Research Policy xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

Social networks, technology ties, and gatekeeper functionality: Implications for the performance management of R&D projects

Chia-Liang Hung

Department of Information Management, School of Management, National Chi Nan University, 470, University Rd., Puli, Nantou 545, Taiwan, ROC

ARTICLE INFO

Article history:
Received 17 February 2016
Received in revised form
14 November 2016
Accepted 25 November 2016
Available online xxx

Keywords:
Data envelopment analysis
Performance evaluation
Gatekeeper
Project management
R&D management
Social networking analysis

ABSTRACT

R&D project teams concerned with efficiency under limited resources must cohesively coordinate cooperation, interactions, and the exchange of ideas to sustain innovation. This research investigated the management of social networks, technology ties, and gatekeeper functionality from a networking perspective and examined their contribution to R&D performance, which was evaluated using data envelopment analysis. This study verified the relationships by using data from the Taiwan National Telecommunication Program, which coordinates more than 100 R&D teams in pursuing next-generation broadband technologies. The results regarding these relationships varied. The density of social networking and the outward- and novel-oriented gatekeeper functionality of a project team was found to significantly promote its R&D performance, whereas the density of technology ties exhibits no significance. Accordingly, this paper presents strategic implications for the management of projects, team interorganizational linkages, and governmental subsidy policies, and discusses the networking activities of R&D teams at the project level.

1. Introduction

Emerging market countries such as South Korea, Taiwan, China, and India have not yet reached developed country status, but have outpaced their developing counterparts (Bożyk, 2006). Some of these countries, such as South Korea, have initiated national programs to advance their technological capabilities to the level of those of developed counties (Lee et al., 2009; Mathews, 2006). Taiwan has launched national technology programs such as the National Telecommunication Program (NTP) to encourage frontier research and development (R&D) of technologies and achieve a globally competitive advantage. However, individual NTP academic projects have performed inconsistently and, therefore, raised practical concerns regarding the quality of project management and the efficiency of resource allocation, particularly under limited R&D resources (Hung and Shiu, 2014). Hung et al. (2010) revealed that several top-tier NTP research groups are centered around particular research institutions or universities, indicating that being part of a high-density research network can produce exceptional R&D performance. Links to local development centers absorb a large amount of resources; complementary technologies seem to be critical to scientific researchers (Tiwana, 2008).

According to Stewart and Barrick (2000), interpersonal skills and relationships mediate the contributions within a research team and affect performance. Coleman (1988) argued that a strongly connected relationship network resembles social capital. Specific capital of this type supports combinatorial innovation, transformative capacity, and knowledge integration in a cooperative team (Obstfeld, 2005; Tiwana, 2008), and channels resources toward the project team leader's network connections (Kao and Shen, 2009). The depth of a social network reflects the importance of a person acting as the information or knowledge source within his or her associated organization or society (Björk and Magnusson, 2009; Tsai, 2001). Centrality involves a high degree of inflow and outflow relationships in a network, and positively relates to the absorptive capacity of a team, attracting more R&D expenditure (Björk and Magnusson, 2009; Chiu, 2009; Tsai, 2001). The higher the centrality of a team within its organization or society, the more the team shares technologies through the networking process and contributes to innovation (Björk and Magnusson, 2009). Beyond its importance in social networks, the gatekeeper of an R&D team serves as an important communication channel and discriminates R&D performance (Hung et al., 2013). Allen (1977) asserted that the role of a gatekeeper is to actively acquire external information sources to meet information requirements and maintain a high level of communication, both within and outside of his or her organization. Gatekeepers are usually accomplished

E-mail addresses: clhung@ncnu.edu.tw, clhung57@gmail.com

http://dx.doi.org/10.1016/j.respol.2016.11.009
0048-7333/

performers who produce more papers for presentation and publication and receive more recognition from their peers (Shumsky and Pinker, 2003). Furukawa and Goto (2006) asserted that corporate scientists with high numbers of publications serve as central conduits for the in-flow of knowledge from outside of their companies, thereby stimulating innovation. Consequently, social network and gatekeeper functionality accumulates technology ties, which involve dense technological connections within a network, leading to advantages in knowledge transfer and sharing (Lin et al., 2010). This process enhances technological development capability (Coleman, 1988). The cohesion theory indicates that benefits result from dense technology networks because of deep accumulative experience and intensive interactions (Coleman, 1988). Therefore, the purpose of this study is to examine the multifaceted influence processes of social networks and gatekeeper functionality mediated by technology ties to R&D project performance and thereby explain the performance discrepancy of R&D projects.

However, this study has a further academic concern. According to the perspectives of Granovetter's weakly tied networking (Granovetter, 1973) or Burt's structural holes (Burt, 2004), a highly closed network cannot encourage innovation; nevertheless, Hansen (1999) argued that weak ties aid a project team in searching for useful knowledge from others but impede the transfer of complex knowledge, which tends to require a strong tie between two parties. Hung and Shiu (2014) also reported that researchers' international educational backgrounds resemble the weakly tied linkages or structural holes that are described by Burt (2004), but they cannot support knowledge acquisition and dissemination for enhancing R&D performance. Therefore, to pioneer basic, large-scaled, and advanced technology programs, it is necessary to examine the contribution of strongly tied project organization to R&D performance. Furthermore, a social network's centrality often evolves a distinct mechanism in sharing technology, from which it forms strong technology ties among actors (Lin et al., 2010). Could such a deep technology paradigm enhance or inhibit R&D performance in the case of a national technology program for pursuing advanced technological frontier (Leonard-Barton, 1992)? Finally, is building the gatekeeper functionality of a project team still important in the current Internet era, in which people appear to have equal access to open information networks (Whelan et al., 2010)?

The paper is structured as follows. First, literature about social networks, technology ties, and gatekeeper functionality is reviewed to derive related hypotheses for examining the relationship between, and performance of, these three constructs. Next, this paper addresses the methodology for measuring R&D performance. This reveals a proposed multicriteria approach and related independent and dependent proxy variables. Third, the collected NTP data are analyzed using a partial least squares statistical method. Finally, the findings and discussion of the results demonstrate the empirical, practical implications and academic contributions, and avenues are identified for future research.

2. Theory and hypothesis

2.1. Social networks and performance

Wasserman and Faust (1994) defined a social network as a finite set or sets of actors and the relationship or relationships between them. The interrelations of actors may involve friends, relatives, classmates, and colleagues, and each actor establishes his or her own style of social networking (Argyle, 1998). Additionally, the social network influences his or her life, work, and emotional state, and may also affect the atmosphere, communication, and operational efficiency of an organization (Argyle, 1998). Moreover, dense networks tend to be loci of shared knowledge, language, and style, thereby facilitating communication and innovation (Walker et al., 1997; Nahapiet and Ghoshal, 1998). Densely embedded networks with numerous connections are identified as being advantageous, in so far as these networks are "closed" (Coleman, 1988). Networks that are dense and cohesive are conducive to mobilized action because interests and perspectives are prealigned, and the language and trust necessary to mobilize those interests are readily available (Obstfeld, 2005). Even though Burt's structural holes under weakly tied networks often led to novel ideas and explorative opportunities (Burt, 2004; Gilsing et al., 2008; Zaheer and Bell, 2005), there was no evidence that those ideas led to implementation efforts, let alone implementation success. Thus, the advantages of communication and accessibility pertaining to distinctively closed social networks should be emphasized, especially when conservatively addressing the efficiency of resource transformation under limited R&D resources. Burt's structural holes theory focuses on the emergence of novel ideas and market transactions resulting from a sparse network (Walker et al., 1997; Obstfeld, 2005), presenting a *tertius gaudens* (third who laughs) strategy in which a broker positioned between two disconnected parties can take advantage of the opportunities generated by being situated between the two parties (Vernet, 2012). Contrarily, the *tertius iungens* (third who joins)–oriented network is a strategy in which users connect people in their social network by either introducing disconnected individuals to each other or facilitating new coordination between connected individuals. This joining activity forms a friendly union that enhances the efficiency of implementation, such that the combinative activity involves both parties in fundamental cooperative innovation on an ongoing basis as the project unfolds (Obstfeld, 2005). Thus, when an organization manager is searching for a new market opportunity (the target), a *tertius gaudens* strategy such as the identification of a structural hole suggested by Burt is necessary to match the proper parties. Contrarily, after targeting a certain goal, a *tertius iungens* strategy is necessary to coordinate the connected people to produce coordinated actions that lead to innovation (Björk and Magnusson, 2009; Lingo and O'Mahony, 2010; Vernet, 2012). This research focused on the implementation problems of a national technology program involving basic research toward the given target and found that a *tertius iungens* networking strategy is preferable for increasing the density of the researchers' social network.

The power of social networks on innovation results from a set of resources including information, technological patents, experience, and financial capital that each actor within the social network possesses (Kilduff and Tsai, 2003). Lawler and Yoon (1998) argued that exchanges within the social network increase personal motivation to form affectionate and cohesive relationships. The degree of affection between people within the social network reflects mutual understanding and trust (Higgins and Kram, 2001). Lack of trust hinders sharing knowledge, combining skills, and making large joint investments, increasing the likelihood of being unproductive (Coleman, 1988). Trust in social relationships facilitates interaction (Chen and Wang, 2008) and enhances personal career success (Argyle, 1998). Hansen (1999) argued that a strong tie between two parties is necessary for the sake of complex knowledge transfer, which tends to be impeded in a weakly tied relationship. Guanxi, the Chinese social network, helps people exchanging resources and breeding trust within Chinese cultural contexts (Lin et al., 2012). Furthermore, trust increases the inclination of team partners to share information and knowledge (Collins and Smith, 2006) and allows them to use organizational resources efficiently and flexibly when encountering unexpected obstacles (Stewart and Barrick, 2000). Thus, dense and cohesive networks, repeated interactions, and the exchange of ideas are crucial to the coordinated actions necessary for sustained innovation efforts (Ahuja, 2000; Uzzi, 1997). Moreover, a dense network increases the probability

Please cite this article in press as: Hung, C.-L., Social networks, technology ties, and gatekeeper functionality: Implications for the performance management of R&D projects. Res. Policy (2016), http://dx.doi.org/10.1016/j.respol.2016.11.009