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CONTRACTORS' NETWORKS IN PUBLIC PROCUREMENT PROJECTS: THE CASE OF THE CONSTRUCTION INDUSTRY IN THE VENETO REGION

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Contractors' networks in public procurement projects: The case of the construction industry in the Veneto region

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Abstract

Our work aims to analyze the inter-organizational relationships of contractors in public procurement projects. We investigate how a firm's network position affects its performance in public procurement practices, measured as the average value of projects won by the firm. To accomplish this objective, we adopt a social network analysis approach to analyze contractor networks. Our evidence comes from an empirical analysis of the network positions of general contractor firms involved in public procurement projects in the construction industry in the Veneto region from 2008 to 2012. Firm performance is affected by firm partnering practices, which are measured in terms of network centrality indicators. We explore how partnering ability, closeness and brokerage influence firm performance and find that a firm's partnering ability (i.e., the number of direct firm ties within a public procurement network) is crucial in determining the success of the firm's public procurement practices. Finally, we propose managerial and policy implications for potential regional development.

Keywords: construction industry; project organizing; public procurement, social network analysis, firm performance

JEL codes: L14; L74

1. Introduction

In line with project-based organizational literature, we study public procurement projects as temporary coalitions of project-based firms that come together to achieve a certain aim (Pryke, 2004). In particular, in this work, we refer to public procurement projects that involve project-based firms in the construction industry. The main characteristics that describe project-based firms in the construction industry, according to Gann and Salter (2000), are: a) the organization of design and production processes by project; b) the one-off, or at least highly customized, character of products and services; and c) the tendency of firms to operate in diffuse coalitions of companies along a value chain. The project-based nature of construction work implies that firms are required to manage complex networks. Performance and competitiveness depend, not solely on a single firm, but on the efficient functioning of the entire network (Gann and Salter, 2000). Thus, it is important to consider the social dimension of project organizing, as has been suggested by Ekstedt et al. (1999) and Beck (2000), which is key to understanding the economic behaviors of firms involved in projects. Previous studies have demonstrated the relevant role of the firm network strategy in managing construction projects (Chinowsky et al., 2008; Chowdhury et al., 2011; Ei-Sheikh and Pryke, 2010; Ling and Li, 2012). Social network analysis (SNA) offers powerful analytical tools to measure the relational capital of firms engaged in projects; however, few studies have applied SNA to the understanding of project organizing (the exceptions are Pryke (2004), in the construction industry; Sedita (2008), in the performing arts; and Cattani and Ferriani (2008), in the film industry).

The SNA approach has been used in project organizing literature to study project coalitions (Prike, 2004), project performance (Eriksson and Westerberg, 2011), project-based coordination (Hossain, 2009), and single-project networks (Pauget and Wald, 2013). Typically, the subject of analysis is not the individual firm, but the project.

Our work aims to analyze the inter-organizational relationships of contractors in public procurement projects. We extend the use of SNA as a potential means to interpret the successful engagement of firms in projects. Our work differs from previous studies in that it uses SNA techniques to investigate how the network position of a single firm affects the success of that firm in terms of the performance of its public procurement practices, measured as the average value of the projects awarded to the firm. Explorative in nature, our work adopts an SNA approach to study the effects on firm performance of inter-temporal relationships among firms involved in traditional public procurement and public-private-partnership (PPP) practices in the construction industry in the Veneto region during the period from 2008 to 2012.

These inter-temporal relationships characterize project networks whose members combine their diverse capabilities into latent modalities, as has been shown in various studies (e.g., Haunschild, 2003; Sedita, 2008). The latency of project networks is due to the survival of actor relations following the completion of specific temporary collaboration projects involving temporary coalitions of actors. This relationship survival gives rise to repeated collaboration practices among coalition members that are likely to share the same objectives, working methods and values. Over time, these members are able to build a collaborative community, eventually reinforced by co-location and collaborative intensity. As argued by Grabher (2001, p.1334), the proliferation of projects is dependent on a social context. In this social context, differently qualified actors interact on a regular basis for both formal and informal knowledge exchange. As a result, a system of cooperation (Becker, 1982) based on common interests serves as a fertile soil for future projects. It is, therefore, worthwhile to investigate the relationship between the role of firms in this social context and their success in project practices.

The paper is structured as follows. Section 2 illustrates the main features of project organizing, referring to the literature on project-based organizations (PBOs). Section 3 illustrates our approach, which examines project organizing in the construction industry through a social network analysis lens, and proposes our research questions. Section 4 describes our empirical analysis, and Section 5 presents the main results. Finally, Section 6 offers concluding remarks.

2. Project organizing in the construction industry

In order to understand the role of partnering in contractor networks, it is worthy to recall here the main features of the construction industry. Firms operating in the construction industry can be classified according to their specialization. There are five possible product categories: a) housing; b) commercial and industrial buildings; c) civil engineering structures and infrastructures; d) public works; and e) the repair, maintenance and improvement of existing facilities. Since the demand for buildings and infrastructures fluctuates with business and investment cycles (Gann and Salter, 2000), this industry suffered a significant hit during the crisis of 2008, and it is still struggling to recover. In the private construction sector, the main problems are related to a) the reduction of household income, b) speculation in the cost of land, c) increases in infrastructure costs, and d) the tendency of firms to invest abroad for greater flexibility of production factors. In reference to the public buildings sector, the well-established attitude of selecting the contract with the lowest bid is a disadvantage for the most innovative organizations, which focus on product quality and compliance to the highest standards. Therefore, cost reduction policies negatively impact final product quality. More generally, the current lack of liquidity has frozen an industry that requires heavy investment and substantial institutional support in order to survive.

In this adverse economic climate, the public buildings sector represents one of the largest sources of income for construction companies. Public procurement tenders offer a way out of the crisis for companies that have the competence, skills and resources required to participate. However, small and medium enterprises (SMEs) are often left out of these activities because of their so-called "liability of smallness." Partnering practices might be seen as a tool to allow SMEs to access and win public procurement tenders.

In the literature, partnering in construction has been presented as a potentially important way of improving construction project performance through direct benefits for clients and contractors (Bresnen and Marshall, 2000). Research has suggested that performance, in terms of costs, time, quality, buildability, fitness-for-purpose, and a wide range of other criteria, can be dramatically improved if participants adopt more collaborative working procedures (Bennet and Jayes, 1998).

There is not one unique definition of partnering; instead, much of the literature refers to the Construction Industry Institute's (CII) definition:

> *A long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based up on trust, dedication to common goals,*

> *and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services.* (CII, 1991)

The partnering procurement method aims to eliminate adversarial relationships between clients and contractors by encouraging the parties to work together towards shared objectives and the achievement of a win/win outcome (Griffiths, 1992; Watson, 1994). Partnering seeks to develop closer relationships among the parties in a project (Black et al., 2000), and it is more successful when it involves a high level of commitment to shared goals, preferably including those of the client (Fellows, 1977). Partnering encourages parties to work together on construction projects within an environment of trust and openness, which ultimately leads to efficient project development and avoids conflicts.

It is important to distinguish between project partnering and strategic partnering. Project partnering refers to partnering for the purposes of a specific project and focuses on short-term benefits, while strategic partnering represents a more long-term commitment that spans several projects (Beach et al., 2005; Cheng et al., 2001; Winch, 2000). Some researchers see project partnering as the first step towards long-term strategic partnering (Cheng et al., 2001; Kubal, 1996; Thompson and Sanders, 1998), considering the latter to be a more mature form of collaboration (Ellison and Miller, 1995).

Considering these perspectives, it is possible to consider public project partnerships as particular PBOs, in which the collective knowledge, capabilities and resources of the firms are built up through the execution of public utility works. According to Luck (1996), "partnering and integration strategies attempt to address a fundamental characteristic of the industry…that is fragmented, as individuals from different organizations which are geographically and temporally dispersed are involved in construction process."

PBOs refer to a variety of organizational forms that involve the creation of temporary systems for the performance of project tasks. Projects are temporary coalitions of actors who come together to achieve a certain aim. According to mainstream project management literature, the most critical features of a project are being: 1) goal-oriented, 2) time-limited and 3) unique. The high flexibility offered by PBOs position them as the sharp opposite of modern mass producers, which connote bureaucracy, inertia, standardization, routine and repetitiveness (Engwall, 1998). Therefore, project organizing is critical to performing highly innovative tasks, particularly when the uncertainty on the demand and process sides is high (Hobday, 1998). For these reasons, PBOs have received increasing attention in recent years as an emerging organizational form that integrates diverse and specialized intellectual resources and expertise (De Filippi and Arthur, 1998; Hobday, 2000; Gann and Salter, 2000; Sydows et al., 2002).

Within a PBO, the project is often the major business endeavor, serving as the standard mechanism for creating, responding to, and executing new business opportunities (Hobday, 2000). PBOs are widespread in 1) traditional industries, such as construction (Bresnen et al., 2000; Gann and Salter, 2000), shipbuilding, and major capital projects; 2) industries that have been regenerated through new technologies, such as the ICT (Information and Communication Technologies) industry (Kodama, 2007); and 3) creative industries, such as media (Windeler and Sydow, 2001), film (Davenport, 2006; De Fillippi and Arthur, 1998), music (Lorenzen and Frederiksen, 2005), performing arts (Sedita, 2008), and advertising (Grabher, 2001, 2002).

The literature so far has addressed various aspects of PBOs, including the human resources recruitment modality (De Filippi and Arthur, 1998; Jones, 1996); the effects on the labor market economy (Ekstedt et al., 1999); the processes enabling the transfer of knowledge, organizational renewal and innovation in projectified systems of organization (Gann and Salter, 2000; Lundin and Midler, 1998; Prahalad and Hamel, 1990); the dimension of trust among project members (Meyrson et al., 1996); the roles and interrelationship of social and human capital (DeFilippi and Arthur, 1998); and, finally, the roles and characteristics of embedded “communities of practice” (Bettiol and Sedita, 2011; Wenger, 1998).

For a complete understanding of project organizing, it is necessary to study in detail the nature, processes and requirements of project formation and the interactions among project members in a

PBO, not simply for the duration of a project, but after the project has come to an end. This type of study requires an understanding of the latent networks of project actors, their formation and their characteristics.

Public procurement is the most diffuse modality of collaboration in the construction industry, which, as stated above, is rooted in complex project organizing practices. PBOs that derive from public procurement projects are normally promoted by a permanent organization (e.g., a firm or, more often, a public institution) and involve a number of contractors and subcontractors with different competencies. A PBO oriented towards the completion of a construction project is an organization built upon a network of firms and institutions focused on achieving the goals of the project (Pryke and Pearson, 2006). These networked partners are enrolled in the temporary organization by means of contractual conditions and are involved in a dense activity of formal and informal information exchange (Pryke, 2004; Winch, 1989); therefore, each partner is influenced by the others (Loosemore, 1998; Pryke and Pearson, 2006).

Temporary contractor networks, which are part of PBOs in the construction industry, may lead to further collaborations in subsequent projects. Such future collaboration is favored by relationships that last beyond the project itself, largely in a latent form. This work analyses the inter-organizational networks of firms operating in the market of traditional public procurement and PPP projects.

The project-based nature of construction work implies that firms have to manage complex networks. Firm performance and competitiveness depend, not solely on the resources and abilities of a single firm, but also on the efficient functioning of the entire network (Gann and Salter, 2000). The difficulties in coordinating heterogeneous actors within a traditional public procurement or PPP project increases project transaction costs, which can be lowered if the relationships among network members go beyond business and are based on something beyond spot transactions in the market: that is, if they are sustained by cognitive proximity and social capital. Thus, it is important to consider the social dimension of project organizing, as has been suggested by Ekstedt et al. (1999)

and Beck (2000), as this is key in understanding the economic behaviors of firms operating in PBOs. Investigating interpersonal and inter-organizational relationships is, therefore, crucial.

3. A social network approach to project organizing

Since the objective of this work is to investigate the inter-organizational relationships of contractor firms operating in public procurement projects, a social network analysis approach is adopted. According to Wasserman and Faust (1994), a social network consists of a finite set of actors and their relationships, which can be studied through SNA techniques. SNA builds upon graph theory (Scott, 1991) and represents organizational groupings as systems of nodes or actors joined in permanent or transitory configurations. These networks of nodes are linked by relational ties, which can take a number of forms. For our purposes, the relationships represent participation in the same project (as will be described in Section 4.1).

Traditionally, SNA research focused on sociological networks involving individuals exchanging task-specific information in the workplace (Borgatti and Everett, 1997; Wasserman and Faust, 1994). However, this approach has expanded to the exploration of technological innovation networks in technology-based industries (Allen, 1977), project-based cultural activities (creative clusters and museums: Cinti, 2007; Lazzeretti, 2012; live shows: Sedita, 2008; design: Bettiol and Sedita, 2011; and cinema: Cattani and Ferriani, 2008), low-tech manufacturing organization-based relationships (Giuliani, 2007; Morrison, 2008), and co-inventor and collaborator networks in biotechnology and life sciences (Belussi et al., 2010; Powell et al., 1999).

Following the suggestion of Pryke (2004), this paper applies a social network theory of construction coalitions governance, using SNA as the preferred analytical tool to analyze the project relationships among firms in the construction industry. The use of SNA is justified by its ability to identify and quantify changes in actor roles and relationships through the analysis of, for instance, the degree of actor centrality within a project coalition (Pryke, 2004).

Other works have implemented SNA tools to investigate construction projects. Loosemore (1998) used SNA to investigate interpersonal relationships in the context of construction projects under crisis conditions. His study argued that the analysis of construction project governance at the interpersonal level sacrifices an opportunity to understand the impact of performance incentives and contractual relationships between the firms that comprise a project coalition. Chinowsky et al. (2008) contrasted the engineering-based approach to that of project management, proposing to investigate the determinants of project success stemming from the analysis of high-performing teams. The social dimension of project networks is, therefore, considered to be crucial. According to their research, "In the social network model, the underlying hypothesis is that projects need to be managed as social collaborations to achieve results that exceed traditional expectations" (Chinowsky et al., 2008: 806). This recognition is formalized through the application of the social network model to construction projects, which integrate classic project management concepts with social science variables. This application facilitates the identification of knowledge sharing practices, learning abilities, trust and communication among individuals participating in projects as drivers for high-performing teams and high-performance project results. In a similar vein, Chinowsky et al. (2010) illustrated how to improve team effectiveness by building and expanding inter-organizational knowledge exchange networks. Park et al. (2011) studied the relational structure of inter-firm collaboration networks and their effects on organizational performance in the construction industry. Wambeke et al. (2012) used SNA to identify key subcontractors in project processes. Pryke (2004) studied how the network approach can facilitate an understanding of coalitions in construction projects. Chowdhury et al. (2011) investigated how actors in an innovation diffusion network become aware of an innovation and how their opinions are influenced. Most recently, Ruan et al. (2012) showed how knowledge is integrated among project participants according to their social network patterns.

Overall, these contributions highlight how different network positions represent different opportunities for organizations to access and adopt new knowledge and to develop new ideas or processes within a project organization structure. An organizational network position, in fact, determines a firm's ability to access external information and knowledge (Tsai, 2001). A network position is an important aspect of "social structure," which can enhance a firm's ability to create new value and achieve economic goals (Coleman, 1990; Tsai, 2001; Tsai and Ghoshal, 1998).

In the context of network positions in construction projects, we propose that, by occupying a central position in a network, a firm is more likely to access strategic resources, information and competences that can improve its performance.

Centrality is a key measure that reflects the distribution of relationships throughout a network. In a highly centralized network, a small percentage of nodes will participate in a high percentage of the total relationships among nodes in the network. In contrast, a network with low centrality will have a relatively equal distribution of relationships throughout the network (Chinowsky et al., 2008).

Centrality measures are usually used to determine which actor(s) occupies a critical position in a network. Network centrality measures are position indicators that describe the intensity of power and the prominence and influence of an actor in a network.

With regard to construction project coalitions, the most frequently used centrality indicators are degree, closeness and betweenness (Pryke 2004), which are measured within a network of nodes representing either contractor or subcontractor firms. These centrality indicators report the same value whether the network has a "star" structure (i.e., all nodes have ties to one central node; highest centralization) or a "circle" structure (i.e., all nodes are connected only with their adjacent nodes; lowest centralization). In all other cases, the three centrality measures differ, representing, for each node, a variety of behaviors within the network. In particular, degree centrality emphasizes the level of firm activity, betweenness centrality emphasizes a firm's potential control over information flow and closeness centrality emphasizes a firm's information independence (Prell, 2012).

Degree centrality, which is the number of direct ties to a node, measures a firm's ability to engage in multiple relationships with other firms within a variety of project organizing networks. This can be viewed also as "partnering ability." We claim that there is a relationship between the partnering ability of a firm and the firm's performance in public procurement practices. Not all nodes in a contractor network have the same probability of being successful. Some firms, which are more likely to centralize a high number of ties with others, may have higher probabilities of playing a leading role in public procurement tenders. Our first research question (RQ) takes this issue into account, as follows:

RQ 1. Does the partnering ability of a construction firm in a contractor network impact the firm's performance in terms of successful public procurement practices?

Degree centrality is a straightforward and efficient metric; however, it does not take into account the network positions of ties. Therefore, a node that is considered central in terms of degree centrality might be connected either to influential nodes or not influential ones—a difference that obviously has a great effect on the node's influence. Thus, there is a need to evaluate the composition of the central node's "neighborhood." Having a few very influential neighbors might be more relevant than having several less influential neighbors. Moreover, degree centrality counts only direct ties; it does not consider the role of indirect ones. In other words, an actor might be tied to a large number of other actors, but those other might be rather disconnected from the network as a whole. In this case, the actor could be quite central, but only in a local neighborhood.

Closeness centrality and betweenness centrality can be used in order to tackle these issues and provide a more complete picture of a network (Chen et al., 2012).

Closeness centrality measures the distance between actors. An actor is considered important if it is relatively close to all other actors. If an actor is close to many other actors, it does not need to rely on others to relay messages through the network (Freeman, 1979); moreover, it can transmit information throughout the network in a short space of time due to its proximity to all other nodes.

In this case, the actor can quickly reach others without having to rely heavily on intermediaries and can also more easily mobilize a network. In the literature, researchers have linked closeness centrality with an actor's ability to easily access network information (Leavitt, 1951) and to manage information through power and influence (Coleman, 1973; Freidkin, 1991). In this work, closeness centrality is a measure of the "reachness ability" of a firm. The greater the centrality, the greater a firm's ability to efficiently transmit information throughout the network. A central position in terms of closeness is also conducive to greater independence, in the sense that central firms do not need to seek information from other, more peripheral firms. Firms that have greater reachness abilities can reach all other firms in the network using the shortest possible path. These firms are well positioned to receive information flows quickly and, thus, obtain novel information early, when it has the most value (Borgatti, 2005). Taking these advantages into consideration, our second RQ follows:

RQ 2: Does the reachness ability of a construction firm in a contractor network impact the firm's performance in terms of successful public procurement practices?

Betweenness centrality measures the extent to which a particular node lies "between" the various other nodes in the network (i.e., the extent to which a particular node acts as a broker). This measure is critical because even a node with few ties may play an important intermediary (or brokerage) role and, thus, be very central to the network. Actors with high betweenness centrality have the potential to influence others that are close to them in the network (Freeman, 1979), either through direct or indirect pathways. Thus, a node with high betweenness centrality can potentially be influential in the spread of information throughout the network by facilitating, hindering, or even altering communications between others (Freeman, 1979; Newman, 2003). Through betweenness centrality indicators, the brokerage role of a firm in a contractor network can be measured. The measure represents the ability of a firm to act as an intermediary between a number of firms within a variety of project-organizing networks. A high between centrality also means that firm, which may or may not be directly connected with many other firms, can act as a broker: that is, many other firms in the network are able to connect through it. Such firms with high betweenness are structurally important to the sustainability of a business ecosystem because, in the event that they disappear or reduce their activity, they disconnect many nodes and, thus, affect the whole ecosystem. Brokers are "key players" that need to be healthy for the rest of the network to be healthy (Borgatti et al., 2009). In our view, being a broker is also important for a firm's self-sustainability, since it allows the firm to capture indirect information flows (incoming) and to manipulate information in its neighborhood (outgoing). Accordingly, the broker firm appears to be more powerful than others in terms of public procurement practices, resulting in a higher probability of inclusion in profitable projects than other, less influential partners. Thus, the third research question is as follows:

RQ 3: Does the brokerage ability of a construction firm in a contractor network impact the firm's performance in terms of successful public procurement practices?

All three research questions are graphically summarized in Figure 1, which illustrates our analytical framework.

INSERT FIG. 1 ABOUT HERE

4. Data and methods

The originality of the research put forward in this work necessitates an exploratory research design, which fits better a nascent theory, which proposes tentative answers to novel questions (Edmondson and McManus, 2007). The method applied is that of the case study, based on quantitative evidence (Yin, 2014).

The case study presented in this paper examines the relationships among firms involved in traditional public procurement or PPP projects in the construction industry in the region of Veneto (located in the northeastern part of Italy) between 2008 and 2012.

The choice of empirical setting results from the fact that Veneto was one of the first Italian regions to adopt a systematic collection of data on traditional public procurement and PPP projects through an observatory that monitors the quality and quantity of each public procurement[1]. This research applies SNA to analyze the relationships among contractor firms in these projects.

The source of the data is a database provided by Regione del Veneto – Osservatorio Regionale Appalti, or SIMOG. SIMOG monitors both traditional public procurement and PPP projects (both referred to from now on as public construction projects, or PCPs) undertaken in Veneto in the period from 2008 to 2012.

This database has been properly cleaned and organized for the functional application of the SNA methodology. The data were treated in order to emphasize the inter-organizational relationships arising among firms with common participation in PCPs during the analyzed period. Following this preliminary screening of the database, which allowed for the detection and correction (or removal) of corrupt or inaccurate records, the sample was composed of 2910 firms, which have been engaged in a total of 9104 PCPs in Veneto from 2008 to 2012. Information on the size of the contractor firms in 2012 (i.e., turnover and number of employees) came from the AIDA (Analisi Informatizzata delle Aziende) database, which contains comprehensive financial information on companies in Italy.

A first look at the sample shows that 89% of the PCPs are formed as traditional public procurement tenders, while 11% were formed as PPPs. Of the full sample, 80.70% of the PCPs were awarded to single firms, 17.51% to ATIs (temporary associations of firms), 1.75% to consortia, and 0.04% to

[1] The complete data are available from 2008.

GEIEs (Group Contracts of European Economic Interest). Other characteristics of PCPs related to the CPV (Common Procurement Vocabulary)[2] classification, are summarized in Table 1.

INSERT TABLE. 1 ABOUT HERE

The data were analyzed using UCINET VI. This software is designed to analyze social networks and other relational data and includes measures of centrality and connectivity, methods of detecting sub-groups and positions and a number of more complex measures (Borgatti et al., 2002). Through the NetDraw tool, the software is able to analyze data, not only in numerical matrixes, but also in the form of sociograms.

4.1 The social network structure of Veneto's PCPs

SNA allows for a) the representation of the two-mode network of PCPs in Veneto, which links each firm to its awarded projects, and b) the representation of the one-mode network, which shows the ties created between firms that participated and won projects together during the overall analyzed period.

Following the methodology used by Borgatti and Everett (1997), the two networks were created starting with the firm-by-project matrix X. If firm i won project j, $x_{ij} = 1$; otherwise, $x_{ij} = 0$. An example of the case of the public procurement project market is reported in Figure 2. Here, public construction project A is won by firm 1, firm 2 and firm 3; public construction project B is won by firm 1, firm 3, firm 6 and firm 7; and public construction project C is won by firm 1, firm 4 and firm 5. The firm-by-project matrix X and its graphic representation are shown in Figures 2 and 3.

INSERT FIG. 2 ABOUT HERE

INSERT FIG. 3 ABOUT HERE

[2] The CPV establishes a single classification system for public procurement aimed at standardizing the references used by contracting authorities and entities to describe the subjects of procurement contracts.

Figure 3 exemplifies the hypothetical social structure of public procurement projects, in which there are three projects (A, B, and C) that are linked by lines between the firms (1, 2, 3, 4, 5, 6, and 7) that won these projects.

The two-mode network (projects-firms) does not highlight the direct relations between social actors (firms) or the direct links between projects. However, it is possible to map the inter-organizational relationships by converting the two-mode network into two one-mode networks and examining the relationships within each of them separately (Hanneman and Riddle, 2005).

In a particular matrix X, it is possible to construct the product of matrix X and its transpose XX', whose *ij*th cell gives the number of projects won by both firm *i* and firm *j* during the observed period of analysis (Borgatti and Everett, 1997).

INSERT FIG. 4 ABOUT HERE

Figure 4 shows the one-mode network, in which two firms are connected by a line if they won at least one project together during the observed period of analysis. Two or more firms may win projects together repeatedly; in these cases, their relationships are assumed to be stronger than others (Cattani and Ferriani, 2008). In the example, this is illustrated in Figure 4 by a thicker line between firm 1 and firm 3, representing a stronger linkage between two firms that, together, won two projects: projects A and B (as shown in Figure 3).

Graph 1 represents the one-mode firm network of our database. This graph was made with the tool Netdraw, adopting as a display criterion the "*spring embedding"* (distance between components: 10). For a better visualization of the network, isolates and pendants have been eliminated. The size of the nodes is related to their degree centrality, and a node's color refers to its seniority, which is based on the date on which the firm won its first project (red = 2012, fuchsia = 2011, yellow = 2010, blue = 2009, and green = 2008).

INSERT GRAPH. 1 ABOUT HERE

Table 2 summarizes some of the structural indicators of the one-mode network represented in Graph 1: density, distance, degree and betweenness. Density is defined as the number of actual direct connections divided by the number of possible direct connections. The adopted formula for network density is as follows (Wasserman and Faust, 1994):

$$\text{Density}\ (\Delta) = \frac{l}{n(n-1)} \qquad (1)$$

When the density score is one, all actors are connected to each other; when it is zero, none of the actors are connected. Density is a measure of connectivity because it facilitates the transmission of ideas, skills and knowledge. The density value shows that, in this network, only 0.03% of all possible links among subjects are present, suggesting a low level of network cohesion.

Centrality is based on the degree index, which represents the number of connections one node has to other nodes. The higher the degree centrality, the higher the firm's prestige in the network, due to its ability to engage directly in many relationships. In this case, considering that the network is composed of 2910 firms, the average degree value is very low (0.753). The minimum and maximum value, standard deviation and variance describe a high degree of heterogeneity among the structural positions of the firms in the network. This result is confirmed by observing the network centralization. This index considers the network as a whole and determines whether it has a centralized structure. In this case, there is a low, nearly zero level of centralization (0.90%).

INSERT TABLE. 2 ABOUT HERE

Going back to Graph. 1, we observe the existence of two modes of interaction within the network: A and B. The first (A)—at the center—is characterized by the most dynamic firms, which are more capable of developing multiple relationships with other actors in the project-organizing network. These firms belong to the part of the network where the most central nodes are located. The second mode of interaction (B)—at the periphery—comprises peripheral firms that tend to work in smaller, well-established groups and that are not open to extra-group relations.

Overall, the network of firms is characterized by a high presence of isolated nodes. This suggests that the majority of the PCPs were performed by individual firms that were not linked to others. In particular, we observe that some firms are much better connected than others. Our analysis is focused on these firms. Therefore, we take into account only the main component of the network[3]. Being formed by firms that implemented more than one project with others over different periods of time, the main component represents, in PBO terms, a latent network. Such a network is governed by mechanisms of trust and reciprocity, which tend to reduce the transaction costs of PBO governance (Grabher, 2002; Sydow and Staber, 2002).

4.2 Variables

Dependent Variable

Firm performance

Our aim is to verify whether the network position of a firm within a project-organizing network affects its performance with regard to public procurement practices. The variable used to measure the performance of public procurement practices in this paper was average project value in euros (FIRM_PERF). Each firm won several projects in the period between 200 and 2012. The variable for average project value is measured as the sum of the amounts of the PCPs won from 2008 to 2012, divided by number of projects won by each firm. The value of a project is a reasonable proxy for the project's complexity (Bajari et al., 2008). Projects with high estimated values can be interpreted as complex PCPs, requiring the involvement of many actors and the management of multiple competences and knowledge flows. Winning complex projects means that a company has

[3] In an undirected graph, two vertices are members of the same component if there is a path connecting them. In a directed graph, two vertices are members of the same weak component if there is a semi-path connecting them. Two vertices x and y are members of the same strong component if there is a path connecting x to y and a path connecting y to x. The largest component is called the main component.

the proper skills and knowledge to govern a network of collaborative relationships with partners. A firm's ability to win many high-value projects can be considered a proxy for that firm's ability to enhance trust, build its reputation, and better align the interests of its project partners (Grabher, 2002).

Independent Variables

Degree centrality

Degree centrality (DEGREE) measures the number of direct contacts of a firm. The greater degree centrality a firm has, the more knowledge it can potentially access (Schilling and Phelps, 2007). The degree centrality of a firm *j* measures the number of points adjacent to *j*. Two points are said to be adjacent if they are linked by an edge. The degree centrality of *j* can be defined as (Freeman, 1979):

$$\text{DEGREE}_J = \frac{X_j}{N-1} = \frac{\sum_{k \in G} a_{jk}}{N-1} \qquad (2)$$

where X_j is the degree of firm *j*. Since a given firm *j* can, at most, be adjacent to $N-1$ other firms, $N-1$ is the normalization factor introduced to make the definition independent of the size of the network and to achieve $0 \leq C_{Dj} \leq 1$.

Degree centrality provides a measure of communication activity (Freeman, 1979), and it is also a measure of a firm's partnering ability. A firm with high degree centrality is in direct contact with many other firms. Being very visible, it is immediately recognized by others as a hub, a very active point and a major channel of communication. Centrality is a key measure that reflects the distribution of relationships throughout a network. In a highly centralized network, a small percentage of the nodes participate in a high percentage of the total relationships among nodes in the network. Thus, degree centrality is often interpreted in terms of a node's immediate risk or opportunity to "catch" whatever is flowing through the network (Borgatti, 2005).

Closeness centrality

The closeness centrality (CLOSENESS) of a node is defined by Freeman (1979) to be inversely proportional to the total geodesic distance from the node to all other nodes in the network. Geodesic distance is defined as the length (i.e., the number of edges) of the shortest path linking two nodes (Borgatti and Everett, 1997). The closeness centrality of point *j* is, therefore (Freeman, 1979; Wasserman and Faust, 1994):

$$\text{CLOSENESS}_J = \left(L_j\right)^{-1} = \frac{N-1}{\sum_{k \in G} d_{jk}} \quad (3)$$

where L_j is the average distance from firm *j* to all the other firms, and the normalization achieves $0 \leq C_{Cj} \leq 1$. C_C is to used when measures based upon independence are desired (Freeman, 1979).

A firm that is close to many other firms can quickly interact and communicate with these firms without firms going through many intermediaries. Thus, if two firms are not directly tied, the existence of only a small number of steps between the two is important to attain higher closeness centrality. Closeness centrality describes the extent of influence of a node on the network.

Betweenness centrality

Betweenness (BETWEENNESS) is the extent to which a firm serves as a potential "go-between" for other pairs of firms in a network as a result of occupying an intermediary position on the shortest paths connecting other firms (Kilduff and Tsai, 2003). If n_{ik} is the number of geodesics linking the two firms *i* and *k*, and $n_{ik}(j)$ is the number of geodesics linking the two firms *i* and *k* that contain firm *j*, the betweenness centrality of firm *j* can be defined as (Freeman, 1979):

$$BETWEENNESS_J = \frac{\sum_{i<k \in G} n_{ik}(j)/n_{ik}}{(N-1)(N-2)} \quad (4)$$

In the double summation in the numerator, *i* and *k* must be different from *j*.

This index identifies the brokerage ability of the firms in a network, such that the firm in the middle is best positioned to exert strategic control and influence over the others.

Control Variables

Seniority

The variable seniority (SENIORITY) takes into account the year in which the first project was awarded to a firm. It ranges from one to five, where one is assigned to less experienced firms (in terms of PCP practices), which won their first PCPs in 2012, and five is assigned to the most experienced firms, which won their first PCPs in 2008. According to the concept of the learning curve, human nature learns from experience, such that behavior and performance improve in future similar processes. If a firm won its first project in 2008, this means that the firm entered the world of PCPs earlier than competitors that won their first projects in later years, increasing the likelihood of that firm having acquired more skills and knowledge useful to managing PCPs.

Type

Type (TYPE) is a dummy variable (1/0) denoting whether a firm won PCPs predominantly as a single firm (TYPE=1) or as part of a temporary group (TYPE=0) during the period from in 2008 to 2012. Every firm involved in on-site activities has to coordinate its activities and resources among the different construction projects in which it is involved. If a firm participates in a project in collaboration with other firms, it may take advantage of its partners' expertise and resources. Moreover, a stronger and more durable partnership provides an opportunity to enhance trust, build reputations, and better align the interests of the project partners (Siemiatycky, 2011).

Type of PCP

The dummy variable PPP takes the value of one if a firm won at least one PPP project (PPP=1) during the observed period, and zero otherwise (i.e., if the firm won only traditional public procurement projects from 2008 to 2012; PPP=0). Since these two types of engagements show peculiarities that must be acknowledged, we control for this variable.

Size (turnover and number of employees)

In order to take in account of the size of the firms, the variables TURNOVER (in euros) and EMPLOYEES were introduced. These two variables reflect the impact of firm size on the performance of public procurement practices. We used the turnover and number of employees statistics reported in the AIDA database for 2012.

Table 3 summarizes the variable descriptions.

INSERT TABLE 3 ABOUT HERE

4.3 The model

Our dependent variable measures the performance of public procurement practices by computing the average value of awarded projects. Multiple linear regressions were used to analyze the data in order to estimate the effects of our independent variable on a firm’s performance in public procurement practices. In particular, the multiple linear regression model was estimated using robust standard errors, which take into account issues concerning heterogeneity and a lack of normality in the distribution of errors. The correlation coefficients (see Appendix A) between the dependent and independent variables were small, as were the coefficients between the independent and the control variables. The correlation between the explanatory variables is significant, which could lead to problems of multicollinearity between the independent variables (Hair et al., 1995). Multicollinearity exists when the independent variables in a model are highly correlated, thereby affecting the accuracy of the regression calculations. Hence, the variance inflation factor (VIF), which indicates the degree to which each independent variable is explained by the other independent variables, was also calculated. All variables had VIF values below the suggested cut-off point of 10 (Studenmund, 1992). In particular, the VIF values for the variables examined ranged from 1.03 and 3.19. Thus, we can exclude multicollinearity.

Our dependent variable takes only positive values. As it is a highly skewed variable, we utilized a logarithmic transformation with an approximately normal distribution[4]. The regression model equation is as follows:

Log λ (FIRM_PERF) = α_1 +β_1 (DEGREE) + β_2 (BETWENNEESS) +β_3 (CLOSENESS) +β_4 (SENIORITY) + β_5 (TURNOVER) + β_6 (EMPLOYEES) + TYPE dummy + PPP dummy + ε_i

5. Results and discussion

Table 4 illustrates some of the descriptive statistics for the performance of the public procurement practices of firms belonging to the main component of the one-mode firm network (Graph 2), compared to that of the others.

INSERT TABLE 4 ABOUT HERE

According to the results of a two-sample t-test with equal variances, the firms in the main component showed higher performance when compared to the firms in the rest of the network ($p<0.000$). This result confirms the idea that the analysis of the main component is more conducive to explaining the performance of firms according to network position.

INSERT GRAPH 2 ABOUT HERE

From now on, all analyses refer to the main component. The descriptive statistics are shown in Table 5. The correlation matrix can be found in Appendix A.

INSERT TABLE 5 ABOUT HERE

[4] The Shapiro-Wilk test was applied to test the normality of our distribution.

INSERT TABLE 6 ABOUT HERE

Table 6 presents the coefficient estimates for our model.

Model 1 is the baseline model and includes all control variables. The coefficient estimates of the variable SENIORITY are the only ones that are not significant, meaning that the experience gained from a lengthy presence in the network does not influence a firm's performance in PCPs. The coefficient estimates of the variable TYPE re significant but not in the expected direction, which means that firms that win PCPs alone show better performance than those that win as temporary associations of firms. The estimated coefficient of the variable PPP is significant and positive, showing that participation in new forms of PCPs may lead to better performance. The coefficient estimates of the variables TURNOVER and EMPLOYEES are close to zero and have low levels of significance. Thus, firm size seems not to be an important factor in predicting the performance of PPP practices.

Model 2 shows the results following the inclusion of the *degree centrality* variable. The p-value of the F-test is zero to four decimal places, meaning that the model is statistically significant. The R-squared value is 0.2346, showing that approximately 23.46% of firm performance is accounted for by the variables in the model. The coefficient estimate of the variable DEGREE is positive and significant. Therefore, we are able to answer the first research question: The number of relationships of a firm in the network (i.e., a greater degree) is positively correlated with the firm's performance in PPP practices.

Model 2 reports the coefficient estimates, taking into consideration the *closeness centrality* as an independent variable that measures the efficiency and independence of the firms in the network. As shown by the F-test, the model is statistically significant, and its variables account for approximately 24.06% of firm performance. The coefficient estimates of the CLOSENESS variable are significant and positive. However, they are also very close to zero, suggesting that the effect of a firm's reachness ability on its performance is low. In other words, though firms that are closer to many others can quickly interact and communicate, thus reaching a greater amount of information and becoming more efficient and independent, these conditions are poorly correlated with better performance. Thus, the answer to our second research question is that the reachness ability of a firm has a very small positive effect on its performance in PPP practices.

Model 4 includes the betweenness variable (BETWEENNESS) as an independent variable. The model is statistically significant (Prob > F = 0.0000), and its variables account for approximately 20.39% of firm performance. The coefficient estimate of the *betweenness* variable is negative and not significant, therefore suggesting the following answer to our third research question: A firm's brokerage role has no impact on its performance in PPP practices.

Model 5 presents the results of the full model, with all variables entered. The overall fit of the model is better than those of the other models, indicating that the full model better fits our data. Overall, the analysis provides good evidence for the influence of social network position on firms' performance in PPP practices. The last column reports the standardized coefficients for the final model, allowing us to better appreciate the actual significance of the variables and to compare their impacts on the dependent variable. Taking into consideration the independent variables, all variables are statistically significant. A firm's partnering and reachness abilities have positive impacts on the firm's performance in PPPs, while its brokerage role negatively impacts performance. Being a broker appears not to be a proper strategy with regard to participating in contractor networks. Moreover, the coefficient estimate of *degree centrality* greatly exceeds that of *closeness centrality.* This illustrates the significant impact on firm performance of a high *degree centrality,* which appears to dominate all other network position effects.

6. Conclusions

The paper addressed project-organizing practices in the construction industry by adopting a social network analysis approach. It investigated the role of a contractor firm's position within a project-organizing network in affecting the firm's performance in PPPs. The data were collected from an original database owned by the Regione del Veneto (SIMOG), which contains information on public procurement and PPP projects undertaken in Veneto (Italy) from 2008 to 2012. Social network analysis and multivariate statistical analysis tools were used to achieve the aims of the work. Firm performance was found to be positively affected both by the number of relationships of the firm (i.e., its partnering ability) and by the firm's reachness ability; however, performance was negatively affected by a firm acting as a broker. Being at the center of a contractor network and being able to quickly reach other firms appeared to be two relevant components of a best practice approach for firms operating in PCPs in the construction industry in the Veneto Region.

Our findings support the view that project-based firms derive their performance from the structural positions they occupy within their project-organizing networks.

To put the implications of these findings into proper perspective, we must consider some key limitations of our study. First, by emphasizing a structural perspective of performance, the study does not measure firm characteristics or behavioral strategies. Clearly, a firm's performance in a project-organizing network might be shaped by the firm's internal factors (e.g., the personality of entrepreneur), by informal ties within the firm, by ties between the firm and public institutions and by structural factors (e.g., centrality in the workflow). Second, the study examines the structure of a project-organizing network at a particular point in time. Longitudinal research is needed to examine the degree to which and the manner in which performance changes over time. Third, the case study refers to a specific empirical setting; to verify the validity of the results and to generalize them, it is necessary to replicate this research work in other geographical areas.

Overall, tempered by these limitations, the findings suggest the following implications for researchers and managers:

- It is necessary to increase the relational skills of project firms that are interested in participating in PCPs and do not have the appropriate skills or knowledge to do so. This is particularly true for SMEs, whose size impedes the availability of in-house experts specializing in or oriented towards increasing firm performance in PPP practices.

- Increasing the number of business relationships of a firm working in a PCP environment is generally a good strategy. Although the ability to select the most influential nodes of a contractor network might seem to increase firm performance (suggesting that quality is better than quantity), this is not the case here. “The more the better” might be a good mantra for best-performing contractors.
- Firms playing intermediary (i.e., broker) roles in their contractor networks do not benefit in terms of performance. A contractor that chooses to include a broker among its PCP partners might benefit more from the relationship than the broker itself. Brokers are useful because they connect several peripheral firms in the network. However, the high transaction costs involved in brokerage activities seem not to be compensated by financial returns.

In conclusion, investing in direct ties with multiple partners leads to greater access to information and increased performance in PCP practices. Due to the way in which we built the one-mode contractor network, we can infer that firms exhibiting high degree centrality are able to cultivate long-term relationships with others through a latent modality. Such firms might be embedded in a network of stable and repeated relationships, in which experiences collected over previous projects contribute to selection processes for involvement in future projects. This finding aligns with Eccles (1981), who, demonstrated how, in the construction industry, for instance, the main contractors tended to use the same trade subcontractors from one project to the next (thus developing strong and repeated collaborative ties). In addition, inter-organizational relationships between project network actors, developed over the course of multiple projects, may also lead to opportunities for learning, reduced supervisory costs and a reduced risk of project failure (Bengtson et al., 2001; Eccles, 1981; Sydow and Staber, 2002; Söderlund and Andersson, 1998; Windeler and Sydow, 2001). Dense networks of strong ties facilitate the flow of information due to the inherent obligations and mutual understandings among network members, which lead to a reduced risk of uncertainty (Coleman, 1990). In this context, direct ties with “familiar” firms seem to ensure improved performance.

This work, which was explorative in nature, confirms the utility of adopting an SNA approach to study project-organizing practices, while leaving room for follow-up research on the topic. The results of this study might be worth continued study in a variety of industrial sectors in order to evaluate the power of the SNA approach and of network position in determining the performance of firms operating within PBOs at large.

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APPENDIX A

Correlation matrix

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1.FIRM_PERF	1								
2.DEGREE	0.0392	1							
	0.4756								
3.BETWEENNESS	-0.0563	0.7908*	1						
	0.3046	0.0000							
4.CLOSENESS	0.1787*	0.5340*	0.4319*	1					
	0.001	0.0000	0.0000						
5.TYPE	-0.2560*	0.0666	0.0629	-0.0344	1				
	0.0000	0.2245	0.2516	0.5312					
6.SENIORITY	-0.2168*	0.2119*	0.2062*	0.0589	0.4434*	1			
	0.0001	0.0001	0.0001	0.2833	0.0000				
7.PPP	0.3400*	0.1157*	0.1059	0.1192*	-0.0723	-0.1272*	1		
	0.0000	0.0345	0.0532	0.0294	0.1876	0.0201			
8.TURNOVER	0.0874	0.3191*	0.2725*	0.2119*	-0.1335*	-0.0039	0.0275	1	
	0.1108	0.0000	0.0000	0.0001	0.0146	0.9428	0.6161		
9.EMPLOYEES	0.0091	0.0439	0.0511	0.0778	-0.0942	0.0213	-0.008	0.5157*	1
	0.8691	0.4275	0.3557	0.1592	0.0880	0.7001	0.8846	0.0000	

Figure 1. Analytical framework

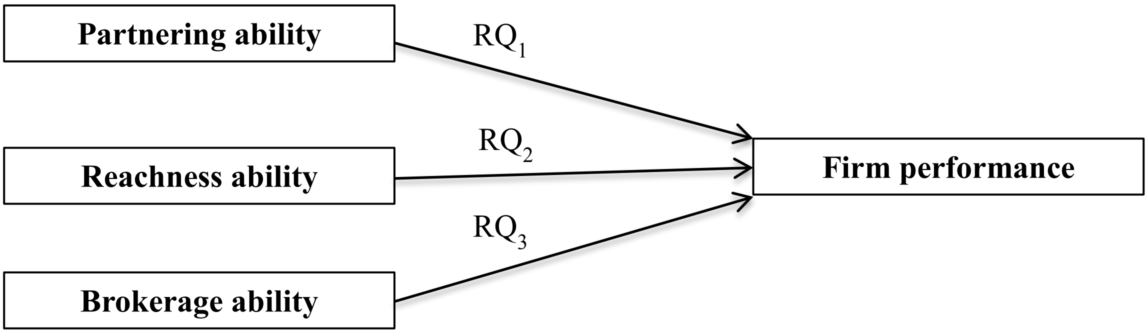


Table 1 – PCP features

CPV (Common Procurement Vocabulary)	%	Amount (Mean - €)
450- Construction work	9.88	516441.51
451- Site preparation work	0.06	220418.47
452- Works for complete or parttial construction and civil engineering	70.07	284437.59
453- Building installation work	6.17	195490.64
454- Building completion work	13.65	236683.87
455- Hiring of construction and civil engineering machinery and equipment with operator	0.17	123312.35

Figure 2. Two-mode matrix – an example

Firm \ Project	A	B	C
1	1	1	1
2	1	0	0
3	1	1	0
4	0	0	1
5	0	0	1
6	0	1	0
7	0	1	0

Figure 3. Graphic representation of the two-mode matrix – an example

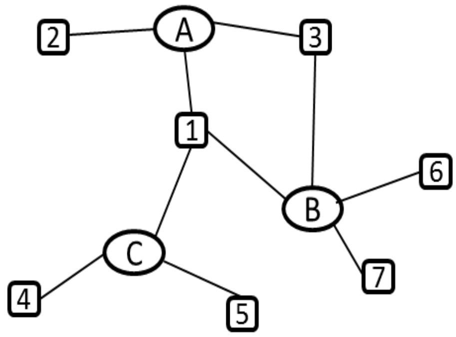
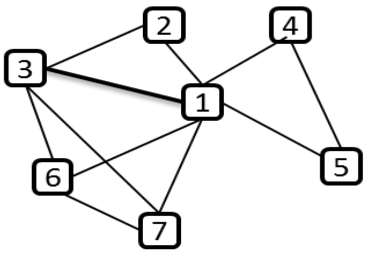


Figure 4. One-mode network and degree centrality



Degree centrality:

Firm 1: 6
Firm 2: 2
Firm 3: 4
Firm 4: 2
Firm 5: 2
Firm 6: 3
Firm 7: 3

Graph 1 – One-mode firm network

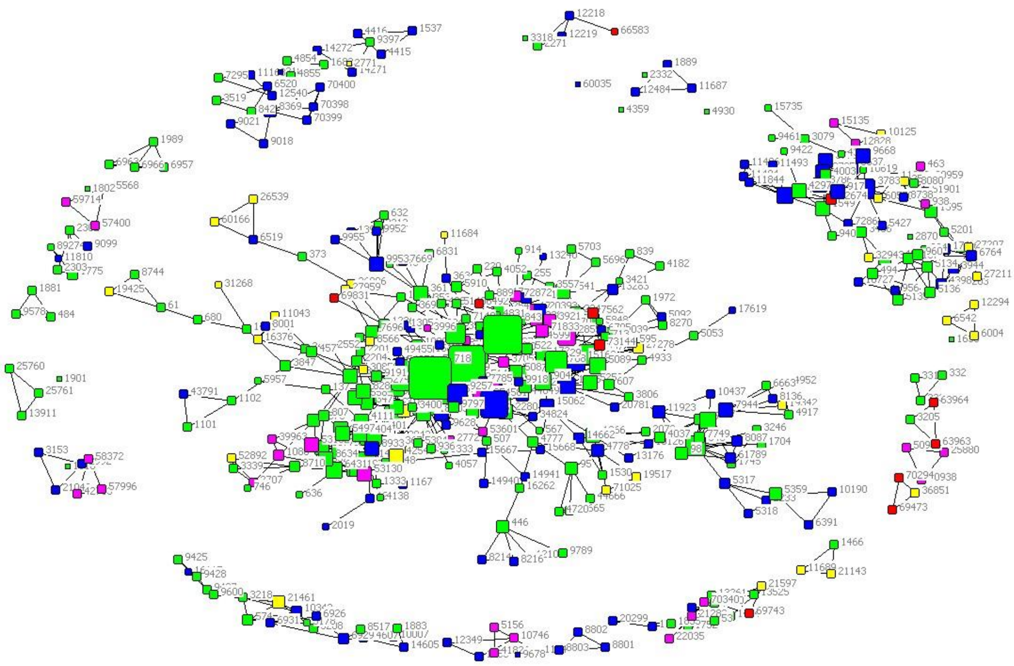


Table 2 – Index of one-mode firm network

Density	**Distance**	**Degree**	**Betweenness**
Density (matrix average) = 0.0003 *Std Dev* = 0.0161	*Average distance (among reachable pairs)* = 5.928	*Mean*= 0.753 *Std Dev*= 0.782 *Sum*= 2192.000 *Variance*= 3.174 *Minimum*= 0.000 *Maximum*= 27.000 *Network Centralization* = 0.90%	*Mean*=115.124 *Std Dev*= 899.654 *Sum*= 335012.000 *Variance*= 809377.125 *Minimum*= 0.000 *Maximum*= 24677.740 *Network Centralization Index* = 0.58%

Table 3 – Variable descriptions

Type	Name	Label	Description
Dependent variable	FIRM_PERF	Firm performance	Average PCPs value awarded to a firm in 2008-2012
Independent variable	DEGREE	Degree centrality	Number of direct connections of a firm
	BETWENNESS	Betwenneess centrality	Number of geodesic paths that pass through a given firm
	CLOSENESS	Closeness centrality	The length of the shortest path from one firm to another
Control variable	SENIORITY	Seniority	Year of the first project awarded (2008=5, 2009=4, 2010=3, 2011=2, 2012=1)
	TYPE	Type	Dummy variable (1/0) denoting whether a firm has won PCPs predominantly as a single firm (1) or as part of a temporary group (0)
	PPP	Type of PCPs	Dummy variable (1/0) denoting whether a firm has won a PPP(1) or not (0)
	TURNOVER	Firm turnover	Value of a firm's turnover (in euros) in 2012
	EMPLOYEES	Number of firm employees	Number of firm employees in 2012

Table 4 – Descriptive statistics for firm performance

Variable	Obs	Mean	Std. Dev.	Min	Max
Main component	329	1.27E+09	2,19E+09	44774.23	2.627E+10
Other	2576	2.72E+08	6.62E+08	17480.54	9.163E+09

Graph 2 – One-mode firm network – main component

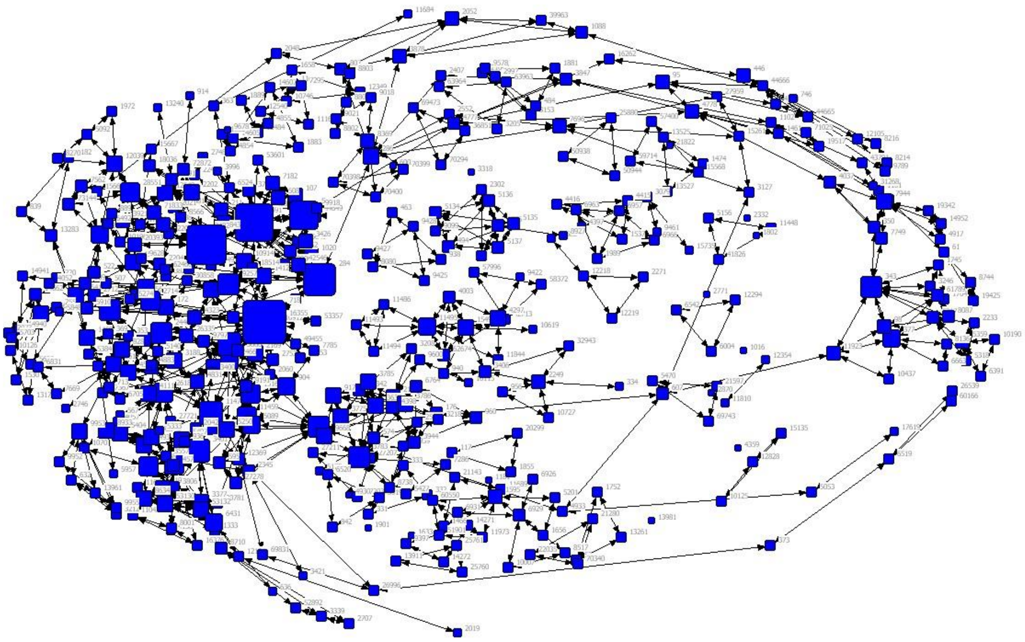


Table 5 - Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
FIRM_PERF	329	1,27E+09	2,27E+09	44774,23	2,63E+10
DEGREE	329	1,032272	0,9264005	0,273	7,377
BETWEENNESS	329	1,467641	3,719419	0	36,945
CLOSENESS	329	17,50444	3,467178	10,436	27,56
SENIORITY	329	4,188623	1,094783	1	5
TYPE	329	0,508982	0,5006694	0	1
PPP	329	0,0508982	0,2201196	0	1
TURNOVER	329	3,22E+07	1,32E+08	2175	1,47E+09
EMPLOYEES	329	115,9757	757,4124	1	13128

Table 6 – Determinants of firm performance coefficient estimates for the multiple linear regression model (329 observations)

	Model 1		Model 2		Model 3		Model 4		Model 5		
	Coeff.	Rob. Std Err.	Coeff.	Rob. Std Err.	Coeff.	Rob. Std Err.	Coeff.	Rob. Std Err.	Coeff.	Rob. Std Err.	Standardized coeff.
Dependent variables											
FIRM_PERF											
Indipendent variables											
DEGREE			0.3089**	0.0982					0.6233***	0.1162	0.3932
CLOSENESS					0.08482***	0.0225			0.0642*	0.0260	0.1507
BETWEENNESS							-0.0043	0.0200	-0.1417***	0.0286	-0.3598
Control variables											
SENIORITY	-0.0154	0.0902	-0.0771	0.0912	-0.0424	0.0907	-0.0121	0.0916	-0.0505	0.0878	-0.0376
TYPE	-1.0122***	0.1696	-1.0169***	0.1687	-0.9872***	0.1663	-1.0122***	0.1697	-1.0015***	0.1586	-0.3400
PPP	1.4366**	0.4393	1.26454**	0.4616	1.27549**	0.4409	1.4457**	0.4424	1.26320**	0.4131	0.1899
TURNOVER	1.52E-09*	7.09E-10	6.42E-10	8.60E-10	1.01E-09	7.21E-10	1.56E-09*	7.73E-10	7.07E-10	8.26E-10	0.0636
EMPLOYEES	-0.0001*	0.0000	-0.0000	0.0000	-0.0001**	0.0000	-0.0001*	0.0000	-0.0000	0.0000	-0.0485
INTERCEPT	14.3752***	0.3684	14.3445***	0.3650	13.0110***	0.4677	14.3661***	0.3699	12.9813***	0.4978	-0.0376
N	329		329		329		329		329		
R-squared	0.2038		0.2346		0.2406		0.2039		0.2973		
	1.38		1.58		1.44		1.54		3.19		

Note: t statistics in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$