EFFECTS OF SOCIAL NETWORKS MANAGING ON WORKING CAREER

Antonelli Gilda, *Prof. of Management*
Corrado Raffaele, *Prof. of Management*
Department of Management, University of Bologna, Italy

Abstract

This work is about the co-evolution of intra-organizational networks and organizational structures and behaviors, in the context of the introduction of an innovation.

A number of network studies, especially those concerned with the role of social capital in organizational settings, has focused on those actors who are most important in shaping the structural features of the network. We focus on one such actors, the broker, that is the one whose ties connect otherwise disconnected sets of network nodes. Our aim is assessing the mechanisms through which the broker legitimizes himself in his own role. In fact, existing studies mainly document the consequences of the broker network position, but do not analyze the mechanisms through which this position is acquired vis a vis the other actors in the network.

In this work we address both the organizational and the individual levels of analysis. At the organizational level we analyze the evolution of intra-organizational networks in the context of an important organizational change. At the individual level we analyze how personal attributes and behaviors co-evolve with the networks, as a consequence of the actors learning processes. We will focus on one specific network member who is shown to improve his own understanding of how to perform the informal role of the broker. We will see that such informal role will be turned into a formal organizational position by the end of the period observed in this study.

Keywords: Organizational networks, evolution, brokerage, social capital

Who is the broker?

A number of organizational researchers adopted a network perspective and addressed issues related to the unfolding, development and reproduction of organizational networks. According to this perspective, social structure can be defined as a general configuration of relations that unfolds from the routine dyadic interactions of actors who enact specific roles (Boissevain and Mitchell, 1973; Burt, 1980, 1982). Social structural change emerges from these dyadic interactions, while actors' behaviors are better understood as related to their location within social structure. The role an actor performs may depend on his competences, and he may exploits his role and competences in order to enhance his own visibility and attractiveness for other actors. At the same time, easy recognition of the competences of an actor reduces the search costs of other actors, and by consequence increases their interest in crediting him a specific role and in connecting to him in such a way that endows him of a specific location in social structure. Some researchers (Walker, Kogut & Shan, 1997; Gulati & Gargiulo, 1999) stated that past ties somehow are the basis for future ties and the network evolves on persistence of structure factors. In this sense persistence is a "structural property" (Giddens, 1984) by which interactions are reproduced over time and across actors.

Burt (1992) introduced the concept of broker, defined as the actor that benefits from bridging a structural hole in the network. A structural hole is defined in terms of the absence of ties among actors in a network, and the broker is the actor through whom otherwise disconnected actors are indirectly connected. Actors that fill structural holes enjoy information and control benefits. Information benefits in particular arise from access to more heterogeneous sources of knowledge; not every actor is equally well placed to fulfill this knowledge broker role, as different network positions offer different opportunities for individuals to access a variety of knowledge sources (Burt, 1992; Tsai, 2001; Rodan & Galunic, 2004; Ahuja, 2000a). Such knowledge brokers are central employees that act as a link-pin between two or more employees and make the transfer of knowledge possible (Ibarra & Andrews, 1993; Fleming & Waguespack, 2007).

Pollock, Porac and Wade (2004) introduced the concept of the "architect" broker, in order to explain the determinants of the strategic choices undertaken for building and managing networks in the context of a competitive business. Pollock et al. state that, in building his business network, the broker tends to prefer long or short-term strategies according to the amount of social resources possessed, the degree of dependence on the specific business as a source of profits, and other exogenous conditions. The more the social resources possessed, the more flexible tends to be the construction and the management of the network. The larger the dependence for profits from a specific business, the more the network is built by balancing short and long run considerations.

We intend to contribute to the study of the evolution of networks as defined by Doreian and Stokman (1994) through the longitudinal study of a case of technological implementation. According to these two authors, in fact, a substantial difference exists between dynamic and evolutionary studies of a network. The first focus on the qualitative or quantitative characterization of change or stability, sequentially, simultaneity or ciclicity of the phenomenon under study (Monge and Dalman, 1996). Goal of the dynamic approach is, therefore, that of providing a sophisticated description of the changes that took place in the network. On the contrary, the evolutionary approach follows the further end of understanding the mechanisms that determine the change across time. In particular, we regard the broker network position as interactively emergent both from the strategic behavior of the broker, and also from him being granted of such role by the other network actors. Recent study (Soda & Zaheer, 2008) has demonstrated that high-performing network actors may be better positioned to create superior network structures for themselves which in turn perpetuate superior performance. We try to point out the characteristics an actor must possess in order to credit himself as a broker in an informal network, by focusing on a specific member of the network we analyze.

This study addresses both the organizational and the individual levels of analysis, in that the broker's attributes and strategies will be assessed in the context of the structural changes that occur at the organizational level. We will show that ownership of specific technological competences and endowment of the legitimacy associated to a formal organizational position, are not sufficient conditions for an actor to acquire/be-granted-of a broker role. This depends also on the amount of relational capital accumulated through past interactions, and on the network capabilities he possesses.

Relational capital, human capital and network capabilities

Relational or social capital is composed of two main social resources: the reputation of reliability and competence an actor is endowed with (Burt, 2000, Bejamin and Poldolny, 1999; Bromiley, 1993), and the acquaintanceship or familiarity with other actors gained through past interactions (Granovetter, 1985; Larson, 1992; Uzzi, 1996).

Social capital has been defined also in terms of a cognitive perspective, as associated to similarities in actors' cognitive schemes and systems of meanings (Nahapiet & Goshal,1998). In fact, actors need to invest in reciprocal learning and understanding, in order to be able to communicate effectively with others who possess different languages (broadly defined) and systems of meanings. It is worth noting that this investment creates an asset, because it enables an actor to access information and social resources that otherwise would be out of reach.

Bourdieu and Wacquant define social capital as "'*the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalised relationships of mutual acquaintance and recognition*'" (Bourdieu and Wacquant, 1992, page 119). Social capital carries potential value because it provides to actors an opportunity to access information and resources in their social network. According to Burt (2000) social capital is linked to the opportunities an actor is given by his position in the network: *"...social structure is a kind of social capital that can create for certain individuals or groups a competitive advantage in pursuing their ends. Better connecting people enjoy higher returns*." (Burt, 2000; 2003.) In this sense the broker has access to more social capital the more structural holes he constructs and manages and, in turn, he can re-configure profitable social structure of future network . Thus, the more social capital an actor possesses, the more likely he is to benefit from the value of his own "human capital". High network centrality frees the actor from dependence on a specific source of support and enables him to access to a wider range of resources. Further, to the extent to which the actor mediates the indirect contact among otherwise disconnected actors, he enjoys the (information and control) benefits of the brokerage position.

Bourdieu (1980) and Coleman (1990) assert that a network tends to reproduce itself on the heritage of past relations and therefore, it follows, on the ability of individuals to preserve their own social capital. If this is the case, social capital accrues to an individual not only by holding an organizational position that enables him to trigger network contacts both within and outside the organization, but mainly through the reputation and legitimacy inherited from his relational history. Several authors have associated a central network position with greater power. Cook and Emerson (1978) hold power to be an attribute of an actor network position, which can be recognized to affect an actor's behaviours even though he is not aware of neither his network position or associated power. According to this approach, centrality generates power as a function of greater access to information and, more general, by enhancing decision making autonomy.

Social capital is counterpart to "human capital". Coleman (1988) defines human capital as the sum of competences and capabilities that characterize a person. Burt (1992) states that human capital is connected to individual capabilities. Ibarra (1993), in a study of the determinants of innovative roles, states that personal attributes like experience, seniority and level of education, are important sources of power that affect the possibility of undertaking an innovation. Related in particular to the implementation of technological innovations, is the fact that individual attributes may translate into greater ease in accessing to social resources. Zenger and Lawrence (1989) believe that seniority can substitute formal role, in that it fosters the presumption that an actor is legitimated by the organization and knows how to manage his own way within it.

Human capital is a basic requisite of the broker in order to secure organizational legitimacy; in turn, human capital and organizational legitimacy together allow him to be trusted by other network actors and keep a central network position. Among the components of human capital that we believe important in this respect are the abilities of listening to others and problem solving, helpfulness and communicative skills. Equally important are network capabilities, that could be broadly described as the ability to identify valuable

opportunities inside the network, and to exploit them by leveraging ties with other actors. To give an example, finding the person who possesses a specific piece of knowledge is often difficult within a multi-unit organization (Szulanski, 2003; Hansen, 1999; Hansen & Haas, 2001); such ability is not common among members of an organization, but can be found in those very skilled managers who achieve the fastest careers; "*managers with networks rich in structural holes tend to be promoted faster and they tend to reach their current rank earlier*" (Burt, 1992).

We may summarize this discussion in the following *proposition (1): An actor holds a broker network position in part as an outcome of his own strategic behaviour, but also as the effect of that actor being endowed of such role by the other actors. The chances of the broker to legitimate himself in such role are positively related to (i) the social resources inherited by past interactions and (ii) to his own personal competences and networking capabilities.*

Specific competences and organizational legitimacy

Ibarra (1993) states that holding a formal organizational position (which is usually associated to holding power and responsibility, and access to a number of resources) is an indicator of the actor's network centrality in the implementation of an innovation. In a similar fashion, Baldridge and Burnham (1975) maintain that the higher is the hierarchical rank of organizational members, the more likely they are to be successful as innovators. Often however, actors who hold a formal organizational position but are marginal to informal interactions do not play a significant role in promoting the innovation.

Formal position endows an actor with organizational legitimacy, and especially in highly formalized contexts this legitimacy is clearly important in orienting interactions and communication processes. It goes without saying, for instance, that in order to deal with a reporting problem about a specific organizational unit, one would not turn to an external collaborator or a "stageur" for asking clarifications and additional information, even if he knew that it is the latter that looks after this on informal grounds. In part then, communications and interactions among organization members are dictated by formal organizational structure.

However, even though formal organizational design is decided in order to cope with day-by-day organizational activities, it is drawn in advance of their actual performance and, to a greater or lesser extent, it has to be adapted in an ad-hoc fashion to the actual flow of events and activities. This is even more true in the context of the organizational changes usually implied by the introduction of important innovations, when it is harder to then usual to assess which organizational design will fit best new and partly unknown activities. Informal organizational networks reflect the ad-hoc arrangements and solutions that always are needed to complement, and sometimes substitute, formal organizational design. Informal networks provide insight into the general ways "things are getting done" within the organization, often bypassing and sometimes undermining formal communication processes. Informal networks are credited of providing faster information flows, and of allowing knowledge and information to flow in both vertical and horizontal fashions, which increases the overall flexibility of the organization (Cross et Al, 2002).

A degree of organizational legitimacy, at least that implied by formal organizational membership, is usually needed for an actor to be regarded as a legitimated participant to organizational interactions and communication processes. At times however, and we will show this to be the case of this study, informal status can even substitute organizational membership as a base for participating to organizational interactions and communications. In other words, the informal the status an actor is given by past collaborations with organizational members, that endow him with their trust and with a positive reputation of problem solving capabilities, can make of him a member de facto of the collective effort

undertaken within the organization, even despite the lack of any organizational affiliation. In fact, Krackardt (1992) points out holds that two people who do not know each other may develop reciprocal trust in part as a consequence of both trusting the same third person. Shared trust in a third party is therefore seen as a proxy of mutual. Thus, the role of one such actor can be expected to translate into a central, and possibly a brokerage position in the informal network mainly composed of organizational members.

To summarize we state our last *proposition (2): Informal status is a sufficient condition for endowing an actor with a key (broker) position within an organizational network.*

Data and Methods
Empirical setting

The empirical context of this research is a small Italian university with about 10,000 students, 2,550 employees and approximately 500 teaching staff members, including both permanently-employed and on-contract professors, in the academic year 2003/2004. In this as in the other Italian universities, the introduction in 1999 of a new law by the Italian Government raised the problem of the restructuring of teaching activities, with a substantial increase of the number of educational paths offered. In this context the governing bodies of the university started a number of administrative, organizational and technological innovations. We focus on one such technological innovations, the introduction of a new information system, that had also broad administrative and organizational consequences.

We analyze the organizational network composed of the persons involved in the project of development and implementation of the new information system. The project consisted of three distinct phases. The first lasted about eight months and ended on October 14th, 2002, with the presentation of the basic design of the system. This first phase involved 14 actors that were formally designated among members of several organizational units: faculties, information technology centre and students secretariat. In the performance of their activities, the 14 officially designated project members activated further contacts. The actors that on the whole have contributed to the development of the phase have been 37.

During the first phase the original objectives were redefined and the scope of the new information system broadened. While originally the main goal was the optimization of the spaces for the didactic activity, soon it became clear that the new system could be exploited also for further ends. These were identified in the following: restructuring the information system that supported didactic activities in general; providing information for supporting decision making at different organizational levels, including broad strategic decisions; decreasing administrative costs without affecting the quality of services.

These new directions of the project were further elaborated and refined during the second and longest phase of the project, aimed at the set up of the data archives needed by the system, and its experimentation. The second phase begun right after the end of the first and was ended 16 months later, on March 14th 2004. In this phase, the original group of official project participants was enlarged to 25 people, who activated further informal contacts for a total of 41 actors involved. The majority of them had also participated to the first phase.

The third and last phase begun with the deliberation of the Academic Senate on February 12th, 2004 which approved regulations concerning the scheduling, organization and performance of didactic activities. This triggered the process of actual implementation of the information system in all the faculties, and started the redaction of a further document concerned with the redefinition of administrative procedures and restructuring of several organizational processes, and with the allocation of functions and responsibilities. The third phase officially involved 31 people, who activated further contacts for a total of 45 actors involved.

Data collection and coding

Data were collected by participant observation, interviews, and through submission of sociometric questionnaires, across all three phases of the project. None of the authors of the present paper participated directly to the activities observed, however one of project participants has been involved in the first stages of the research and contributed, together with the first author, to the redaction of a first draft of the present paper. For each phase all the persons who were actually involved in the project were identified; the names of those participants who were not officially designated were elicited from official participants. For each of the three phases a sociometric questionnaire was submitted to all the actors involved in the project (whether formally or not).

The questionnaire presented a list of all the persons involved in each phase and asked with whom among them the interviewee had interacted with (without distinction among face to face, phone or e-mail contact) for discussing issues related to the project. The questionnaire asked to specify separately the interactions related to four distinct types of issues (two categories related to administrative and organizational subjects - a. organizational and procedural, and b. related to regulations- and two concerned with technical subjects -c. technical constraints and d. related to technology operation), and to specify for each the frequency of contact. At the same time the questionnaire was submitted to each actor, an interview was conducted in order to further explore and clarify salient facts that the participant researcher had noticed. The results of the questionnaire and the interviews were coded and analyzed by a researcher who was not involved in any of the project activities.

Methods

We built distinct relational matrices for each project phase and content of interaction (type of issue discussed), by coding the frequency of contact each person reported with any other. We analyze the three relational matrices (networks), one per project phase, obtained by conflating the four relational contents into a single one through a union operation. Interaction was coded as present or absent, without distinction of frequency. In other words i sends a tie to j in the network observed for a given phase of the project, if i reported that during that phase he discussed with j (at least once in a semester) about at least one of the four general topics.

We first present a description of the networks based on graphical representations and on structural indices at both the network and individual actors levels. We then report qualitative evidences that emerged from the interviews of the network members and from direct observation of the project activities, and conclude by presenting the estimation of stochastic models of the evolution of the network across the three phases.

Network descriptive

We report graphical representations of the network in each phase. This is effective and intuitive for describing general structural features, but implies an ambiguity because which structural features are made evident depends on the geometrical location of the nodes in the picture. Layout algorithms, that compute the set of nodes' coordinates that best fits a number of criteria, overcome this arbitrariness and help reveal the structure of the network. There may not exist a unique set of coordinates which is optimal according to the criteria to be matched, and the iterative nature of the layout algorithms implies that the locations of nodes vary on repeated runs of the layout algorithm. The layouts of the pictures presented were found to be very stable on repeated runs in their general appearance, changes from run to run consisted at most in very small adjustments or in the rotation of the most central part of the network.. The software we used is *NetDraw* (Borgatti, 2002).

We used the most common layout criterion, that might be roughly described as that of making the geometrical distance in the picture among two nodes proportional to their graph theoretic distance, that is the minimum number of lines that should be crossed in order to move ideally from one node to the other across the network ties. One implication of the graph theoretic distance criterion is that the nodes that are best connected tend to be located at the centre of the picture. How well a node is connected in the network may be assessed in different ways, in fact many node level centrality indexes exist that grasp different aspects. We will discuss a few of these below, however this distinction, though very important, does not greatly affect the layout of nodes in graphical representations

For each phase we also computed indices at both the network and the individual actors levels. At the network level, *density* expresses the extent to which actors interact with each other, and is computed as the ratio of the number of ties to its maximum possible value[263]. Network *centralization* expresses how interaction is distributed among network actors, and measures the extent to which a few actors are very well connected (high centrality) while a majority is marginal (low centrality). While this is true in general, centralization is computed on the base of node level centrality scores, it is then contingent upon the specification of the node level centrality index. The centralization index is computed by summing the differences between the greatest observed centrality and all centrality scores, and taking the ratio of this sum to its maximum possible value.

We will compute two types of node level centrality indexes (and associated network level centralizations) (Freeman, 1979). An actor *degree* centrality is the number of others he interacts with in the network; if a distinction is made between tie sender and receiver, degree centrality splits in *outdegree* (number of others an actor sends a tie to) and *indegree* (number of others an actor receives a tie from). *Betweenness* centrality measures the extent to which an actor is located over the shortest chains of contacts (geodesics) that connect other actors. It is then a measure of how important is an actor as broker of the (indirect) contact among others, or in other words a measure of the extent to which an actor fills the gaps (structural holes) due to the lack of ties among other actors.

While any network tie may affect the *betweenness* score of an actor, the *constraint* index (Burt, 1992) focuses on his network neighborhood, his *ego-network*. The ego network of a given focal actor (*ego*) is composed of the other actors he is connected to and the ties among them. The constraint index is a measure of the extent to which the network contacts of the focal actor are tied to each other, and is inversely related to the presence of structural holes in his network neighbourhood.

Evolution of the network

Interviews with actors of the project network focused on motives orienting individual choices of partners of interaction. Somewhat in a similar fashion, the stochastic models of network evolution that we present are based on the estimation and testing of the actors structure of preferences, which directs their choices of the contacts to send a new tie to or withdraw an old tie from.

We model the evolution of the network across the three phases based on these actor-oriented models of network change (Snijders 2005a, 2005b, 1996). These simulation based models allow estimation and testing of parameters associated with the dynamical tendencies of the network. We will estimate structural effects which quantify the general tendency of the actors to reciprocate ties (reciprocity) and their tendency to cluster in internally dense network subgroups (transitive closure). We will then add to the model the interactions that

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[263] This is *n(n-1)* in a network that includes *n* actors, if a distinction is made among the tie from actor *i* to actor *j* and that from *j* to *i*.

capture the differential between the general network dynamics and the evolution of the ties that involve a specific network actor, the *broker*.
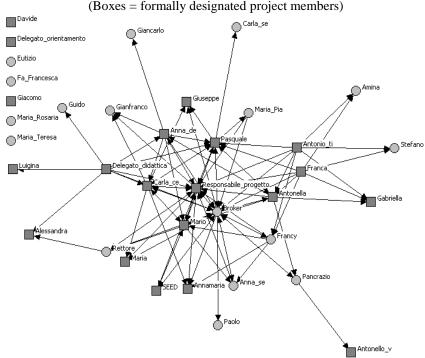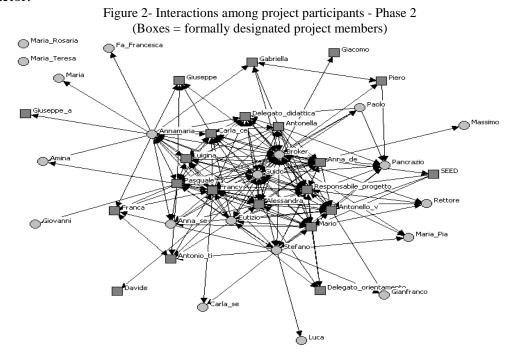
Figure 1- Interactions among project participants - Phase 1
(Boxes = formally designated project members)

Transitive closure is exemplified in Figure 2; this structural tendency implies the dashed tie shown in the right side to directly connects the two nodes only indirectly connected in the left side. The stronger the tendency to transitive closure, the more the network is articulated in subgroups whose members are all tied each other, while no ties exist between members of different groups. In terms of the ego networks of Figure 1, perfect transitive closure would imply that all network contacts of a given node are directly tied each other, with absence of structural holes, null betweenness and high constraint scores for the focal actor.

Figure 2- Interactions among project participants - Phase 2
(Boxes = formally designated project members)

Qualitative account

We will add to the first results by focusing on the key actors of the network, and reporting evidences from interviews with network participants and direct observation. Here, in order to give empirical content to the concept of *network capabilities*, we focus on key statements and concepts collected during the interviews. In particular, we maintain that an actor recurrently reported as accessible, helpful, effective at problem solving, at activating the right contacts for accessing valuable information, at coordinating collective efforts is endowed with network capabilities.

Results

Figures 1 to 3 show the network in each of the project phases. A quick look at all three figures shows an increase of network density from phase 1 to 3. The network densities were 7.6%, 14.8% and 16.1% in phase 1 through 3 respectively. The remarkable centralization of the network is better appreciated in Figure 3 for phase 1, when the network is sparser; the increase of density in later phases tends to obscure network centralization in Figures 4 and 5, however centralization indexes show it increases from 35% to 53% for both in and out-degrees, and from 12% to 21% for betweenness.

Both the official project leader Responsabile_progetto, and the informal one Broker, are in the central - densest part of the graph in all three phases. Other actors who play a major role in the network tend to vary somewhat from phase to phase. This is confirmed by the centrality indexes. In all three phases Broker is most central to the network, and his ego-network is richest in structural holes. Indeed Broker's constraint score is always the lowest, which indicates he mediates the contact among other actors in his network neighbourhood. He performs the same role also for the entire network, as shown by the fact that his betweenness is always highest. Broker is reported to be partner of interactions by 15 actors already in phase 1 (in-degree), and reports the same number of network contacts; next highest on in-degree is Responsabile_progetto (in-degree = 14) and others follow at some distance.
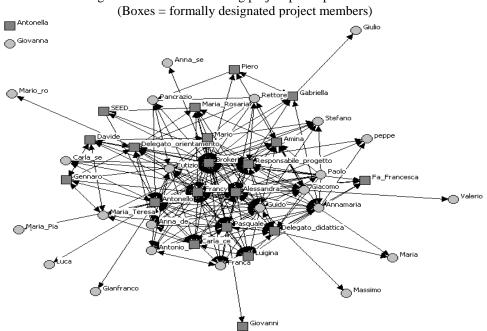
Figure 3 - Interactions among project participants - Phase 3
(Boxes = formally designated project members)

Responsabile_progetto, whose network weight is closest to broker in phase 1, loses some importance in later project phases. Worthy of note in phase 1 is the case of some actors who seem to bridge structural holes in their network neighborhood (low constraint) while do

not play the same role in the network as a whole, as testified by their null scores on betweenness. This depends on the fact that they are not reported as partners of interaction by any other actor in the network (in-degree = 0), that is no tie is directed toward them. It follows that they are not located on any chain of contacts that indirectly connect other actors, since these chains in a directed network must involve ties with concordant orientation. Guido, who is peripheral in phase 1, gains a prominent role in phase 2 (Figure 2), while Antonello enters the network in phase 3 in a very central position (Figure 3). Nobody however equals Broker, who quickly increases his importance in the network, as shown by the improvement of all network indices across the three phases.

Table 4 documents some structural tendencies that characterize the evolution of the network across the three phases. Parameters estimates 1 and 2 measure simply the amount of network change in period 1 (phase 1-2) and period 2 (phase 2-3). Parameters 3 and 4 are included in order to account for the distribution of actors out-degrees while assessing more complex structural effects. All four effects do not deserve further comments.

Reciprocity (5) shows a significant tendency for the reporting of interactions to be reciprocated by actors on both sides. Next three effects (6, 7 and 8) express in slightly different ways the structural tendency to transitive closure, of the greatest importance in the study of networks. This is the tendency of actors to cluster in densely knit and mutually exclusive subgroups, and of structural holes to disappear from the network. It can be noted that this tendency exists in the network as a whole, as shown by the positive and significant estimates of parameters 6 and 7.

Estimates 9 through 12 are dummies that control for some actor level characteristics. It is shown some evidence that administrative employees, one of the three job categories we distinguished, were more reluctant at participating to interactions than IT technicians (these were the reference category; Academics, the third category, did not show any significant effect on any model and the effect was not included in the models we are reporting). Estimate 11 shows that official members of the innovation project were preferred target of interactions, while estimate 12 shows they did not initiated interactions more often that average (effect not significant).

Table 4
Model of project network evolution – Phases 1-3
(* significant at .05 level)

	controls	model 1	model 2	model 3
1. constant network rate (period 1)	35.74* (8.12)	44.12 (23.15)	44.33* (13.60)	44.22* (12.64)
2. constant network rate (period 2)	16.37* (2.04)	17.87* (2.55)	18.23* (3.11)	18.23* (2.76)
3. outdegree (density)	-1.38* (0.21)	-1.78* (0.28)	-1.81* (0.28)	-1.85* (0.23)
4. 1/(outdegrees + 1)	6.04* (0.74)	5.34* (0.68)	5.24* (0.73)	5.19* (0.62)
5. reciprocity	1.42* (0.16)	1.59* (0.15)	1.58* (0.15)	1.58* (0.14)
6. transitive triplets	0.04* (0.01)	0.04* (0.01)	0.04* (0.01)	0.04* (0.01)
7. (direct and indirect) ties	0.33 (0.19)	0.60* (0.26)	0.62* (0.23)	0.66* (0.23)
8. balance	-0.27 (0.30)	-0.23 (0.33)	-0.11 (0.36)	-0.03 (0.35)
9. Employees ego	-0.22* (0.11)	-0.16 (0.10)	-0.16 (0.10)	-0.15 (0.12)
10. Employees identity	0.08 (0.13)	0.19 (0.13)	0.20 (0.14)	0.21 (0.13)
11. Project alter	0.27* (0.08)	0.23* (0.09)	0.22* (0.09)	0.21* (0.09)
12. Project ego	-0.07 (0.09)	-0.01 (0.12)	0.00 (0.10)	0.01 (0.09)
13. int. Broker ego × reciprocity		13.321 (fixed)	13.321 (fixed)	13.321 (fixed)
14. int. Broker ego × transitive triplets		0.0761 (0.06)		
15. int. Broker ego × (direct and indirect) ties			0.7743 (0.45)	
16. int. Broker ego × balance				-0.89* (0.36)

Next are presented the effects that isolate the specific contribution to network transitive closure of the ties sent by Broker; these are interactions among the dummy for this actor and effects 5, 6, 7 and 8. Interaction with reciprocity was included as a control, but it gave estimation problems; since it was shown to be large in many estimates, it was fixed at a large value in order to assess effects 14, 15 and 16. These show that the tendency toward network closure that holds for the network does not hold for Broker: interactions of this actor are not bounded within cohesive subgroups, as shown by the positive and significant estimate of effect 16 (and the near significant effect 15).

How happens that Broker, nor a member of the project or employed at the University, was found in such a key network location since the beginning? Did this depend on organizational legitimacy, like being designated as coordinator, this location would have been occupied by Responsabile_progetto. At least, in order to take a de facto coordinating role Broker had to be already familiar to and trusted by other actors, and endowed with some other kind of legitimacy. We hold the present case shows that Broker establishes and extends his own role incrementally, by exploiting and developing further the social resources he was already endowed with.

Interviews shed some light over this somewhat anomalous circumstance. Actors were asked about the motives of their first interaction with Broker. It is quite evident from the interviews that Broker, though relatively young, had a positive reputation because he was found reliable and trustworthy in his voluntary active participation in prior projects. Guido also tried to take a coordinating role and actively involves in interactions with project members; in the second phase he sharply increased his outdegrees (from 0 to 19) and indegrees (from 1 to 14). This is interesting to note because he is a direct competitor of Broker. Like the latter, Guido didn't hold a position in the University and wanted to get in. He was aware that the innovation project could be an important chance for building a good reputation and tried to develop good relations with others. He didn't succeed, and the reasons seems that he didn't have the same network capabilities, coordinating and personal skills of Broker.

Other clues can be obtained by looking at the reasons "why one would look for organizational or technical support from somebody who does not belong to the project". Two main types of motivation emerged from the answers, those related to the history and type of interaction, that might be labelled "social", and others more specifically related to characteristics of the person, defined as "personal". Based on all the interviews we reconstructed some specific characteristics of Broker, which might be generalized to any person who performs a brokerage role in a network like the one we observe. Especially recurrent were the ideas of effective problem solving, understanding of the organizational system and internal communications, the ability to obtain relevant information by tapping the right sources, to leverage the right contacts to get things done. Many stated that the broker "… *is very resolute and prompt to collaboration in solving problems, and has excellent communicative capabilities*", "… *can't imagine how difficult it is to get the information you look for … never know who to ask, who could be a reliable source …*". These are *network capabilities*.

On the other hand, it is interesting to note the evolution of the role of Delegato_didattica, the delegate for teaching operations. This formal role was important for coordinating flows of information needed for the implementation of the IT system. The university Rector, who understood the growing importance of Broker in the informal management of the project but could not formally invest him of this role since he was not employed at the university, decided to give full power of managing the project to Delegato_didattica. In spite of this, even though he was held a competent and trustworthy

person, he was listened to only on normative aspects and didn't take a leading position. Broker kept being identified with the innovation project itself. Even though in the first phase he had only little more power of the formal project leader, Responsabile_progetto, his role grew from phase to phase until the Responsabile_progetto manager himself decided to turn it into a formal position by means of a consulting contract. This changed the formal design of the innovation project to match the actual, though informal, system.

Discussion and implications

Organizational implications of innovation include the simultaneous change of both relational and non relational aspects of the organizational roles of the actors. Among the first are both formal and informal networks (information exchange, reporting …); among the latter are actors objectives and competences. At the same time the innovation process itself is affected by existing networks and individual capabilities. It is argued, for instance, that the informal communication network is of key importance for the inter-unit process of knowledge transfer (Maurer I., Ebers M., 2006; Cross et al., 2002). The present work is consistent with these ideas, but focuses also on the interplay between network and actor levels of analysis.

It is shown how individual characteristics shape informal networks, by looking at how personal competences affect the network role of actors that are key to the innovation process. While much of the debate about social capital has focused on the translation of this idea in network structural terms, this work sheds some light on the processes through which a given structural position is acquired. We try to bridge social and human capital by exploring the personal capabilities that allow an actor to be a legitimate (though only informally at the beginning) occupant of a brokerage network position within an intra-organizational network.

At the network level it is also shown that the informal network may affect the evolution of the formal one, depending on the strategies of the actors. From a managerial perspective, this points to a way of improving innovation processes, that always involve the interplay of formal and informal roles. In this respect, most effective seems to be the role of actors who merge formal legitimacy and informal status, by maintaining non-redundant relations in both formal and informal networks.

While we believe that the implications of this study may be generalized, one limitation of this work might be found in the specificity of the Italian university organization that served as our empirical setting. The direction of research we pursue in this work, by addressing both the effects and the generative mechanisms of intra-organizational networks, and the interplay between emergent and projected organizational structures and behaviours, may narrow the gap between network studies of organizations and concrete organizational practice. This could contribute to the construction of the network theory of organization (Salancik, 1995) that is needed to improve the design of organizations.

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