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Multilayer network analysis of innovation intermediaries' activities: methodological issues and an application to a regional policy programme

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Abstract

To enhance innovation processes in small and medium-sized enterprises (SMEs), in the last decade innovation policies have increasingly supported the creation and strengthening of intermediaries (Howells, 2006; Lazaric et al, 2008; Kauffeld-Monz and Fritsch, 2013; Russo and Rossi, 2009; Caloffi et al, 2015). So far, however no adequate analytical framework to assess the activity and performance of these intermediaries has been developed. In this paper we address this issue by suggesting a network perspective (a) to analyse the multidimensional activities undertaken by innovation intermediaries and (b) to assess the contribution of the agents involved in different activities promoted by intermediaries. Methodological issues are discussed both in theory and with regard to an empirical application to analyse a regional policy supporting the creation of specialized intermediaries, named "innovation poles", in the Italian region of Tuscany.

The creation of innovation poles has mobilized a large number of agents that were directly involved with different roles in the creation of the regional system of technology transfer. Through the different activities they perform, the various agents create connections between the poles; the poles, in turn, create links between agents, facilitating the exchange of information and creating opportunities for joint actions to boost innovation. This network of networks perspective of analysis asks for the identification of pivotal agents embedded in multidimensional interactions and helps in detecting emerging communities of innovators in the regional innovation system. By adopting the analysis of multilayer networks approach (recently developed by Rosvall & Bergstrom, 2007 and 2008, and De Domenico et al., 2015), we identify the emerging multilayer communities and the intercohesive agents, framing the intermediaries' impact. The paper concludes discussing the implications of this methodology on policy assessment.

Keywords: innovation policy, multilayer multiplex networks; regional innovation systems; innovation poles; intermediaries; overlapping communities

JEL codes: O25 Industrial Policy; O38 Technological Change: Government Policy; 30 Innovation; Research and Development; Technological Change

1. Issue: intermediaries in innovation processes

Within knowledge-intensive economies, intermediary organizations that support firm-level and collaborative innovation have gained increasing prominence (Howells, 2006; Lazaric et al., 2008). These 'innovation intermediaries' provide a range of knowledge-intensive services which might include, among others, technology foresight and technology scouting, supplier selection, R&D partnership formation, technical assistance in the realization of R&D projects, dissemination and commercialization of results, and technological transfer. Innovation intermediaries can also contribute to the success of innovation policies (see e.g. Kauffeld-Monz and Fritsch, 2013). Their role is particularly important for policies targeting micro firms and small and medium-sized enterprises (SMEs), since the presence of intermediaries may facilitate the exchange of knowledge and competencies with other organizations (large firms, universities and research centres) that have different languages, organizational cultures, decision-making horizons, systems of incentives and objectives (Howells, 2006; Russo and Rossi, 2009; Caloffi et al., 2015). Policies aimed at promoting local, regional and national development increasingly involve the public funding of organizations that perform at least some innovation intermediary functions: examples are the regional competitiveness poles in France, the Innovation Networks in Denmark, the Strategic Centres for Science, Technology and Innovation in Finland, the Catapult Centres in the UK.

With the growing importance of policies sponsoring innovation intermediaries, a need has emerged for appropriate instruments to analyse their activity and performance. In our approach we suggest a network perspective (a) to analyse the multidimensional activities undertaken by innovation intermediaries and (b) to assess the contribution of the agents involved in the different activities promoted by the intermediaries. Methodological issues are addressed within the context of an empirical application to a regional policy, support-

ing the creation of specialized intermediaries in the Italian region of Tuscany. In the programming period 2007-2013, the regional government of Tuscany funded twelve 'innovation poles' (effectively starting from 2010). They are regional innovation intermediaries (organized to provide a range of services, including brokering and matchmaking) that bring together a number of universities and innovative service providers with the potential end-users of these services. Their main goal is to promote linkages between regional actors: universities, public research organizations, KIBS, large businesses and SMEs.

In a companion paper (Russo et al. 2015), we have analysed the performance of the twelve innovation poles in fostering the demand of advanced innovative services, on different and diverse technological specializations and areas in the region. In this paper, we analyse through what channels the poles have been active in supporting the systemic dimension of innovation policies of the Tuscany region. Specific objective of the analysis are the many interactions between the poles that were active in the three years of the policy. We consider both the interactions developed through formal linkages, as in the case of cooperation agreements, and those not formalized by agreements between the poles. Among the latter are the cases of resources (managerial or technical personnel, research laboratories or incubators) in common across the poles sharing the same managing organizations (to whom those resources were associated). The creation of innovation poles has mobilized a large number of agents that were directly involved with different roles in the creation of the regional system of technology transfer. Through the different activities they perform, the various agents create indirect connections between poles; the poles, in turn, create links between agents, facilitating the exchange of information and creating opportunities for joint actions to boost innovation. We analyse the intermediaries' infrastructures with a focus on the multidimensional linkages. This network of networks perspective of analysis asks for identification of the pivotal agents embedded in multidimensional interactions and helps in detecting emerging communities of innovators in the regional innovation system.

We highlight a multidimensional perspective on the many interactions that support the entire system of the poles. We consider the agents promoting the system of poles: this network involves both the organizations directly leading and managing the poles' consortia, through the creation of temporary associations, and the organizations that have shareholdings in those organizations. Another set of interactions expresses the competence networks initiated by the system of the poles: these are activated not only through the provision of services by the various operators, but also through the skills of employees and consultants, the collaboration agreements with parties outside the poles.

For each of these domains we examined the characteristics of the networks and the centrality index of the agents involved. In this paper, by adopting the analysis of multilayer networks (recently developed by Rosvall & Bergstrom, 2007 and 2008, and De Domenico et al., 2015), we identify and compare the relevant clusters of agents and the most relevant agents (with regard to the information flow index) in the aggregate network and in the multilayer networks.

Section 2 presents the empirical data set; section 3 outlines the main research questions that we can investigate in the empirical analysis; section 4 introduces the multilayer methodology adopted in our analysis and section 5 summarizes the results with regard to both the centrality of agents in the different networks and the characteristics of emerging communities. The implications of this approach and current developments are discussed in section 6.

2. Data: Tuscany policy programme 2011-2014

We ground our analysis on a unique database of a regional policy supporting the creation of specialized intermediaries in the Italian region of Tuscany. In the programming period 2007-2013, the regional government of Tuscany funded twelve 'innovation poles' (effectively operating in the period 2011-2014).

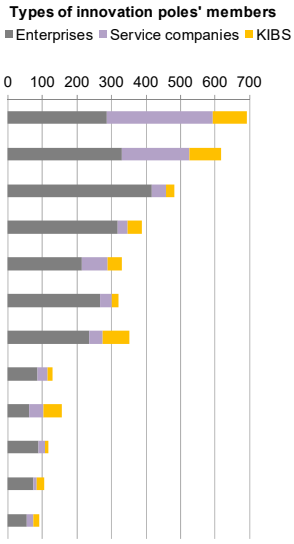
Tuscany's industrial structure includes a large number of micro and SMEs active in traditional industries (fashion, leather, marble, jewellery, automotive), having relatively few connections with universities and other regional research hubs. Nevertheless, in the region there are three main universities (in Florence, Pisa and Siena) with many research departments (covering knowledge areas from architecture to arts and humanities, medicine and technological domains from life sciences to engineer) and some outstanding public research centres belonging to the National Council of Research, with specializations in optoelectronics and information technologies. Goals of the policy were manifold: to strengthen the regional innovation system making the links across the many fragmented research institutions more effective; to support the development of a range of knowledge-intensive services (also through complementary policies aiming at defining the characteristics of those services); to encourage technology transfer and stimulate the innovation capabilities of regional SMEs.

The innovation poles (organized to provide a range of services, including brokering and matchmaking) were active in the period July 2011 and June 2014. After that period of activity, the Tuscany Region started a process of evaluation of their activities to enhance their transformation in technological districts (Russo et al. 2015). Analysis and modelling of innovation poles may provide a contribution to policy design. Poles are specialized in different technological areas and applications, listed in Table 1, with overlapping compe-

tences from the point of view of consortium participants and members associated to each of them. The poles' main goal is to promote linkages between regional actors: universities, public research organizations, KIBS, large businesses and SMEs. They bring together in the consortium, created ad hoc to manage the activities, a number of universities and innovative service providers with potential end-users of these services (members of the poles). Leaders of the consortia are mainly service centres, but among them there are also public or private research centres. The 3,181 members associated to poles are mainly manufacturing enterprises (66.3%). The remaining share is made of companies in the service sectors: from traditional services (21.9%) to knowledge intensive business services (11.8%). Less than one per cent of members are other types of organizations (e.g. associations).

Table 1 The 12 innovation poles: key technologies and applications, consortium participants and member companies, by type
(Figures in red highlight the type of organization leading the consortium)

id	Innovation pole (consortium's acronym)	band	Key technologies or applications	Organizations managing the consortia: N (including leader)	Types (in red the type including leader): University	Public reserch center	Private reserch center	Enterprise	Tech. Park	Service Center	Members of the consortia N. (2014)
12	POLITER	1	ICT Technologies, Telecommunic.& Robotics	13	4	6				3	697
7	POLIS	1	Technologies for sustainable cities	8	2	2				4	643
3	OTIR 2020	1	Fashion (textiles, apparel, leather, shoes, jewelry)	7			2			5	501
11	POLO12	1	Mechanics, particularly for automotive and transport	6			1			5	390
6	PENTA	1	Shipbuilding and maritime technology	5				1		4	352
9	CENTO	1	Furniture and interior design	6	1					5	322
10	PIERRE	2	Renewable energies and energy saving technology	13	5	2	1			5	368
2	INNOPAPER	2	Paper	1						1	139
4	VITA	3	Life science	8	5	1			1	1	158
8	NANOXM	3	Nanotechnologies	6	2	2				2	128
5	PIETRE	3	Marble	4	1			1		2	122
1	OPTOSCANA	3	Optoelectronics for manuf. & aerospace	2		1				1	92



3. Research questions

Innovation intermediaries create links between agents, facilitating the exchange of information and creating opportunities for joint actions to boost innovation. In turn, through the different activities they perform, those agents create indirect connections between the intermediaries.

a) Centrality of agents

With regard to this case study, the regional innovation intermediaries have mobilized a large number of agents that were directly involved with different roles in the creation of the regional system of technology transfer: 46 organizations managing the poles, 420 technicians and consultants, more than 100 research laboratories and 8 incubators were pooled to supply innovative services to more than three thousand members of the poles (mainly SMEs). By adopting a network perspective in the analysis of the impact of the activities of the poles, we explore to which extent the poles are the pivotal agents in those multidimensional interactions, and who are, if any, other pivotal agents.

b) Detecting overlapping communities

To analyse the structure of the network, we focus on overlapping communities of agents mobilized by the creation of intermediaries in the multilayer regional innovation policy.

What is the emergent structure of communities supporting the regional innovation system?

4. Methodology

A multilayer network perspective

Rosvall and Bergstrom (2007 and 2008) introduced a method based on information theory to reveal communities. It solves the main problems with Newman and Girvan (2004) in identifying communities of very different sizes. It operates by minimizing the description length of a network and the loss of information due to the clustering. De Domenico et al. (2015) extend the setup to multiplex networks, showing that by taking into account the multilayer structure of networks one can see new features emerging from nodes interacting in the different layers. Communities maximize the probability of a random walker to remain into a cluster when starting from one of the nodes in that community. Since there is no reason to exclude overlapping communities, the adoption of Infomap to multilayer analysis is more appropriate than other methods that maximize modularity producing disjoint clusters.

A random walker is used to compute flows among nodes in the same layers. With some probability (r=0.15) the random walker can jump across layers through available interlayer linkages (such as the teleportation in the PageRank algorithm). If two nodes in two different layers tend to be visited with similar patterns, they are associated to the same community that becomes a multi-layer community. Thus the algorithm is able to identify both communities in one single

layer and communities on multiple layers. As layers are themselves informative, the outcome is a more realistic and informative clustering. For each agent-node, the algorithm computes the total information flow resulting in the aggregate network and from the state-node's activity in the various layers.

The algorithm identifies the overlapping communities and nodes belonging to more than one community. These intercohesive agents (Sewell 1992; Stark & Vedres 2008) are particularly important in our analysis as they create bridges among communities allowing for the passage of information and competences between them.

Layers

We analyse the intermediaries' infrastructures with a focus on multidimensional linkages. The identification of the different modes of interaction is a crucial component of the analysis. With regard to our case study, we identify six modes of interaction-layers (Fig. 1): Shareholding of organizations managing the poles; Leading and managing the poles; Collaboration agreement, Service provision; Being seconded to (or being consultant of) a managing organization and providing work services to a pole; Membership to a pole. All linkages are undirected. Descriptive statistics of agents' activities in the layers are summarized in Fig 2.

Fig. 1 Graph of 3,896 agents, by mode of interaction (layer)

Legenda: nodes' colours: black nodes with white figures: poles; managing organizations; KIBS; personnel, all other types of agents, edges' colour: by layer

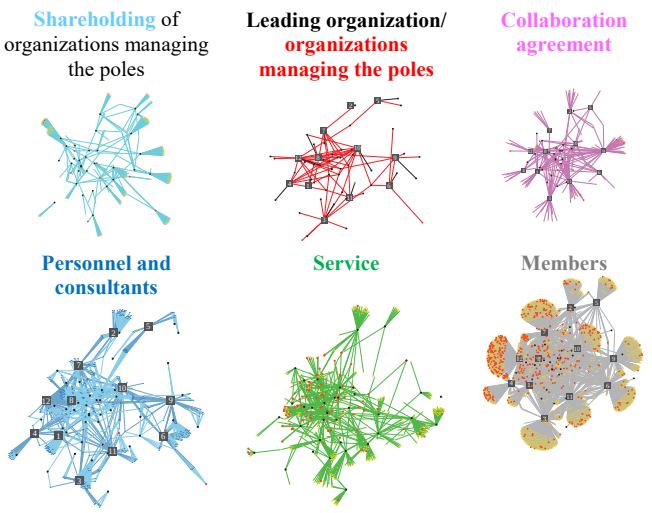
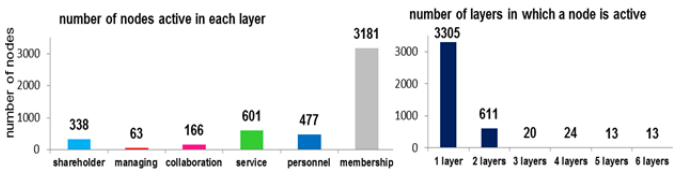


Fig. 2 Agents' activities in the six layers: descriptive statistics



5. Main results

For each layer and the full network (last column), Table 2 summarizes the descriptive statistics of the aggregate network (in the top part) and of the multilayer network (bottom part). The latter has data on "state-nodes" in each layer. In the aggregate network, the number of nodes in the layers ranges from 63 (leaders and other managing organizations of the poles consortia) to 3,181 (the company members associated to the poles). Density of the networks varies greatly across the layers (with highest density in the managing the innovation pole consortium and leading the consortium). With regard to the multilayer network we observe a larger number of edges in the layers "managing", "worker", "member", where the state nodes are more active, generating a corresponding greater network density for each layer, a lower number of connected components and a greater mean degree. The proportion of nodes in the giant components does not change significantly between the two views of the network.

Table 2 Descriptive statistics per type of agent and per layer

aggregated network	shareholder	managing	collaboratio	service	worker	member	Complete Network
Number of Nodes	338	63	166	601	477	3181	3986
Number of Edges	353	88	210	633	960	3926	6113
Avg Shortest Path	Inf	Inf	Inf	Inf	Inf	Inf	Inf
Density	0,0031	0,0225	0,0077	0,0018	0,0042	0,0004	0,0004
Diameter	Inf	Inf	Inf	Inf	Inf	Inf	Inf
Clustering	0	0	0	0	0	0	0
Mean Degree	2,089	2,794	2,530	2,107	4,025	2,468	3,067
Number Connected Components	26	51	154	34	46	3169	2684
Proportion_Nodes_Giant_Component	0,956	1	1	0,940	1	1	1
multilayer network							
	shareholder	managing	collaboratio	service	worker	member	Complete Network
Number of Nodes	338	63	166	601	477	3181	3986
Number of Edges	358	193	338	644	1147	4465	6113
Avg Shortest Path	Inf	Inf	Inf	Inf	Inf	Inf	Inf
Density	0,0031	0,0494	0,0123	0,0018	0,0051	0,0004	0,0004
Diameter	Inf	Inf	Inf	Inf	Inf	Inf	Inf
Clustering	0	0	0	0	0	0	0
Mean Degree	2,118	6,127	4,072	2,143	4,809	2,807	3,067
Number Connected Components	25	41	138	30	36	2779	2684
Proportion_Nodes_Giant_Component	0,962	1	1	0,960	1	1	1,000

Aggregate network vs multilayer network

Fig. 3 presents the graph of the aggregate network (colours of the nodes group different categories of agents, colours of the edges are according the different type of linkage, as in Fig. 1). The aggregate graph shows a more connected zone and several groups of peripheral agents; from the individual layers in Fig. 1 we can single out who are the most connected agents, but we miss the interplay of some agents on more than one layer.

Fig. 3 Graph of the aggregate network

Legenda
edges=layers as in Fig. 1
nodes:
1-12 innovation poles managing organizations
KIBS
personnel
all other types of agents

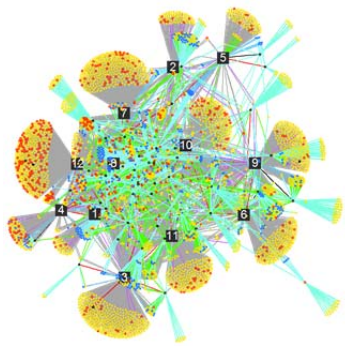


Fig. 4 compares the multilayer flow with the aggregate flow: except the poles, all other agents have a higher flow in the multilayer analysis. This result depends on the fact that innovation poles are not directly involved in two of the six layers (shareholding, services). Moreover, as shown in Fig. 5, agents with high degree have neighbours with very low degree: this is particularly significant for the poles linked to of a large share of member companies that have only one linkage just through their membership to the pole (80% of companies being only member, while only 20% of company members buying services from one, two, three or four poles). The network is thus disassortative.

Fig. 4 Aggregate and Multilayer Flow

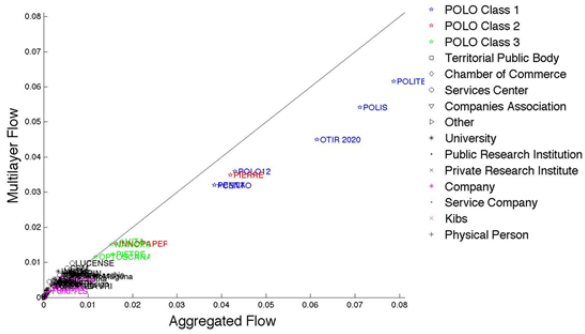


Fig. 5 Degree vs neighbourhood degree

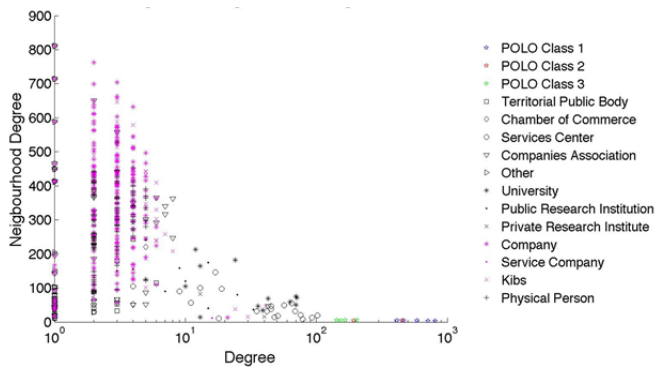


Fig. 6 Multilayer Flow and Eigenvector Centrality

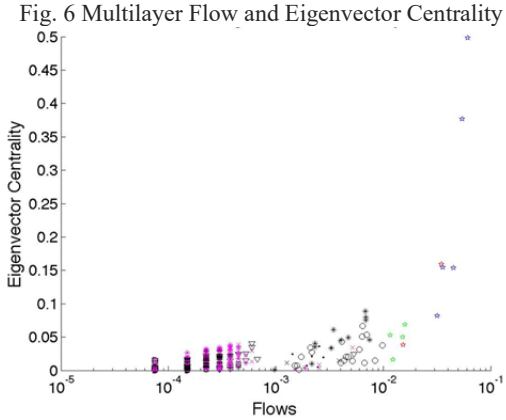


Fig. 6 compares the multilayer flow with the eigenvector centrality: these measures are strongly correlated in this data set. There is also a strong correlation between Infomap flow and degree: all these measures are embedded in the structure of the network. The value added of the multilayer analysis is twofold: it allows for both the analysis of contribution of each «layer» to the determination of the «centrality» of the agents and the identification of overlapping communities and intercohesive agents.

Multilayer analysis

The multilayer Infomap algorithm allows detecting the contribution of each layer and each agent, or groups of agents, to the generation of the total Infomap flow.

From Table 3 we observe that the six layers have different importance in generating the information flow: 60% is generated by the membership to the poles; almost 16% is due to the network of interactions across poles through workers and consultants of the managing organizations providing their assistance to the poles in which the organization, seconded them, belongs to as a consortium' partner; 10.6% is the share activated by the provision of services from managing organizations to the poles' member companies; almost 6% of the Infomap flow reinforces the connections across poles through their indirect links due to the many organizations (mainly local government or public institutions, like Chambers of Commerce) owning shares in the managing organisations of the poles.

Table 3 Multilayer flow, by layer and groups of agents: poles, leaders and 46 managing organizations, other member agents

layers	12 poles	46 agents*	all the others	all agents
shareholder	0,00	3,53	2,57	6,1
managing	0,93	1,83	0,04	2,8
collaboration	1,84	1,08	1,50	4,4
service	0,00	5,82	4,75	10,6
worker	4,16	4,49	7,21	15,9
member	29,66	1,28	29,30	60,2
	36,59	18,03	45,38	100,0

* threshold: total multilayer flow > 0,01%

Let us now consider the Infomap flow generated by the innovation poles: almost 37% of the total multilayer flow is generated by the interactions in which poles are engaged, the larger part (almost 30%) is created in the activation of membership. This was the primary goal of the regional policy: the activation of a support to member companies in demanding advanced services, but only 20% of them was demanding service after becoming member (as discussed by Russo et al 2016, this a sign of partial failure of the policy).

With regard to the 46 agents leading and managing the poles, we observe that their centrality, as measured by the Infomap multilayer flow, is due not only in proving services to the member companies (5.82 %) and workers to the poles (4.49 %) but also through the many connections across the shareholders of some of them. Detailed information on the top 58 agents with the highest Infomap flow (the 12 poles and the 46 leaders managing organizations of the poles' consortia) is presented in Appendix.

Overlapping communities

The Infomap algorithm on the aggregate network produces a large number of overlapping communities (44 out of 45)

with 1,019 intercohesive agents (26% of total) active in two to seven communities. When multilayer analysis is run, it produces 71 communities, 63 of them are overlapping (represented in Fig.3), with 605 intercohesive agents (15% of the total) mainly active in two communities.

Table 4 Number of nodes, by type, belonging to one or more communities, in the aggregate and in the multilayer network

	AGGREGATED network								MULTILAYER network			
	Number of communities								*Number of communities*			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**Total**	**1**	**2**	**3**	**Total**
POLO band_1	5	1	0	0	0	0	0	**6**	1	3	2	**6**
POLO band_2	1	1	0	0	0	0	0	**2**	1	0	1	**2**
POLO band_3	3	0	0	0	0	1	0	**4**	1	3	0	**4**
Territorial Public Bodies	107	4	3	1	0	1	0	**116**	112	4	0	**116**
Chamber of Commerce	7	0	1	1	0	0	0	**9**	8	1	0	**9**
University	74	6	2	0	0	0	0	**82**	78	4	0	**82**
Public Research Institutions	18	2	1	0	0	0	0	**21**	20	1	0	**21**
Private Research Institutions	15	3	1	0	0	0	0	**19**	19	0	0	**19**
Services Center	27	1	0	0	0	0	0	**28**	19	9	0	**28**
Manufacturing Company	1.902	364	106	33	10	0	0	**2.415**	1.991	424	0	**2.415**
Service Company	201	28	11	0	0	0	0	**240**	194	46	0	**240**
KIBS	322	96	55	21	6	3	1	**504**	406	98	0	**504**
Companies Association	55	6	6	4	2	2	0	**75**	67	8	0	**75**
Other	44	1	0	0	0	0	0	**45**	44	1	0	**45**
Workers/consultants	186	172	41	16	5	0	0	**420**	420	0	0	**420**
Total	**2.967**	**685**	**227**	**76**	**23**	**7**	**1**	**3.986**	**3.381**	**602**	**3**	**3.986**

The multilayer analysis is more informative with regard to the structural aspects of the network: it disentangles communities presenting a higher probability of specific connections. Fig. 7 and Fig. 8 show the relative importance of the multilayer communities: the first twelve communities (with 3,202 agents) account for 62% of total Infomap flow and have links with other 60 communities. Each of them has one pole as a pivotal agent. In these communities, the largest part of agents is active only in the layer of membership, the one of the pole they belong to. In the graph of Fig. 9 those communities are the biggest bundles of nodes, each inked to one of the 12 poles. The poles largely contribute to generate the overlapping with other communities, as can be seen from Fig. 10, where: the 12 communities centred on poles are represented only with their label; the other 51 overlapping communities are represented as nodes whose size is proportional to Infomap flow; slices represent the share of flow per layer. All this information provides a tool to characterize specific activities and types of agents in each community.

Fig. 7 The 71 multilayer communities: number of nodes and Infomap flow (by type of agent)

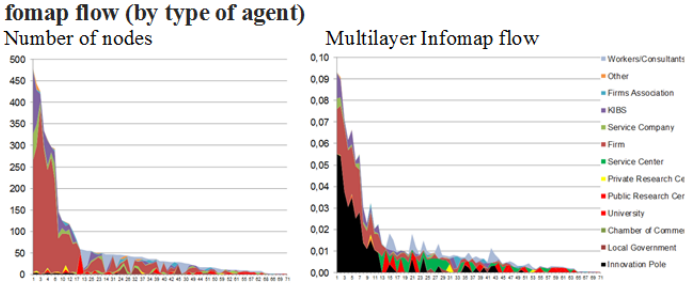


Fig. 8 The 71 multilayer communities: Infomap flow (by layer)

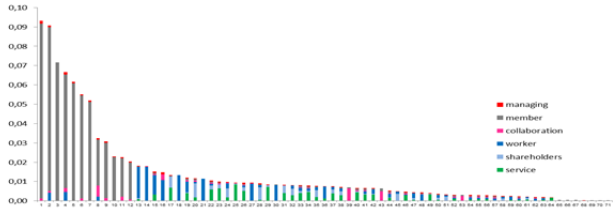


Fig. 9 Graph of the 71 multilayer communities
Legenda: Nodes: Colour=cluster; Size=number of layers; Slices=communities of belongings.
Label-Numbers: pole_Id [1-12] Edges: all the six layers in light grey

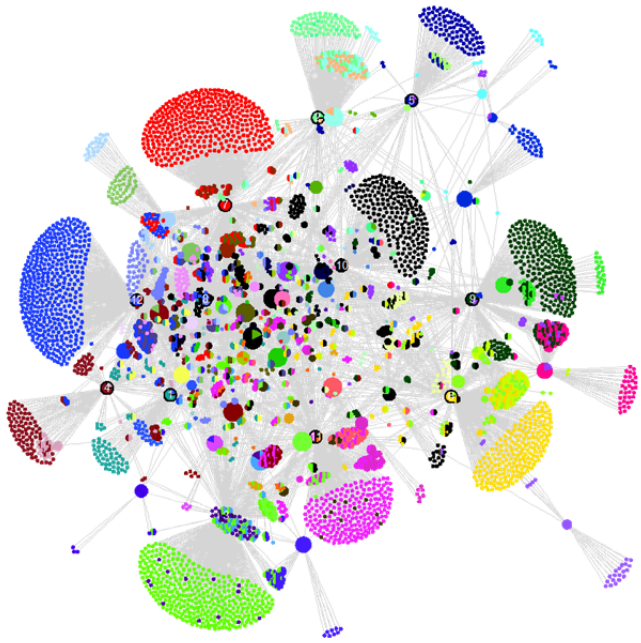
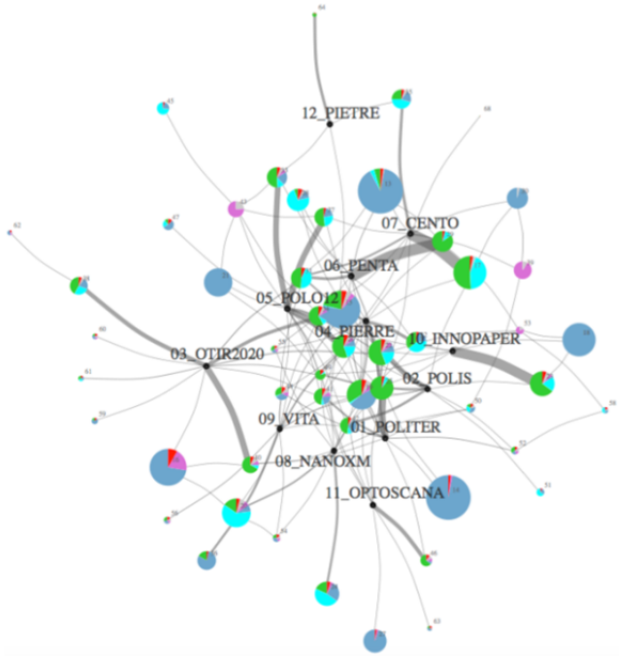


Fig. 10 Multilayer overlapping communities (63 communities)
Legenda: Nodes' size is proportional to Infomap flow (the 12 communities centred on poles are not represented in proportion to their size); slices represent the share of flow per layer (see colours in Fig. 1); edges' width proportional to the number of agents in common between communities



6. Lessons from the multilayer analysis

In the regional innovation system, innovation poles are supported by the multidimensional activity of a number of managing organizations, and some of them have a central role in the system: universities, research centers, and some service centers are in the top position in Infomap multilayer flow. Some lessons on methodological and analytical ussues are drawn by the implementation of the infomap multilayer algorithm.

First of all, identification of layers is crucial for an effective analysis and weights of linkages are a critical aspect in this analysis. Weights of relationships are not comparable and information has different granularity, this reason asks for a great attention in the identification of layers. Let us take the case of services: the algorithm computes fo this layer 10.6% of the total multilayer Infomap flow, but when we use all the information in our dataset, distinguishing each type of service provided, we could obtain a quite different results, since Infomap flow is also affected by the repetition of an interaction, which is in principle an acceptable statement, but we should weight information flow also for the other interaction streams examined (eg. by weighting the share of shareholdings, the number of meetings in the board of directors in each consortium, etc). None of these additionl pieces of information would produce a comparable set of weights to be associated to interactions in each layer. After all, the basic outcome we obtain is illuminating the further investigation (by each layer) that can be done with other tools. Directedness may affect the result, but in the case study it did not affect ranking (results not reported).

A second methodological issue is the core of the application of the multilayer analysis instead of the aggregate one. By comparing aggregate and multilayer results we can stress that multilayer analysis is very informative on structural aspects of the intermediation infrastructures: since the algorithm applies to state-node, the computation of the infomap flow may be used to assess how much is generated by the interactions in the different activities and which is the contribution of the different communities (and for which activities).

This paves the way to the application of multilayer analysis in assessing the outcome of network policies: an important contribution to adopt a network perspective. One of the current developments of our research is modelling the relation between agents' multilayer Infomap flow and their performance. A complementary exploration regards the analysis of intercohesive agents and of their performance.

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Appendix - The 58 agents with the highest Infomap flow: total Infomap flow and flow by layer

Agents are ordered by total Infomap flow. The classification of the innovation poles in three bands, according their size (number of members and total sales), is drawn from official documents.
In the table: colours of conditioned formatting highlight the intensity of flow by layer per each agent, unless the poles (having a total flow much higher than the other agents)

id_node	Infomap flow								type of agent
	total		by layer						
		partial sum	Shareholding of organiz.s managing the poles	Leading organization / org. managing the poles	Collaboration agreement	Personnel & consultants	Services	Membership	
12	0,06153			0,00135	0,00105	0,00644		0,05269	POLO _band 1
7	0,05419			0,00082	0,00060	0,00427		0,04850	POLO _band 1
3	0,04499			0,00105	0,00187	0,00434		0,03772	POLO _band 1
11	0,03585			0,00067	0,00240	0,00307		0,02972	POLO _band 1
10	0,03496			0,00120	0,00120	0,00457		0,02799	POLO _band 2
9	0,03204			0,00075	0,00359	0,00322		0,02433	POLO _band 1
6	0,03189			0,00060	0,00090	0,00397		0,02657	POLO _band 1
4	0,01602			0,00082	0,00097	0,00217		0,01205	POLO _band 3
2	0,01534			0,00030	0,00127	0,00314		0,01063	POLO _band 2
5	0,01512			0,00052	0,00060	0,00187		0,00936	POLO _band 3
8	0,01235			0,00075	0,00232	0,00217		0,00988	POLO _band 3
1	0,01160			0,00045	0,00165	0,00240		0,00711	POLO _band 3
		0,36587							
819	0,00981		0,00127	0,00052	0,00045	0,00337	0,00367	0,00052	Services Center
473	0,00838		0,00307	0,00037		0,00097	0,00359	0,00037	Services Center
1379	0,00749		0,00052	0,00037		0,00112	0,00442		Services Center
2250	0,00704		0,00075	0,00030		0,00202	0,00359		Services Center
259	0,00689		0,00015	0,00067	0,00060	0,00269	0,00217	0,00060	University
279	0,00689		0,00022	0,00060	0,00075	0,00240	0,00217	0,00067	University
215	0,00681		0,00045	0,00045	0,00060	0,00232	0,00254	0,00067	Services Center
994	0,00666		0,00202	0,00052		0,00135	0,00210		Services Center
1600	0,00644		0,00135	0,00052	0,00060	0,00075	0,00314	0,00052	University
1218	0,00636		0,00120	0,00060	0,00045	0,00082	0,00284	0,00045	Services Center
2676	0,00599		0,00389	0,00045	0,00067	0,00052	0,00120	0,00075	University
2847	0,00531		0,00030	0,00052		0,00157	0,00172		Services Center
796	0,00516		0,00052	0,00052	0,00045	0,00090	0,00247	0,00045	Companies Association
1073	0,00516		0,00037	0,00045	0,00060	0,00082	0,00187	0,00060	University
1077	0,00472			0,00030	0,00022	0,00277			University
1690	0,00472		0,00067	0,00045	0,00045	0,00082	0,00232	0,00045	Kibs
2971	0,00449		0,00105	0,00030		0,00060	0,00195		Private Research Institute
1087	0,00434		0,00045	0,00037		0,00112	0,00172	0,00037	University
542	0,00412		0,00180	0,00030		0,00067	0,00157		Services Center
2844	0,00404		0,00225	0,00045	0,00037	0,00105	0,00105		Services Center
193	0,00404		0,00202	0,00037		0,00075	0,00112	0,00045	Services Center
1515	0,00389		0,00112	0,00037		0,00067	0,00150	0,00037	Services Center
2293	0,00344			0,00022	0,00022	0,00232			Public Research Institution
831	0,00329		0,00015	0,00052	0,00060	0,00067	0,00090	0,00060	University
2297	0,00329			0,00045	0,00045	0,00037	0,00157	0,00045	Public Research Institution
558	0,00277		0,00045	0,00037		0,00112	0,00060		Kibs
3260	0,00254			0,00022		0,00097	0,00067		Company
481	0,00254		0,00277	0,00037		0,00052	0,00045	0,00037	Services Center
640	0,00254			0,00052	0,00030	0,00097		0,00030	Services Center
1018	0,00247		0,00052	0,00052		0,00075	0,00037		Services Center
2305	0,00232		0,00007	0,00037	0,00052	0,00037	0,00067	0,00052	Public Research Institution
962	0,00232		0,00180	0,00022		0,00052			Kibs
260	0,00217			0,00015			0,00082		University
2632	0,00217			0,00030		0,00067	0,00030		Private Research Institute
1089	0,00217		0,00037	0,00037	0,00052	0,00052		0,00052	University
2410	0,00210		0,00067	0,00037		0,00060	0,00045	0,00037	Public Research Institution
125	0,00195		0,00105	0,00022		0,00037			Services Center
387	0,00187		0,00007	0,00045	0,00045	0,00052	0,00045	0,00037	University
2255	0,00172		0,00067	0,00037		0,00037		0,00030	Services Center
2298	0,00165			0,00045	0,00037	0,00045	0,00052	0,00037	Public Research Institution
188	0,00157		0,00082	0,00022		0,00045			Service Company
803	0,00150			0,00037	0,00045	0,00045	0,00052	0,00037	University
1831	0,00150		0,00045	0,00030		0,00037	0,00045		Services Center
809	0,00142			0,00030	0,00030	0,00052	0,00007	0,00030	Services Center
3254	0,00127				0,00052			0,00015	Companies Association
722	0,00097			0,00037		0,00045	0,00030	0,00030	Public Research Institution
		0,18031							