11-15], [16-20], [21,30],[31-50], [51-100], [101-200], [201-249], more than 249)
v19 Revenue (million €) (< 1; 1-5; 5-10; 10-20; 20-30; 30-40; >40; not relevant)
v20 Localization of headquarters: town
v34 Localization of headquarters: province
v21 Localization of headquarters: type of area outside objective 2; phasing out; objective 2
v22 The organization has taken part in the negotiation stage (yes; no)
v23 Affiliation with other participants to RPIA-ITT projects
v24 Participation to other (i.e. non RPIA-ITT) research projects, whether regional, national or EU; collaborations
v25 Budget (million €)
v26 Requested funding (million €)
v27 Cofinancing (million €)
v28 Cofinancing %
v29 Project evaluation (Funded; Approved but not funded; Not approved)
v30 Funded project (yes; no)
v31 Sector of economic activity (reclassified) (NACE rec. 1.1, 4-digit)
v32 Sector of economic activity (NACE rec. 1.1, 2-digit)
v33 Economic activity (macrosector)(Agriculture, hunting and forestery; Manufacturing; Computer & related activities; Business services; Research and development; Education; Activities of membership organizations; Other)
v35 Participation to more than one RPIA-ITT project (yes; no)
v36 Number of projects to which the organization takes part (observed range: 1-18)
v38 SME (EU standard) (yes; no)
v39 Approved budget
v40 Approved funding
v41 Approved cofinancing
v42 Approved % cofinancing

[22] The information for constructing the database was drawn from the following documents: the official call for tender of the RPIA programme by Tuscany Region, the 36 "synthetic application forms" and funding plans presented by the networks applying for funding, on the basis of which the projects were evaluated; the report assessing the projects presented; the database prepared by the evaluators of the RPIA-ITT who collected some summary information on the projects; the "executive projects" presented by the 14 funded projects at the start of the work; the "concluding reports" presented by the 14 funded projects on conclusion of the work; the funding plans approved; the funding data regarding the "certified expenses of the programme"; the guidelines sent by the Tuscany Region to those responsible for the RPIA-ITT projects for drafting the final report; the EU CORDIS project website, institutional websites, and websites of individual organization.

Appendix 2. Participant centrality indexes.

Participant organization	1. Degree centrality calculated on **58** participants	1. Degree centrality calculated on **404*** participants	Participant organization	2. Closeness centrality calculated on **58** participants	Participant organization	3. Beetweenness centrality calculated on **58** participants
	range 1-28			**range 0,27-0,64**		**range 0-0,19**
S.Anna	28	*112*	***S.Anna***	0,64045	***S.Anna***	0,18856
INOA	22	*56*	**UniPi - DII**	0,58763	***CPR***	0,10936
CNR - IFAC	20	*93*	**Sistemi Inf.**	0,57576	**UniPi - DII**	0,10024
ARPAT	19	*41*	***INOA***	0,56436	CGS	0,07078
CPR	19	*78*	***SAT***	0,56436	***ARPAT***	0,06981
UniPi - DII	19	*50*	***ARPAT***	0,55882	***SM***	0,05364
CGS	18	*71*	***CPR***	0,54808	***INOA***	0,05360
EL.EN	18	*78*	***CNR - IFAC***	0,54286	**Sistemi Inf.**	0,05184
SM	18	*31*	***SM***	0,54286	***CNR - IFAC***	0,04752
CEO	17	*69*	***CEO***	0,53774	***Tecnotex***	0,04099
Eurobic	17	*59*	**VR**	0,53774	***SAT***	0,04085
Sistemi Inf.	17	*41*	CGS	0,53271	**Gianna**	0,03509
Firenze Tecn.	16	*46*	***EL.EN***	0,53271	**ITAL TBS**	0,03379
SAT	15	*32*	**ITAL TBS**	0,52778	***CEO***	0,02980
Flyby	14	*27*	***Eurobic***	0,52294	***Eurobic***	0,02786
ITAL TBS	14	*37*	***Tecnotex***	0,51351	**VR**	0,02575
UniSi - Sc.Amb.	14	*62*	***Firenze Tecn.***	0,50893	***EL.EN***	0,02094
VR	14	*44*	***Flyby***	0,50893	**Strategica**	0,01722
CNR - ISTI	13	*31*	**Nodalis**	0,50442	**Nodalis**	0,01710
SBAAAS	13	*31*	**Triumph**	0,50442	***UniSi - Sc.Amb.***	0,01343
CII PT	12	*52*	**UniPi - DAGA**	0,50442	**UniFi - DMTI**	0,01070
Tecnotex	12	*48*	Alfea	0,49565	**Triumph**	0,01059
Nodalis	11	*25*	Techne	0,49565	**UniPi - DAGA**	0,01059
Pont-Tech	11	*33*	UniPi - Arte	0,49565	**ISCI**	0,01029
PTN	11	*34*	**PTN**	0,49138	***CNR - ISTI***	0,00992
Rebechi	11	*23*	**Rebechi**	0,49138	***SBAAAS***	0,00992
SECO	11	*31*	**UniPi - DIMNP**	0,49138	**UniFi - DEF**	0,00953
UniPi - DIMNP	11	*53*	**SECO**	0,48718	***CII PT***	0,00951
Alfea	10	*21*	***CNR - ISTI***	0,48305	**Sarti**	0,00891
DTA	10	*16*	**ISCI**	0,48305	**Polimoda**	0,00832
OPD	10	*41*	**Pont-Tech**	0,48305	***Firenze Tecn.***	0,00817
Techne	10	*30*	***SBAAAS***	0,48305	***Flyby***	0,00802
UniPi - Arte	10	*21*	***CII PT***	0,47500	UniPi - BPA	0,00786
PST - Livorno	9	*29*	***UniSi - Sc.Amb.***	0,47500	**Pont-Tech**	0,00704
Strategica	9	*44*	**PST - Livorno**	0,47107	**SECO**	0,00434
Triumph	9	*27*	**Legambiente**	0,46721	Techne	0,00391
UniPi - DAGA	9	*27*	***OPD***	0,45968	**PTN**	0,00320
Aerospazio	8	*10*	DTA	0,44186	**Rebechi**	0,00320
Eclipse	8	*10*	**Strategica**	0,44186	**UniPi - DIMNP**	0,00320
ISCI	8	*30*	**Confindustria**	0,43846	**Confindustria**	0,00159
Polab	8	*10*	**Sarti**	0,43511	**UniPi - DEA**	0,00150
UniPi - BPA	8	*39*	UniPi - BPA	0,43511	**CH**	0,00143
CH	7	*27*	Aerospazio	0,42857	**Colombini**	0,00143
Colombini	7	*27*	Eclipse	0,42857	DTA	0,00137
UniFi - DMTI	7	*32*	Polab	0,42857	Alfea	0,00077
Legambiente	6	*29*	**UniFi - DMTI**	0,42857	UniPi - Arte	0,00077
UniFi - DEF	6	*23*	**Polimoda**	0,41912	**CESECA**	0,00065
UniPi - DEA	6	*36*	***ACTIS***	0,40714	***OPD***	0,00040
ACTIS	5	*23*	**UniFi - DEF**	0,40426	Aerospazio	0,00008
Confindustria	5	*29*	**CH**	0,37748	Eclipse	0,00008
CSP	5	*34*	**Colombini**	0,37748	Polab	0,00008
Polimoda	5	*30*	**CSP**	0,37500	***ACTIS***	0
PromoFi	5	*34*	**PromoFi**	0,37500	**CSP**	0
Sarti	5	*20*	**UniPi - DEA**	0,37255	Florconsorzi	0
Gianna	4	*22*	**Gianna**	0,36538	**Legambiente**	0
CESECA	3	*26*	**CESECA**	0,36306	**PromoFi**	0
Florconsorzi	2	*14*	Florconsorzi	0,35185	**PST - Livorno**	0
UniFi - PIN	1	*24*	UniFi - PIN	0,26887	UniFi - PIN	0

* The number of network vertices for which the centrality index was calculated (404 organizations) is different from the actual number of participant organizations (409) because the calculation excluded some organizations which joined the temporary associations of purpose (ATI) after the projects had been approved while it included some organizations which, although involved in the initial ATI, dropped out at the start of the programme.

Key

bold: organizations involved in funded projects

underlined italics: organizations belonging to clusters E and F

9% of participants to funded PRAI projects received a share of 50% of the programme's entire budget

Appendix 3. Project centrality indexes.

Project	1. Degree centrality	Project	2. Closeness centrality	Project	3. Beetweenness centrality
	range 0-15		range 0,25-0,63		range 0-0,19
BIOVIT	15	LDG - INCONTRO	0,63462	**BIOVIT**	0,18775
LDG - INCONTRO	15	ARCA	0,60000	LDG - INCONTRO	0,16229
ARCA	13	**BIOVIT**	0,60000	**PENELOPE**	0,12756
CAPROTI	13	**SERQUA**	0,56897	**SERQUA**	0,10167
SERQUA	13	CAPROTI	0,55932	**OPTOCANTIERI**	0,08528
ITITO-PI	11	**ITITO-PI**	0,55932	ARCA	0,08177
OPTOCANTIERI	11	**OPTOCANTIERI**	0,54098	CAPROTI	0,07193
TESTES	11	GAOLIN	0,50000	**ITITO-PI**	0,05720
GAOLIN	9	**STILNOVO**	0,50000	NEWPRODNET	0,05378
MULTISKIN	9	TESTES	0,50000	TESTES	0,05030
OPTOMED	9	**INDICA**	0,49254	GAOLIN	0,03132
STILNOVO	9	RESIT	0,49254	ABC	0,02691
ABC	8	TECNET	0,47143	MULTISKIN	0,02318
INDICA	8	MULTISKIN	0,46479	**OPTOMED**	0,01980
LAMPYRIS	8	**OPTOMED**	0,46479	**STILNOVO**	0,01691
PENELOPE	8	**PENELOPE**	0,46479	**TT&T NET**	0,01487
RESIT	8	ABC	0,45833	LIBS FOTOCAM	0,01313
CARABIOTEC	7	LIBS FOTOCAM	0,45833	**INDICA**	0,00833
LASERSTONE	7	**TT&T NET**	0,45833	RESIT	0,00833
TT&T NET	7	**TOSCANAPA**	0,45205	**TOSCANAPA**	0,00636
BASATO	6	**3T -NET**	0,42857	OPTOROB	0,00619
LIBS FOTOCAM	6	BASATO	0,42857	**CARABIOTEC**	0,00492
SATLA	6	**ITT_SHOE Net**	0,42857	BASATO	0,00481
OPTOROB	5	LAMPYRIS	0,42857	LAMPYRIS	0,00384
3T -NET	4	**LASERSTONE**	0,42308	**3T -NET**	0,00248
ITT_SHOE Net	4	OPTOROB	0,42308	**ITT_SHOE Net**	0,00206
OFS	4	SATLA	0,41772	TECNET	0,00203
TECNET	4	**CARABIOTEC**	0,41250	**LASERSTONE**	0,00149
AIPPO	3	OFS	0,38824	AGRI -TRACCIA	0,00000
TOSCANAPA	3	TECVAN	0,37931	AIPPO	0,00000
NEWPRODNET	2	AIPPO	0,37079	COBOSA	0,00000
XBRL	2	NEWPRODNET	0,32673	OFS	0,00000
AGRI -TRACCIA	1	XBRL	0,32673	PESCA	0,00000
TECVAN	1	AGRI -TRACCIA	0,24812	SATLA	0,00000
COBOSA	0	COBOSA	n.d.	TECVAN	0,00000
PESCA	0	PESCA	n.d.	XBRL	0,00000

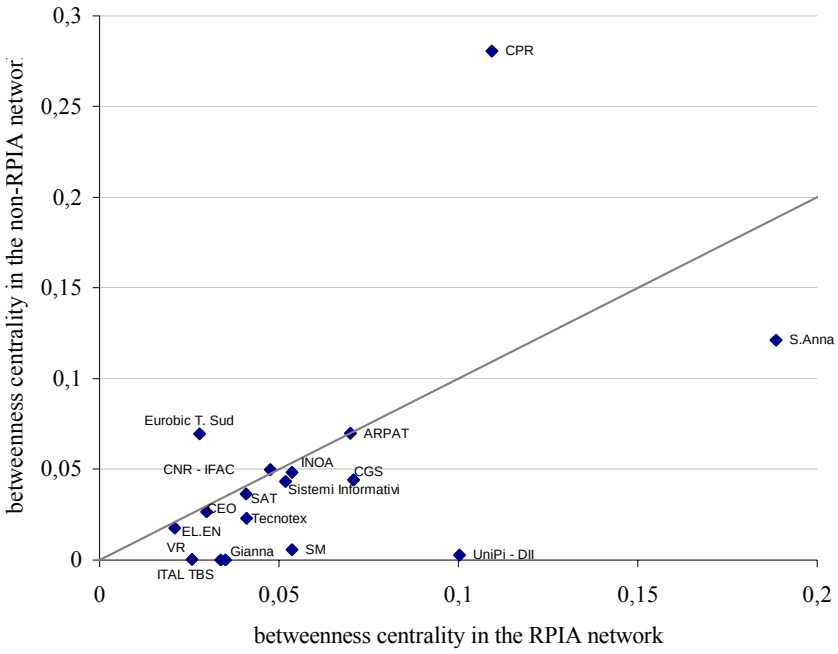
Key

bold: funded projects

Appendix 4. Betweenness centrality.

For each of the 15 organizations with higher betweenness centrality in the RPIA-ITT network, we present the corresponding betweenness centrality values calculated on the network representing the RPIA participants' involvement in non-RPIA projects.

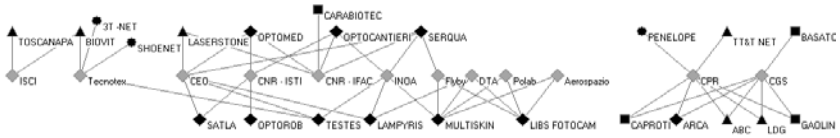
	betweenness centrality in the RPIA projects' network	betweenness centrality in the non-RPIA projects' network
S.Anna	0,19	0,12
CPR	0,11	0,28
UniPi - DII	0,10	0,00
CGS	0,07	0,04
ARPAT	0,07	0,07
SM	0,05	0,01
INOA	0,05	0,05
Sistemi Informativi	0,05	0,04
CNR - IFAC	0,05	0,05
Tecnotex	0,04	0,02
SAT	0,04	0,04
Gianna	0,04	0,00
ITAL TBS	0,03	0,00
CEO	0,03	0,03
Eurobic T. Sud	0,03	0,07
VR	0,03	0,00
EL.EN	0,02	0,02



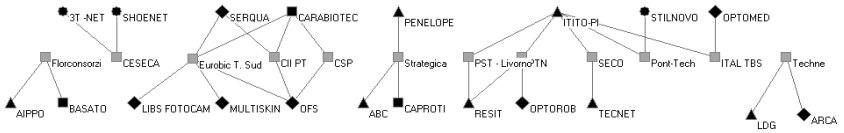
The betweenness centrality index (Freeman) shows to what extent a vertex provides connections between other vertices (it can be computed also on networks with disconnected components). Max **betweenness centrality = 1**

Appendix 5. Connections between subsets of participants.

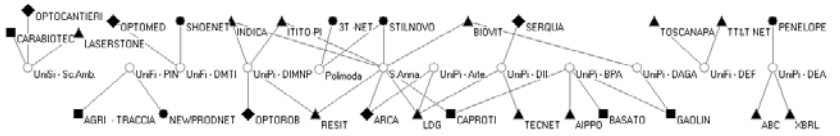
Research and development (Ateco 1991: 73)



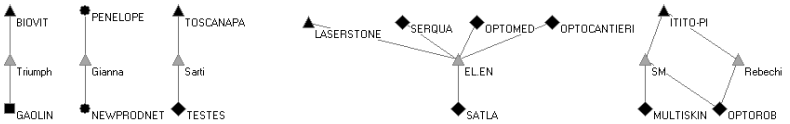
Business services (Ateco 1991: 74)



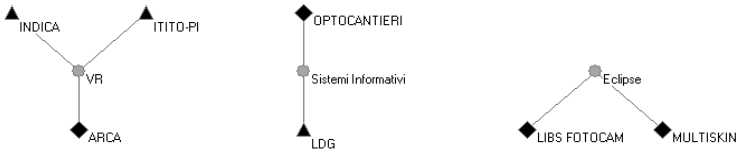
Education (Ateco 1991: 80)



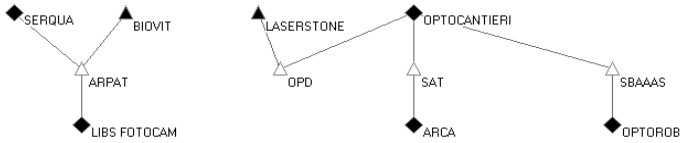
Manufacturing (Ateco 1991: 15-36)



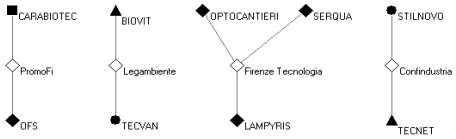
Computer&related activities (Ateco 1991: 72)



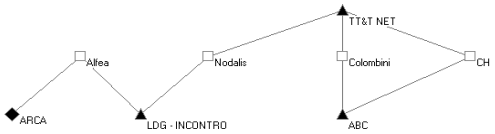
Public administrations



Membership organizations (Ateco 1991: 91)



Other activities



Key

Projects

The 4 "actions" of the programme

- ▲ Action 1 "western Tuscany": 13 applications
- ● Action 2 "the fashion district": 6 applications
- ◆ Action 3 "optoelectronics": 11 applications
- ■ Action 4 "biotechnologies": 6 applications

Participants:

Sector of economic activity of the 58 organizations that were involved in more than one candidate project

- ▲ Manufacturing (Ateco 1991: 15-36)
- ● Computer and related activities (Ateco 1991: 72)
- ◆ Research and development (Ateco 1991: 73)
- ■ Business services (Ateco 1991: 74)
- △ Public administrations
- ○ Education (Ateco 1991: 80)
- ◇ Activities of membership organizations (Ateco 1991: 91)
- □ Other (excluding agriculture hunting and forestery)