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## Materiali di discussione

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**Industrial districts in a globalizing world:  
A model to change, or a model of change?**

by

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July 2009

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### *Credits*

We thank Federica Rossi and Stefania Sardo, members of our research group on “Innovation as a complex social process. Implications for public and private interventions”, who have contributed mightily to the analysis presented in this paper, and Daniela Bigarelli for allowing us to draw on the results of her joint work with one of the authors (Russo, ed., 2009; in press). The analytical framework of the research project has been discussed with David Lane and David Stark that we wish to thank for fostering a creative dialogue on the interpretation of the case study.

A preliminary version of this paper was presented at the Copenhagen workshop “Global Component”, 14-16 June 2009. We wish to thank the participants and in particular Charles Sabel, Annalee Saxenian and Jonathan Zeitlin for their comments.

## **Abstract**

Industrial districts – and especially industrial districts in Italy – have been put forth as a model of economic development premised on the deep rooting of firms in a local socio-economic system that is both rich in skills and tied into international flows of goods and knowledge. But there is also a sense today that those districts are in transformation, that globalization has put them “on the move.” This has led some to question whether a model that is becoming many models can still in fact be a model. In this paper, we use a study of the Modenese mechanical district – an archetypical industrial district – to examine this “movement.” We argue that when properly understood the Italian districts do still offer lessons that are generalizable to other regional economies. We show that the district in question is changing, and show in particular that there has been a rise to prominence in the district of relatively small multinational firms. These are changes that are not atypical of industrial districts in Italy. We argue that a deeper look at just how the districts are changing makes clear that this rise to prominence has not severed these firms’ ties to smaller firms in the district. Rather, they have drawn upon those relations for essential support both on production and innovation. We also show also that there is a cognizance of this fact in the district, evidenced in efforts to recreate private regional institutions consistent with a district structure “on the move.”

Drawing on our these findings, and on a theoretical approach that holds that productive systems in industrial districts are constituted by the multiplicity of interactions between firms, we conclude that changes in the district in question require also changes in the institutions that sustain those interactions, including especially the emergence of “new public spaces” and new “scaffolding structures.” Using the concrete example of a company created to foster collaborative technology transfer among its owner-members, we discuss the nature of the public spaces and scaffolding structures attuned to the needs of a more vertical and fragmented open district structure. We finally consider implications for public policies supporting innovation.

**Keywords:** Innovation policy; local development policies; regional development policies; evaluation management

**Classification-JEL:** D78; O31; O32; O38; R58

## 1. Introduction

This paper is about recent changes in the organization of the metalworking industrial district in the Italian province of Modena, and the implications of those changes for regional industrial policy. But if we do our job right, it should be about more than that, for the Modenese district is not just any industrial district. When industrial districts made their big splash in the international social scientific literature in the early 1980s, it was, along with Prato, *the* archetypical industrial district. It was the place managers, scholars, and policymakers alike went to learn how local governments might work hand in glove with worker, artisan, and employer associations to enable masses of masses of small firms to outcompete bigger and more capitalized rivals by flexibly intermingling competition and cooperation.

Today, of course, some of the questions one asks of industrial districts have changed. But as we shall show in the pages that follow, the Modenese district remains a useful archetype and an almost ideal setting to unpack the theoretical and policy implications of perhaps the biggest question facing the industrial district -- or at least the theoretical construct called the industrial district -- today. What are we to make of the fact that industrial districts today seem to be “on the move” - to use an expression invoked by Sabel (2004) and recently but separately by Rabellotti, Carabelli and Hirsch (Rabellotti, et al. 2009) to capture recent goings on in the Italian districts?

This expression is intentionally paradoxical. When Giacomo Becattini-- and then others -- borrowed the concept of the industrial district from Marshall to describe the seemingly anomalous economies observed in central Italy, the point was to underscore the territorial characteristics and relationships of production. This did not mean that Becattini, or those who followed, saw the districts as *unchanging*. The authors of district discovery did explicitly recognized that districts that were not able to change would not survive (Becattini 1987). But they did hold that the sources of change were inseparable from the very particular form characteristic of the districts of that heyday of Italian smallholder capitalism, a form deeply rooted in “the local community [and] its relatively homogenous system of values and views” (Becattini 1990: 33). And reviews of the empirical literature on industrial districts today do clearly find an increasingly heterogeneous population, rife with new specializations, new international strategies, new innovation strategies, and even with new forms of enterprise organization. Indeed, as Rabellotti *et al* (2009). observe, although “some districts are experiencing a deep crisis, others” - such as that in Modena - “are reacting to globalization and increased competition, are changing their structural features and evolving into different patterns of industrial organization.”

The question has thus become one of understanding the drivers of change, the contours of novelty, the determinants of success, and asking in the face of such heterogeneity what general lessons are still to be drawn from the analysis of these ostensibly anomalous economies.

There are two ways to get at answers to such questions. One is to go “broad” with a survey of firms across multiple industrial districts. This is the tack taken, for example, by Di Maria and Micelli (2007) who use a survey of 650 firms across 41 different districts to argue that the districts have been transformed by the emergence of

“leader” firms that “organize their value chains by coupling district knowledge and competencies with opportunities offered by globalization processes.”<sup>1</sup>

The other approach is to go “deep” into a particular industrial district. We take this latter tack, drawing upon a combination of a representative sample survey of 164 metalworking firms conducted in 2001 (Russo and Pirani 2003) and of 404 firms conducted in 2006 (Russo, ed. 2009), qualitative interviews with 30 firms in the district conducted in 2007 (by the authors), and a longitudinal network analysis of a regional “technology broker” (Rossi, et al. 2009; Sardo, 2009) to understand in detail how the emergence of such leader firms affects the reproduction of that district knowledge and the renewal of those district competencies in an archetypical district – Modenese mechanical production – that is rife with new specializations, new international strategies, new innovation strategies, and even with new forms of enterprise organization.

We argue that when properly understood, the Italian districts do still offer lessons that can be generalized to other regional economies. We show that the district in question is changing, and in particular that there has been a rise to prominence in the district of small multinational firms. We recognize these changes, but we argue that a deeper look at just how the districts are changing makes clear that this rise to prominence has not severed these firms’ ties to smaller firms in the district. Rather, they have drawn upon those relations for essential support both on production and innovation. We show also that there is a cognizance of this fact in the district, evidenced in efforts to recreate regional institutions consistent with a district structure “on the move.”

To understand these developments, we draw on (but also reconstruct) theoretical work on the districts by Brusco (1999), Lane (2002), Lane e Maxfield (1997, 2005, 2009) e Lester e Piore (2004). They argue that industrial districts are constituted by the multiplicity of interactions between firms and a set of rules of the game and institutions supporting firms in the changing environment. We argue that changes in the district in question require also changes in the institutions that sustain those interactions, including especially the emergence of “new public spaces” and new “scaffolding structures.” Using a concrete example, we discuss the nature of the public spaces and scaffolding structures attuned to the needs of a more “vertical” and fragmented open district structure. We also consider implications for public policies supporting innovation.

<sup>1</sup> While this is not the venue for a detailed methodological analysis, it is worth noting some key limitations of many broad surveys of Italian industrial districts. There is not a consensus in Italy on the ideal methodology for empirical analyses of industrial districts in Italy, but there is some sense that the basic steps include defining the spatial and sectoral unit of analysis, extract a representative sample, get data of appropriate quality, and finding proxy measures for the variables in question. It is also well understood that the diffuse nature of production and thousands of small firms that make up an industrial districts make almost any systematic method very difficult to follow in practice, even more so when one wishes to extend the analysis across a multiplicity of districts. As a result, most surveys, including the TeDis survey used by Di Maria and Micelli (see also Chiarvesio, et al. 2004), focus on the larger firms in industrial districts as these are more easily found and sampled (and, some argue, more relevant for particular questions). Others rely heavily on available administrative data, such as accounting materials relating to larger firms or to firms a particular juridical form. This means that their results may be fundamentally conditioned by a tendency to “see” only larger firms, or firms of a particular juridical form (See Russo, ed. 2009, Appendice “Bilanci di impresa per l’analisi dei distretti: una nota critica”).

The paper is in four sections, beyond this introduction. In the next, we describe the general contours of the Modenese metalworking district and its evolution in recent years. In the third, we use the recent founding of a “technology broker” by some of the district’s leader firms both to elucidate emergent tensions and to show that the “district type strategy” contains, at least potentially, some means for their resolution. The fourth section concludes with some thoughts on the implications of our findings for analyses and policies of districts and regional economies more generally. Appendices present the main figures and tables related to the case study discussed in the two last sections.

## **2. Modenese metalworking “on the move”**

Our surveys and interviews generally paint a picture of Modenese metalworking district that has done quite well in recent years, and that maintains many of the classic elements of the industrial district model that catapulted the region into the global eye a quarter century ago. Metal manufacturing industries employed 56,511 workers in 2005. This is some 47% of provincial manufacturing employment (20% of total employment)<sup>2</sup>, and is almost a 10% increase from just five years previous (the district continued to grow until the recent downturn). The basic district structure also remains essentially unchanged. Although the number of metalworking firms in the district has fallen by 2% since 2000, there were still more than 3,800 in the province. As is typical of industrial districts, the majority of those firms serve primarily or exclusively as subcontractors to a smaller (but still quite large) number of “final” firms. Where subcontractors concentrate a vast majority of their sales in and around Modena (73%) or at least in Italy (93%), Modenese final firms serve world markets, with 59% of their sales outside Italy, and they do so quite successfully. Exports from the province have continued to grow at faster rate than have exports from Italy as a whole, and the district, which was already extremely diversified within metalworking industries, has gotten more so. As we were told by in one interview, Modenese firms often take the view that the “best way to compete is not to compete” by which he meant that firms did not so much try to “take on” producers in the low wage world as they sought to avoid them by seeking out specialized niches in which quality and service could deliver price premiums on world markets. His assertion is reflected in our survey data both by the fact that firms in the district sells products and components across a vast array of end user sectors, and by the fact that very short production series or even one-off products comprised some 60% of firms’ total sales.<sup>3</sup>

However, those surveys and interviews also paint a picture of firms in the district that, as our phrase of choice goes, have been “on the move.” Specialized niches don’t just happen. They are made<sup>4</sup>. And Modenese firms have been restructuring their relations and roles in order to move away from what one interviewee referred to as a “horizontal” district model and towards a “vertical” district model.

The distinction is an important one. The interviewee's reference to a "horizontal" model of the industrial district was a reference to precisely the model of the industrial

<sup>2</sup> Source: “Imprese e occupazione in provincia di Modena, Anno 2005”, Chamber of Commerce, Modena.

<sup>3</sup> A full set of figures and tables is available from [www.metalnet.unimore.it](http://www.metalnet.unimore.it), the web site of the Metalnet project on “Structure and change of the relationships in the mechanical industry in Modena”, directed by M. Russo.

<sup>4</sup> On the social construction of markets in the innovation process, see Bonifati (2008).

district that first thrust central Italy into the international spotlight. It was a time when a relatively large percentage of the producers in the province either had relationships with the end-users of their products (which might well be other firms), or could reasonably develop such relationships if they so chose. Collaborations were "horizontal" in the sense that they tended to be between firms in similar situations. In a vertical model, by contrast, there is far more place for what are referred to in the Italian literature as "leader" firms. These are firms that have come to specialize in the establishment of contacts with final markets, and that have thus developed in many cases a sort of gatekeeper role because they are in the best position to "react to or anticipate relevant changes in global competitive positioning" (Zucchella 2006). Leader firms in Italian industrial districts may not be large by global standards, but they are larger and have the organizational wherewithal both to manage a considerable value chain in the district, and to make investments abroad that can then be used either to produce abroad or to increase exports from the district.

A "verticalization" of the district is clearly born out in the survey data. While the province counted just 20 firms with more than 250 employees (and just 6 with more than 500 employees<sup>5</sup>), those firms accounted for 69% of the export sales of Modenese metalworking firms in 2005. Likewise, while it is not unheard of for smaller Modenese firms to have invested in production facilities abroad, it was a step taken by a strong majority of the province's somewhat larger firms by 2005.

Importantly, a shift to a more vertical structure is hardly the only major change. The survey data also suggest a trend towards increasingly formality in relations between firms in the district. The province has also seen the widespread diffusion of "groups" – a term used in Italy to refer to firms that may be independently managed but that are nonetheless bound together by at least some degree of cross-ownership ties. Grouping is an organizational form that is seen in the district as capable of coupling the flexibility characteristic of small firms with the need to achieve critical mass for certain shared functions. While it is not especially common for subcontractor firms to be in groups, among firms selling their own products, some 60% of firms with 20 or more employees are members of groups. Also, while Modenese firms generally report high levels of trust in their relationships with suppliers, their answers to our surveys (and their responses in our interviews) suggest that trust is increasingly accompanied by more formal criteria in the functioning of inter-organizational relationships in the district. Compared to the 2000 survey, in 2005 firms trust, while still important, had fallen as a factor in the selection of "strategic" suppliers. Firms reported instead that those choices had become more likely to be based upon technological needs or shorter lead times (and, interestingly, less on price).

The shift to a more formalized vertical and fragmented structure fragmented into ever more niche markets – both for final products and for the components that go into those products – is an important change. But it also one that must be interpreted cautiously lest it be misinterpreted to suggest a "disembedding" of these leader firms from the rest of the district. And this, our data suggest, is not what has happened. Rather, the most common logic was that put forth by an interviewee at a prominent leader firm who told us that their investment in developing countries had been to "export technology, therefore bypassing the difficulty of entering into those countries with a finished product," thus seeking primarily to "export know-how" they could use

<sup>5</sup> Tetra Pak (554), Maserati (584), Terim (702), Italtractor (787), Ferrari (2.902), CNH (3.576). Source: Metalnet 2005

to build and sell their machines in the countries in which they were used. And in fact, the survey data show that many of the firms that have invested in facilities abroad have simultaneously been investing in the district. And while some groups are foreign owned, the majority of those groups are centered in Modena (though they may include firms outside the region - since we are also in many cases talking about the small multinationals represented by the aforementioned leader firms).

Also, while there has certainly been some “delocalization” (the Italian term for offshoring) of component supply, it was not cited as a major point of tension in the district. With the exception of the three companies in the region that are a part of the Fiat Group (CNH, Ferrari, Maserati), around 70% of components purchased from suppliers were purchased within the region (those three firms do retain a significant local supply base, but also buy more components in other Italian regions specialized in the particular componentry they require). Some interviewees did report that some work had been moved offshore, but said that even that had often come back as those delocalizing found themselves frustrated by quality and delivery problems. The response of Modenese subcontractors was captured in the words of a maker of customized parts for motorcycles who said that a few years previous, there had been lots of talk about China, but that they had resisted with a strategy of “being innovative, and maintaining very high quality. ... We know that the long production runs are gone ... [but] for high quality and prototypes, we are better; if you go in China and ask to make our parts, they don’t know how to do it.”

This suggest that perhaps the big story in the shift to a more vertical and more fragmented structure is not necessarily one of *disembedding* from the territory. And in fact, our data suggest that a particular strength of the Modenese district has been its firms’ *collective* ability to continuously position themselves in a strong intermediate position in global value chains.

By this, we mean two things. First, we mean that the products in which the district specializes are sophisticated components sold to other industrial users and that are in many cases tailor made to the particular needs of those users. From the point of view of many Modenese producers, the rapid industrialization of parts of the low wage world, including especially but not exclusively China, has not just been a threat. It has also created an important new market for Modena’s producers of machine tools, hydraulic equipment, industrial gearboxes and the like.

Second, we mean to recognize that efforts to capture and maintain those intermediate markets have indeed engendered changes in the structure of relations in the district as firms have sought to develop (1) more systematic and continuous - though still incremental - streams of innovation than had been necessary in the past; and (2) more sophisticated and more international marketing capacities than was customary of organizational structures traditionally and tightly held by owner-entrepreneurs. But along with that recognition, we mean to caution against an interpretation of the rise of leader firms that is not attentive also to the bases of that leadership and thus to the dynamics of “followership.”

The obvious and aforementioned quantitative importance of Modenese leader firms to the district’s export success, as well as scholarship’s embrace of the leader-follower metaphor, might seem to suggest that the former as the active authors of district transformation, the latter as their passive subjects. However, this easy narrative is off the mark. The real picture, our interviews suggest, is instead one of a studied combination of independence and interdependence.



It is certainly true that Modenese subcontractors have become increasingly specialized on particular technologies and/or phases of production, that an increasing share of district output ultimately flows through a particular leader firms. But it is also true that Modenese final firms do continue to rely quite heavily, and explicitly, on subcontractors in the area for help producing the steady streams of incremental innovations so central to their global strategies. Our survey data show that it has become increasingly common for subcontracting firms in the area to provide design and R&D services. It is likewise increasingly common for subcontractors to work stably with other local subcontractors in what amount to informal groups in order to collectively offer clients a more complete set of services. But even as these trends suggest growing interdependence, they are tempered by a deep commitment on the part of many Modenese subcontractors to diversifying their business across clients and across sectors.

This commitment is in a certain sense traditional to the district, and seen merely as prudent business practices: as we were told by a metal fabricator specialized in working with stainless steel, his firm “had never been tied to a single client, because in Modenese history people who were tied to a single client have always had problems”; and they were diversified across sectors because “different industries have different highs and lows.” Another interviewee at a subcontractor made clear the degree of her firm’s attachment to their independence describing a time that a multinational client “asked [them] to increase [their] capacity and offered [them] more work but we said, ‘no thanks.’” “They’d “never had any problems with the multinational,” and had in fact used their reputation as a supplier to that multinational to “open some doors” but felt that at the end of the day, “they are a multinational: today they are here, tomorrow they might be gone.”

Diversification is in a certain sense an obvious good – one of those things that is nice to have when you can. But as the above quotes suggest, the deep attachment of Modenese firms to that diversification can also be a constraint on growth. Indeed, among Modenese subcontractors it is certainly valued to a degree that they are willing to forgo growth to ensure independence in what is not merely a defensive strategy but rather a strategy premised also on the belief that diversification was necessary for the reproduction of their own technical capacities. To quote again the aforementioned fabricator of stainless steel components, “our experience in multiple fields can help us to solve problems and to improve parts in ways our clients never thought of.” Or in the words of another supplier, a foundry that had said that they keep a vast array of clients but ensures that none takes more than 25% of business said, “we are able to learn from the developments of all of them.”

### **3. Modenese institutions on the move: new scaffolding structures for ever lasting needs**

In the previous section, we described an industrial district that is on the move, but also one that remains both quite healthy and that certainly bears clear continuities with the model that brought central Italy into the international eye in the first place. Nonetheless, the transition to a more vertical yet fragmented structure is a real change. And, as we shall show in this section, it has implications for the future of the Modenese district and offers an opportunity to both test and update some of the received lessons that have been drawn from analyses of those districts, including especially lessons rooted in the celebrated imagery of industrial districts as shared

“interpretive communities” (Lester and Piore 2004: 125) that foment innovation because they augment what Lane and Maxfield (2005) refer to as agents’ “generative potential.”

To make that case, we switch tacks to focus on the birth, development and functioning of an organization that is some cross between an association and a firm – called *CRIT Centro di Ricerca and Innovazione Tecnologica* (Center for Research and Technological Innovation) – that acts to foster collaborative technological transfer. A “technology broker” acting primarily but not exclusively for many of the more recognizable leader firms in Modenese and Emilian metalworking industries. The organization counts among its member-owners not only Ferrari, CNH, and Tetrapak, but also less famous global powers such as System (a leading producer of ceramic tile machines), GD (the world’s leading producer of cigarette rolling machines), IMA (a leading producer of pharmaceutical packing machines), and beyond. Appendix 1 provide a list of current members and their specializations.

Our analysis of the broker is based on interviews with the director and several employees, attendance and participation in activities sponsored by the CRIT, and, most importantly, access to CRIT’s internal database of contacts generated by the services sold between 2000 and 2008. The goal of our empirical analysis was to reconstruct the organization’s brokerage activities in an analytically tractable way across the 9 year period (see Sardo 2009).<sup>6</sup> Our basic claim shall be that the participation of these leader firms in activities sponsored by the broker are revelatory of two things: (1) their continued reliance for their innovative capacities on diffuse interactions with other firms in the territory; (2) their belief that the existing regional institutional infrastructure is insufficiently attuned to changes in the patterns of those interactions that have occurred in the wake of the transition in the region’s mechanical industries to a more vertical yet fragmented structure.

On the basis of that claim, we will in the conclusion draw implications for the district and for the regional industrial structure more broadly. The second part of the section will be devoted to an analysis of the broker’s activities, and particularly to patterns of interaction enabled by the broker. But it is important that we first locate the initiative in the broader context of industrial policy debates in Emilia-Romagna.

### *The founding of CRIT*

CRIT was founded in many ways almost as an accidental “side-effect” of a broader set of policies that had been established in the second half of the 1990s to sustain innovation in that region. Most specifically, CRIT was an indirect consequence of a 1999 law that offered funding and incentives for universities to connect themselves to other research centers in the region, and that took advantage of some national level-financing for “technology districts.”

In Emilia-Romagna, funding for a technology district naturally concentrated on mechanical technologies (“Hi-Mech”<sup>7</sup>), which manifested in a series of policies and initiatives responding to fears at the time that the very small firms characteristic of the

<sup>6</sup> The relational database contains a record of every person and organization that has attended an event sponsored by CRIT, as well as a record of the purpose of the event in question. We thus know who was simultaneously where, and for what purpose. We also track events with common characteristics, so we know, for example, that members of two organizations met regularly regarding some topic or other.

<sup>7</sup> Detailed description on Hi-Mech are available at <http://www.hi-mech.it/>

region would be unable to incorporate rapidly emergent information and communications technologies into their production and business models, and to a sense that existing institutions in the region, including especially the University system, were both too disconnected from that fabric of small firms in the region and too fragmented internally to usefully connect the world of research to the world of production. Among these initiatives was a proposal to link a network of university research centers to a “Science technology park” that would be placed in Spilamberto, a town in an area densely packed with mechanical firms on the border between the provinces of Modena and Bologna.

The project was promising, at least on paper. It had the support of local governments, who saw a chance to rehabilitate a large swath of industrial land long in disuse since the closure of a large producer of explosives in the late 1970s (Sipe – so the park is referred to as the *Parco Scientifico-Tecnologico Ex-Sipe*). The region’s two major universities, Modena and Bologna, were interested in using the park for purposes of technology transfer. And the private sector was interested enough that its support went beyond merely the endorsement of regional artisanal and employers associations. In addition, fourteen of the larger mechanical firms in the region established CRIT.

CRIT was the brainchild of leading figures at Ferrari and Tetrapak who recruited other like-minded firms to join an organization that would be something between an association and a small research center. They each committed to paying what was for such leader firms a relatively limited amount – 25,000 euros annually – to sustain the organization. The idea was that CRIT would have a small technical and administrative staff that could draw upon the expertise of its member-owners to analyze the demand for innovation in the region. Using that knowledge, it would then aim to broker the demands for technology of the mechanical industry, including especially member firms, and sources of supply. Naturally, these would tend especially to be located in the proposed technology park, which would for its part aim to organize that supply relying especially on regional research centers and universities. And it was hoped that the flow of business from the members of CRIT would both ensure the park minimum efficient scale, and, given the prestige of those member firms, would also attract interest from other parties.

However, time has told a different tale. CRIT was founded as part of an initiative with little obvious relevance to the classic model of the industrial district. Indeed, the vision behind the technology park was premised precisely on the view that a model of innovation rooted in diffuse interactions between territorially rooted actors had become inadequate. In the new vision, “real” innovation became something that happens in research centers, that then pass to leader firms and that are then pushed down the supply chain as needed. Yet that vision – or at least its policy cognate – is today on the rocks. Efforts to establish the technology park have foundered amid political infighting in the region – infighting that, while interesting, goes beyond the scope of this article – and its future remains even today uncertain.

CRIT, meanwhile, has not only survived, it has added eleven new members (see Appendix 2). And, most importantly for purposes of our narrative here, it has done so because it has substantially re-oriented its *raison d’être* by remaking itself as an organization that aims more generally to stimulate “collaborative innovation,” working primarily but hardly exclusively with member firms that are generally not

direct competitors, but that do often share at least some overlapping technologies and perhaps suppliers.<sup>8</sup>

It is this non-death and transformation that brought CRIT into our purview, by making the organization into what David Lane (2002) refers to as “scaffolding structure” of the sort that underpins the peculiar “market system” characteristic of industrial districts. Moreover – and this is the reason we invoke CRIT in this paper – it is not just any scaffolding structure. It is a scaffolding structure that is consistent with the more vertical and fragmented structure of the industrial district that we described in the previous section. And it includes many of the district’s most powerful firms.

As such, it is indicative of the fact that the supporting institutions of the Modenese district are themselves on the move.

This is a point to which we will return in some detail in the conclusion. Before we do that, however, we must explain just what CRIT has become and what it does, and must make clear that what interests us is not its size.

#### *What CRIT does*

The interesting thing about CRIT is not its size: the organization’s capital is just 383,000 Euro, it has but 20 employees, and had a turnover of just 614,000 Euro in 2008. What interests us about CRIT is its novelty, and especially the *combination* of activities in which this technology broker is engaged. In particular, we are interested in the way in which CRIT combines services to firms of two basic sorts that we conceptualize as either *switches* or *spaces*.

CRIT acts as a *switch* when it activates one-to-one relationships (generally between a member firm and a non-member firm or research organization). Switching is classic brokerage, in which CRIT is approached with a demand for a service or for information, uses data in internal databases or conducts an external search, and either provides the service using internal engineers or connects the client to an organization that can provide the desired service. Switching includes R&D projects, technology “scouting,” proposals for external funding (e.g. from the EU), or analyses of competitors patenting patterns conducted by a small consultancy that is a wholly owned subsidiary of CRIT.

It serves instead as a *space* of potential interactions when it creates opportunities for open dialogue. CRIT does this by hosting events such as “thematic working tables”, seminars, technology tours, group training events, and meetings of technical directors. These events are sometimes proposed by CRIT, but are often born of initiatives proposed by member firms. The key is that they take place in a setting in which participants can openly share ideas, but are structured enough that the conversation will be limited to particular topics of “technological” relevance.

There is one type of event – offered free to members, and off limits to non-members – that guides the organization. This is the meeting of technical directors (RDT), held approximately four times per year. These meetings are intended both to ensure that members are familiar to each other and to give CRIT personnel collective guidance on

<sup>8</sup> There is only one case of direct competition between CRIT member firms – between System and SACMI – and even that is consolidated enough that the firms tend not to attack each other’s market segments. When a new firm asks to enter CRIT, all member firms are given the right to veto. This veto has been used at times.

the direction of other services desired. It is notable, we should add, that the organization is guided by technical directors, and not necessarily by company leadership per se.

In nine years, the actions of CRIT have occurred not merely against a changing political backdrop in the region, but also against the debate over the technology park. The demands for services from members changes; but CRIT also offers new services. Initially, many firms asked for R&D projects and for technological “scouting” (where CRIT, either by itself or with the aid of external consultants investigates available technologies or perhaps the organizational capabilities of firms with which a member might be considering collaborating). New services are put into place, such as for example thematic “technical tables” on various subject, many of which meet multiple times over the course of weeks or months. CRIT has also introduced new services, which, if not important quantitatively, do show that CRIT experiments in response to needs signalled by firms (tours, PatMole, Lapcos). In this way, CRIT can itself become part of other organizations’ networks and can itself learn.

Appendix 3, with a list the various services classified into switches and spaces, offers a brief description of each, and shows their relative prevalence over the years in which CRIT has been in existence<sup>9</sup>. Appendix 4 shows the number of services by year and by type of service.

What we are primarily interested in are the patterns with which Crit’s members and non-members use those services over time. For us, the point is that those using CRIT services enter in contact with one another and have occasion to discuss technical matters with persons outside their organization in a semi-structured format. Hence, we analyze the structure of interactions made possible by the joint use of the same services (e.g. a thematic working table, a seminar, and so on) and thus by the presence at the same event. From this, we infer that CRIT generates interactions between organizations that perhaps would not otherwise have occurred.

Put another way, we are interested in the *co-presence* of different organizations at particular events, and the way in which those co-presences evolve over time. Those co-presences can be analyzed in a variety of ways. We begin most simply with some bare numbers (see Appendix 6). There were 295 “switches events, against 187 “space”; 94 organizations participated in just switches events, 169 in just spaces, while 60 took part in both sorts. Of the 25 members, five took part in just one space event (a meeting of technical directors). Most participants are manufacturing firms, primarily engaged in mechanical, electronic, or automotive industries (see Appendix 5 and 6 with the classification of participants by economic activities and by type of services they use). Services that we classify as “switching” are more likely to also involve non-manufacturing organizations (including especially research centers and universities) with complementary competencies especially for R&D and other technological “scouting.”

The share of participants from each member organization to each CRIT event that the organization has subscribed to, is an indicator of the importance that that organization assigns to the various services provided by CRIT. Events are mostly attended by technical and management staff of mechanical firms (see Appendix 6) and some firms have used CRIT services more intensely than others (Appendix 7): six member firms have in fact committed more than one person-month per year to participating in CRIT

<sup>9</sup> For our purposes, the mere existence of the services on the Crit’s catalogue is of little moment.

initiatives. The activities to which most person-days have been committed are thematic working tables, seminars and meetings of technical directors: these provide opportunities for interactions structured around the discussion of technical topics which, especially in the case of working tables, may require several joint meetings and may involve different teams from the participating firms, depending on the topics under discussion.

If we want to understand how the interaction space changes, we need to think both about the organizations involved and the moments of interaction structured by CRIT's actions. Hence, we conduct an analysis of the network structure and its dynamics between 2000-2008<sup>10</sup>. We first analyze the participation of organizations to the various activities promoted by CRIT<sup>11</sup>. The analysis shows that there has been a shift in the range of services in which interactions have taken place, as well as changes in the range of actors involved– the original members of CRIT, the organizations who elect to join, CRIT itself.

Using a combination of unimodal and bimodal graphs of both switches and spaces, we observe that the network generated by serviced offered by CRIT and the particular composition of the demand – on the part of both CRIT members and non members – grows around a nucleus of more active and “central” actors.

The unimodal graph of the two sets of services (Appendix 8) makes clear that the interaction patterns generated by "switches" and by "spaces" are not the same, and highlights differences in the relative importance of the main services and the organizations involved (Appendix 9). Moreover, it must be noted that the population of organizations involved changes over time, as some organizations remain very central, while others are involved in just one event (Appendix 10)<sup>12</sup>. For many, the fact that they have very particular competencies explains their occasional involvement in a seminar, or in a particular technical work table. In general, the centrality of a vertex depends on how important it is in the chain of interactions in terms of how intermediate it is, that is, on the degree to which it can facilitate information flows in the network (or, for that matter, control or distort those information flows).

Mechanical firms have the highest betweenness centrality<sup>13</sup> in space events (see Appendix 15). Members' centrality values, naturally, are even higher. The most central group is a nucleus of seven that are especially active: GD, IMA, Tetrakpak, Gruppo Fabbri, Selcom, System, and CMS, which are slightly more central than another also quite central group that includes Sacmi, Italtractor, Rossi Motoriduttori,

<sup>10</sup> The history of CRIT is intertwined with efforts to found a science-technology park. CRIT entered into the consortium created to run the park in 2002, and was involved until 2005 when that consortium was fully taken over by another group associated more strongly with the provincial government. Since 2006, CRIT has been a member of that consortium, but no longer shared its activities with the consortium. Hence, in looking at CRIT's activities across the nine years of its existence, it is important to recognize that some CRIT personnel had other responsibilities until 2006. In 2006, those personnel were hired full time into CRIT, which in turn sought to expand its activities and to recruit new members (which it did, bringing the membership to 25) (see Sardo 2009).

<sup>11</sup> Such analysis concerns the organizations that have participated in switch or space events, rather than the individual members of staff actually attending the events.

<sup>12</sup> For each type of service, both switch and space, bimodal networks have been constructed showing participation to events through time (Appendices 12-14). These networks highlight the time profile and the intensity of activity of the various organizations (members and non members).

<sup>13</sup> The index of *betweenness centrality* shows the frequency with which a point is found between two others along the shortest path between those points.

CNH, and Datalogic. These are also, notably, the same firms who generally have a high betweenness in switch events. But for switch events, we see high betweenness centrality also for non-members, including especially research centers and universities. Data for degree centrality<sup>14</sup> are similar (see Appendix 16).

Indices of centrality refer to the entire period. By way of an analysis of line islands across time, however, we can observe an interesting dynamics within the central nucleus (see Appendix 17). The analysis of “islands”, which allow us to see subnetworks in a network, confirms that even among central actors, there is a nucleus that is even more central, whose members interact a great deal (and that has become even more stable since 2005, the year that CRIT became fully independent of the Ex-Sipe consortium). The same result is observed by analyzing the intercohesive subnetworks and the lineage of cohesion in the years 2000-2008 with the clique percolation method (as developed by Vedres and Stark, 2007). A synthetic presentation of this method is available in Appendix 18.

The network of participations to events organized by CRIT shows that there is a nucleus of members that are extremely active, and that their activities are highly varied (by type of event, and therefore by the potentiality of interactions with other participants occasionally present).

Only a few members do not participate regularly. As members, they are informed of activities sponsored by CRIT and can take part in meetings of technical directors, whose cost is included in the membership fee. Nonetheless, there are a few members who do not participate even in these events. Our hypothesis is that they nonetheless remain members because the cost is relatively contained, and they do at the very least retain the advantage that it is a club that places their logo next to Ferrari, CNH and Tetrapak.

#### **4. By way of conclusion: What CRIT tells us about a district "on the move"**

What do we learn from CRIT? We could here invoke testimonials from member firms about the value of specific services, or in some cases even about specific innovations that they ascribe to their participation in events.<sup>15</sup> But that is not what we believe to be most relevant for purposes of understanding just what is going on in the Modenese district today. For us, the significance of CRIT lies mostly in the interest it, and its combination of switches and spaces, holds for its member-owners. While each has a major presence in the region, all are major global players in their respective market niches and generally have both the means and the contacts to tap into global knowledge flows. Yet as the technology park project failed, they not only remained members of CRIT, they recruited new members and – using meetings of technical

<sup>14</sup> The *degree of centrality* is a measure of the number of lines emanating from (or arriving at) a node. Degree corresponds in an undirected network to the number of neighbours. Vertices with higher degree tend to be in the densest part of the network. By analyzing the degree distribution, one can see whether ties are distributed evenly across the network, or whether they tend to concentrate in particular points in the network.

<sup>15</sup> If we were to invoke such testimonials, we would talk, for example, about the birth during a tecnotour of a project between GD and IMA. GD is a producer of cigarette rolling and packing machines and IMA is a producer of pharmaceutical packaging machinery. During the tour, IMA engineers saw a technology on a GD machine of which they had been unaware – a technology for testing doses of powders – that has since led to a valuable patent for IMA. GD willingly shared the technology, since the firms are not competitors.

directors – encouraged CRIT to come up with new switches and spaces that would not only bring them together, but that would ensure continued and often relatively diffuse interactions with a diversity of organizations. And the most central organizations have devoted a significant amount of their technical personnel’s working time to participating in CRIT events – not just the meetings of technical directors for CRIT member firms, but also thematic working tables, seminars, training sessions.

This becomes significant when we return to stories about just what it is that has allowed industrial districts – such as that in Modena – to maintain their positions in world markets, and we revisit the lessons that have been drawn from that success in light of the changes we described in the first section.

Take for example the story offered by Richard Lester and Michael Piore (2004) in their book *Innovation: the missing dimension*. Lester and Piore argue that innovation depends not just on analysis and problem solving, but also upon “interpretation.” It is interpretation, they argue, in the face of ambiguity that lends itself to novelty. And while analysis can be improved simply by education, interpretation, they write, requires continuous confrontation with others of the sort that tend to occur in what they call “public spaces” that “provide a venue in which new ideas and insights can emerge, without the risk that private appropriation will undermine or truncate the discussion.”

The search for exemplars of public spaces leads Piore and Lester to industrial districts, on the grounds, they write, that in the districts “the knowledge and understanding circulating from firm to firm have the properties of language and evolve through conversation.” Piore and Lester’s formulation of the functioning of industrial districts and the core lesson that can be drawn, however, notably draws on the classic vision of a space in which interactions are primarily horizontal even as this is less and less the structure of many Italian industrial districts. Theirs is thus an understanding of district functioning that suggests that the transition to a more vertical and more fragmented structure might present some challenges for the reproduction of necessary public spaces. And in fact, they recognize that industrial-districts-as-public spaces have been subjected to pressures by globalization, and that they thus require “internal governance structures that try to conserve and enrich the conversational process and orient it strategically.”

Along a complementary strand of understanding industrial district is David Lane’s (2002) “complexity” perspective. Lane argues that industrial districts are defined by four types of competence networks: networks of information, interpretation, production and marketing. These networks in turn depend on two specific subclasses of institutions that he refers to as “scaffolding structures”<sup>16</sup>: “institutions that provide both a meta-stable identity for system agents *and* the possibility for renewal and change for the system itself.” In the districts, he argues, the existence of *interaction loci* and emergent *rules* and *roles* are at the center of a model premised on rapid

<sup>16</sup> For the notion of *scaffolding structure* see Clark (1997) and Lane (2002). Lane and Maxfield (2005) refer to scaffolding structure in analysing innovation processes: “Scaffolding structures provide a framework for *controlling* the kinds of new entities –both agents and artifacts – that enter the market system, and for *aligning* the attributions of agents in the market system about one another and the artifacts they make, exchange, install, maintain and use. Through scaffolding structures, agents can consolidate a zone of agent-artifact space, making it sufficiently stable to support both markets and the generation of new artifacts to be traded within those markets”. Bonifati (2008) uses that notion with regard to the emergence of new market systems.



reaction to uncertain markets insofar as these scaffolds enable what Lane – with Maxfield (1997; 2005) – calls “generative relationships” That is, they must enable recurring interactions among heterogeneous agents capable of inducing changes in how agents interpret themselves, other agents and artifacts, thus bringing about innovations that are generally characterized as new entities. In the districts, he further argues, these scaffolds include especially those that “promote social cohesion ... while at the same time mixing heterogeneous identities among district agents.” And Lane, like Piore and Lester, envision these scaffolds especially in the classic form of the broad powerful associations and constant role switching characteristic of the classically horizontal district. But what of a district in which the transition to a vertical structure both potentially removes interaction loci, and tends to fix firms into roles (final firm, suppliers, subcontractor) to a greater degree than occurred in years previous?

In pointing at Lester and Piore (2004) and at Lane (2002) for our exemplars of “received lessons” drawn from analyses of industrial district we do not mean to suggest that their views are the only, or even the most important, understandings of just what is to be learned from analyses of the Italian industrial districts.<sup>17</sup> It is an enormous literature, and the contributions have been many. We focus on these two here in part because their approaches do seek to capture a relatively general set of points about district functioning, but also because their understandings of the district as public space, or of the district as defined by a particular set of scaffolding structures, are precisely the sorts of conceptual formulations ostensibly challenged by the transition to a more vertical and more fragmented structure. But where much writing on industrial districts has seen in this transition a transcendence of territory by leader firms that increasingly play on the world stage, we see CRIT as exemplary instead of the continued salience of the territory. Certainly, there have been changes and certainly, codified knowledge has become more important. But the founding by, and continued participation in, CRIT by leader firms in the organization shows by “revealed preference” both that they believe that despite their global prowess, they have a continued need for ties not only to the sub-suppliers with which they work, but with the vast array of competences and ideas still available in the territory. CRIT is, if nothing else, an effort to create what Lester and Piore call a public space that is consistent with the new structure of the district by bringing together not just customers and their suppliers – which happens anyway – but precisely those leader firms in their heterogeneous fields with related technologies.<sup>18</sup> Yet it is also

<sup>17</sup> In a companion paper, we will also be directly in dialogue with Brusco’s (1999) “The rules of the game in industrial district.” We will discuss how those rules have been changing in light of today’s more vertical and fragmented structure, and will argue that goings-on within CRIT, including especially debates between members over the procedures by which prospective members can be blocked, are exemplary both of the fact that the “rules” still matter and that they too are “in motion.” To fully make that argument, however, we must incorporate additional ethnographic material into our description of CRIT, some of which we intend still to gather.

<sup>18</sup> Bespeaking their cognizance of the importance of the territory, it is no accident that one of the more important projects born of a reunion of technical directors was the formation of a database of accredited “excellent” suppliers available only to members. The database was generated by CRIT personnel surveying all CRIT members for suppliers they viewed as exceptional in some regard. When a CRIT member consults the database, that member is also able to see the name of the person who recommended the supplier, and can thus ask personally about the suppliers’ characteristics (beyond the wealth of technical information in the database). CRIT is also now trying to generate a relational space between these suppliers by, for example, representing them as a group at industry

significant that they do not want to meet just with each other, but ensure also the continuous flow of other actors, of other knowledge that they might collectively discuss. The space is a structured space, a scaffolding structure (in Lane's terms) that aims to support the creation and maintenance of competence networks and generative relations that revolve about the "nucleus" found in our network analysis, and who are thus capable of guiding the allocation of roles and enforcing rules; but participants to the network are studiously kept heterogeneous.

In short, Emilian "leader" firms operate on a global scale, but they remain interested in maintaining ties within the district because they believe the district helps them to operate in niche markets and make products that are highly customized for sophisticated users. CRIT is another window into the territorial rooting of these firms. It is a response to the needs of a group of medium sized firms, with strong local ties, but which move in global circles. What needs? The need for a space in which firms can openly exchange ideas about technology, organization and markets with others making products in different niches, but with related technological content. And while CRIT is but a small organization, and but one of many actors in the district, it is exemplary of considerations that policymakers – in Modena and elsewhere – might usefully keep in mind as they assess the policy lessons of a district model that has been too caught up in a schizophrenic debate over whether it is a model to be emulated, or a model to change. We submit simply that while it is both, it is above all a model from which to learn.

Indeed, in Italy, there is a willingness to come up with money to support the districts only if they are finally ready to move into what policymakers think is the modern world, viz. a world in which the districts' smaller firms grow enough to be able to take advantage of scale economies. On the theoretical front, there has often been a return to a more strictly "economicist" understanding of production, an understanding that looks for the advantages of agglomeration in information flows. The abstraction of the term "spillover" has thus been abandoned in favor of the "externality." Increasing returns are thus explained in terms of purely economic interactions; and the embedded of economic action is shunted aside, a residual. Still, schizophrenia aside, there have been real changes. The district model has spread, at least as a normative model, well beyond Italy – though it is often conflated with the "cluster," a concept that emphasizes technical-productive relationships and abstracts them away from actual territories. The industrial district, the service district, the technology district, and all the various empirical declinations are allusions to phenomena of agglomeration in a world in which it is hard to understand relations as they cut between transnational and national dynamics. And in all of these, innovation continues to matter. Production happens in real places. The exact relationship between the two is an empirical question. But is an empirical question to be asked through a theoretical lens. And as the Modena case makes clear, the lens of the district and the territory, of scaffolding structures and public spaces, of rules, relations and roles, remains flexible enough to uncover potentialities.

fairs, with a goal of connecting them also to a broader network of clients. The goal, once again, is to bring knowledge into the network at a multitude of levels.

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## Appendix 1. List of Crit's current members and their specializations

<b>Company</b>	<b>Specialization</b>
<b>AliSpA</b>	Machinery for the production of gelato and pastries
<b>Beghelli</b>	Emergency lighting
<b>Caprari</b>	Pumps and water treatment systems
<b>Cefla</b>	Multisector: water depuration systems, machine tools (especially for woodworking), dental equipment, shelving systems
<b>Cineca</b>	Inter-university consortium: high powered computing
<b>CMS</b>	Specialized machine tools
<b>CNH</b>	Agricultural machinery
<b>Datalogic</b>	Barcode readers, laser technologies
<b>Ducati Energy</b>	Electrotechnical condensers, electronic measurement devices
<b>Ferrari</b>	Sports cars
<b>G.D</b>	Cigarette rolling and packing machines
<b>GrFabbri</b>	Food handling machinery
<b>Hydrocontrol</b>	Hydraulic equipment for industrial vehicles
<b>IMA</b>	Pharmaceutical packaging machinery; machinery for the making of teabags
<b>Italtract</b>	Tractor undercarriages and componentry
<b>RossiMotorid</b>	Gearreducers, gearmotors, motion control equipment
<b>Sacmi</b>	Ceramic tilemaking machinery; beverage packaging machinery
<b>Saima</b>	Logistics
<b>SCM</b>	Woodworking machinery
<b>Selcom</b>	Electronic componentry for home appliances, automotive, telecommunications, industrial automation
<b>Sitma</b>	Packaging machinery
<b>System</b>	Ceramic tilemaking machinery and systems
<b>Technogym</b>	Fitness equipment
<b>TetraP</b>	Food and beverage handling machinery
<b>WAM</b>	Screw conveyors for construction industry

## Appendix 2. CRIT's members by year

	2000	2001	2002	2003	2004	2005	2006	2007	2008
■	Ali	Ali	Ali	Ali	Ali	Ali	Ali	Ali	Ali
■	Beghelli	Beghelli	Beghelli	Beghelli	Beghelli	Beghelli	Beghelli	Beghelli	Beghelli
■	CNH Italia	CNH Italia	CNH Italia	CNH Italia	CNH Italia	CNH Italia	CNH Italia	CNH Italia	Caprari
			Cineca	Cineca	Cineca	Cineca	Cineca	Cineca	Cineca
			CMS	CMS	CMS	CMS	CMS	CMS	CMS
■	Datalogic	Datalogic	Datalogic	Datalogic	Datalogic	Datalogic	Datalogic	Datalogic	Datalogic
■	Ducati Energia	Ducati Energia	Ducati Energia	Ducati Energia	Ducati Energia	Ducati Energia	Ducati Energia	Ducati Energia	Ducati Energia
■	Ferrari	Ferrari	Ferrari	Ferrari	Ferrari	Ferrari	Ferrari	Ferrari	Ferrari
■	G.D	G.D	G.D	G.D	G.D	G.D	G.D	G.D	G.D
■	Gruppo Fabbri	Gruppo Fabbri	Gruppo Fabbri	Gruppo Fabbri	Gruppo Fabbri	Gruppo Fabbri	Gruppo Fabbri	Gruppo Fabbri	Gruppo Fabbri
								Hydrocontrol	Hydrocontrol
■	IMA	IMA	IMA	IMA	IMA	IMA	IMA	IMA	IMA
■	Italtractor ITM	Italtractor ITM	Italtractor ITM	Italtractor ITM	Italtractor ITM	Italtractor ITM	Italtractor ITM	Italtractor ITM	Italtractor ITM
■	Rossi Motoriduttori	Rossi Motoriduttori	Rossi Motoriduttori	Rossi Motoriduttori	Rossi Motoriduttori	Rossi Motoriduttori	Rossi Motoriduttori	Rossi Motoriduttori	Rossi Motoriduttori
						Sacmi	Sacmi	Sacmi	Sacmi
								Saima Avander	Saima Avander
■	Selcom Elettrotelecomunicazioni	Selcom Elettrotelecomunicazioni	Selcom Elettrotelecomunicazioni	Selcom Elettrotelecomunicazioni	Selcom Elettrotelecomunicazioni	Selcom Elettrotelecomunicazioni	Selcom Elettrotelecomunicazioni	Selcom Elettrotelecomunicazioni	Selcom Elettrotelecomunicazioni
■	System	System	System	System	System	System	System	System	System
■	Tetra Pak	Tetra Pak	Tetra Pak	Tetra Pak	Tetra Pak	Tetra Pak	Tetra Pak	Tetra Pak	Tetra Pak
									SCM Group
									Sitma
									Technogym
									Tetra Pak
									WAM Group
Totale	14	14	16	16	16	17	17	19	25

### Legenda

- Red box ■ mechanical, electronic, automotive industries
- Blue circle ● other manufacturing industries
- Yellow diamond ◆ reserach and university
- Green triangle ▲ others

### **Appendix 3. List of services, classified into switches and spaces. Brief description**

#### **Switch events**

R&D/tech transfer (launched 2000)	CRIT offers R&D services, and aids processes of technology. CRIT coordinates and manages relationships with research partners, and also helps clients to obtain financing from public (Italian/European) sources when possible
Technological Scouting (launched 2000)	Technological scouting refers to the gathering of documents, patents and other information from available sources, including databases to which CRIT subscribes and requests for information from sources with which CRIT personnel are in contact. A client interested in developing a particular technology, can, for example, ask who in the world uses (or might want to use) that technology anywhere in the world, and CRIT will provide a report thereon.
Financing (launched 2001)	CRIT helps clients to identify available public financing at regional, national, and European levels, and helps them to prepare applications (individually and collectively)
PatMOLE (launched 2002; name and technology changed 2005)	Patmole is the further development of a particular sort of technological scouting. In 2002, CRIT began doing analyses of competitors technologies. In 2005, in collaboration with a member - CINECA - specialized in supercomputing, CRIT developed a data mining tool that analyses competitors patents in order to predict their future technological strategies.
LAPCOS (launched 2005)	LAPCOS is a subsidiary of CRIT, developed together with a series of small and mid-sized firms in the region (Agop, Coxa, Curti Costruzioni Meccaniche, ITG, Procomec). It is a virtual modelling and simulation laboratory.

## Space events

Meetings of technical directors [RDT] (launched 2000)	Meetings to which all technical directors of all member firms are invited. "Outsiders" participate by specific invitation only. At these meetings, CRIT personnel describe their recent activities and plans for the future. Member firms raise issues and discuss needs. RDT are generally held at a member firm, and include a tour of the plant and a dinner afterwards.
Seminars (launched 2000)	Attended primarily but not exclusively by members. Can be on a topic chosen by CRIT, but generally, it is a technical topic requested by a member firm and of interest to others. An outside expert is brought in, and a presentation is held in a forum in which attendees interact both with the expert and each other. Examples of recent seminars include topics like "analysis, control and simulation of production lines and logistic systems"; or "Risk analysis during the product life cycle."
Thematic working tables [ <i>Tavoli di lavoro</i> ] (launched 2001)	Working tables are open discussions generally of technical (but also organizational) issues. They are generally born by request of CRIT members who express interest in topic. Recent examples have included "excellent suppliers in emerging countries"; and "enabling contexts for collaborative innovation." CRIT surveys other members, and if there is sufficient interest, CRIT puts together the technical documentation, but it is expected also that some member firms kick off discussion with a presentation of some sort. For some topics, multiple events are held. In some cases, projects have been launched as a result of working tables (see Lapcos below), including the formation of the <i>Associazione Italiana Documentalisti Brevettuali</i> (AIDB -- Italian association of patent documenters), which was seeded by a few CRIT members who, after a working table, decided that they needed a more structured to share information on how to submit patents.
Tecnotours (launched 2002)	Tecnotours are organized visits to research centers, firms, or science/technology institutions (in Italy and abroad). They aim to create contacts between participants and possible partners, or, at the least, to make members aware of available technologies. <sup>19</sup>
Training (launched 2004)	CRIT organizes training courses upon request of clients, and then recruits other attendees both to defray costs and to create further opportunities for cross-firm interaction. Instructors are generally drawn from universities. Training was added to the panoply of services on specific request made at a RDT.

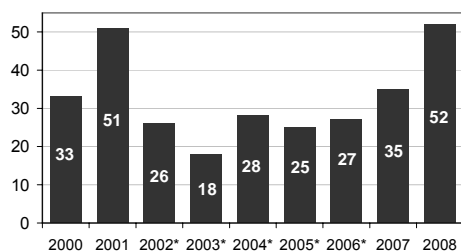
<sup>19</sup> NB: that many RDT, working tables and seminars include tours. We have classified as "tours" only those events that are "only" tours.



## Appendix 4. Switch and space events, by type and by year, 2000-2008

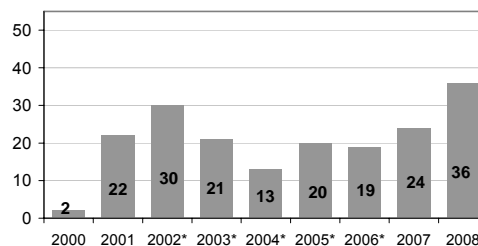
### Switch events

**total switch**  
295 events

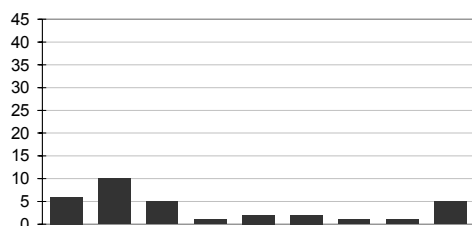


### Space events

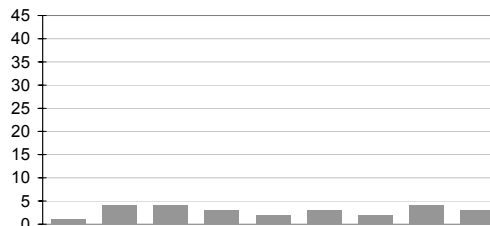
**total space**  
187 events



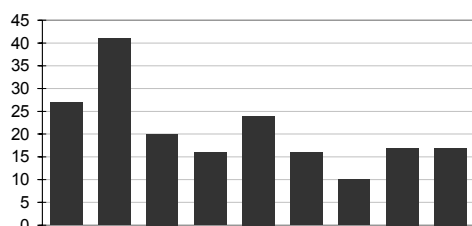
**R&D techn.transfer**  
33 eventi



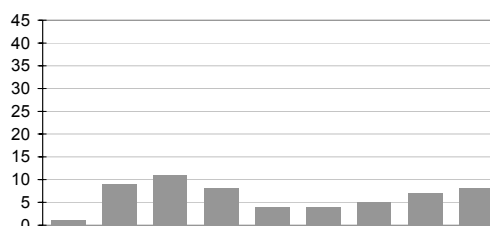
**Meeting of technical directors**  
26 events



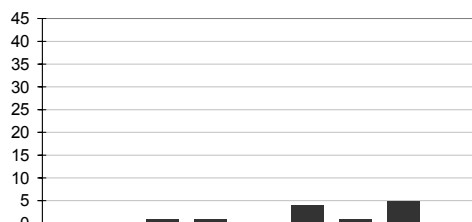
**Technical Scouting**  
188 events



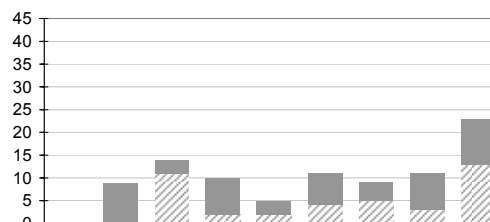
**Seminars**  
57 events



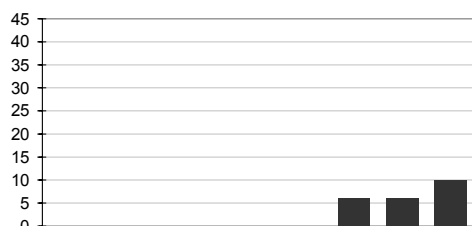
**PatMOLE**  
12 events\*



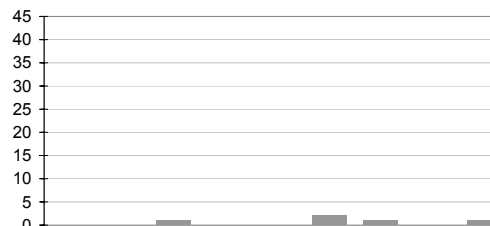
**Thematic working tables**  
92 events\*



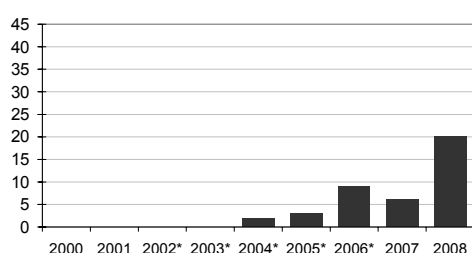
**LAPCOS**  
22 events



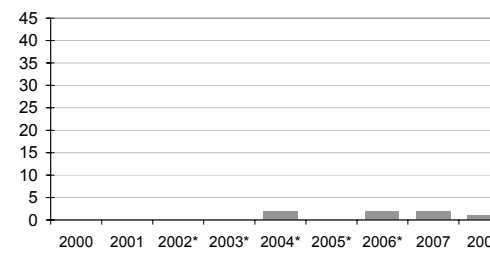
**Technotours**  
5 events



**Financing**  
40 events



**Training**  
7 events



\*Thematic working tables initiated in the previous years are highlighted with dotted lines

## Appendix 5. Organizations participating at Crit's activities

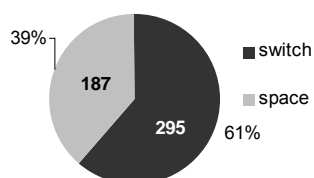
		Numero di organizzazioni				
		totale	di cui			
		137	di cui	22		
<b>Metalmeccanica elettronica automotive</b>			di cui			
<b>Ateco2007</b>						
<b>25</b>	Fabbricazione prodotti in metallo (esclusi macchinari e attrezzature)	13				
<b>26</b>	Fabbricazione di computer e prodotti di elettronica e ottica; apparecchi elettromedicali, apparecchi di misurazione e di orologi	25	3	Datalogic SpA Ducati Energia SpA Selcom Elettronica SpA		
<b>27</b>	Fabbricazione di apparecchiature elettriche ed apparecchiature per uso domestico non elettriche	13	1	Beghelli SpA		
<b>28</b>	Fabbricazione di macchinari ed apparecchiature nca	81	17	C.M.S. s.p.a. Caprari SpA Carpigliani Group Ali S.p.A. CNH ITALIA - S.P.A. CEFLA Sc G.D SpA	GRUPPO FABBRI Spa Hydrocontrol SpA I.M.A. S.p.A. Italtractor ITM Spa Rossi Motoriduttori S.p.A. Sacmi Imola S.C.	SCM Group SpA SITMA MACHINERY S.p.A. System S.p.A. Tetra Pak Italia S.p.A. WAM S.p.A.
<b>29</b>	Fabbricazione di autoveicoli, rimorchi e semirimorchi	4	1	Ferrari SpA		
<b>30</b>	Fabbricazione di altri mezzi di trasporto	1				
<b>Altre attività manifatturiere (10-24 e 31-33)</b>		<b>40</b>	<b>di cui socie</b>	<b>2</b>		
<b>10</b>	Industrie alimentari	2				
<b>11</b>	Industria delle bevande	2				
<b>17</b>	Fabbricazione di carta e di prodotti di carta	1				
<b>18</b>	Stampa e riproduzione di supporti registrati	1				
<b>20</b>	Fabbricazione di prodotti chimici	15				
<b>22</b>	Fabbricazione di articoli in gomma e materie plastiche	3				
<b>23</b>	Fabbricazione di altri prodotti della lavorazione di minerali non metalliferi	4				
<b>24</b>	Metallurgia	8				
<b>32</b>	Altre industrie manifatturiere	1	1	Technogym SpA		
<b>16-17-22</b>	16) Industria del legno e dei prodotti in legno e sughero (esclusi i mobili); Fabbricazione di articoli in paglia e materiali da intreccio; 17) Fabbricazione di carta e di prodotti di carta; 22) Fabbricazione di prodotti farmaceutici di base e di preparati farmaceutici	1				
<b>H</b>	Trasporto e immagazzinaggio	1	1	Saima Avandero S.p.A.		
<b>XX</b>		1				
<b>Ricerca e università</b>		<b>48</b>	<b>di cui socie</b>	<b>0</b>		
<b>72</b>	Ricerca scientifica e sviluppo	26				
<b>85</b>	Istruzione	22				
<b>Altro</b>		<b>98</b>	<b>di cui socie</b>	<b>1</b>		
<b>43</b>	Lavori di costruzione specializzati	1				
<b>46</b>	Commercio all'ingrosso (escluso quello di autoveicoli e di motocicli)	2				
<b>47</b>	Commercio al dettaglio (escluso quello di autoveicoli e di motocicli)	1				
<b>58</b>	Attività editoriali	1				
<b>62</b>	Produzione di software, consulenza informatica e attività connesse	3				
<b>63</b>	Attività dei servizi d'informazione e altri servizi informatici	13	1	Cineca		
<b>70</b>	Attività di direzione aziendale e di consulenza gestionale	16				
<b>71</b>	Attività degli studi di architettura e d'ingegneria; collaudi ed analisi tecniche	15				
<b>74</b>	Altre attività professionali, scientifiche e tecniche	1				
<b>84</b>	Amministrazione pubblica e difesa; assicurazione sociale obbligatoria	3				
<b>86</b>	Servizi ospedalieri	1				
<b>94</b>	Attività di organizzazioni associative	7				
<b>nc</b>	(non classificato)	34				
		<b>323</b>				

CRIT\_dati x analisi\_Sw\_Sp\_2009.09.02 > 5 Tab\_Aggregati Ateco

## Appendix 6. Crit's activities ad participants, by type of organization, 2000-2008

### Tables

**Number of events switch and space (2000-2008)**



**Organizations participating at the events, by type of organization (2000-2008) at least once in 9 years**

Only Switch events	members	non members	total
mechanical, electronic, automotive	0	27	27
other manufacturing industries	0	13	13
research and university	0	20	20
others	0	34	34
<b>total</b>	<b>0</b>	<b>94</b>	<b>94</b>
Only Space events	members	non members	total
mechanical, electronic, automotive	5	72	77
other manufacturing industries	0	21	21
research and university	0	17	17
others	0	54	54
<b>total</b>	<b>5</b>	<b>164</b>	<b>169</b>
Space & Switch	members	non members	total
mechanical, electronic, automotive	17	16	33
other manufacturing industries	2	4	6
research and university	0	11	11
others	1	9	10
<b>total</b>	<b>20</b>	<b>40</b>	<b>60</b>

**Number of people participating at space events, by type of organization (2000-2008)**

Space	members	non members	total
mechanical, electronic, automotive	2.152	247	2.399
other manufacturing industries	19	55	74
research and university	0	71	71
others	60	109	169
<b>total</b>	<b>2.231</b>	<b>482</b>	<b>2.713</b>

**Events by type**

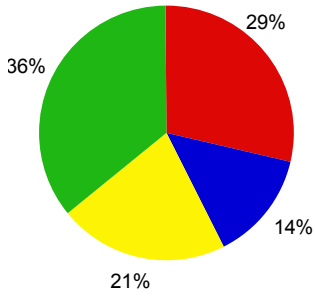
R&D technological transfer	33
Technical Scouting	188
Financing	40
Lapcos	22
Patmole	12
<b>switch</b>	<b>187</b>
Meeting of technical directors	26
Seminars	57
Thematic working tables	92
Tour	5
Training	7
<b>space</b>	<b>295</b>

**Organizations participating at the events, by type of organization (2000-2008)**

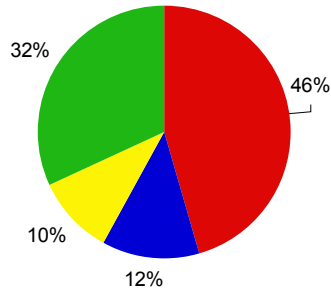
Switch	members	non members	total
mechanical, electronic, automotive	259	67	326
other manufacturing industries	4	19	23
research and university	0	141	141
others	9	96	105
<b>total</b>	<b>272</b>	<b>323</b>	<b>595</b>
Space	members	non members	total
mechanical, electronic, automotive	1.126	188	1.314
other manufacturing industries	16	36	52
research and university	0	55	55
others	42	92	134
<b>total</b>	<b>1.184</b>	<b>371</b>	<b>1.555</b>

*Figures*

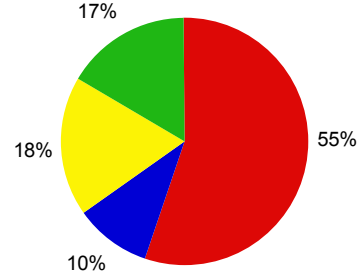
**Organizations (94) participating only at SWITCH events (295), by type of organization (2000-2008)**



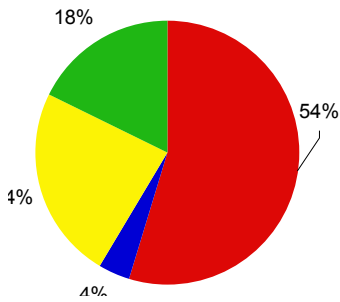
**Organizations (169) participating only at SPACE events (187), by type of organization (2000-2008)**



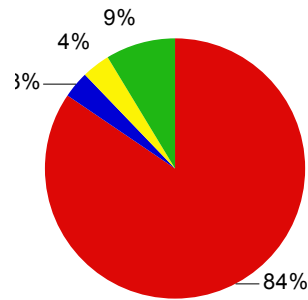
**Organizations (60) participating at SWITCH (295) and SPACE (187) events, by type of organization (2000-2008)**



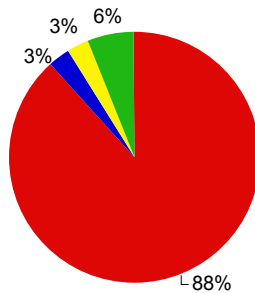
**Number of participations (595) at SWITCH events (295), by type of organization (2000-2008)**



**Number of participations (1.555) at SPACE events (187), by type of organization (2000-2008)**



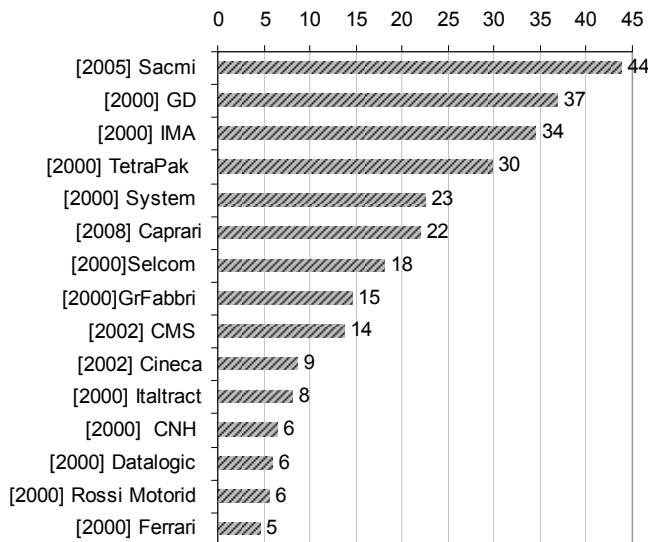
**Number of people (2.713) participating at SPACE events (187), by type of organization (2000-2008)**



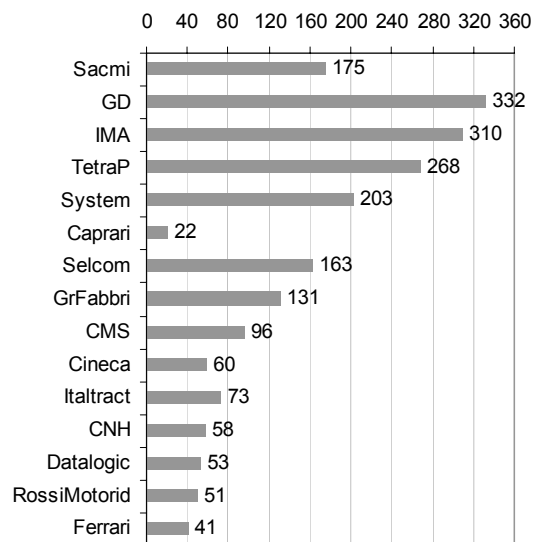
- mechanical, electronic, automotive industries
- other manufacturing industries
- research and university
- others

## Appendix 7. Participants by organization\* and by type of space events, 2000-2008

*Annual average of participants\*\**

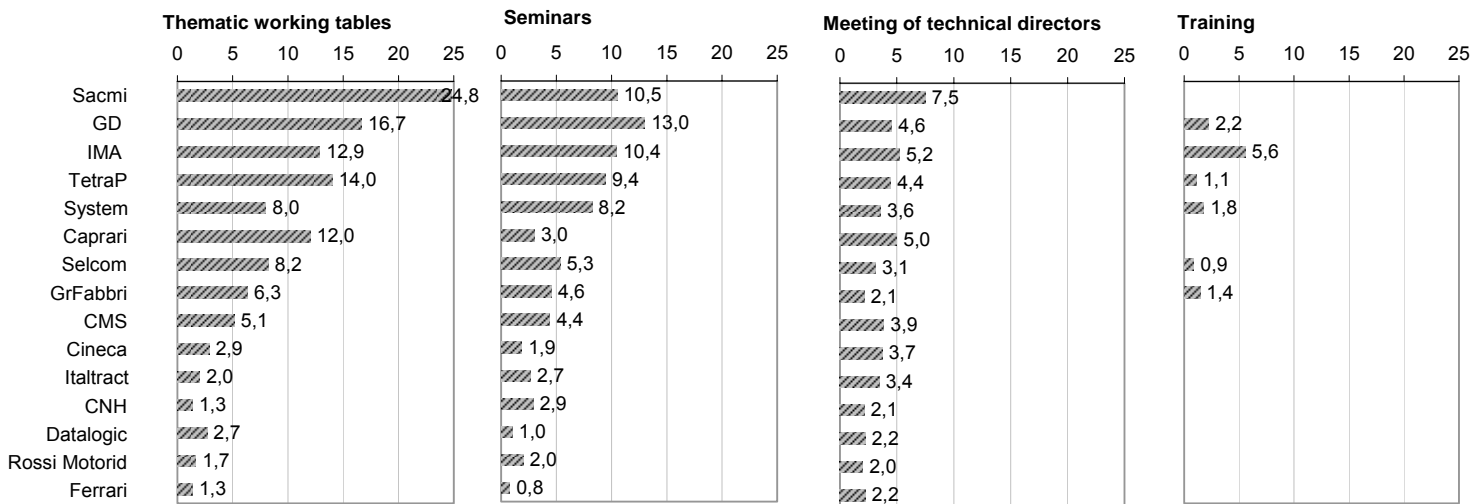


*Cumulated number of participants\*\*\**



*Annual average\*\* of participants by type of space event*

only the space events with the highest cumulated number of participants are considered



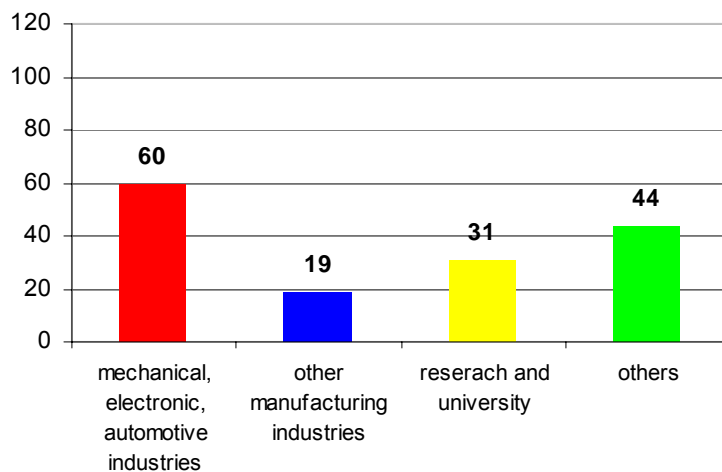
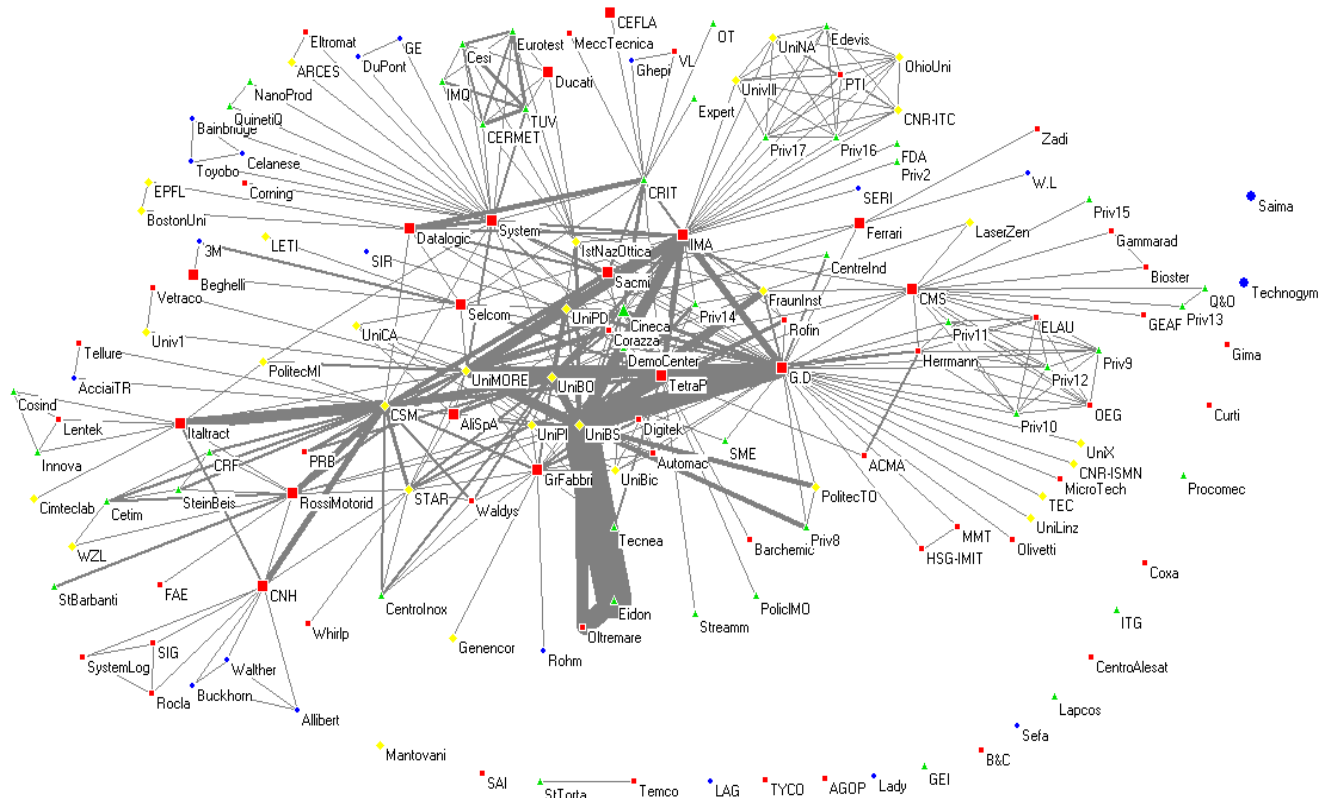
\*Organizations with the greatest number of participants are listed. Year of membership is in square brackets.

\*\*Average is weighted on the number of years of membership by the organization. All the space events are considered. Since participation in each event usually requires one person's work per firm, the number of presences to events indicates the number of person-days committed by each firm.

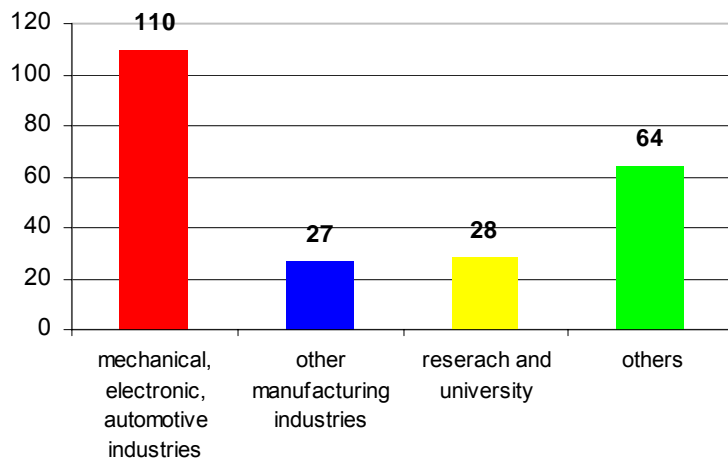
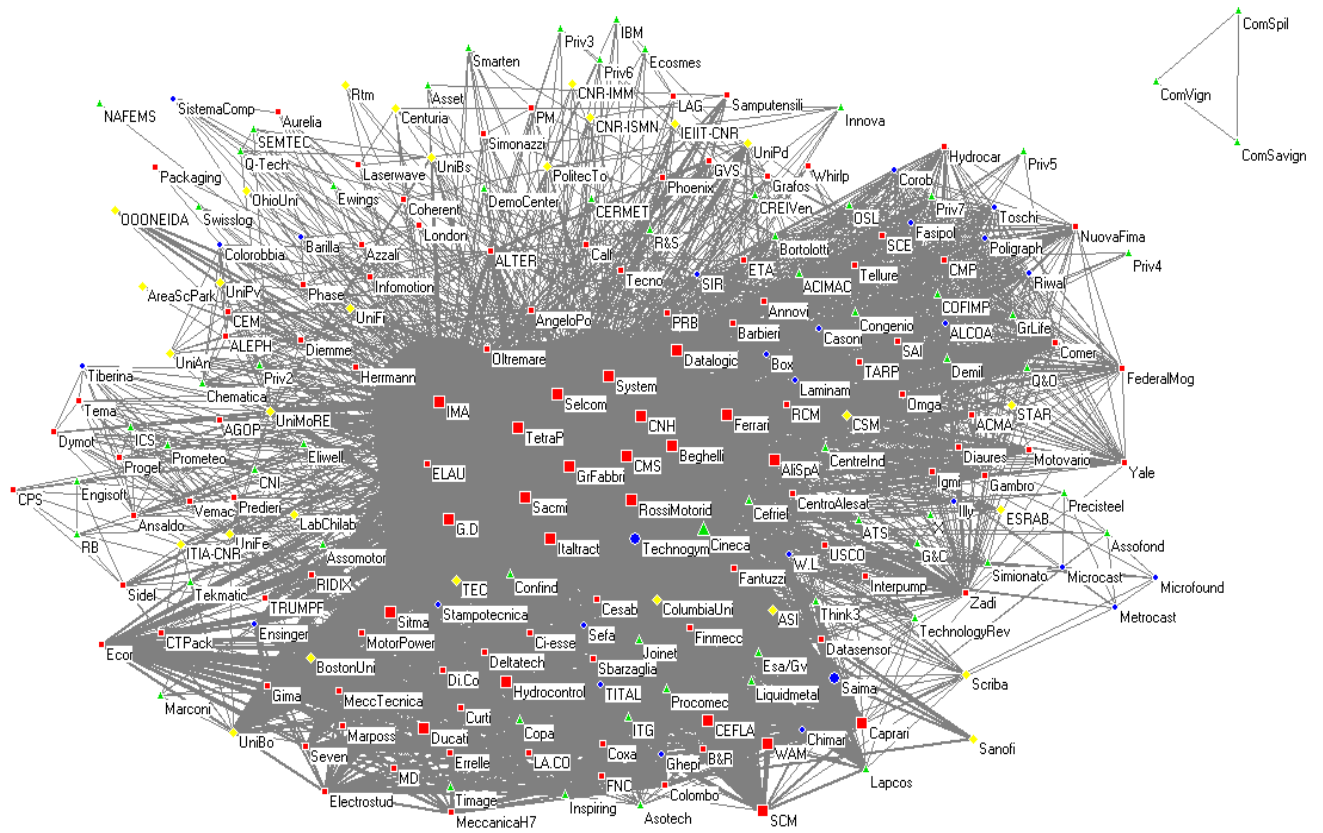
\*\*\*All the space events are considered

## Appendix 8. Unimodal networks (switch, space) 2000-2008 and number of organizations by type

Switch (289 events; 154 organizations)



Space (186 events; 229 organizations)

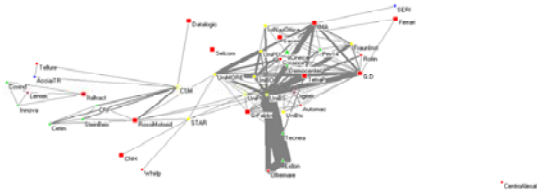


## Appendix 9. Unimodal network of switch and space events by type, 2000-2008

### Switch events by type, 2000-2008

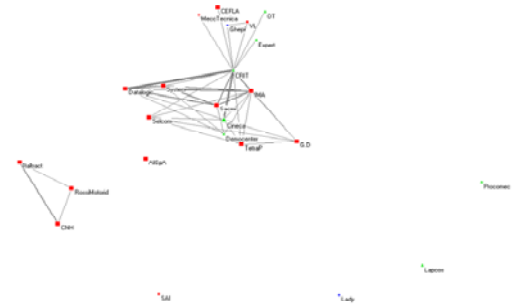
Collaborative R&D

Lapcos & PatMOLE



Technical Scouting

Financing

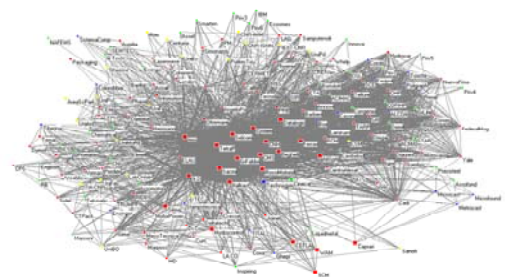


Vertices are positioned as in the 2000-2008 unimodal network of all the switch events

### Space events by type, 2000-2008

Meetings of technical directors

Seminars



Thematic working tables

Technotours & Training



Vertices are positioned as in the 2000-2008 unimodal network of all the space events

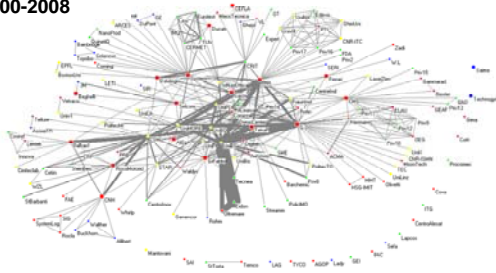
Elaboration with Pajek



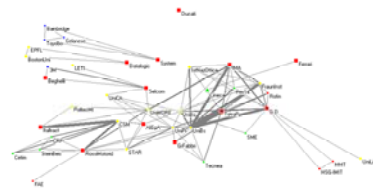
## Appendix 10. Switch and space events: Unimodal *networks* by year, 2000-2008

### Switch events

2000-2008



2000



2001



2002



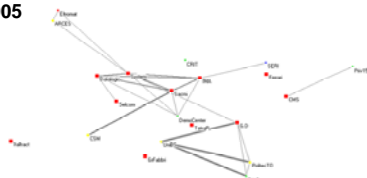
2003



2004



2005



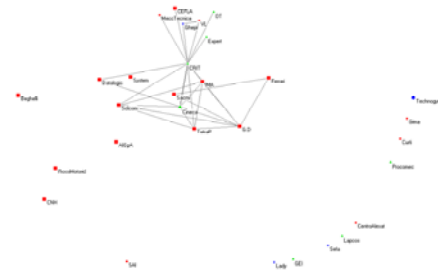
2006



2007



2008



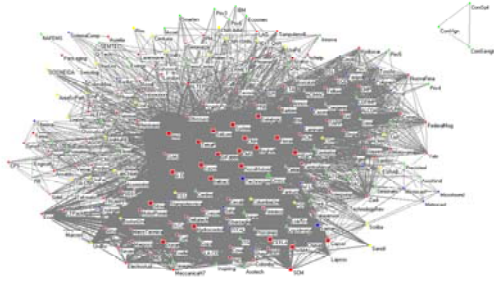
Elaboration with Pajek

Fruchtman-Reingold algorithm for vertices of the total space events 2000-2008 network.

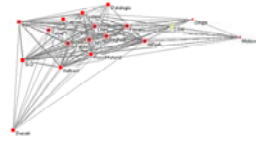
In all graphs: vertices are positioned as in the 2000-2008 unimodal network of all the switch events

## Space events

2000-2008



2000



2001



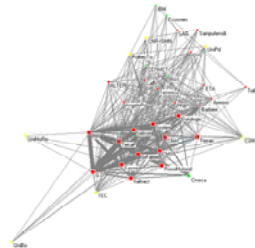
2002



2003



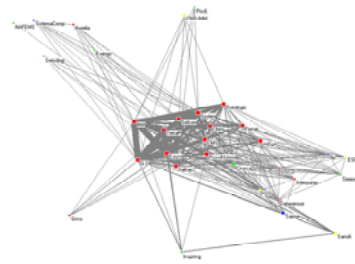
2004



2005



2006



2007



2008



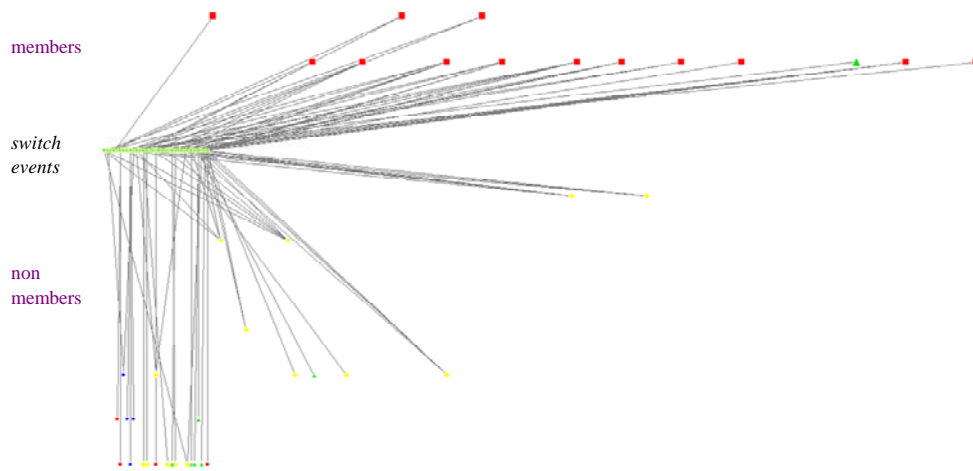
Elaboration with Pajek

Fruchtmann-Reingold algorithm for vertices of the total space events 2000-2008 network.

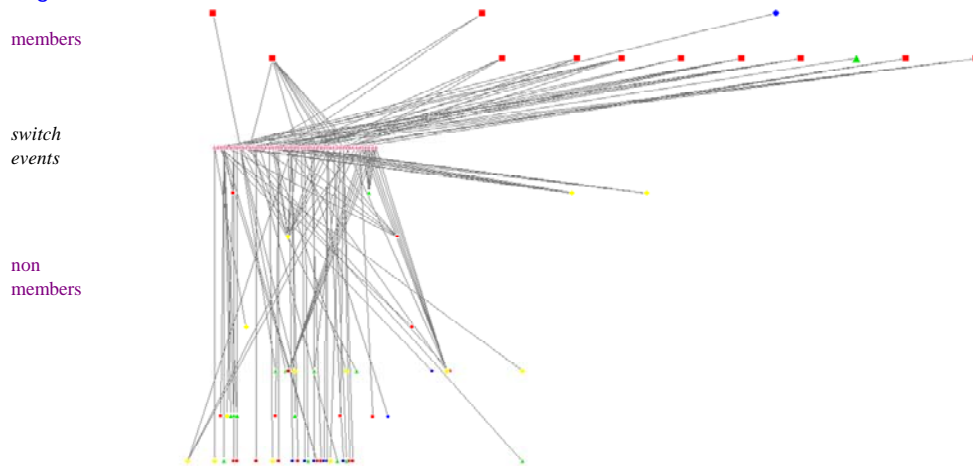
In all graphs: vertices are positioned as in the 2000-2008 unimodal network of all the space events

Appendix 11. Switch events: bimodal *networks* by year, 2000-2008

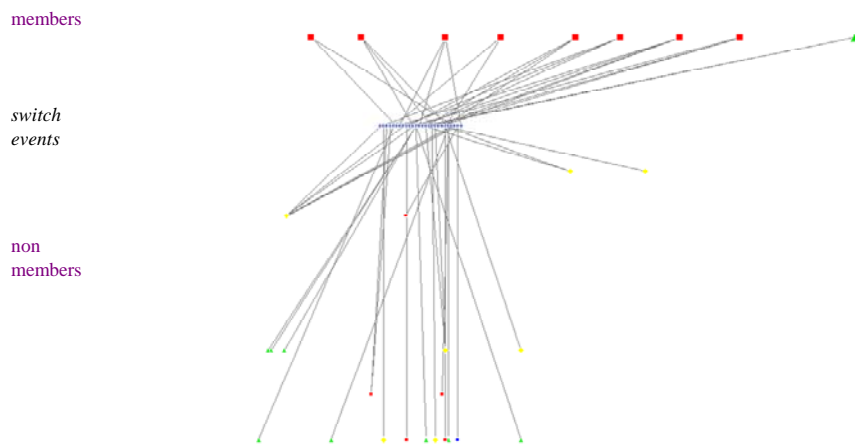
2000 events: 33  
organizations: 42



2001 events: 51  
organizations: 66



2002 events: 26  
organizations: 30

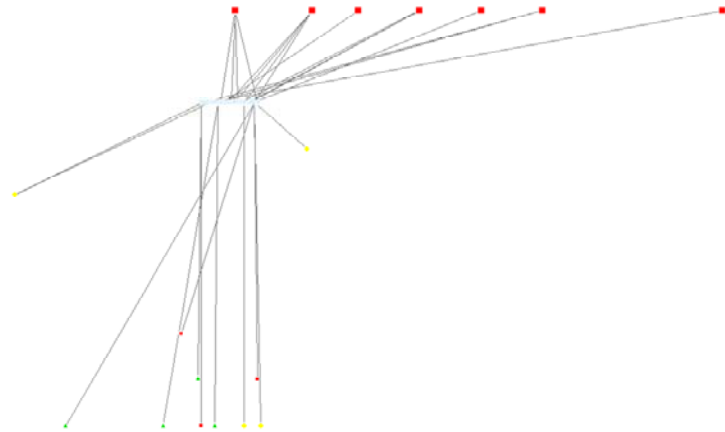


**2003** events: 18  
organizations: 18

members

*switch  
events*

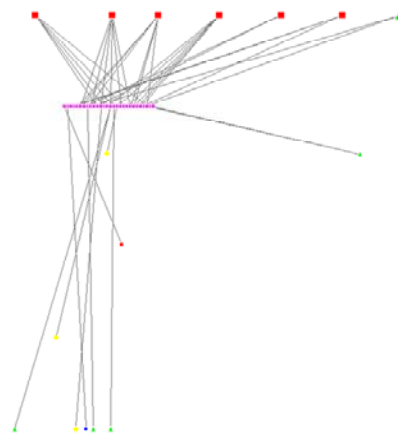
non  
members



**2004** events: 28  
organizations: 16  
members

*switch  
events*

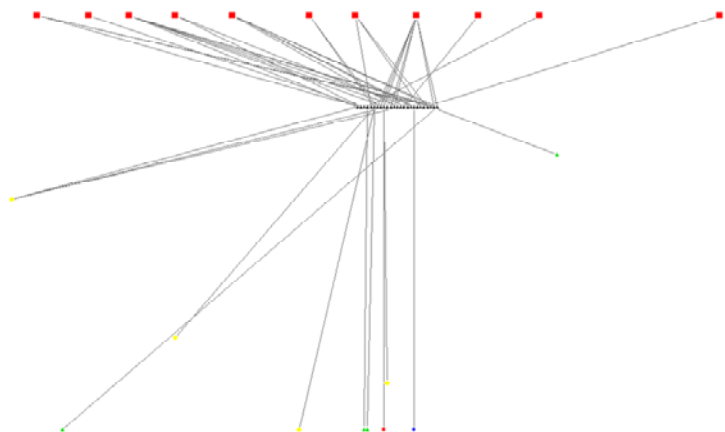
non  
members



**2005** events: 25  
organizations: 21  
members

*switch  
events*

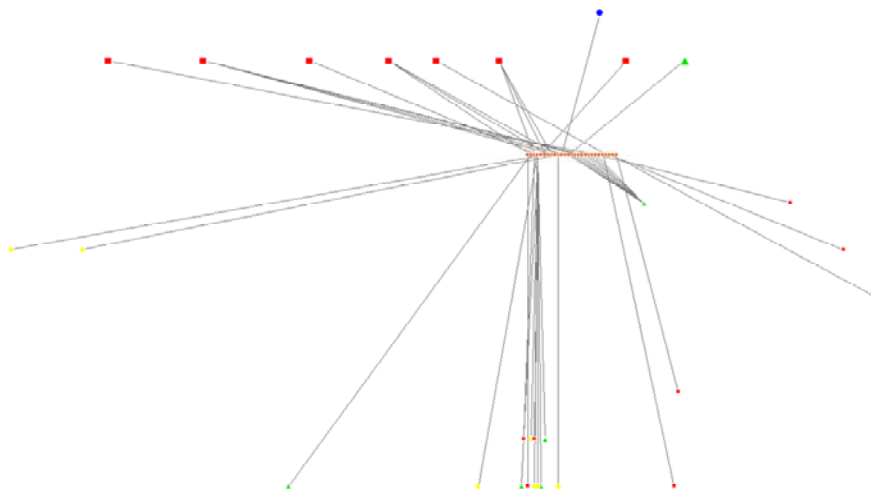
non  
members



**2006** events: 27  
organizations: 29  
members

*switch  
events*

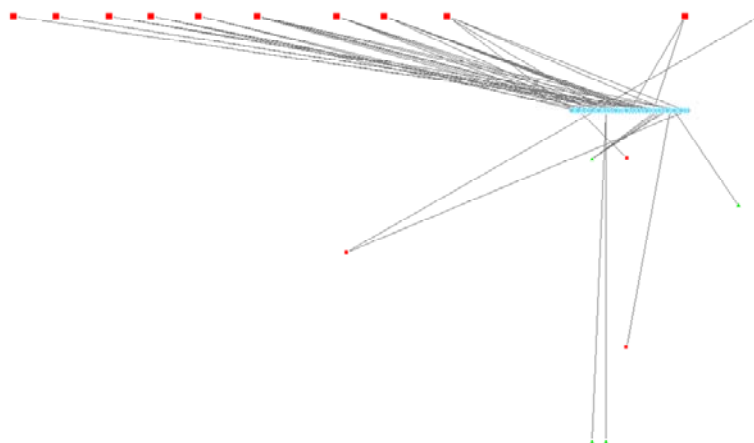
non  
members



**2007** events: 35  
organizations: 18  
members

*switch  
events*

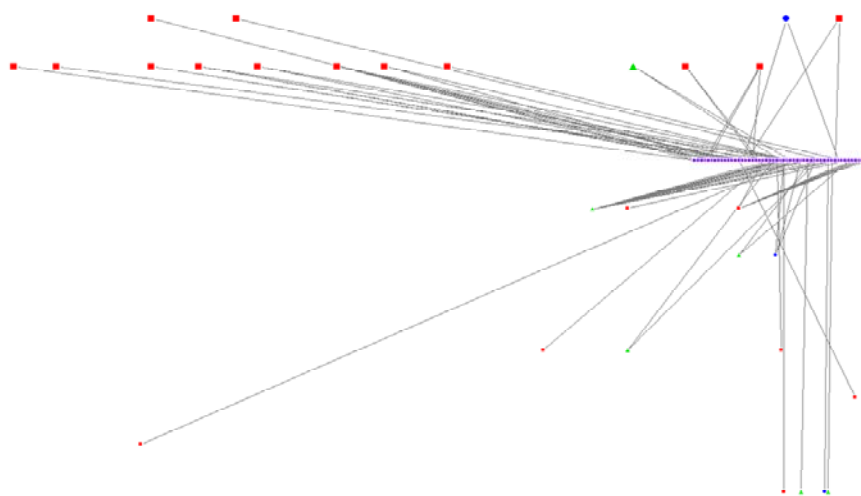
non  
members



**2008** events: 52  
organizations: 30  
members

*switch  
events*

non  
members



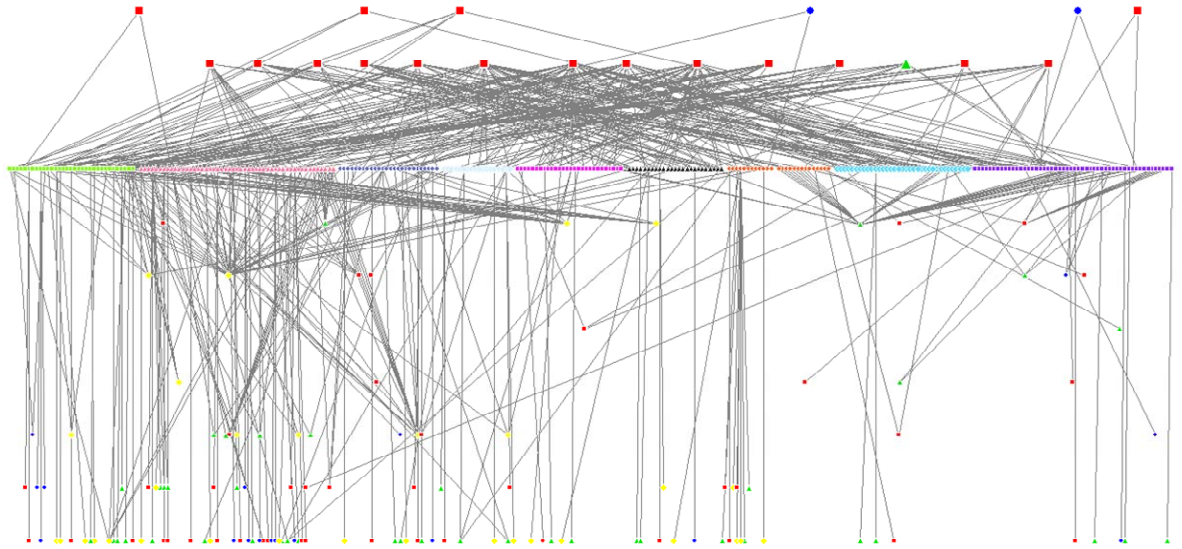
**2000-2008**

events: 295  
organizations: 154

members

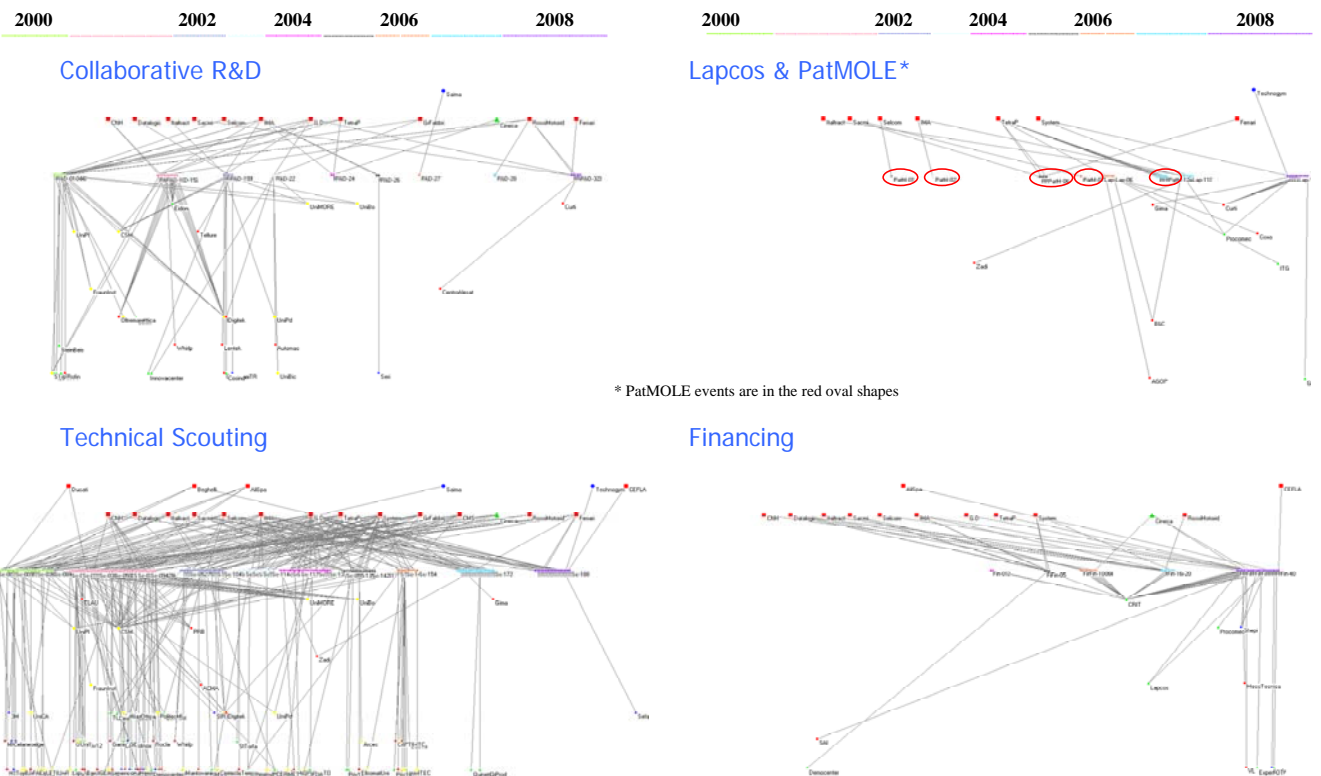
switch events

non members



Elaboration with Pajek. Vertices are positioned as in the bimodal space network 2000-2008, hence the distance from the events line does not necessarily measure the number of events at which the organization has participated.

**Appendix 12. Switch events: bimodal networks by type, 2000-2008**

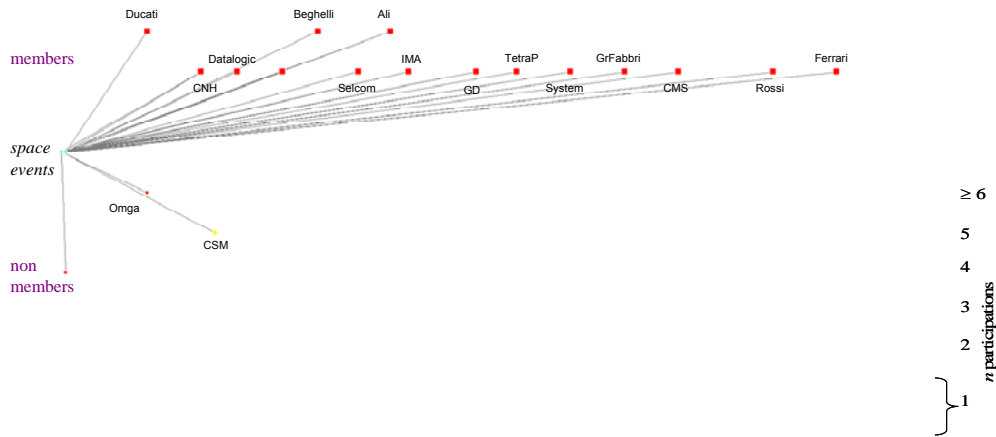


\* PatMOLE events are in the red oval shapes

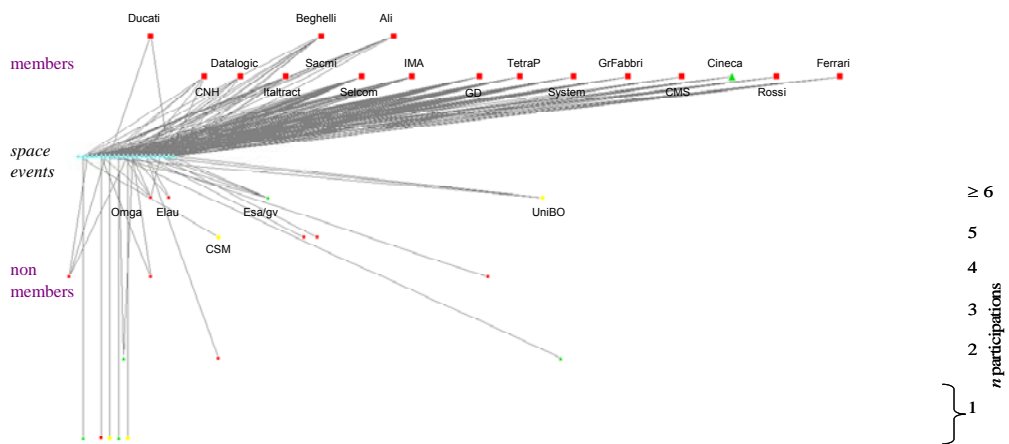
Elaboration with Pajek. Vertices are positioned as in the bimodal space network 2000-2008, hence the distance from the events line does not necessarily measure the number of events at which the organization has participated.

## Appendix 13. Space events: bimodal *networks* by year, 2000-2008

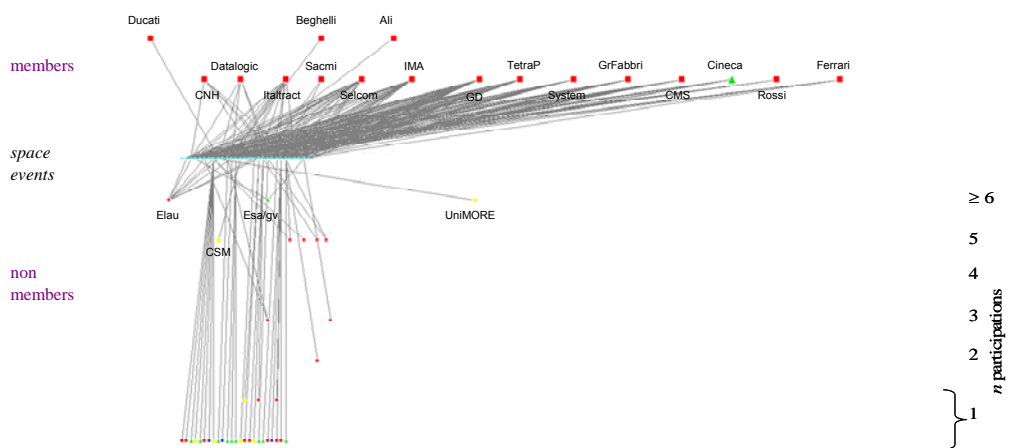
2000 Events: 2  
Organizations: 20



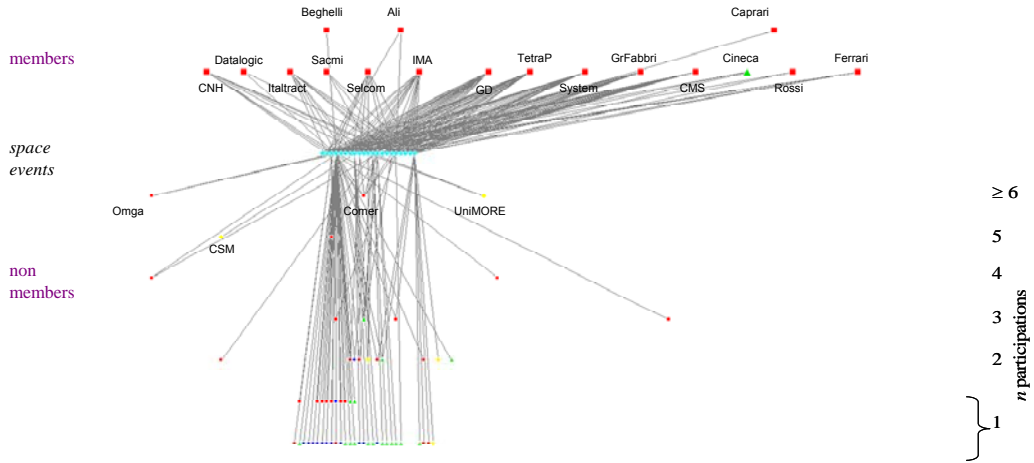
2001 Events: 22  
Organizations: 34



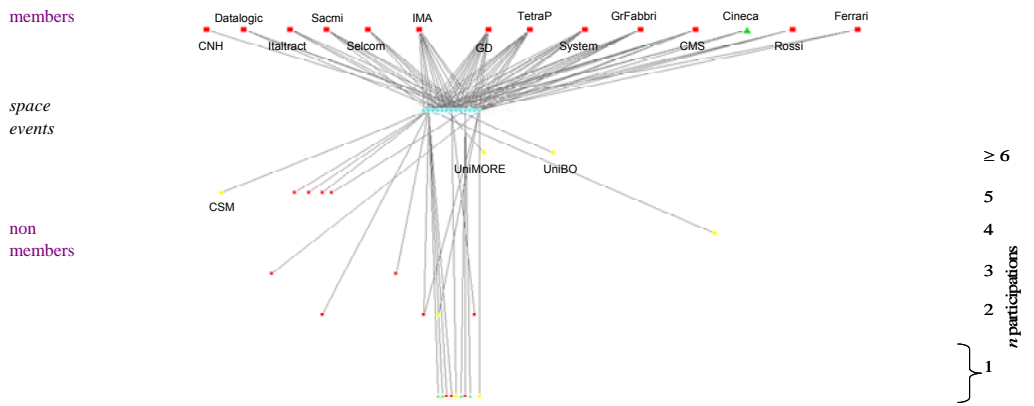
2002 Events: 29  
Organizations: 55



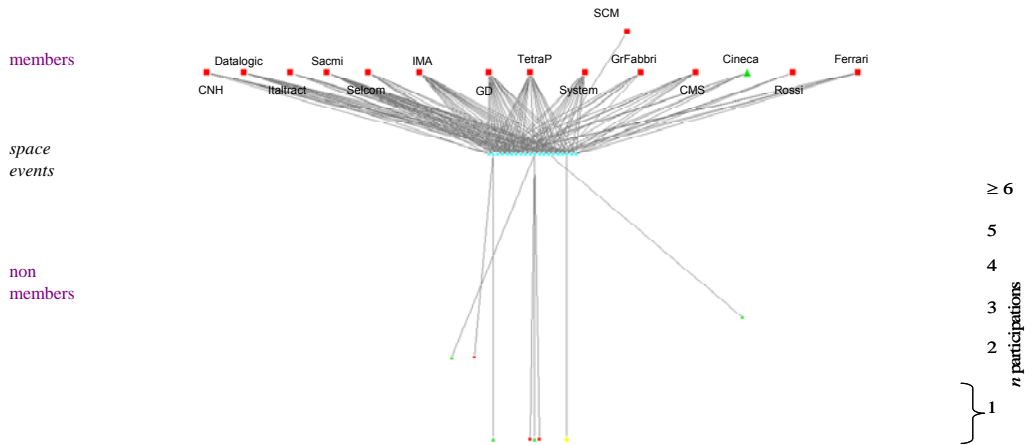
2003 Events: 21  
Organizations: 76



2004 Events: 13  
Organizations: 37

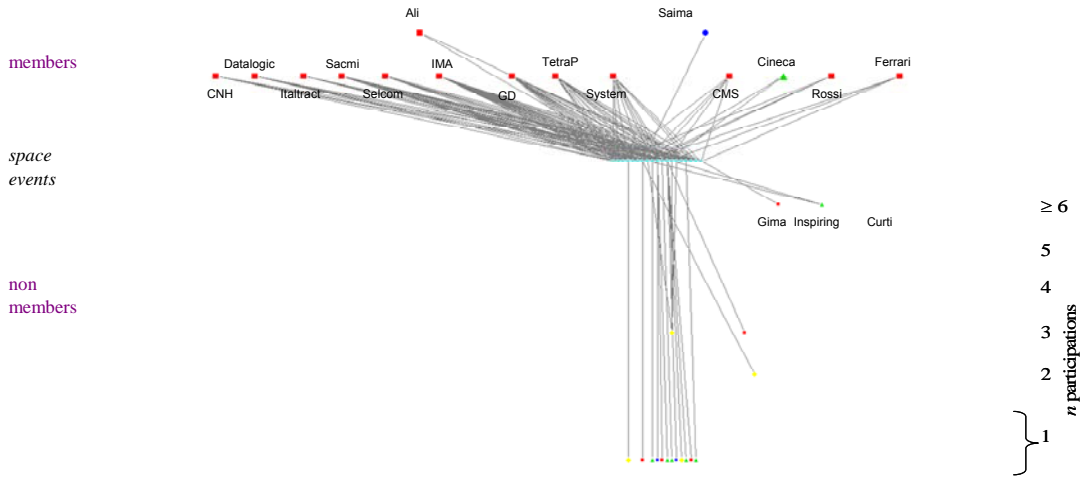


2005 Events: 20  
Organizations: 23

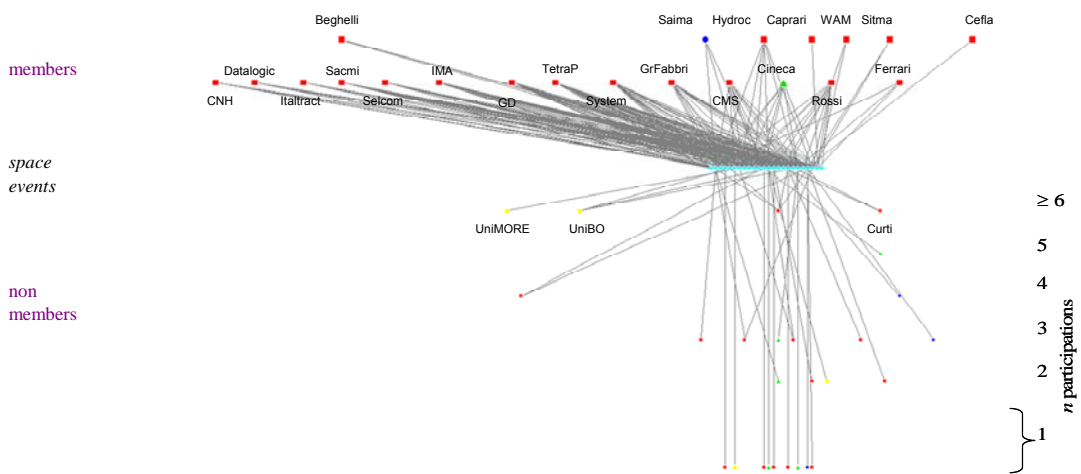




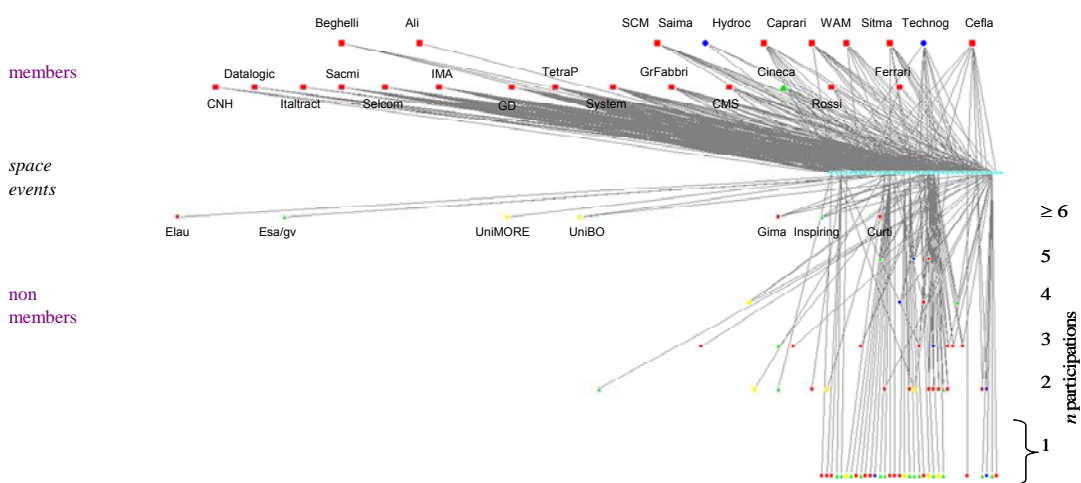
2006 Events: 19  
Organizations: 32



2007 Events: 24  
Organizations: 47

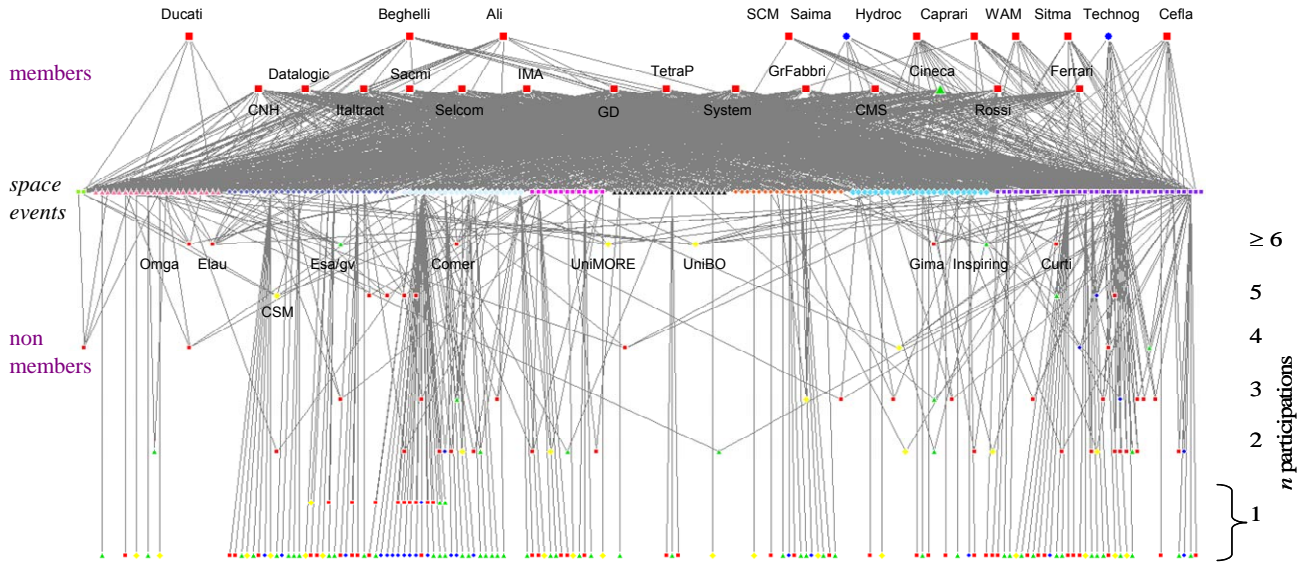


2008 Events: 36  
Organizations: 94



2000-2008

Events: 186\*  
Organizations: 229



\*data not completed (participants of one event are not specified)

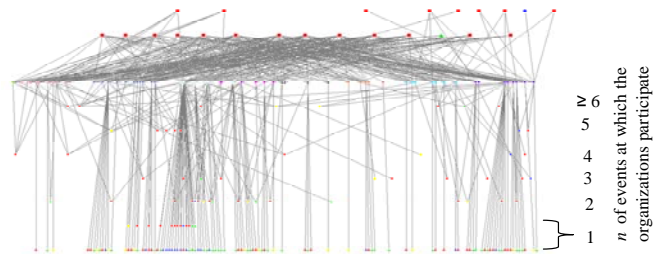
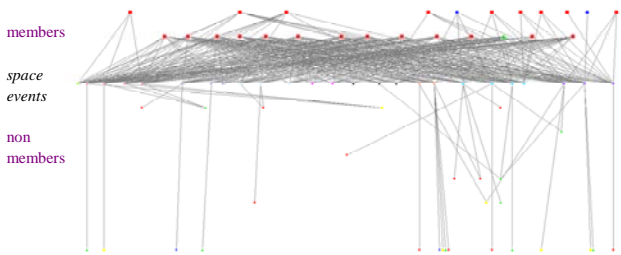
Elaboration with Pajek. Events are ordered by date, from 2000 to 2008. Vertices are positioned as in the bimodal network of space events 2000-2008

Appendix 14. Space events: bimodal networks by type, 2000-2008

2000 2002 2004 2006 2008 2000 2002 2004 2006 2008

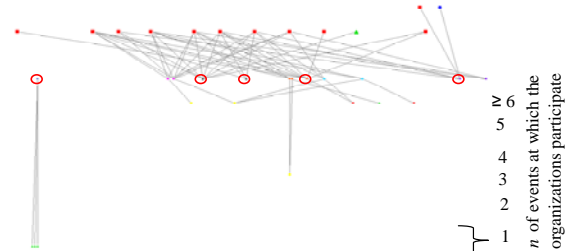
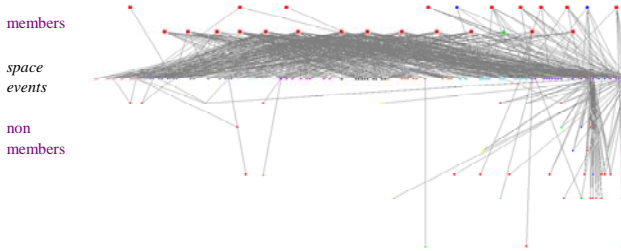
Meeting of technical directors

Seminars



Thematic working tables

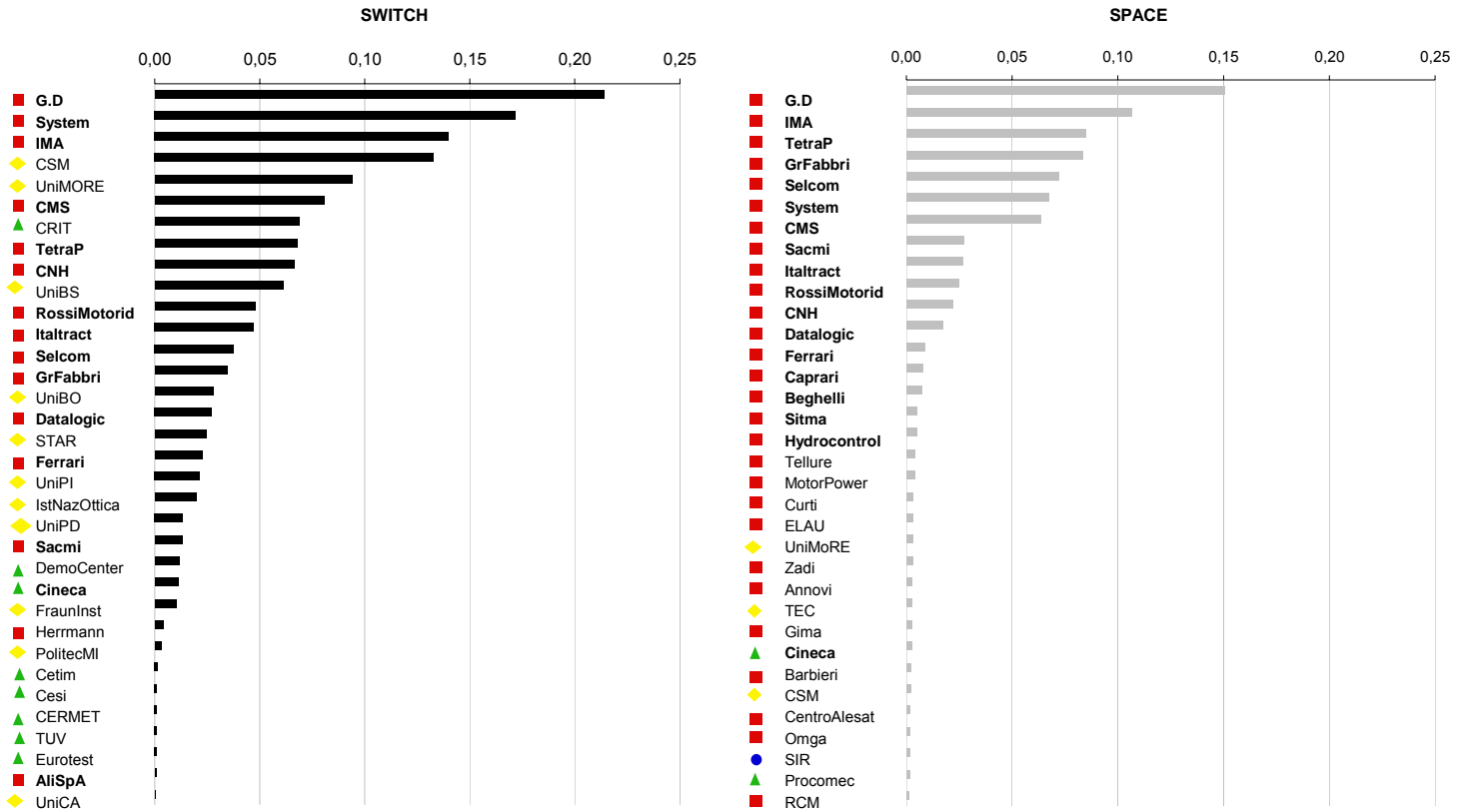
Technotours\* & Training



\* Four events are highlighted with red circles

Elaboration with Pajek. Events are ordered by date, from 2000 to 2008. Vertices are positioned as in the bimodal network of space events 2000-2008

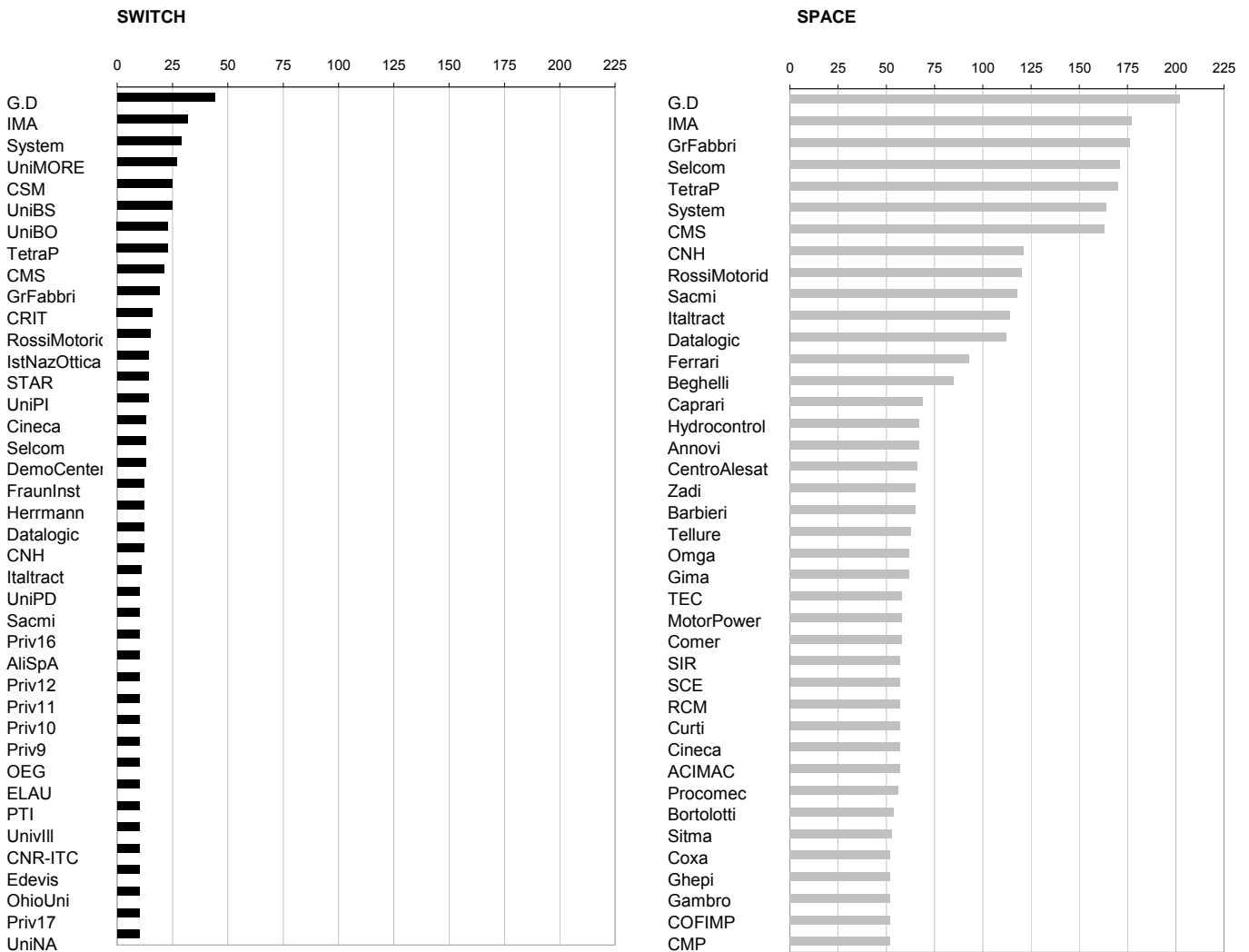
## Appendix 15. Betweenness centrality (most central organizations): switch and space events 2000-2008



### Legenda

- Red box ■ mechanical, electronic, automotive industries
- Blue circle ● other manufacturing industries
- Yellow diamond ◆ reserach and university
- Green triangle ▲ others

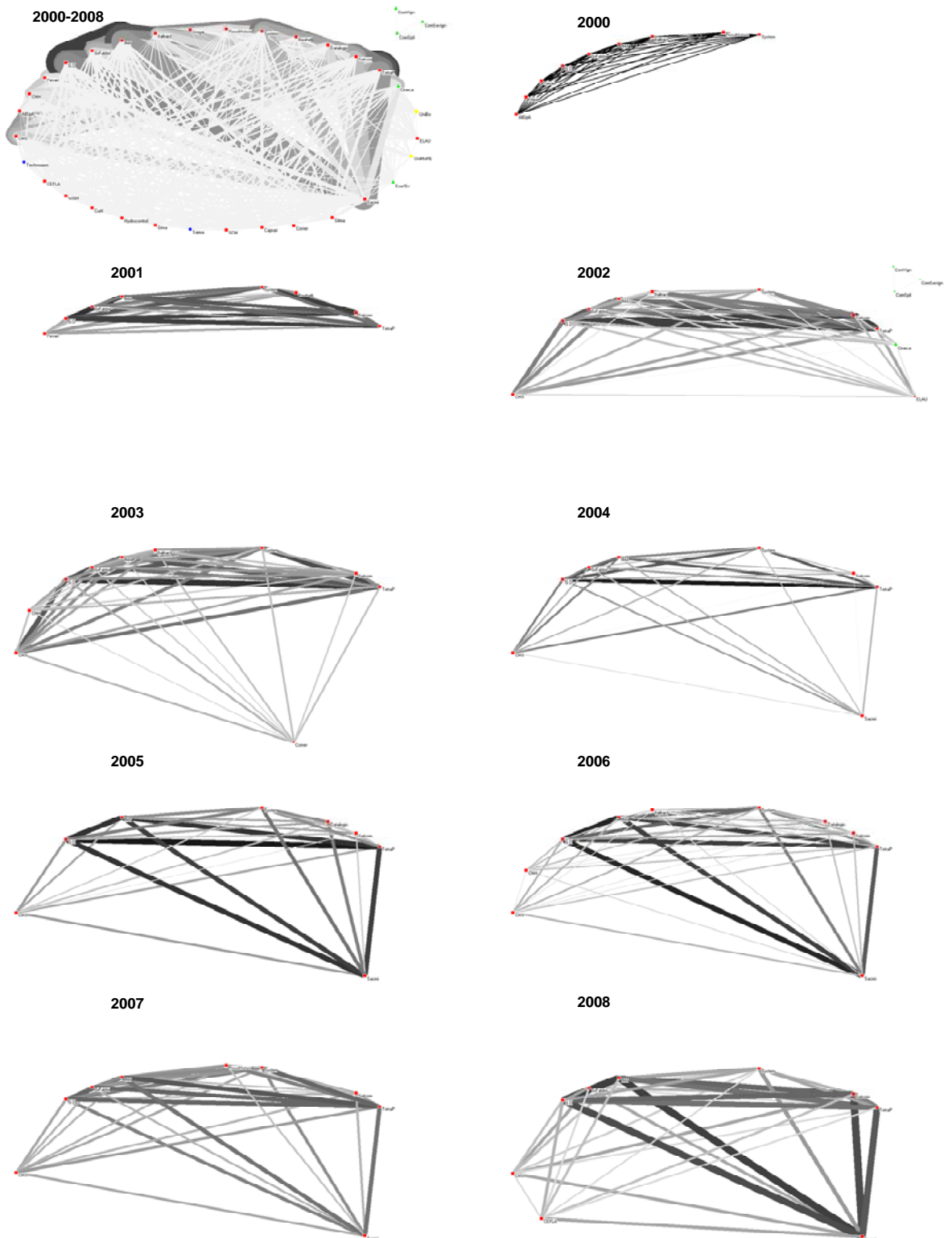
## Appendix 16. Degree centrality (most central organizations): switch and space events 2000-2008



### Legenda

- Red box ■ mechanical, electronic, automotive industries
- Blue circle ● other manufacturing industries
- Yellow diamond ◆ reserach and university
- Green triangle ▲ others

## Appendix 17. Line islands of space events networks 2000-2008 and by year



Elaboration with Pajek. Fruchtmann-Reingold algorithm for vertices of the line island (min2-max32) space events 2000-2008 network. In all graphs: vertices are positioned as in the line island (3-32) subnetwork of the 2000-2008 space events.

## Appendix 18. Space events intercohesive subnetworks 2000-2008. Clique percolation method

(in collaboration with Federica Rossi)

Clique percolation allows to identify sets of adjacent  $k$ -cliques. Two  $k$ -cliques are adjacent if they share  $k-1$  vertices. Thanks to the clique percolation algorithm implemented in the software CFinder, it is possible to identify, for each possible value of  $k$ , the sets of  $k$ -cliques that are adjacent. Each of these sets is called a “community.” The concept of community is related to but distinct from the concept of cohesion in social networks. For a social group to be cohesive it is not necessary that each member is connected to all other members (as in a  $k$ -clique) but it is usually sufficient that each member is connected to at least  $k-1$  other members in the group.

The concept of intercohesion, developed by Vedres and Stark (2007) builds upon this notion of community. According to Vedres and Stark, individuals who belong to more than one community at the same time provide a connection between these communities. Unlike brokers, who bridge two or more cliques without belonging to any of them, intercohesive nodes belong to two or more sets of adjacent  $k$ -cliques and are therefore characterized by membership in multiple social groups<sup>20</sup>.

### *Choosing a value for $k$*

We identified intercohesive nodes in the unimodal networks connecting participants to all *space* events, in the years from 2000 to 2008 (to reduce computational requirements, we removed from each network the organizations that had participated only to a single event). Table A lists the members of the various communities when  $k=7$ , in the unimodal networks constructed for the period 2000-2008, the name of intercohesive nodes in each network are highlighted in bold. By setting  $k=7$ , more than one community is found. There is no general rule in order to identify an “optimal” value for  $k$ . In our case, the value  $k=7$  was chosen because it is the value for which most networks simultaneously break into more than one community.

Firms that are intercohesive nodes tend to remain so over time: three (System, GD and Fabbri) appear in all years in which intercohesive nodes are present, while two (Selcom and IMA) appear two times out of three. Intercohesive nodes are interesting because they simultaneously belong to more than one social group and are therefore in a position to promote the exchange of ideas and innovation between groups<sup>21</sup>.

<sup>20</sup> “The importance of intercohesion lies in the fact that it is an intersection of social structures. Such intersection points are locations of structural tension where multiple routines of operation and schemas to organize resources are at work. As prominent locations of restructuring agency, such intersecting social structures can be engines of social change from within” (Sewell 1992, cit. in Vedres e Stark 2007).

<sup>21</sup> However, according to Vedres and Stark, groups that over time have mutually exclusive membership are more stable but less innovative. This could be explained by a reduction in the heterogeneity of the organizations in terms of the knowledge they share.

**Table A Organizations in the communities and intercohesive nodes (k=7), space events 2000-2008**

	2000		2001		2002		2003		2004		2005		2006		2007		2008	
	1 community	organizations	2 communities	organizations	1 community	organizations	3 communities	organizations	3 communities	organizations	1 community	organizations	1 community	organizations	1 community	organizations	1 community	organizations
total	18		34		55		76		37		23		32		47		94	
	9		20		15		27		13		12		13		17		44	
	A	AliSpa	B	Omga	D	Cineca	E	CMP	H	Barbieri	K	Cineca	L	Cineca	M	Cineca	N	Beghelli
	A	CNH	B	RCM	D	CMS	E	COFIMP	H	Sacmi	K	CMS	L	CMS	M	CMS	N	Caprari
	A	Ferrari	B+C	<b>G.D.</b>	D	CNH	E	RCM	H+I	<b>GrFabbri</b>	K	CNH	L	CNH	M	CNH	N	Cefa
	A	G.D.	B+C	<b>GrFabbri</b>	D	Datalogic	E+F	<b>Comer</b>	H+J	<b>CMS</b>	K	Datalogic	L	Datalogic	M	Datalogic	N	Cineca
	A	GRFabbri	B+C	<b>IMA</b>	D	ELAU	E+F	<b>CMS</b>	H+I+J	<b>G.D.</b>	K	Ferrari	L	Ferrari	M	Datasensor	N	CMS
	A	IMA	B+C	<b>Selcom</b>	D	Ferrari	E+F	<b>G.D.</b>	H+I+J	<b>IMA</b>	K	G.D.	L	G.D.	M	G.D.	N	CNH
	A	Italtract	B+C	<b>System</b>	D	G.D.	E+F	<b>Tellure</b>	H+I+J	<b>System</b>	K	Grfabbri	L	IMA	M	Gima	N	Colombo
	A	RossiMotorid	C	AliSpa	D	GrFabbri	F	ACMA	H+I+J	<b>TetraP</b>	K	IMA	L	Italtract	M	GrFabbri	N	Coxa
	A	System	C	Beghelli	D	IMA	F	AliSpa	I	RossiMotorid	K	RossiMotorid	L	RossiMotorid	M	Hydrocontrol	N	Datalogic
			C	Cineca	D	Italtract	F	Cineca	I	Selcom	K	Sacmi	L	Sacmi	M	IMA	N	Ecor
			C	CNH	D	Rossi Motorid	F	CNH	J	Cineca	K	Selcom	L	Selcom	M	Italtract	N	Electrostud
			C	CSM	D	Sacmi	F	COFIMP	J	Datalogic	K	TetraP	L	System	M	RossiMotorid	N	Ensinger
			C	Datalogic	D	Selcom	F	Datalogic	J	Italtract				TetraP	M	Sacmi	N	Errelle
			C	Ducati	D	System	F	Ferrari							M	Saima	N	Esa/Gv
			C	EsaGv	D	TetraP	F	Gambro							M	Selcom	N	FNC
			C	Ferrari			F	IMA							M	System	N	G.D.
			C	Italtract			F	Omga							M	TetraP	N	Ghepi
			C	RossiMotorid			F	Sacmi									N	Gima
			C	TetraP			F	Selcom									N	GrFabbri
			C	UniBo			F+G	<b>Italtract</b>									N	Hydrocontrol
							F+G	<b>System</b>									N	IMA
							F+G	<b>GrFabbri</b>									N	Inspiring
							F+G	<b>TetraP</b>									N	ITG
							G	ACIMAC									N	La.Co
							G	Annovi									N	MeccanicaH7
							G	RossiMotorid									N	MeccTechnica
							G	SCE									N	Motorpower
																	N	Procomec
																	N	RossiMotorid
																	N	Sacmi
																	N	Saima
																	N	Sbarzaglia
																	N	SCM
																	N	Sefa
																	N	Selcom
																	N	Seven
																	N	Sitma
																	N	System
																	N	TEC
																	N	Technogym
																	N	TetraP
																	N	Timage
																	N	TITAL
																	N	WAM

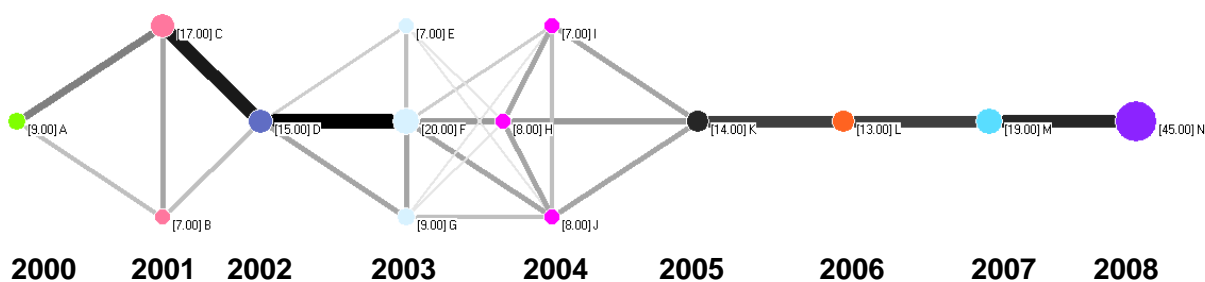
in  
communities

### Lineage of cohesion

In order to study how communities transform over time, Stark and Vedres (2007) use the concept of “*lineages of cohesion*”. In particular, they define “a lineage tie between a group at time  $t$  and another group at time  $t+1$ ” as “the sharing of at least two members”. The underlying idea is that social groups can persist over time although part of their members change.

Figure A is based on the data presented in Table A and highlights lineage ties between the various communities, over time. Each vertex represents a community. Vertices are coloured according to the year to which the communities refer. Vertices are ordered chronologically from left to right. Each community is uniquely identified by a letter from A to N. The size of each vertex is proportional to the number of nodes in each community (shown next to each vertex), while the width of each line is proportional to the number of members that each community has in common with the corresponding community in the following year. The lines between vertices in the same year indicate the number of intercohesive nodes (simultaneously belonging to both communities)

**Figure A Lineage of cohesion, space events 2000-2008 (k=7)**



Elaboration with Pajek using output from Cfinder

This graph suggests that communities have become more stable over time, with a greater number of members in common between communities over time. Starting from 2005, it is not possible to identify separate communities<sup>22</sup>. The analysis of lineages of cohesion identifies increasing cohesion around a nucleus of organizations that has become larger in the course of the last four years considered.

<sup>22</sup> With respect to their case study, Vedres and Stark (2007) observed that “Within this overall structure there might be subsets, lineage clusters, with groups that maintain their lineage separation from outsiders and share a distinct set of ancestral groups. In this case, the structure of lineage ties is organized; members leaving a group will have a strong tendency to reform a group with others from the same lineage cluster. Lineage clusters represent separate evolutionary paths of cohesion”.



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