Social capital in project-based organizations: Its role, structure, and impact on project performance☆

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Abstract

The aim of this study is to provide evidence about the role of social capital within project-based organizations. Our assumption is that the social capital of project units increases knowledge integration, producing in turn high levels of performance at the project level. We collected primary data via sociometric questionnaires on 54 projects in the construction field. The analysis has been conducted to study the distinctive structural configuration of projects’ social capital, among which we emphasize the role of network cohesion and network range. Our results provide evidence that levels of project performance are significantly associated with the particular structure of projects’ social capital.

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1. Introduction

Organizational literature argues that project-based modes of organizing and controlling work are a response to changing contextual factors (DeFillippi and Arthur, 1998; Powell, 1996). In particular, these modes’ fluid and temporary nature is seen as a means of bringing about organizational change as well as responding to the increasingly complex environments that organizations are faced with as a result of the high pace of technological development in many of the innovative sectors. Thanks to their ability to overcome typical permanent organizational inertia and achieve organizational change or renewal, project-based organizations (or PBOs) have become more noticeable in a range of industries.

In such organizations, projects do not simply occur against a backdrop of relatively established, routine activities. Instead, they constitute the organization, creating a scenario in which knowledge diffusion and emergent working practices are likely to be the result of a complex interplay between structural and environmental project conditions and the role played by each individual who takes part in the project itself. Within temporary organizations, teams represent group of people with well-specified objectives and in which members are aggregated in order to bring together individuals and their resources. The complex environment often requires frequent interactions that concern not only members of the same project, but also individuals affiliated with different projects. A better understanding of how groups and projects gather access to tangible and intangible resources may come from studying these patterns of interaction, as well as their overall structure. The way individuals and groups of people are linked, creating a system of interdependent social exchanges between partners who are

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called upon for tangible and intangible resources, is here referred to as project social capital.

While prior literature devotes considerable attention to formal multi-project management arrangements (Cusumano and Nobeoka, 1998), there is a dearth of study on the benefits that informal social exchange relationships may have for a number of organizational outcomes. The aim of the present paper is to explore whether and how a project’s social capital has an impact on its levels of performance. Our assumption is that the structural properties of social capital might have important performance implications for projects. In particular, we analyze the structural configurations of projects’ social capital, among which we emphasize the role of cohesion (Burt, 1992; Fernandez and Gould, 1994) and diversity (Burt, 1992). The level of cohesion of project social capital accounts for how strongly interconnected project members are, and is generally used to highlight the degree of constraint of actors as network members. The level of diversity of project social capital, also known as network range, considers how different the partners involved in social exchanges are, taking into account the prevalence of cross-boundary social interactions between projects. Project social capital has thus range to the extent that project members spread their exchange social relationships across multiple areas of expertise.

The occasion to bring these theoretical issues to bear on the actual analysis of social capital of temporary projects is provided by network data that we have collected on 54 projects in the construction industry.

Our argument proceeds as follows. The next section presents a literature review on project-based organization and inter-project relationships, introducing the concept of project social capital. The third section provides information on our research design, and discusses issues related to data and measurements. In the fourth section we report the results of our analysis. A final discussion section concludes the paper.

2. Theoretical background

2.1. The project-based organization

The PBO is an organizational form in which the project is the primary unit for production organization, innovation and competition (Hobday, 2000). The literature has broadly revealed that PBOs are especially needed in significantly customized industries, such as film-making and media (DeFillippi and Arthur, 1998; Sydow et al., 2004), complex products and systems (Hobday, 1998), software development (Ibert, 2004), construction (Bresnen et al., 2004), engineering design (Cacciatori, 2008), and biotechnology (Ebers and Powell, 2007).

Numerous benefits have been associated with the adoption of a PBO. They refer to better processes, control and lead-time reduction (Verona and Ravasi, 1999), higher output quality (Bresnen, 1990), increasing ability to respond quickly and flexibly to each customer’s needs (Hobday, 2000; Mitzberg, 1983) and to innovate in collaboration with clients and suppliers (Pinto and Rouhiainen, 2001). Overall, this organizational model allows a much more flexible application and integration of different types of organizational knowledge and skills, learning within the project boundary and coping with emergent properties in production, project risks and uncertainties (Grabher, 2002a; Keegan and Turner, 2002).

In spite of such benefits, PBOs also present considerable drawbacks in performing routine tasks, achieving economies of scale and coordinating cross-functional resources (Hobday, 2000). In addition, they show difficulties in promoting organization-wide and project-to-project learning (DeFillippi and Arthur, 1998). This happens because knowledge generated in the project activities is embedded in tacit experiences of the group members and is therefore difficult to consolidate and spread at the organizational level (Prencipe and Tell, 2001). Projects often are also quite different, and solutions developed in the context of one project can seldom be applied to another (Bresnen et al., 2003). Finally, knowledge is at risk of being dispersed as soon as a project is dissolved and members are assigned to different tasks or teams (DeFillippi and Arthur, 1998).

2.2. Inter-project relationships and project social capital

Even though projects are autonomous from each other most of the time, inter-project coordination is a desirable thing especially when the adoption of new technologies or development of new project routines could be used and applied elsewhere in other projects of the organization. As a consequence, whether PBOs live on their ability to mobilize and conduct projects, for organizational performance as well as for that of other projects some key managerial tasks are needed to integrate project-based learning into the organization (Gann and Salter, 2000).

Organizational projects are highly autonomous units that, especially in knowledge-based organizations, represent the way through which organizations seek to achieve innovation and new knowledge production. Project units allow dividing labor within organizational boundaries and giving firms the opportunity to focus on fewer but highly customized activities, but producing at the same time a high degree of differentiation into organizational sub-systems (Lawrence and Lorsch, 1967). Such differentiation is reflected, for example, in the partial vision of whole organizational activities, potential conflicts among projects, and different priorities that characterize scheduled activities and the project agenda. This approach to organizational design complicates the management of interdependences across projects performing different, well-specialized tasks and activities. In sharp contrast, internal learning and knowledge creation via long-term changes in explicit and tacit knowledge in their own areas of work are essential for organizations in order to achieve an adequate profitability and to stay competitive in knowledge-based contexts. The activities of each project must be integrated and the access to the knowledge and competences residing in other projects is required to respond appropriately to the environment.

Staffing solutions enhance collective learning in organizational project teams (Borgeon, 2007). The diversification of project-team composition and individual characteristics of its
members, such as demographic, tenure and competence diversification, is one way through which often firms integrate sub-systems according to the need to coordinate tasks and activities. Yet the rotation of individuals across projects is desirable to reconcile single projects’ differentiation with knowledge integration at the organizational level. Horizontal structures and coordination roles which emphasize collaborative networks inside and outside of the organization (De Meyer and Mizushima, 1989; Hakanson and Zander, 1988) represent other crucial responses adopted by companies to master, promote and keep the collective learning developed during new projects’ development.

These are, however, partial solutions. To achieve integration effectively, a project needs to establish and maintain exchange relationships with other projects within the organization, so as to pull in important informational resources and, consequently, improve project performance. Tasks and activities carried out at the project level are based on heterogeneous and often complex sets of knowledge and information (Polanyi, 1966). Innovation and technology development rely consistently on the combination and sharing of explicit and tacit knowledge that allow individuals to learn and gain access to experiential knowledge and new techniques and methods developed by colleagues (Cockburn and Henderson, 1998). Under these circumstances, relationships with other projects in the organization are likely to provide access to a valuable set of tangible and intangible resources, which may be important for project performance. Within temporary organizations, project teams represent groups of people aiming to achieve well-specified objectives, in which members are aggregated in order to put together individuals and their resources. Among such resources, social capital available through individual members’ social relations appears to be of critical importance, given the work performance and work processes at the project level.

Social capital encompasses a set of resources inherent in the structure of social relations among individuals (Burt, 1992; Coleman, 1988; Nahapiet and Goshal, 1998). Social capital and its effects have been studied at different levels of analysis: individual (Burt, 1997), group (Oh et al., 2006) and organizational (Pennings and Lee, 1999). In this paper we introduce the concept of project social capital, defined as the overall web of inter-personal and inter-project relationships in which single project units are embedded, and through which important resources can be accessed. Whenever project tasks require new relevant knowledge located outside project boundaries, individuals taking part in projects may be strongly motivated to create network relations with members of other projects having access to new knowledge. Network relationships are project-specific since they are formed around project boundaries and serve as a form of social capital that, being exploited, may produce a wide range of benefits at the project level. The importance of the project social capital relies upon a number of recent studies which have stated that projects are more than just temporary systems (Sydow and Windeler, 1998), in the light of the complex web of network relationships which they create to perform project tasks and from which they mobilize essential resources (Sydow and Staber, 2002).

2.3. Social capital and project performance: the role of cohesion and range

Even though the amount of social capital resources is likely to affect project effectiveness, we hypothesize that the structural properties of project social capital might have important performance implications for projects. In general, the structural properties of social capital highlight the idea that actors with the “right” types of network ties can more effectively employ, mobilize and use informational and other kind of resources than actors can with network linkages of a different type (Hite and Hesterley, 2001).

In the traditional view of social capital, one of the network structural properties that can assume a pivotal role for the production of knowledge for network members is cohesion (Coleman, 1988; Reagans and Zuckerman, 2001). A network can be defined as “cohesive” when members are strongly interconnected, taking into consideration the proportion of possible ties between a set of nodes that actually exist (Gargiulo et al., 2009). In highly cohesive networks, information diffuses rapidly, and individuals belonging to the same network are likely to share the same knowledge. Cohesion is helpful in promoting the creation of social norms and sanctions within networks, and to facilitate trust and effective coordination between network members (Coleman, 1988; Granovetter, 1985; Krackhardt, 1999; Reagans and McEvily, 2003). A dense cohesive network would thus benefit from greater cooperation, conformity to norms, information sharing, and less tendency to engage in competitive behavior, thereby increasing the willingness of members to engage in discussion and knowledge exchange.

Increasing individuals’ access to knowledge is important for the performance of project units, as it increases the probability of obtaining specific resources to apply to their context. Highly dense networks provide an arena in which, apart from identifying useful ideas and knowledge of network members, project members can use other projects and their own members as resources to augment their own prior knowledge. In this manner, individuals do not just add to their own knowledge stocks, but also use others’ knowledge to further stimulate the usefulness of their own skills.

However, very cohesive networks are not always efficient in developing new knowledge and, in turn, for performance of single projects. First, cohesive networks might have unintended consequences if they result in comfortable or validating interactions but not in the most relevant and useful knowledge for the project activities at hand (Mizruchi and Stearns, 2001). Furthermore, as suggested by Burt (1992) in his theory of “structural holes”, cohesion is the empirical indicator of redundancy, because in densely connected networks many of the ties carry the same information and there are many alternative paths that the information follows to reach individuals belonging to the network. In this respect, when a project shares knowledge and intellectual capital with another project within the same organization, the two projects become more redundant inside the network. The two projects have knowledge and ideas in common, and therefore might represent substitutable points of exchange in
the collaborative network. Project teams are temporary structures and have a common goal — finishing the project in time. Considering that one day is composed of 24 h, exposing projects to a high amount of inter-project exchange relations can be devastating for the exchange of knowledge between project teams and for project performance. By generating redundant information and less diversified knowledge, high levels of network cohesion can soon produce information overload, scarce novelty and unintended knowledge homogeneity within collaborative networks among projects.

Based on the above discussion, we argue that project performance has an inverted U-shaped relationship with the level of cohesion of project social capital because it is at moderate levels of cohesion that the access to useful knowledge resources by projects within networks will be maximized. More formally, we hypothesize:

\[ H_1. \text{ Project performance has an inverted U-shaped relationship with the level of cohesion of project social capital, and is maximized at a moderate level of cohesion.} \]

Another important perspective that can be taken into account when exploring the project performance considers the relationship between cognitive diversity and performance of single projects. At an individual level, knowledge diversity — or heterogeneity — is shaped by the background of project members, as well as by their previous work experiences. Following the arguments on social capital, the discussion about cognitive diversity relates directly to the collaborative ties that project members may establish with other colleagues specialized in different areas of expertise. While similarity in the stock of knowledge owned by individuals can, to some extent, improve communication and commonality among them, diversity enhances the capacity for creative problem-solving and allows individuals to share different sets of contacts, skills, information, and experiences (Reagans and Zuckerman, 2001).

Burt (1983) translated the discussion about the heterogeneity of network relations into the language of range. Network range is defined as the prevalence of ties that cross institutional, organizational, or social boundaries (Burt, 1992). Relations have range to the extent that they connect an actor with an extensive diversity of other actors. Actor diversity, indicating network range, does not take into account the number of actors, but rather the number of different types of actors. The greater the number of different types of actors to which an individual who takes part in a single project is linked, the greater the diversity of information and social support which the individual can have access to (Burt, 1983).

In this paper, we consider cognitive diversity in terms of both the different project members’ areas of expertise and the degree of presence/absence of relations with heterogeneous project members. Each area of expertise can be viewed as a distinct pool of knowledge possessed by individuals affiliated with the various projects within the organization. Network range reflects a property of the project social capital that takes into account the extent to which project members’ interpersonal networks are rich in “cognitive diversity”. Individuals are chosen and assigned to single projects on the basis of their specific competences and past experiences. Such capabilities are often represented by the functional units that overall represent the permanent part of the organizational chart. Projects that spread connections across multiple pools bridge holes between projects in the broader “community” of knowledge at the organizational level. As a result, they are exposed to knowledge that is more diverse. The network range of single projects is therefore high.

The property of diversity is of crucial importance in PBOs. Intense and frequent communication among their members is a highly desirable condition within project teams. Connections with members of other projects who have a different background may enhance an individual’s capabilities to interpret ideas from people with different knowledge in a way that suits his or her knowledge and experiences. At the same time, through “different” ties, individuals are capable of transferring what they know to others with different backgrounds in an easier manner. The ability to transfer knowledge effectively leads to higher exposure of projects to a broader set of perspectives and cross-fertilization of ideas, and thus to variation in knowledge and problem-solving approaches which can help project teams to identify and use multiple knowledge components in their activities. In other words, projects that have exposure to more diverse knowledge through their members’ interpersonal networks will have access to more knowledge components, and will be able to mobilize and exploit different intellectual resources embedded in the network. As a consequence, it is likely that higher levels of diversity of their network relationships will be associated with higher performance.

Although relations across disciplines can be beneficial, in certain cases excessively high levels of diversity can be problematic. To the extent that knowledge is transferred across boundaries which demarcate distinct bodies of knowledge, it is unlikely that individuals on both sides of the boundary will have much knowledge in common. Cohen and Levinthal (1990) labeled the ability to assimilate and replicate new knowledge gained from external sources as “absorptive capacity”. In discussing how this contributes to innovation, they argued that absorptive capacity tends to develop cumulatively and builds on prior related knowledge. High levels of diversity featuring project social capital could result in a lack of common knowledge among linked projects, decreasing their absorptive capacity and making their attempts to transfer knowledge across the boundary vulnerable. Lower ability to transfer knowledge will in turn reduce opportunities to gain access to different cognitive strategies and others’ experiences, reducing potential for project performance.

Based on the above discussion, we argue that project performance has an inverted U-shaped relationship with the level of diversity of project social capital because it is at moderate levels of diversity that projects maximize the possibility to integrate and combine novel knowledge resources into their activities. Overall, we hypothesize the following:

\[ H_2. \text{ Project performance has an inverted U-shaped relationship with the level of diversity of project social capital, and is maximized at a moderate level of diversity.} \]
3. Methods

3.1. Institutional setting

The relationship between project social capital and performance seems to be particularly salient in the construction industry, as the work performed at the project level in this context is likely to be enhanced heavily through information available from others. We chose this sector for a number of reasons that we are now going to explain in more detail.

The construction industry is one in which project-based organizational forms have long been taken to be the norm across a significant range of activities (from large-scale, one-off engineering projects to smaller-scale, more repetitive building work). It is a prime example of a project-based industry, in which new product involves not only non-routine production processes, but also development (of roads, bridges, offices, housing and the like) prime example of a project-based industry, in which new product significant range of activities (from large-scale, one-off engineer-organizational forms have long been taken to be the norm across a context is likely to be enhanced heavily through information obtained from others. We chose this sector for a number of reasons that we are now going to explain in more detail.

Yet in this industry, project teams are decentralized and heterogeneous because they consist of a mixture of staff from different professional and organizational backgrounds, and where the regular secondment and movement of staff between projects is common (Bresnen, 1990). These conditions imply that the individuals in the project teams are recombined in each project. The construction project may be considered as a specific temporary network within a more permanent network, where the firms have to coordinate their activities and resources among the different construction projects in which they are involved (Dubois and Gadde, 2002: 624).

Moreover, these characteristics lessen the possibility that the knowledge obtained from a project can be captured and spread in others, because of the project-specific nature of the knowledge produced. Project-based firms often have only patchy knowledge of their own portfolio of projects, relying on informal channels of communication between project groups as the principal source of information on their activities (Bresnen et al., 2004). Several authors analyze case studies in order to identify mechanisms at the project level that played an important role in shaping innovation processes (e.g. Gann, 2000). Their findings suggest, for instance, that among the different ways in which integrative and relational capabilities might influence innovation processes, one important mechanism is the ability to build upon existing inter-organizational and intra-organizational networks to generate resources (Dubois and Gadde, 2002; Grabher, 2002a; 2002b). Networks among project teams represent, in particular, an important mechanism through which organizations involved in innovation processes acquire and create relevant informational resources.

3.2. Sample and data collection

In the present study, the single project is the unit of analysis. Our sample is represented by 54 projects that pertain to a major Italian company operating in the construction industry. Founded in the early 1970s, it currently operates in three strategic areas of building) with more than 300 employees and twenty million euros in turnover.

The present analysis is developed with the support of primary data collected through semi-grounded mode and with the use of secondary data already available. In particular, primary data relate to the collection of information about the structure of single projects’ social capital. In this vein, preliminary interviews with corporate managers and with project managers allowed us to make assumptions, develop the methodology of investigation, and make a pre-test of the subsequently administered questionnaires. A sociometric questionnaire was submitted to project managers and team members in order to gather relational data about each investigated project. Of the 54 investigated projects, 26 belong to the gas and fluid pipelines business area, 24 to the electric power plants business area, and 4 to the factory building business area.

In the first section, each project manager was found to indicate inter-project exchanges of technical resources typically undertaken in the daily project work. Here follows an example of the questions we asked: “Does your project unit offer products of services to other units? If yes, please indicate the projects within your organization that receive your product or services.” Further, the employees in each project were given a questionnaire and asked to indicate with whom they usually discussed two predefined matters integral to project activities: (1) the current dialog and exchange of opinions about the development of the project, and (2) the utilization of specific knowledge to develop specific parts of their work. The questions were followed by a list of all members of other projects investigated. We obtained valuable relational data between members of the projects, since also the weekly frequency of the interaction was checked.

Regarding performance, there was consensus by project leaders about the net profit margin and quality problems as good measures of project performance. In particular, the quality problems have been derived from problems occurring before, during and after the time when the product is delivered (Love and Li, 2000). Defective workmanship, insufficient work separation, delays, and failures in setting out are among the main causes of additional costs in construction projects (Josephson et al., 2002) and have a negative impact on performance. Data for each project were gathered from internal sources of information available, mostly electronic annual reports. In addition, we interviewed managers and project leaders that provided us with archival data used to compute the control variables of this study.

3.3. Variables

3.3.1. Dependent variable

In this paper we employ two different indicators that consider the economic as well as the quality dimensions of project performance. The first variable, Economic Performance, is measured as the net profit margin on the total revenues. Generally speaking, the higher the net profit margin, the higher the economic performance achieved at the project level. The second variable is called Quality Problems and concerns the frequency with which delays, defective workmanship and other forms of technical negligence are encountered during project activities and
reported by project managers. Within the company, problem detection is managed by a specific quality-system that provides information about the average frequency of problems for single projects. We measure Quality Problems by dividing the number of actual problems reported by the number of possible problems that may be encountered. Higher percentages of quality problems detected at the project level correspond to lower levels of quality achieved. Data for both variables were gathered from annual reports and company archives for the year 2004.

3.3.2. Independent variables

Our indicator measuring the level of cohesion of project social capital is Network Constraint, an appropriate indicator to measure the extent to which inter-project collaborations at the organizational level are redundant (Burt, 1992):

\[ NC_{ij} = \sum_{a=1}^{N} v_{ia} v_{aj} - a \neq j \]

where \( v_{ia} \) is the strength of the network connection from project member \( i \) to individual/alter \( a \), and \( v_{aj} \) is the strength of the connection from member \( a \) to member \( j \). All connections used for the calculation of this measure are only intra-organizational ties among project members. The above formula expresses a triadic cohesion measure of how much an actor is constrained by its direct neighborhood, and indicates the presence of strong third-party connections around a relationship. Strong third-party ties link member \( i \) to member \( j \) indirectly to the extent that member \( i \) has a strong network link with member \( a \) and member \( a \) has a strong network link with member \( j \). We summed \( v_{ia} v_{aj} \) across all partners \( a \) in order to obtain the overall strength of the third-party connections around collaborative relationships. The Network Constraint measure was aggregated to the project level in order to test our first hypothesis. In order to test for the presence of a curvilinear relationship between cohesion of project social capital and its performance, we also included Network Constraint squared.

Our indicator measuring the level of diversity of project social capital is Network Range (Burt, 1983). Projects are surrounded by a “diverse” social capital to the extent that the members spread their exchange social relationships across multiple areas of expertise, namely the three business areas of the surveyed company. Network Range has two distinct components. The first is a function of how project members’ ties are spread across different expertise areas. The second is a function of the strength of connections with other projects working in those areas. Thus, this variable is defined as:

\[ NR_{ij} = 1 - \sum_{k=1}^{N} v_{ik} v_{jk}^2 \]

where \( v_{ik} \) is the strength of the network connection from member \( i \) to area \( k \), and \( v_{jk} \) describes the strength of the connections between project members in area \( k \), while \( v_{ik} \) is in turn defined as:

\[ v_{ik} = \frac{\sum_{j=1}^{N} v_{ij} - x_{ij}}{\sum_{q=1}^{N} x_{iq} q j} \]

where \( N_k \) is the number of contacts that a given project member maintains in area \( k \), \( M_k \) is the number of employees with expertise in the area \( k \), \( x_{ij} \) is the intensity of the relationship between a given project member in area \( k \) and any project member, \( x_{iq} \) is the intensity of the relationship between a project member in area \( k \) and a project member working in the same area. Therefore, increasing \( v_{ik} \) indicates the absence of diverse knowledge inside a network. The Network Range measure was aggregated to the project level in order to test our second hypothesis. We test curvilinear association by including Network Range squared. For further discussion about this measure, see Burt (1992) or refer to the application provided by Reagans and Zuckerman (2001).

3.3.3. Control variables

We create several controlling variables to capture the effects of other factors that are potentially important to explain project performance. (1) Dimension. The dimension might affect the level of performance achieved at the project level. We control the dimension by considering a dichotomous variable that takes on 1 for those projects whose number of employees was above the median value of the sample, and 0 otherwise for projects below the median. (2) Duration. Project duration may affect the level of performance achieved. A dummy variable, considering whether the project has annual or multiannual duration, takes on 1 for annual projects, and 0 otherwise. (3) Geographical location. Since projects here surveyed operate in different countries (mainly in Italy), we included a dummy variable that takes on 1 for projects pertaining to organizations with headquarters in Italy, and 0 otherwise.

4. Analysis and results

Ordinary least squares (OLS) regression equations, the results of which are displayed in Table 1, are used to test our hypotheses. Our aim is to determine whether the two peculiar properties of project social capital, namely cohesion and diversity, have an influence on the project performance, measured distinctively as economic performance and quality. For both variables, we adopt a stepwise approach to model building. In Model 1, we examine the impact of the control variables on the performance of single projects. In Model 2 we include the variables that directly speak about the explanatory power of social capital resources on project performance, focusing our attention on Constraint and Range. In a third and final Model we also entered the quadratic terms of the independent variables of theoretical interest, to test for a non-linear relation between cohesion and diversity, and project performance. This final model will give an answer to our hypotheses. In the present section we interpret our findings,
bearing in mind that while higher net profit margins correspond to higher levels of economic performance, in contrast, the higher the percentages of quality problems encountered, the lower are the levels of quality achieved.

One concern with network data is that the observations may be interdependent, because each actor in the network appears in multiple dyads. Using network data the requirements of OLS with regard to the distribution of error terms may not be met. There are several methods that are more appropriate for use in regressions with relational variables. Following previous studies, in our models we estimated standard errors and significance using the random permutation method for constructing sampling distribution of R-squared and slope coefficients (Snijders and Borgatti, 1999).

Model 1 in Table 1 regresses separately the Economic Performance and the Quality Problems on the set of control variables. Overall, the inclusion of the control variables results in a model that is significantly different from a null model. Of the three control variables, two are significant. As expected, surveyed projects characterized by Duration and Dimension above the median are more likely to achieve higher levels of performance. This makes sense since duration indicates the previous experience developed at the project level, which in turn can influence the performance. Also the variable Dimension is positively and significantly associated with performance. Even in this case, it is reasonable to expect that projects composed of a large number of team members perform better, at least in terms of gross profit.

Model 2 in Table 1 regresses Constraint and Range, the variables of social capital, on project performance expressed both as the percentage of the net profit margin on the total revenues and as the percentage of quality problems encountered and reported by project managers. The coefficient for Constraint is positive and significant, providing strong confirmation that the level of cohesion of projects’ social capital within the organization has a positive effect on the level of performance that they achieve. It follows, then, that it is true that cohesive relationships enable greater willingness to transfer knowledge and share information among project units. Also the coefficient for Range is positive and significant, highlighting a positive relationship between the level of diversity of project social capital and the variable Economic Performance. This pattern of results implies that the creation of collaborative ties with other units operating in different areas of expertise enriches effectiveness of projects. For the variable expressing quality project performance, both coefficients for Constraint and Range are negative and significant, confirming how dense and diverse social networks of single projects have a positive effect on quality performance by showing a negative association with the percentage of technical problems reported at the project level.

The network hypotheses are tested in the third model. Hypothesis H1 proposed an inverted U-shaped relationship between cohesion of project units’ social capital and their effectiveness. To support an inverted U-shaped relationship, the coefficient estimates for Constraint should be positive and the estimates for Constraint squared should be negative and significant, with a significant change in the model’s explained variance. Again, the expectation about the signs of the coefficient estimates is reversed for the quality project performance.

The results in Model 3 in Table 1 show that, for both the variables considered, at moderate levels of Constraint the project performance was maximized, suggesting support for the hypothesized inverted U-shaped curvilinear relationship between the level of cohesion of project social capital and project effectiveness. In particular, for the dependent variable Economic Performance the coefficient for Constraint is positive and significant, and the coefficient for Constraint squared is negative and significant. On the contrary, for the variable labeled Quality Problems the coefficient for Constraint is negative and significant, and the coefficient for Constraint squared is positive and significant. These findings provide strong support to the hypothesis that cohesion of projects’ social capital within the organization has a positive, and then a negative, effect on the level of performance that they achieve. Fig. 1 shows that as we increase the level of Constraint the Economic Performance at first grows, but thereafter reaches a maximum and begins to decrease gradually. Fig. 1 also shows that as we increase the level of Constraint the Quality Problems at first decrease (values on the y-axis are negative) but, once past the minimum, begin to increase. It follows, then, that although it is true that cohesive ties enable greater willingness to transfer knowledge and share information among project units, there are also costs associated with the time and effort that team members devote to communicating what they know, as well as with the redundancy of knowledge exchanged within highly cohesive inter-project relationships. After a certain level, greater cohesion produces excessive redundancy in informational

Table 1
OLS estimation.

<table>
<thead>
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<th>Variable</th>
<th>Economic performance</th>
<th>Quality problems</th>
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<tbody>
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<td>Model II</td>
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<td>(0.001)</td>
<td>(0.001)</td>
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<td>Duration</td>
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<td>0.26**</td>
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<tr>
<td>(0.09)</td>
<td>(0.09)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Dimension</td>
<td>0.11**</td>
<td>0.12*</td>
</tr>
<tr>
<td>(0.04)</td>
<td>(0.03)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>Network constraint</td>
<td>0.14*</td>
<td>0.16*</td>
</tr>
<tr>
<td>(0.03)</td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Network squared</td>
<td>-0.19**</td>
<td></td>
</tr>
<tr>
<td>(0.08)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>range</td>
<td>0.20</td>
<td>0.23</td>
</tr>
<tr>
<td>(0.09)</td>
<td>(0.10)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Network squared</td>
<td>-0.16*</td>
<td></td>
</tr>
<tr>
<td>range</td>
<td>(0.06)</td>
<td></td>
</tr>
<tr>
<td>R² (adjusted)</td>
<td>0.325</td>
<td>0.341</td>
</tr>
<tr>
<td>N projects</td>
<td>54</td>
<td>54</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses.

* p<0.05.

** p<0.10.
resources channeled within the network that, in turn, will result in significant incremental costs outweighing the benefits.

Model 3 in Table 1 adds also the variable labeled Network Range in order to test our Hypothesis H2 that relates to the degree of diversity of each project’s social capital. In this case, too, we proposed an inverted U-shaped relationship between Range and performance for single projects. As shown in Table 1, as long as the variable Economic Performance is taken into account, the coefficient for Range is positive and significant and the coefficient for the same variable squared is negative and significant. Vice versa, the coefficient for Range is negative and significant and the coefficient for Range squared is positive and significant when the variable that measures projects’ quality problems is considered.

These results provide support for the hypothesized inverted U-shaped curvilinear relationship between the degree of diversity of project social capital and project performance. As shown in Fig. 2, when increasing the level of Range the Economic Performance at first grows, but thereafter reaches a maximum and begins to decrease. Fig. 2 also shows that when increasing the level of network range, the variable Quality Problems at first decreases (values on the y-axis are negative) but, once past the minimum, begins to increase. This pattern of results implies that even though the creation of collaborative ties with other units operating in different areas of expertise enriches effectiveness of projects, there are also costs for projects which seek other units to add and integrate new know-how to their knowledge stock. As further collaborative ties which cut across areas of expertise boundaries are added, the cost of assimilating, absorbing, and combining diverse information eventually begins to outweigh the benefits.

5. Discussion

Understanding how temporary units coordinate resources and exchange knowledge within project-based organizations is a matter of substantial theoretical interest. Drawing from theoretical concepts of social capital theory, the main objective of this work was to explore a strand still little debated by the organizational literature — the role that social capital plays for organizational project units. We emphasized that the members of a project can engage in formal or informal socializing relationships with people.
within and outside their unit. These all represent different types of ties or conduits through which project social capital flows. We analyzed the structural properties of social relationships among individuals affiliated with 54 projects relating to an organization operating in the construction industry, focusing in particular on the properties of cohesion (Coleman, 1988) and diversity (Reagans and Zuckerman, 2001).

Our findings indicate a positive relationship between the degree of cohesion of projects’ social capital and their effectiveness. It follows that cohesive ties not only enable greater willingness to transfer knowledge and share information among project units, but also, if too high, can generate redundant information, less diversified knowledge and scarce novelty (Burt, 1997) which, we suppose, influence project effectiveness negatively. Our empirical results show a quadratic U-shaped curvilinear relationship between the cohesion of project social capital and project performance, demonstrating that intermediate levels of cohesion maximize project performance.

Diversity relates to the specific areas or domains of single projects and project members: it is shown that although heterogeneity enhances the capacity for creative problem-solving and allows individuals to share different sets of contacts, skills, information, and experiences, an excessive level of diversity featuring the project social capital decreases absorptive capacity, and in turn project performance. Results reported in this study show that there is a U-shaped curvilinear relationship between the level of diversity of project social capital and project performance, demonstrating that intermediate levels of network range maximize single project performance.

The present study contributes to previous research in several ways. To our knowledge, except in a few cases (Arthur et al., 2001; Grabher, 2002a), there is a lack of studies exploring in an analytical way and through the use of empirical data the interdependences between projects and the network of personal relationships built around projects (Grabher, 2002a). In addition, no studies have yet analyzed the relationship between social capital and project performance by considering the impact of the structure of inter-unit exchange networks on both qualitative and economic dimensions of performance.

In the present study we have examined how resources and knowledge are channeled through network relations that mainly involve the project level. Although the effects of social capital have been studied at individual, group, and organizational level (Burt, 1997; Oh et al., 2006; Pennings and Lee, 1999), there is a dearth of study on project social capital. Recent literature has labeled “the set of resources made available to a group through group members’ social relationships within the social structure of the group itself, as well as in the broader formal and informal structure of the organization” as group social capital (Oh et al., 2006: 570). Our notion of project social capital, however, is not introduced to compete with that of group social capital, but instead to adapt and expand it to the specific context in which PBOs operate and perform. Like groups, projects are formed by multiple members who are engaged in frequent communication with other individuals within and outside the group. Unlike groups, projects often involve people working together on complex innovative tasks for a well-defined limited period of time. It is likely that projects will become highly embedded in a set of project-specific relationships in addition to those that their individual members develop.

But our construct of project social capital also differs from that of organizational social capital, defined as a distinctive organizational resource reflecting the character of social relations within the firm (Pennings and Lee, 1999). We use this project-level definition, because it especially highlights how social capital contributes both to resources and information generation and their appropriation with project-based organizations, where employees likely engage in social activities either inside or outside of the workplace (e.g. Bresnen et al., 2004). While the organizational social capital assumes that resources accrue to the “firm”, we assume that in PBOs individuals draw on social capital to perform in activities which are integrative to specific projects. As a result, whereas social relations produce benefits that directly affect single projects, the extension of such benefits to the whole organization will depend on the capability to further manage such social relations beyond the duration of the project. In this situation, project social capital might be incorporated, and turned into, organizational social capital.

Our findings have important managerial implications as well. They may be helpful for project leaders and individuals who manage people working in project-based contexts, because they provide important insights about the management of inter-project exchange networks within organizations. Our results suggest that through an appropriate management of social capital, project units can increase coordination and knowledge integration, producing in turn high levels of performance at the project level. More specifically, the social capital is useful not only to improve the economic performance of the project, but also to reduce the number of quality problems, which are some of the main causes of additional costs in construction projects.

The results of this study must be viewed with respect to a number of limitations. First, most of the data were gathered at a single point of time. While the theory implies causality in a number of relationships studied, this study could not verify the direction of causality. Further, the study was conducted within the construction industry and, while it enhances the literature in these areas, questions remain open about the empirical extension of our results. Obviously the non-random choice of setting for our study and the specific sample that we have chosen introduce a number of idiosyncratic elements in our design, and make its replication in different organizational fields problematic.

References


