



# Measuring social capital through network analysis and its influence on individual performance



Alireza Abbasi<sup>a,\*</sup>, Rolf T. Wigand<sup>b</sup>, Liaquat Hossain<sup>c</sup>

<sup>a</sup> School of Engineering and IT, University of New South Wales, Canberra, ACT 2610, Australia

<sup>b</sup> Departments of Information Science & Management, University of Arkansas at Little Rock, AR 72204-1099, USA

<sup>c</sup> Centre for Complex Systems Research, Faculty of Engineering and IT, University of Sydney, Sydney, NSW 2006, Australia

## ABSTRACT

Studies of social networks highlight the importance of network structure or structural properties of a given network and its impact on performance outcome. One of the important properties of this network structure is referred to as social capital, which is the network of contacts and the associated values attached to these networks of contacts. This study provides empirical evidence of the influence of social capital and performance within the context of academic collaboration (coauthorship) and suggests that the collaborative process involves social capital embedded within relationships and network structures among direct coauthors. Association between scholars' social capital and their citation-based performance measures is examined. To overcome the limitations of traditional social network metrics for measuring the influence of scholars' social capital within coauthorship networks, the traditional social network metrics is extended by proposing two new measures, of which one is non-weighted (the power–diversity index) and the other (power–tie–diversity index) is weighted by the number of collaboration instances. The Spearman's correlation rank test is used to examine the association between scholars' social capital measures and their citation-based performance. Results suggest that research performance of authors is positively correlated with their social capital measures. The power–diversity index and power–tie–diversity index serve as indicators of power and influence of an individual's ability to control communication and information.

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## 1. Introduction

Notable sociologists such as Burt (1992), Coleman (1988), and Granovetter (1973) claim that individuals' personal characteristics are not their only success factors; rather it is the extent of social capital accrued in their respective personal networks that is more influential (Oh, Choi, & Kim, 2006). The core idea of social capital is that a person's, or a group of people's, associates (e.g., family members, friends, colleagues) form an important asset that can be used to gain optimal performance (Woolcock & Narayan, 2000). Social capital produces benefits or outcomes for individuals and collective actors which drive from their social structure (Burt, 1992).

The concept of social capital provides a useful and comprehensive conceptual perspective (Sawyer, Crowston, & Wigand, 1999; Tsai & Ghoshal, 1998) for understanding the benefits and outcomes of individual and collective action, as well as value creation within a networking context. Accordingly, social capital has been defined as “the set of social resources embedded in relationships” (Tsai & Ghoshal, 1998, p. 464).

Social capital has three components: structural, relational, and cognitive (Tsai & Ghoshal, 1998; Wellman, 1988). The structural dimension involves social interaction that the actor uses to gain access, information,

or resources. The relational dimension encompasses aspects that arise from interactions, including trust and loyalty. The cognitive dimension includes attributes such as shared norms, codes of action, and convergence of views. In this line of research, studies have anticipated “the creation of value” owing to the existence of social relationships (Arregle, Hitt, Sirmon, & Very, 2007).

Research suggests that conceptualizing social capital in terms of network structures, as articulated by the strength of weak ties theory (Granovetter, 1973, 1983), provides valuable insight into scholars' coauthorship activities. In most large organizations performance of individuals and teams is measured through a set of metrics that pertain to task and contextual performance. Similarly, in academia, scholars and scientists are evaluated on their academic performance (e.g., research productivity, teaching evaluations, governance capabilities, funded research grants). Such evaluation of scholars is necessary, not only for faculty recruitment and promotion schemes, but also for industry and government funding allocation, as well as for achieving a high reputation within the research community (Abbasi & Jaafari, 2013).

Collaboration is essential in the enhancement of knowledge and experience of graduate students and post-doctoral researchers (Bozeman & Corley, 2004) and also leads to improved productivity of scholars (Melin, 2000). On a global level, with respect to governmental funding (i.e., the allocation of funding for a specific project to a scientific research group) and university strategy, it is important to identify key scholars,

\* Corresponding author.

E-mail address: a.abbasi@unsw.edu.au (A. Abbasi).

collaboration areas, and research strengths within universities, with the aim of maximizing research output, cost optimization, and resource utilization.

A researcher's time, abilities, skills, and resources are understood to be restricted. Therefore, to conduct most large research projects, collaboration is required and, in turn, often leads to large-scale scientific collaboration. Bringing together scholars with different skills, expertise, and knowledge as human capital, in group work is, thus, essential (McFadyen, Semadeni, & Cannella, 2009). Diversity of actors involved in group work then facilitates the integration of expertise, contributes to successful projects' implementation, and accelerates cycle time for new product development (Cummings, 2004; Eisenhardt & Tabrizi, 1995; Griffin & Hauser, 1992; Pinto, Pinto, & Prescott, 1993). However, in such group work, a basic and shared understanding of each participant's knowledge and expertise is crucial to the overall understanding of the project, or research, as a whole.

A coauthorship network represents a form of collaboration among scholars that includes scientific interactions and collective action to conduct research, producing results in the form of a publication. Therefore, social norms and trust build among scholars, over time, through collaborations and constitute a form of social capital for academia. In other words, when researchers collaborate on projects they share substantial amounts of knowledge. This flow of knowledge becomes a stock of knowledge that mutually benefits the researchers (Dierckx & Cool, 1989). Therefore, social capital resulting in collaboration networks can be used to explain the concept of knowledge capital (Oh et al., 2006).

The motivating questions for this study were as follows: (a) How does one measure the concept of social capital of scholars? (b) Do scholars' social capital metrics associate with their performance?

## 2. Problem statement

The number of collaborations is the simplest proxy for quantifying the collaborative activities of scholars. Other studies have used concepts such as proximity (e.g., Frenken, Hardeman, & Hoekman, 2009; Havemann, Heinz, & Kretschmer, 2006; Ponds, van Oort, & Frenken, 2007) and diversity (e.g., Abbasi & Jaafari, 2013) to conceptualize the frequency of relationships among authors and institutions. By considering only the direct partners, such approaches reflect only the local position of the scholars in their respective collaboration network. In order to overcome this simplicity, i.e., considering only the number of partners, the RC-index (Abbasi, Altmann, & Hwang, 2010) is proposed as a bibliometric measure of scholars' collaborative activity that takes into account the performance of collaborators in combination with their frequency.

To quantify and highlight the importance of global position and role of the scholars in their collaboration network, studies (e.g., Abbasi, Chung, & Hossain, 2012; Yan & Ding, 2009; Zhuge & Zhang, 2010) have used traditional centrality measures and also proposed new hybrid centrality measures (Abbasi, 2013). These studies have shown the applicability of social network measures for coauthorship networks to indicate how centrality measures (as a proxy for scholars' collaboration activity) are useful for reflecting scholars' performance based on their position and influence within their collaboration network. But most of those studies are lacking a proper theoretical justification for the network measures used to evaluate scholars' collaborative activity. To fill that gap, the current study considers the social capital theory to conceptualize scholars' collaborative activity, emphasizing the importance of coauthors' roles and positions in their collaboration network, and proposes new collaborative measures.

## 3. Literature review

### 3.1. Social capital and network theories

The concept of social capital has become increasingly popular in a wide range of social science disciplines (e.g., political science, economics,

and organization science). Social capital has been used by social scientists as an important factor in explaining success in a number of areas (e.g., educational performance, career success, product innovation, inter-firm learning, and real-estate sales). Hanifan's (1916) work on evaluating effects of community participation in enhancing school performance can be considered the first study on social capital. But Bourdieu's (1986, 1992) and Coleman's (1987, 1988, 1990) work on education, as well as Putnam's (1993, 1995, 2001) work on civic engagement and institutional performance, are the main studies inspiring most of the current research in social capital (Woolcock & Narayan, 2000).

Bourdieu (1986) identified several forms of capital: *economic capital*, "which is immediately and directly convertible into money and may be institutionalized in the forms of property rights" (p. 47); *cultural capital*, which could be embodied (in persons), objectified (e.g., in art), or institutionalized (e.g., university degrees); *social capital*, or resources grounded in durable exchange-based networks of persons; and *symbolic capital*, or the manifestation of each of the other forms of capital when they are naturalized on their own terms. Bourdieu and Wacquant (1992) defined social capital in detail as "the sum of the resources, actual or virtual, that accrue to an individual or group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (p. 119).

Coleman (1988), who was interested in the role of social capital in human capital creation and educational outcome (Narayan & Cassidy, 2001), defined social capital as a function of social structure producing advantage:

It is not a single entity but a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors—whether persons or corporate actors—within the structure. (p. S98)

Putnam (1993) defined social capital as "those features of social organization, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions" (p. 167) or as "features of social life—networks, norms and trust—that enable participants to act together more effectively to pursue shared objectives" (Putnam, 1995, pp. 664–665).

Coleman's (1988) definition regards social capital as one of the potential resources that an actor can use besides other resources such as human or cultural capital (their own skills and expertise), physical capital (tools), or economic capital (money) (Gauntlett, 2011). He also highlighted the importance of social capital as effecting the creation of human capital. But social capital differs fundamentally from other types of capital, as it resides not in the objects themselves (i.e., people) but in their relations with other objects. For instance, human capital represents individual attributes and characteristics (e.g., attractiveness, intelligence, and skills). These assets are possessed by individuals, yet social capital is additionally embedded in the relationships among individuals (Shen, 2010).

Emphasizing social capital's function in different contexts, Portes (1998) defined social capital as "the ability of actors to secure benefits by virtue of memberships in social networks or other social structures" (p. 3). Adler and Kwon (2002) focused on social capital as a resource that exists essentially (permanently) in the social network binding a central actor to other actors: "the resources available to actors as a function of their location in the structure of their social relations" (p. 18).

In another approach, Lin's (1982) social resource theory named power, status, and wealth as determinants of *valued resources* in most societies. Accessing and using social resources can lead to better socioeconomic status and is determined by structural positions and use of ties. Some researchers defined social capital by considering capital (attributes) individuals possess in a network. For instance, Boxman, De Graaf, and Flap (1991) described social capital as "the number of people who can be expected to provide support and the resources

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