

Boundary spanning and knowledge exploration in a professional services firm

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ABSTRACT

Exploration for new knowledge is critical to the performance of professional service firms. The networks of partners in professional service firms are thought to be important for knowledge exploration because they typically span both the firm's internal and external boundaries aiding the flow of novel information to the firm. Yet, to date prior studies of individual-level boundary spanning have focused primarily on the benefits of boundary spanning and only recently begun to address the costs of building and maintaining boundary spanning ties. We add to this stream of research and propose that the knowledge exploration benefits of internal boundary spanning ties accrue more slowly than the costs, resulting in a curvilinear relationship with knowledge exploration. Moreover, we propose that the effects of internal and external boundary spanning ties on exploration are interdependent, because effective exploration requires not only selection of ideas externally, but also their transmission internally. Our study of 1,449 ties of partners in a consulting firm supports these arguments providing a more nuanced view of boundary spanning ties for knowledge exploration in professional service firms.

Keywords: Exploration, boundary spanning, knowledge domains, innovation, informal relationships, networks, professional services, consulting firms.

INTRODUCTION

It is well established in research on professional service firms that exploration for new knowledge is vital for firm growth and performance (Fu, Flood, and Morris 2016; von Nordenflycht 2010). Indeed, knowledge intensity is a distinctive characteristic of professional service firms (Starbuck 1992; Alvensson 1995; von Nordenflycht 2010), and identifying new knowledge is essential to their survival. Knowledge exploration as generally defined by Levinthal and March (1993: 105) described as “the pursuit of new knowledge, of things that might come to be known.” In professional service firms, knowledge exploration refers to the search for and development of ideas for growth opportunities for the firm, including new solutions for clients or new processes to make client interactions more effective (Alvensson 2004; Faulconbridge 2015). Yet, knowledge exploration is difficult, in particular, because it often faces resistance when it comes at the expense of exploitation of existing activities (March 1991; Benner and Tushman 2003; Rosenkopf and McGrath 2011; Fu, Flood, and Morris 2016). Recent research has suggested that encouraging interactions across formal organization boundaries is one way to overcome this resistance and generate new knowledge (Kleinbaum and Tushman 2007; Tortoriello and Krackhardt 2010; Carnabuci and Operti 2013; Dahlander, O’Mahony, and Gann 2016). Maintaining boundary spanning ties, i.e., relationships in different formal knowledge domains within and across organizations (cf. Aldrich and Herker 1977; Kaplan, Milde, and Cowan 2017), may therefore be particularly useful for professional services firms in which new knowledge is vital to performance and survival.

A key insight of organization theory is that employees’ interactions are influenced by the firm’s formal organization structure such that most interactions occur within formal boundaries, be they the external boundaries of the firm or formal boundaries between different knowledge

domains or expertise within the firm (Barnard 1938; Karim and Kaul 2015; Kleinbaum, Stuart, and Tushman 2013). Because firm's existing boundaries are adapted to the current knowledge environment (Lawrence and Lorsch 1967; Thompson 1967), interactions within them tend to support knowledge exploitation. In contrast, knowledge exploration often requires connections across formal boundaries (e.g. Hansen and Løvås 2004; Kleinbaum and Tushman 2007; Gulati and Puranam 2009; Soda and Zaheer 2012; Kleinbaum and Stuart 2014). In professional service firms, these connections are formed via employees' interactions with colleagues and clients outside formal organizational boundaries (Briscoe and von Nordenflycht 2014; Lazega 2001), which allow for access to different knowledge domains (Dougherty 1992; Cummings and Kiesler 2005; 2007). To be sure, developing new knowledge requires boundary spanning, but how much boundary spanning is optimal is less clear. Thus, in this study, we consider how professional service firms' partners utilize their informal boundary spanning ties across formal knowledge domains to explore for new knowledge for the firm.

In prior research, boundary spanners are defined as individuals or units that have ties to other individuals or units outside their formal groups (unit or firm), and thus, a boundary spanner is one who bridges formal intra- or inter-organizational boundaries (Aldrich and Herker 1977; Powell, Koput, and Smith-Doerr 1996; Zhao and Anand 2013).¹ By bridging boundaries, managers cross into different knowledge domains, which allows them to bring diverse information (Allen and Cohen 1969; Tushman 1977; Geletkanycz and Hambrick 1997) and knowledge (Hansen 1999;

¹ Boundary spanners are distinct from the brokers that have been theorized extensively about in organizational sociology work (e.g., Burt, 1992) and the concepts remain "theoretically distinct" (Fleming and Waguespack, 2007: 166). Brokers connect two unconnected, densely connected cliques in a social network and this allows them to broker information between such cliques. However, brokers need not be boundary spanners, as the social network in question may occur within the same formal boundary (for example, in a department of an organization). Schotter, Mudambi, Doz and Gaur (2017: 413) also offer a distinction: "A broker increases distrust (maintains the need for brokerage) and a boundary spanner makes the connection more penetrable (increases trust) and greases the channel." Although the boundary spanners in our study indeed could also be brokers, the interest and focus in this paper is in understanding the nuances of both the costs and benefits for actors of crossing formal organizational boundaries.

Haas 2006, 2010; Zhao and Anand 2013) into their subunit or firm. Boundary spanning has been shown to provide a variety of benefits, such as improved innovation performance (Ancona and Caldwell 1992; Powell et al. 1996; Rosenkopf and Nerkar 2001; Mors 2010; Dahlander et al. 2016), increased communication (Kleinbaum, Stuart, and Tushman 2013) and leadership capabilities (Fleming and Waguespack 2007).²

Although prior theory suggests that boundary spanning is vital for firm performance, we still know little about the nuances of these effects. As noted by Dahlander and colleagues (2016: 296); "...understanding how boundary spanners straddle the firm and its external environment is a key question for strategy." Recent work has acknowledged that there may be significant costs to spanning boundaries such as attention costs (Dahlander et al. 2016) or cognitive or political costs (Kaplan et al. 2017; Leahey et al. 2017) that may lead to negative performance effects (Leahey et al. 2017). Others have suggested that bridging different knowledge domains is difficult because it requires actors to interpret, share and integrate diverse knowledge (Dougherty 1992; Bechky 2003; Cummings and Kiesler 2007; Mors 2010; Murray 2010; Uzzi, Mukherjee, Stringer and Jones 2013). Boundary spanners not only to select information from the external environment, but also to transmit and interpret this information for other internal units (Tushman 1977; Tushman and Scanlan 1981a; Kaplan et al., 2017; Murray 2010). For an individual's external boundary spanning ties to support knowledge exploration, they often need be combined with internal boundary spanning ties for effective transmission and interpretation of the novel information. This is well illustrated in the context of professional service firms, where boundary spanning managers extract knowledge from the external environment (e.g., from clients) and transmit it internally to develop new processes, practices or solve client problems (Briscoe and von Nordenflycht 2014; Lazega

² To be sure, we control for the density of the internal and external network (a proxy for the interconnectedness of the social network and hence the ability to broker), but neither of those variables are significant in our models.

2001; Ter Wal, Criscuolo and Salter 2017; Liu 2018). However, with few exceptions (Rosenkopf and Nerkar 2001; Mors 2010), empirical research has neglected this interaction between external and internal boundary spanning ties.³ This omission is surprising because a key insight of foundational work on boundary spanning is that innovation processes involve crossing not only the extra-organization boundary, but also crossing the boundaries inside the firm, i.e., between units or laboratories (Tushman 1977; Tushman and Scanlan 1981a; 1981b).

Taken together, the costs of boundary spanning and the interdependence of internal and external boundary spanning suggest that the relationship between boundary spanning and knowledge exploration is more complex than previously understood. Complementing recent research that has recognized significant attention costs associated with high levels of boundary spanning (Dahlander et al. 2016), we develop a novel theory of the costs and benefits of boundary spanning for knowledge exploration in professional service firms. We propose that costs are incurred even for single boundary spanning ties and that the benefits associated with internal boundary spanning ties initially accrue slowly. Thus, at low counts of ties, the costs may outweigh the benefits, and the overall effect on knowledge exploration is very low or negative. We propose that only when a manager has multiple boundary spanning ties internally will their effects on knowledge exploration become positive, and that the benefits of external boundary spanning ties are increased when the manager also has internal boundary spanning ties to support the transmission of knowledge.

³This study complements Rosenkopf and Nerkar's (2001) study of firm-level boundary spanning by offering arguments for individual-level boundary spanning mechanisms that affect exploration. Mors (2010) study of individual-level boundary spanning showed that the effect of network density on innovation is contingent upon the context in which the individual is situated. In contrast, the current study focuses on the interdependent effects of internal and external boundary spanning ties on knowledge exploration.

We investigate these arguments by studying the boundary spanning ties of senior partners in a global management consultancy. We examine the association between the network ties that these partners have across formal organizational boundaries and their exploration for new knowledge. In our arguments and analyses, we distinguish between ties that cross intra-organizational knowledge boundaries (i.e., internal ties that span different industry sectors) and those that cross both the firm's inter-organizational boundary and the knowledge boundary (i.e., external ties that span different industry sectors). Analyses of data on 1,449 relationships for 79 senior partners in a consulting firm provide evidence of a curvilinear relationship between internal boundary spanning ties and knowledge exploration and a significant and positive association of the interaction of internal and external boundary spanning ties with knowledge exploration.

In contrast to prior views of boundary spanning ties as primarily beneficial (e.g., Tushman 1977; Taylor and Greve 2006; Mors 2010; Murray 2010), our findings suggest under certain conditions the costs of maintaining these outweigh the benefits. When a partner holds enough boundary spanning ties to make relative comparisons of the value of the ideas and can match these to the appropriate unit and also has the legitimacy needed for the ideas to be accepted by internal units, then the benefits of boundary spanning outweigh the costs. Our results also provide much needed empirical support for a foundational argument of the boundary spanning literature, that effective knowledge exploration requires individuals to have boundary spanning ties both inside and outside the firm (Tushman 1977; Tushman and Scanlan 1981b). Given the critical role that boundary spanning plays in the performance and survival of professional service firms, our arguments and findings also provide insight into the relationship between the professional service firms' networks and their competitive advantage.

BOUNDARY SPANNING AND EXPLORATION

Prior work on boundary spanning has argued that crossing into new knowledge domains aids exploration for new information and opportunities, which in turn leads to innovation and firm growth (March 1991; Kleinbaum and Tushman 2007; Tortoriello, Reagans, and McEvily 2012; Kaplan et al. 2017). Hence, an outcome that has received attention in the boundary spanning literature is exploration for new knowledge (e.g., Rosenkopf and Nerkar 2001). Kleinbaum and Tushman (2007: 104), for example, argue that; “collaboration across divisional boundaries...provides multibusiness firms with unique opportunities for exploration.” Most prior work has theorized about exploration at the firm level (March, 1991; Levinthal and March, 1993; Greve, 2007). Recently, however, it has been argued that, in some contexts – including professional services - individuals may be the conduits of exploration for their firms (Groysberg and Lee 2009; Mom, Van Neerijnen, Reinmoeller, and Varwaal 2015). Therefore, it is important to further understand the roles that managers in professional service firms play in exploration of new knowledge.

Although “the importance of transferring information across analogous organizational boundaries exists for all innovating systems” (Tushman 1977: 589); according to Aldrich and Herker (1977: 218), the “definition and location of a specific boundary may be possible only given a specific conceptual and empirical context”. Therefore, and in line with this view, we describe the empirical context and define the relevant boundaries in that context prior to developing our arguments. The context is a global management consultancy, a unique and appropriate setting for studying boundary spanning in professional service firms. Previous research has established that in professional services individual managers must explore for new knowledge to grow the firm, and therefore, the use of boundary spanning relationships is particularly important for both individual and firm performance (Nohria and Eccles 1992; Maister 1993; Anand, Gardner, and

Morris 2007; Groysberg and Lee 2009; Briscoe and von Nordenflycht 2014). Furthermore, in the firm we studied, the boundaries were clearly defined, making the identification of boundary spanning ties unambiguous. Consistent with prior boundary spanning studies, these boundaries were defined by the formal organization structure (Geletkanycz and Hambrick 1997; Rosenkopf and Nerkar 2001; Kleinbaum and Tushman 2007). The key organizing unit in the firm was industry sector (e.g. financial services, resources, etc.) which represented a specific knowledge domain, with its own terminology and practices. The relevant internal boundaries were those existing between industry sectors, and external boundary spanning ties were defined as ties that not only crossed the firm's formal organizational boundary, but also crossed industry sectors (i.e. a manager in the resources group with a tie to an external contact in government). Figure 1 illustrates boundary spanning ties in this context.

----- Insert Figure 1 about here -----

Both internal and external boundary spanning ties provide the potential for accessing diverse knowledge, and therefore are important for knowledge exploration. However, they connect managers in professional services firms to different types of knowledge (Maister 1993). Internal ties connect to contacts inside a firm such as colleagues in other divisions of the firm. External ties connect to contacts outside the firm such as clients and other stakeholders (Geletkanycz and Hambrick 1997; Cummings and Kiesler 2005; Stuart and Liu 2010). Thus, internal and external contacts represent sources of different information, resources, and opportunities, and thus, they will also likely have different influences on knowledge exploration. For these reasons, and in line with prior work on boundary spanning, we treat them separately in the development of our arguments below.

Internal boundary spanning ties

A long tradition of research suggests that boundary spanning ties inside firms positively affect exploration (Allen 1977; Tushman 1977; Tushman and Scanlan 1981b). Formal organizations are differentiated systems where specialized skills and competencies are grouped together and selectively linked to other units (e.g. Weber, 1947; Lawrence and Lorsch 1967; Thompson 1967). Because these units actively select, develop, and retain individuals with similar specialized skills (e.g. Allen and Cohen 1969) and develop their own specialized routines and competencies (e.g. Nelson and Winter 1982; Hannan and Freeman 1989), the formal structure of an organization can be a significant source of within-firm heterogeneity in terms of resources, capabilities, and schemes (Dougherty 1992; Karim and Mitchell 2004; Karim and Kaul 2013; Zhao and Anand 2013). Consequently, internal relationships across the formal structure can provide individuals with opportunities to bring together ideas and practices across different knowledge areas. Therefore, consistent with prior work, we expect that having internal boundary spanning ties into different areas of specialization (i.e. industry sectors) will give managers access to diverse information and knowledge, which in turn will positively affect their exploration for new knowledge.

However, the relationship between internal boundary spanning ties and exploration is likely to be more complex than previously theorized. Like other types of network ties, there are costs to building and maintaining boundary spanning ties (Burt 2001; Hansen, Podolny and Pfeffer 2001). Indeed, without investment, network ties are likely to decay and cease to exist (Burt 2001). Complementing arguments for the attention costs that arise when a manager devotes too much time towards boundary spanning activities (Dahlander et al. 2016; Kaplan et al. 2017), we argue that there are two types of fixed costs that managers incur when building even a single boundary spanning tie. One type involves the effort required to develop a boundary spanning capability

(Schotter et al. 2017). In a framework of managing knowledge across boundaries, Carlile (2004: 558) describes this capability as a “common lexicon that sufficiently “specifies the differences and dependencies of consequence at the boundary,” and it applies to boundary spanning ties across any knowledge domain. For example, when exploring for new knowledge, managers engage in activities outside of their normal routines, such as communicating with others outside the normal workflow, seeking knowledge from experts outside their current team, or engaging in work with other units. These behaviors contrast to their routine ones, and engaging in these requires the development of an additional capability.

The second set of fixed costs is specific to the new knowledge domain accessed by the boundary spanning tie. A boundary spanning tie, by definition, connects the manager to a different knowledge domain which has its own language and members who have their own way of working. To benefit from the tie, the manager must invest effort to learn that specific language and way of working, and translate the knowledge gained into something that can be used by members of the manager’s domain. In professional service firms, such challenges to learning across boundaries have been described by Faulconbridge (2015), building on Wenger (1998). He notes that for the exchange of knowledge across boundaries to occur, there must be a common task, a common way of working and a similar approach to work. Establishing these routines is costly, and until these are established, the benefits of the boundary spanning tie will not be realized.

After these fixed costs are incurred, the additional marginal cost of building another boundary spanning tie decreases. Investment in a boundary spanning capability applies across all ties, and additional fixed costs are incurred only when a tie into a new knowledge domain is built and knowledge domain specific fixed costs are required.

In summary, with a single boundary spanning tie, managers incur fixed costs of developing a boundary spanning capability and fixed costs that are knowledge domain specific. The marginal costs associated with additional boundary spanning ties decrease as more are added, up to a point at which attention costs associated with high levels of boundary spanning ties documented by Dahlander and colleagues (2016) arise.

If the costs of boundary spanning were incurred at a slower rate than the benefits arose, they would not be a problem for knowledge exploration. However, for at least four reasons, we expect the exploration benefits of internal boundary spanning ties to accrue more slowly than the costs, and so at low levels of boundary spanning ties, the costs are likely to outweigh the benefits.

First, while having a few internal boundary spanning ties may provide exposure to some new ideas and information, they may not provide the requisite variety necessary to identify valuable ideas for the firm (Ashby 1991). Although the ties are to contacts outside the manager's unit, the contacts are still members of the same firm. The contacts' knowledge and ideas are likely to overlap with those of the manager, and therefore, an internal boundary spanning tie is likely to provide less novel information than a tie to a contact outside the firm. Multiple internal boundary spanning ties may therefore be needed to reach the requisite variety to generate exploration.

Second, effective boundary spanning involves the selection of ideas from the environment, which requires making a relative comparison of the value of the ideas accessed. This dynamic is similar to that observed in research on strategic decision making by Eisenhardt (1989) in which fast decision makers used more, not less, information. Eisenhardt (1989: 558) explains how "...the process of comparing alternatives helps decision makers to ascertain the alternatives' strengths and weaknesses..." which helps them achieve superior performance. If managers are drawing from a small sample of ideas and lack comparable alternatives, their judgments are prone to bias (Fiedler

2000). With only a single tie to another unit, the manager is will be accessing a smaller sample of ideas, and may be less able to assess the value of each idea. With multiple internal boundary spanning ties, a manager can make more effective comparisons of alternatives and is at a lower risk of ignoring a potentially valuable idea or selecting a poorer quality one.

Third, knowledge exploration often requires not only accessing novel ideas but also matching them to others inside the firm who can develop them further (Monteiro and Birkinshaw 2017). Thus, a key boundary spanning activity is transferring information and practices that are established in one knowledge domain to units where they are novel (e.g. Hargadon and Sutton 1997; Burt 2004; Uzzi et al. 2013). Managers with ties into several other units inside the firm can search more broadly for new knowledge and for users of that knowledge, which improves the odds of good matches. With only one or two internal boundary spanning ties, the manager will be less able to transfer the ideas to the units that will value them.

Lastly, knowledge exploration efforts often are met with resistance (March 1991; Groysberg and Lee 2009) if they are perceived to be counter to the firm's current strategy (Dougherty 1992). A key role of a boundary spanner is overcoming this resistance to transmit and interpret new ideas for use in other units (Tushman 1977; Tushman and Scanlan 1981b; Kaplan et al. 2017). Thus, not only does a manager require access to diverse information and resources for successful exploration, the manager also needs legitimacy as a boundary spanner (i.e., to be an "internal communication star" (Tushman and Scanlan 1981b)) to gain support for these exploration efforts. When a manager holds several boundary spanning ties inside the firm, he or she is more likely to be perceived as competent and legitimate, and thus more effective at knowledge exploration.

Together the costs associated with boundary spanning and the slower accrual of exploration benefits suggests that the relationship between internal boundary spanning and exploration is best conceptualized as curvilinear rather than simply linear. At low levels of boundary spanning, managers are subject to the costs of boundary spanning, but have not yet developed enough ties to judge the value of the ideas accessed, to match the ideas to other units and to gain the legitimacy necessary for others to be receptive to the ideas.⁴ As more boundary spanning ties are added, the benefits of boundary spanning accumulate, and the fixed costs are spread across these ties. At this point, the manager has enough ties to be able to judge ideas, match these and develop the necessary legitimacy required for knowledge exploration. In formal terms:

Hypothesis 1. The relationship between internal boundary spanning ties and knowledge exploration is curvilinear (u-shaped) such that increasing boundary spanning ties is associated with lower exploration until an inflection point at which increasing boundary spanning ties is associated with higher exploration.

External boundary spanning ties

In parallel to the research into internal boundary spanning, several studies have established that firms also benefit from boundary spanning externally when searching for new knowledge and ideas (Laursen and Salter 2006; Cummings and Kiesler 2005; Foss et al. 2013; Dahlander et al. 2016).

⁴ The argument above suggests that knowledge exploration would be greater at zero internal boundary spanning ties than at one boundary spanning tie. While at first this may seem counterintuitive, the argument is based on an assumption that the inputs to knowledge exploration include factors other than boundary spanning ties, such as knowledge management systems (Brivot 2011) or “specification sheets for products, memos regarding customers, organization charts, and spreadsheets that compute estimates for customers” (Schulz 2003:444). A manager with no internal boundary spanning ties could explore for knowledge by engaging with these inputs. When the manager builds a single boundary spanning tie, our theory suggests that the effort required to build that tie create an attention cost that distracts the manager from engaging with these inputs, and so the move from zero boundary spanning ties to one boundary spanning tie could actually be associated with lower exploration for new knowledge. However, our setting is that partners in the consulting firm that we study few had zero internal boundary spanning ties, which limits our ability to fully explore this issue.

Unlike internal ties, external boundary spanning ties span not only the firm boundary, but also different knowledge domains that represent sources of heterogeneity for exploration (Tushman 1977; Dougherty 1992). Accordingly, we expect that these ties will allow the manager to gain access to information and knowledge significantly different from that available within their own knowledge domain and within their own firm, facilitating the development of new knowledge.

External boundary spanning ties may be sources of diverse information, but it is not trivial to integrate such information (Aldrich and Herker 1977; Cummings and Kiesler 2007; Mors 2010; Murray 2010). They cross into other organizations where different languages and coding schemes exist (Allen and Cohen 1969; Argote and Ingram 2000; Dougherty 1992). Transferring the diverse information and knowledge accessed via these ties to others inside the firm may not be straightforward (Ter Wal et al. 2017). Tushman and co-authors (e.g. Tushman and Katz 1980; Tushman and Scanlan 1981b) established that one of the key roles of a boundary spanner is “obtaining information from outside units and disseminating this information to internal users” (Tushman and Scanlan 1981b: 292). To effectively explore for new knowledge, the boundary spanner must be “able to translate this [external] information into terms that are meaningful and useful to their more locally oriented colleagues.” (Tushman and Katz 1980: 1073).

Internal boundary spanning ties play an important role in the transmission and interpretation of the new knowledge accessed via external boundary spanning ties (Monteiro and Birkinshaw 2017). First, having internal ties increases awareness of the needs of internal units and aids the boundary spanner in matching the new knowledge to the internal unit that is most likely to value it. Second, connections inside the firm are useful for translating the information into terms and language understandable by others inside. Lastly, boundary spanners gain legitimacy through internal boundary spanning ties. Our arguments build on arguments by Tushman and Scanlan

(1981b: 84) that effective boundary spanners are both internal communication stars and strongly connected to external information areas. They argue that internal links define the difference between individuals who engage in “boundary spanning activity” in which managers gather information externally but fail to disseminate the information inside the organization, and “boundary spanning individuals” who are strongly linked internally and externally such that they both gather and transfer information from outside the firm into units inside the firm (Tushman and Scanlan 1981: 84). Hence, we expect that internal boundary spanning ties increase the positive effect of the external boundary spanning ties on knowledge exploration.

Like internal boundary spanning ties, there are also costs associated with building and maintaining external boundary spanning ties. These could include both fixed and marginal costs, such as developing a boundary spanning capability and also engaging in knowledge domain specific activities, such as attending industry events, meeting with prospective clients, or collaborating on joint projects. However, in contrast to internal boundary spanning ties, the benefits of external boundary spanning ties for knowledge exploration are likely to accrue more quickly. Because a single external boundary spanning tie connects the manager both to a different knowledge domain (i.e. industry sector) and a different organization, it provides access to more novel information than would an internal boundary spanning tie. Therefore, relatively fewer external boundary spanning ties should be needed to generate the requisite variety for exploration.

Although a single external boundary spanning tie can provide access to a variety of novel ideas, the ability to make relative comparisons of ideas could require more ties. In this case, managers with only one or two external boundary spanning ties would still be prone to errors in the selection of ideas from the environment because they could be less able to compare the strengths and weaknesses of the ideas accessed. However, because even one or two external

boundary spanning ties can provide several novel ideas and ideas of greater novelty, managers with only a couple external boundary spanning ties could still have multiple alternatives to consider and would be able to make relative comparisons of ideas. Thus, we anticipate that the ability to compare ideas begins at a much lower level of external boundary spanning ties than internal boundary spanning ties.

In summary, in contrast to the curvilinear relationship of internal boundary spanning ties and exploration, we expect that the relationship between external boundary spanning ties and exploration will be positive linear. However, to fully benefit from external boundary spanning ties, managers also need internal boundary spanning ties. Therefore, the effect of external boundary spanning ties increases with the number of internal boundary spanning ties held by the manager. In formal terms:

Hypothesis 2: Managers with more external boundary spanning ties have higher knowledge exploration.

Hypothesis 3: The positive relationship of a managers' external boundary spanning ties and their knowledge exploration is greater for managers with more internal boundary spanning ties.

BOUNDARY SPANNING IN A GLOBAL MANAGEMENT CONSULTING FIRM

The empirical context for the study was a large global consulting firm⁵. The firm employed more than 50,000 professionals and delivered a wide range of management consulting services across more than 100 countries. Our study focused on approximately 1,000 senior partners who owned

⁵ For further descriptions of the context and data collection process please see Mors (2010) and Rogan and Mors (2017).

and managed the firm. The senior partners of the firm were responsible for, evaluated on, and rewarded for their performance in selling projects and mobilizing the resources needed to implement them. Meeting revenue targets required each senior partner, on average, to generate nearly \$10 million per year in consulting revenues. As with any consulting firm, to stay competitive the firm continuously had to develop new knowledge and expertise that would improve and expand the client business. Therefore, a key activity for partners was the exploration for new knowledge and expertise.

Collecting survey data on boundary spanning relationships

To test our hypotheses, we used an egocentric network survey instrument; a commonly used methodology for mapping individual networks (e.g. Burt 1992, 2007; Rodan and Galunic 2004). The egocentric approach differs from roster approaches (e.g., Lazega 2001) that bounds the network of each individual to for example a firm or department. An egocentric survey is advantageous for our study, as we want to examine both the internal and external networks of the partners. This network questionnaire was based on the methodology originally used by Burt (e.g. 1997, 2000; for a more detailed discussion see 1992:121–125). The survey questions were customized to be relevant to the firm. Participants responded to a set of seven name generators; questions that help generate a list of the contacts in each participant's network. The name generator questions were developed in cooperation with the firm and included questions such as “Who are your most valuable contacts in terms of gaining new business (i.e. closing deals)?” or “On whom do you rely to sponsor and support your projects and activities?” The ties to contacts could have arisen through overlapping work activities in the formal hierarchy or could have come from activities outside out work. Partners were asked to focus only on ties to those contacts that were important for them to be successful in their work. Using the name generators, we generated the

contacts in each partner's network. The partners then answered a set of name interpreter questions regarding characteristics of the interaction with each contact in their network, for example "How often do you currently talk to each person?"

Five trained researchers administered the network surveys face-to face. To remain within budget, we selected senior partners at random from 10 major offices (San Francisco, Chicago, New York, London, Paris, Frankfurt, Milan, Madrid, Tokyo, and Sydney). The researchers scheduled meetings with 133 partners, and 102 surveys were completed, yielding a 71% response rate. Of the partners surveyed 92% were male with an average age of 44 and tenure in the firm of 16 years (s.d. of 5.1 years).

MEASUREMENT

Knowledge exploration

Performance data were collected via a separate survey administered to the supervising partners of the partners in the study. The supervising partners were responsible for partners' annual performance reviews. Data were collected via 30-minute telephone interviews, shortly after the actual annual reviews of the partners had been completed. The telephone interviews allowed for the raters to ask questions about the survey and hence ensured that they had a good understanding of the scale. They rated the partners' *knowledge exploration* on a five-point Likert scale, from "Much better at leveraging existing knowledge and expertise" (1) to "Much better at developing new knowledge and expertise" (5). Prior to collecting the data, we ensured that the questions accurately reflected those used in the actual evaluations in the firm. We also clarified that scores at the middle point of the scale indicated that the partners engaged equally in both exploration and exploitation and not that they were engaging in neither. We also conducted interviews prior to the survey data collection and here it was also confirmed that these partners are expected to perform

highly and contribute to the firm both in terms of exploration and exploitation. This further ensured that the supervising partners conducting the evaluations had a common and clear understanding of the question. It was also emphasized that new knowledge development referred to the development of fundamentally new knowledge with existing and new clients.

Performance data on 79 of the 102 partners surveyed were collected from 21 supervising partners shortly after the network surveys were completed, resulting in a final sample of 79 partners with 1,449 ties.⁶

Independent variables

Internal and external boundary spanning ties. Consistent with Geletkanycz and Hambrick (1997), we measure boundaries by industry specialization. Industry sector was the organizing unit in the firm and therefore our measure is also consistent with the conception in prior work of boundary spanning ties, which stated the importance of grounding the measure in the specific empirical context (Tushman 1977). The firm's five industry groups were the main sources of formal specialization and differentiation, both for assignment of responsibilities in the marketplace (for example, a partner in the financial services industry was expected to have banks and insurance companies as clients) and in terms of the internal organization structure (for example, partners in financial services reported to the same global supervising partners, were members of the same industry practice groups, and were evaluated and rewarded according to their ability to develop the firm's practice in that global industry group).⁷ We coded all ties in the partners network as internal or external and as within or outside of their industry sector to form

⁶ Scheduling conflicts and changes in partners' responsibilities impeded collection of performance data for 23 partners. To ensure that there were no systematic biases between the 102 senior partners on whom network data were collected and the 79 on whom performance data were collected, we tested differences in the mean value of the main independent variables. Levene's (1960) test revealed no significant differences.

⁷ The partners in this firm also had competency specializations, for example strategy or process. However, the specializations were used only to aid internal project staffing and were not considered the main organizing units.

four variables: *count of internal boundary spanning ties*, *count of internal within boundary ties*, *count of external boundary spanning ties* and *count of external within boundary ties*. Using the count of boundaries spanned is in line with other recent work on boundary spanning that has used a count measure to represent the number of knowledge domains or boundaries crossed (Taylor and Greve 2006; Fleming and Waguespack 2007).

Network control variables. The *size of the internal network* and *size of the external network* were included to control for the idea that a large network can provide more opportunities for discovering new business knowledge (Burt 1992, 2004). The strength of the ties may also affect the ability to access and transfer information (Hansen 1999). A commonly used measure of strength is the frequency of interaction (Reagans and Zuckerman 2001). *Frequency internal* and *frequency external* capture how often (on average) individual partners communicate with the contacts in their internal and external networks. Network density can affect exploration behavior (Lazer and Friedman 2007) so we also control for the *internal network density* and *external network density* using the measure proposed by Wasserman and Faust (1994). The measures were constructed as the number of strong ties among the contacts in each partner's internal and external networks respectively (t) divided by the total number of possible ties in the internal or external network (N) (i.e., $t/[N(N-2)]$).

Additional control variables

Financial performance. To control for the possibility that the supervisors' ratings of partners' knowledge exploration were measuring the partner's general performance rather than the partner's knowledge exploration, we included a measure of the partner's financial performance in all models. The performance survey included two items where the supervising partners rated the partners on their contributions to the firm's revenues and margins using a five point Likert scale

where 1) represented those partners that “operate below a sustained level” and 5) represented those partners that “operate at an exceptional level (is in the top 15% of their peer group in revenue generation)”. Financial performance was measured as the product of revenue generation and profit margins.⁸

Partner demographics. *Age* was included as a control because younger partners could be more oriented towards developing new knowledge, whereas older partners might be more biased towards exploitative activities (Wiersema and Bantel 1992). The controls also included the number of years the partner was with the firm before being promoted to partner (*years to partner*). The longer each partner has worked for the firm, the more familiar he or she is likely to become with organizational routines, leading to a potential bias against exploration. Controls for gender and education had no effect on knowledge exploration, so to preserve degrees of freedom, we excluded these variables from the final analyses.

Industry growth rate. We controlled for the average industry growth rate of the partner’s industry sector because partners working in a fast changing industry unit could be rated as relatively better at exploration. This measure was compiled from Value Line⁹ and is a composite measure based on the reported growth rate of each industry in the five years prior to the time of our study.

Count of boundaries spanned. A partner could have several boundary spanning ties but these ties could all be to the same industry sector. In this case, although the count of boundary spanning ties would be high, the diversity of knowledge domains to which the partner connects is

⁸ To ensure that our results do not suffer from common method bias because we include measures from the performance survey on both sides of the regression, we also estimated a model that did not include financial performance. The results are consistent with the main results presented in Table 2.

⁹ The source for these data is from the Value Line Database. The data were generously made available to us by Professor Aswath Damadoran at NYU (<http://pages.stern.nyu.edu/~adamodar/>).

low. To control for this, we constructed an alternative measure of boundary spanning using the count of different industry sectors to which the partner's ties connect (rather than the count of ties). This measure captures the diversity within each partner's set of boundary spanning ties. We use this measure in robustness checks reported below.

Model

We estimated ordinary least squares regressions (OLS) using robust standard errors clustered by rater (raters were the 21 supervising partners that evaluated the senior partners' performance) to control for interdependence among scores of partners evaluated by the same supervising partner, i.e. the fact that the data is nested within each rater, and also to correct for heteroskedasticity¹⁰. As described above, the dependent variable was measured on a Likert scale from 1 to 5. The use of an ordinal dependent variable can yield inefficient estimates in OLS regression (McCullagh 1980). We confirmed that the OLS results were robust to ordered probit and ordered logistic regressions. We report the OLS estimates because these do not differ significantly from the ologit and oprobit, and are easier to interpret.

RESULTS

Table 1 provides the descriptive statistics and correlations. Table 2 reports the OLS regression estimates on the dependent variable, knowledge exploration.

----- Insert Tables 1 and 2 about here -----

Model 1 in Table 2 reports the effects of the control variables. These results indicate that partners that were at the firm for a long time before being promoted to partner had lower knowledge

¹⁰ To control for the fact that the data are nested within the rating partners, we also estimated the models using robust standard errors and the results remain the same. We also estimated the models including a control for the average rating of each supervising partner and the results remain consistent.

exploration ($p=0.095$). A short time-to-partner typically indicates that the partner was an experienced hire. Experienced hires would have been less socialized into the firm's norms of behavior, and thus more likely to engage in exploration, consistent with March's (1991) arguments regarding enculturation. None of the network controls are significant in the first model¹¹.

The results for the tests of the hypotheses are presented in Models 2, 3 and 5 in Table 2. Hypothesis 1 is tested in Model 2, which includes the square term for internal boundary spanning ties. The square term is positive and significant ($p=0.021$). The main term for internal boundary spanning ties is negative and significant at the 10%-level ($p=0.102$). Including the square term significantly improves the fit of the model (F-test: 2.99, $p=0.0569$). Although the coefficients suggest a u-shaped curvilinear effect; according to Lind and Mehlum (2010), testing for a curvilinear effect requires that the beta is significant and of the correct sign, that the slope is sufficiently steep at both ends of data range, and that the turning point is well within the data range. We conducted the post-estimation 'utest' in Stata 14 developed by Lind and Mehlum based on Sasabuchi's test (1980) for a u-shaped effect.¹² As reported in line 1 in Table 3, the test of the u-shape for internal boundary spanning ties is supported with a t-value of 1.72 ($p=0.0508$), the downward slope is negative and significant ($p=0.051$) and the upward slope is positive and significant at the 1%-level ($p=0.004$). The turning point of 2.69 is also well within the data range. Figure 2 illustrates the curvilinear effect graphically. For partners with networks with fewer than three internal boundary spanning ties, the effect of an additional internal boundary spanning tie on knowledge exploration was negative. For example, an increase from zero to two internal boundary

¹¹ We find no significant effect for the measure of frequency of interaction. This could be because although it is a commonly used measure, it is an imperfect measure of the intensity of communication (Marsden and Campbell 2012).

¹² See also Fernhaber and Patel (2012) and Haans, Pieters, and He (2016) for further discussion of testing of curvilinear effects.

spanning ties (one standard deviation) is associated with an 11% decrease in knowledge exploration. In contrast, for partners with networks including more than three internal boundary spanning ties, the effect was positive. An increase from four to six ties (one standard deviation) is associated with a 13% increase in knowledge exploration. Hence, we can conclude there is support for a curvilinear effect of internal boundary spanning ties on knowledge exploration both in terms of statistical significance and magnitude of the effect.¹³

Model 3 in Table 2 introduces the count of internal boundary spanning ties and the count of external boundary spanning ties to test hypothesis 2. This model does not support hypothesis 2, which predicted a positive linear relationship between external boundary spanning ties and exploration ($p=0.693$).

----- Insert Table 3 about here -----

Model 5 in Table 2 reports the test of hypothesis 3, which predicted a positive interaction effect between the count of external boundary-spanning ties and the count of internal boundary-spanning ties. The co-efficient is positive and significant at the 5%-level ($p=0.011$) supporting hypothesis 3. Figure 3 illustrates the difference in the relationship of external boundary spanning ties and knowledge exploration when the partners have no internal boundary-spanning ties, the mean (1.82) level of internal boundary-spanning ties and one standard deviation above the mean (3.82) internal boundary-spanning ties. The graphs clearly show that the relationship between external boundary ties and knowledge exploration is increasingly positive as the number of internal boundary spanning ties in the network increases. When a partner has zero external boundary spanning ties, the change in effect size for internal boundary spanning ties is very small. For

¹³ In an additional robustness test of the u-shape effect, we ran a split sample test (Hansen 2000; Haans et al 2016). This effectively involves splitting the sample at above and below the turning point (2.69) and running the OLS on the split samples to test whether the results are significant on both sides of the turning point. The results are consistent and support the u-shape effect.

example, moving from the mean to one standard deviation above the mean in internal boundary spanning ties, knowledge exploration decreases by 2%. In contrast when the partner has two external boundary spanning ties, the moving from the mean to one standard deviation above the mean for internal boundary spanning ties increases knowledge exploration by 14%. At four external boundary spanning ties, the increase is 25%.

----- Insert Figures 2 and 3 about here -----

Robustness checks

We conducted several robustness checks of our results. In order to control for the fact that our measure could be capturing magnitude of performance (and not direction of effort), we included a measure of financial performance in all the models. This variable was not significant in any of the models. Thus our results can be interpreted as the effect of boundary spanning ties on exploration, holding partner financial performance to the mean.

Although we did not predict a curvilinear effect of external boundary spanning ties, our arguments for hypothesis 2 rest on the assumption that at low counts of external boundary spanning ties, partners can still access sufficient diversity and novelty of knowledge for knowledge exploration. However, it is possible that the same slow accrual of benefits that we argued for internal boundary spanning ties hold for external boundary spanning ties. Therefore, in model 4, we include a square-term for the count of external boundary spanning ties to further examine the relationship between external boundary spanning ties and exploration for new knowledge. Although the square-term was positive and significant ($p=0.074$), the main term was negative and insignificant ($p=0.229$). Furthermore, the ‘utest’ for curvilinear relationship was insignificant ($p=0.114$). The upward slope of the utest was significant at $p=0.017$ with an extreme point of 1.92. This suggests that there may be a lower threshold for the main effect of external boundary spanning

ties. In other words, managers may need two external boundary spanning ties before the ties generate sufficient diversity and novelty of knowledge to support knowledge exploration. However, unlike internal boundary spanning ties, we did not find a significant, negative effect of boundary spanning ties on knowledge exploration at low levels of ties. Further research is needed to investigate potential threshold effects of external boundary spanning on exploration.

Our main measures of boundary spanning were the counts of ties crossing boundaries. However, it is possible that a partner could have several boundary spanning ties but that these ties are all to the same industry sector. In this case, although the count would be high, the diversity of knowledge domains to which the partner connects is low. We constructed an alternative measure using only the count of different industry sectors to which the partner's ties connect (rather than the count of ties) to capture the diversity within each partner's set of boundary spanning ties.¹⁴ The results are reported in Table 2, Models 6 to 8. The results are consistent with those in the main models, suggesting support for our arguments that the diversity of knowledge accessed via the network is what matters for knowledge exploration.

To control for the fact that our measures of boundary spanning are skewed; we conducted a check where we transformed these variables by adding a constant of one and taking the natural logarithm to achieve a more normal distribution. Using the logged variables, we find consistent support for our hypotheses and for ease of interpretation, we therefore chose to stay with reporting the count variables.¹⁵

¹⁴ We also estimated models including a Blau index of industry diversity. The pattern of results was consistent with the main results. For ease of interpretation, we report the count measures of diversity in Table 2.

¹⁵ With the transformed variables, the significance levels improve for the test of hypothesis 1 (the p-value goes from 0.021 to 0.000 for the square term of internal boundary spanning ties and from 0.102 to 0.002 for the main term) and hypothesis 3 (the p-value of the interaction term goes from 0.011 to 0.001). Hypothesis 2 is still not supported.

Inspection of variance inflation factors did not show evidence of multi-collinearity among our variables. Nevertheless, we also estimated a model that includes only the significant control variables and the main independent variables. The results of this model are consistent with the main results reported in Table 2.

DISCUSSION

In this study, we developed and tested arguments for nuances in the benefits and costs of internal and external boundary spanning ties for exploration for new knowledge. We find that the relationship between boundary spanning and knowledge exploration is more complex than previously theorized. In fact, rather than a simple positive linear relationship between counts of boundary spanning ties and exploration, we find evidence consistent with both curvilinear effects for internal boundary spanning ties and interdependent effects of external and internal boundary spanning ties.

Hence, our findings offer several implications for research. In contexts in which sufficient heterogeneity exists such as within the firm we study, our study shows that managers' internal boundary spanning ties can be sufficient to support the identification of novel ideas needed for knowledge exploration. A partner that we interviewed explained: *"My experience is that cross naturalization from one sector to another is very important.... A good example of that was what I did in the banking sector.... The management techniques that we brought into that sector when I started were coming from the manufacturing industry."* This finding is consistent with recent research by Dahlander and colleagues (2016) into boundary spanning at IBM. Citing Gouldner (1957); they observed that individuals who were locals in that they searched for new ideas primarily inside the firm could still achieve significant innovation performance. Our study extends this prior work on internal boundary spanning (e.g. Tortoriello and Krackhardt 2010) and offers a

caveat. As we argue and show, the benefits of internal boundary spanning for knowledge exploration arise only once an individual has a sufficient number of boundary spanning ties.

By distinguishing internal and external boundary spanning ties, our study uncovers additional nuances of the relationship between boundary spanning and knowledge exploration. Although previous work has made this distinction (Geletkanycz and Hambrick 1997; Rosenkopf and Nerkar 2001; Stuart and Liu 2010), our analysis differs in that we show an important interdependence between internal and external boundary spanning at the level of the individual manager's network. In our analysis, the effectiveness of external boundary spanning ties for exploration increases with internal boundary spanning ties. This idea was also confirmed in the qualitative part of this study. As described by one partner we interviewed: “...*Internally you have your networks, who may help you to...succeed in the outside world.... Being aware of having both [internal and external] networks... helps you succeed....*” While this finding is consistent with early work on boundary spanning by Allen (1977), Tushman (1977) and Tushman and Scanlan (1981), it contrasts with other recent studies of boundary spanning. For example, whereas Dahlander et al. (2016) find that managers were most innovative as locals (i.e., internal search focus and attention) or as cosmopolitans (i.e. external search focus and attention) (Gouldner 1957), we find that managers that can play both roles achieve the highest exploration. One reason for this difference could be that, in our sample, no partner had more than six external boundary spanning ties, which may be too few to observe the attention costs to high levels of external boundary spanning observed in Dahlander et al.'s (2016) study. Future research is needed to better understand both the costs and benefits of boundary spanning for managers' knowledge exploration.

Our arguments and findings also complement prior work examining interdependencies in internal and external ties for innovation outcomes (Rosenkopf and Nerkar 2001; Mors 2010). For

example, whereas Mors (2010) identified the importance of the density of ties between internal and external contacts in a manager's network (i.e., indirect ties) for innovation performance, in this study we consider the impact of the manager's own ties that span the firm's internal and external boundaries (i.e., direct ties) on knowledge exploration. To be sure, crossing boundaries into different domains is central to the development of new knowledge, but attention, translation and political costs suggest that the relationship between boundary spanning and innovation is highly complex (Kaplan et al. 2017).

Limitations

Our study is subject to several limitations. First, an implication of the argument for an curvilinear effect of internal boundary spanning ties on knowledge exploration is that a manager with zero internal boundary spanning ties would have greater knowledge exploration than a manager with a single boundary spanning tie. However, this counterintuitive prediction is logical if one considers the full set of inputs to knowledge exploration by managers such as knowledge management systems or internal documents (Schulz 2003; Brivot 2011). Social relationships, while important, are far from the only factor that affects knowledge exploration. It is likely that efforts to build and maintain an initial boundary spanning tie distract attention from these other inputs but do not yet yield the benefits of boundary spanning. We are not able to observe managers use of these alternative inputs in the exploration process, but this represents a potential avenue for future research.

A second limitation of the study is the generalizability of the findings. Like prior work on boundary spanning and knowledge flows, we focus on a single firm (e.g. Hansen 1999; Haas 2006; Soda and Zaheer 2012; Kleinbaum et al. 2013). A single-firm study provides a detailed understanding of the setting and in turn allows us to develop a nuanced theory of boundary

spanning and its relationship with exploration (Flyvbjerg 2006). However, focusing on one firm can limit generalizability to other settings. Other formal contexts or innovating systems, such as manufacturing or high-tech firms, might have different formal boundaries defined by other important knowledge domains in the organization structure; for example, new product development and sales and marketing. Furthermore, it is likely that our arguments would not apply to small, specialized professional service firms (i.e., single office firms) (Malhotra and Morris 2009). The firm we studied is typical of most large professional service firms, and so our study findings would extend to similar firms in professional services.

Lastly, like other cross-sectional studies of networks, we cannot rule out reverse causality (e.g. Reinholt, Pedersen, and Foss 2011). Thus, we cannot claim that the boundary spanning ties caused partners' exploration, rather than that exploration shaped the formation of ties. However, qualitative evidence from the interviews suggests the direction of causality is in line with our arguments. In a representative quote from the interviews, a partner explained, *"I have a lot of extended relationships with people that I've come in contact with over the last 15 to 20 years – when we worked in teams and lived together. Then we disband but we've constantly stayed in touch with one another. We asked for help and we get help from one another."* As illustrated by the quote, the partners in our study actively built and maintained the relationships in their networks in order to benefit from these ties at a future time. Hence, the results of the regression analyses combined with the findings from the interview data suggest that the boundary spanning ties do affect partners' knowledge exploration.

Theoretical Contributions

By focusing on senior managers and their boundary spanning ties, this study contributes both to research into the micro-foundations of strategy (Felin and Foss 2005; Felin, Foss, and

Ployhardt 2015) and recent work advancing a processual view of the professions (Liu, 2018). Both views emphasize how individual manager's purposive actions shape the strategy of their organization, as in the micro-foundations view, and also the professional jurisdiction itself. Related research has begun to focus on how the boundary spanning networks of managers affect firms' innovation performance (Dahlander et al. 2016) or how partners in professional services firms can utilize their networks for performance (Lazega 2001; Briscoe and von Nordenflycht 2014). Our study contributes to this stream of research by providing further insight into how senior managers utilize their boundary spanning ties to explore for new knowledge. As we have argued and shown, managers' boundary spanning ties are significantly related to their knowledge exploration, but in more complex ways than previously thought. Future research should consider the potential for non-linearity in relationships between managerial actions and performance outcomes.

Second, with this study we have answered the call for closer study of boundary spanning via individual managers' networks within organizations (Kleinbaum and Tushman 2007). In contrast to research that favors external sourcing of ideas for firm innovation (e.g. Dahlander and Gann 2010), we have considered the effects of senior managers' external and internal boundary spanning for knowledge exploration. Our study suggests that managers' internal networks play two key roles in exploration for new knowledge: they provide a source of novel ideas despite being inside the firm and a means to transmit the ideas accessed via external ties to other units inside the firm. Relatedly, our study also adds to recent work on organization design, which shows that the interplay between informal relationships and formal organization boundaries has important implications for firm performance (e.g. Karim and Mitchell 2004; Gulati and Puranam 2009; Karim and Kaul 2015; Rogan and Mors 2017).

Finally, our study makes a contribution to the literature on boundary spanning (e.g. Tushman 1977; Tushman and Scanlan 1981a; 1981b; Dahlander et al. 2016). Despite its central role in early research, boundary spanning by individual managers has suffered from a relative lack of scholarly attention. Our study joins a stream of recent research that builds on foundational boundary spanning arguments to investigate how the individual networks of managers affect exploration (e.g. Taylor and Greve 2006; Kleinbaum and Tushman 2007; Dahlander et al. 2016). As such, our research highlights a central tension in many firms, including professional services (Fu et al. 2016). As noted by Liu (2018: 54), “...As soon as boundary processes start to create social structures, these structures also begin to exercise constraints on individual action.” Hence, in most firms, managers work only within their specialized knowledge domain, and formal organization structures reinforce this tendency (Gulati and Puranam 2009; Karim and Kaul 2015). Indeed, related research (Rogan and Mors 2017) has shown that managers with networks of individual, informal ties rather than only firm, formal ties are better at developing new business for the firm. In the current study, we study a distinct but related outcome; knowledge exploration, and investigate the nuances in crossing knowledge domains on exploration.

Practical Implications

Our work has several practical implications. The results of our study indicate that the relationship between spanning boundaries and knowledge exploration is not a simple linear one. It is one that involves both costs and benefits that are incurred at different rates, and is marked by interdependency. It takes time before managers gain the benefits of crossing into different knowledge domains and hence they need to allow for a period of learning. Moreover, there are initial investments (i.e., fixed costs) in developing boundary spanning relationships. Our findings also imply that a fruitful avenue for developing an individual-level boundary spanning capability

is to encourage managers to develop internal and external boundary spanning ties concurrently because they only gain the full benefits from external boundary spanning ties if they also have internal boundary spanning ties. By showing the complexities of boundary spanning, our study may provide insight into why few firms are effective at spanning boundaries, despite the fact that it is well established that innovation and exploration outcomes require recombination from different knowledge domains (e.g., Rosenkopf and Nerkar 2001; Taylor and Greve 2006; Kaplan et al. 2017). Our study also highlighted the importance of interactions that cut across formal structures for exploration. Given the criticality of knowledge exploration for the performance and survival of professional service firms, a practical implication is that these firms must allow managers to seek knowledge outside their own knowledge domains, despite the lack of alignment with the firm's formal organizational boundaries.

CONCLUSION

In this paper we set out to gain a better understanding of how managers in a professional service firm most effectively utilize their boundary spanning ties across knowledge domains for exploration. The results of our study revealed that the effects of boundary spanning on exploration are more complex than previously theorized. Recognizing that costs exist for building and maintaining boundary spanning ties, we developed arguments for a curvilinear (U-shaped) effect of internal boundary spanning ties on knowledge exploration. Furthermore, we distinguished between internal and external ties across knowledge domains and presented arguments for why managers benefit more from their external boundary spanning ties when also maintaining internal boundary spanning ties. Our analysis of the networks of senior partners in a large consulting firm provides evidence of a curvilinear effect of internal boundary spanning ties on knowledge exploration and a significant interaction effect of internal and external boundary spanning ties for

exploration. Future research that recognizes the complexity of the relationship between boundary spanning and knowledge exploration is needed.

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Table 1. Descriptive statistics and pairwise correlations (N=79)

	Mean	Std.	Min.	Max.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Knowledge exploration	2.97	0.92	1	5	1.0													
2. Financial performance	12.94	6.38	1	25	.09	1.0												
3. Age	43.72	4.45	37	55	-.04	-.13	1.0											
4. Years to partner	9.61	3.58	0	15	-.17	-.02	-.30*	1.0										
5. Industry growth rate	0.07	0.03	0.03	0.11	.24*	-.07	-.01	-.07	1.0									
6. Frequency internal	2.97	0.43	2	4	-.12	.14	-.05	-.07	.15	1.0								
7. Frequency external	2.39	0.62	1	4	-.05	-.01	-.18	-.10	-.08	.01	1.0							
8. Internal density	0.27	0.16	0.02	0.68	.06	-.00	.13	.04	.18	.41*	-.02	1.0						
9. External density	0.22	0.26	0	1	-.12	.13	-.11	.17	-.02	.04	.22*	-.02	1.0					
10. Ct. internal within-boundary ties	11.14	3.55	4	19	-.03	-.05	-.13	.05	-.06	-.41*	-.06	-.35*	.10	1.0				
11. Ct. external within-boundary ties	5.90	2.77	0	12	-.08	-.04	.07	.19	-.13	.13	-.17	.26*	-.05	-.23*	1.0			
12. Ct. internal boundary-span. ties	1.82	2.00	0	9	.11	-.05	.16	-.07	-.09	-.36*	-.05	-.28*	.19	.03	-.16	1.0		
13. Ct. external boundary-span. ties	0.54	1.20	0	6	.12	-.10	.17	-.16	.18	.08	-.16	.06	-.15	-.14	.12	.08	1.0	
14. Ct. internal boundaries spanned	1.01	0.97	0	4	.09	.06	.01	.07	-.05	-.18	-.12	-.14	.08	.01	-.17	.71*	.24*	1.0
15. Ct. external boundaries spanned	0.35	0.77	0	4	.09	-.07	.17	-.11	.12	.20*	-.21*	.21*	-.11	-.22*	.12	.05	.75*	.24*

*correlation significant at $p < 0.05$

Table 2. OLS regression of boundary spanning and knowledge exploration^a

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	5.46 (2.08) •	5.95 (2.10) ••	5.55 (1.97) ••	5.22 (2.05) •	5.97 (1.90) ••	5.76 (1.98) ••	4.86 (2.25) •	5.48 (1.78)••
Financial performance	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.01 (0.02)	0.02 (0.02)	0.02 (0.02)
Age	-0.03 (0.02)	-0.04 (0.03)	-0.03 (0.02)	-0.03 (0.02)	-0.03 (0.02)	-0.03 (0.02)	-0.02 (0.02)	-0.02 (0.02)
Years to partner	-0.05 (0.03) †	-0.04 (0.03)	-0.05 (0.03)	-0.05 (0.03) †	-0.07 (0.03) •	-0.06 (0.04)	-0.05 (0.03)	-0.07 (0.03) •
Industry growth rate	7.40 (5.60)	8.54 (5.22)	7.29 (5.90)	7.81 (5.86)	9.21 (6.14)	7.81 (5.14)	7.85 (6.07)	8.81 (5.59)
Size internal network	-0.00 (0.04)					0.00 (0.04)	0.01 (0.04)	0.00 (0.03)
Size external network	-0.01 (0.03)					-0.00 (0.03)	-0.02 (0.04)	-0.03 (0.03)
Frequency internal	-0.52 (0.37)	-0.70 (0.37) †	-0.49 (0.38)	-0.41 (0.38)	-0.50 (0.34)	-0.62 (0.37) †	-0.41 (0.40)	-0.52 (0.35)
Frequency external	-0.08 (0.17)	0.03 (0.20)	-0.05 (0.17)	-0.10 (0.18)	-0.11 (0.17)	0.08 (0.20)	-0.06 (0.18)	-0.08 (0.18)
Internal density	0.85 (0.92)	1.01 (0.92)	0.89 (0.97)	1.02 (0.91)	0.65 (0.88)	0.95 (0.90)	0.96 (0.94)	0.66 (0.78)
External density	-0.33 (0.31)	-0.45 (0.30)	-0.39 (0.28)	-0.43 (0.27)	-0.24 (0.28)	-0.40 (0.31)	-0.45 (0.28)	-0.20 (0.27)
Ct int within-boundary ties		-0.00 (0.03)	-0.01 (0.03)	-0.01 (0.04)	-0.02 (0.03)			
Ct ext within-boundary ties		0.07 (0.11)	-0.01 (0.03)	-0.01 (0.03)	-0.02 (0.03)			
Ct int boundary-span ties		-0.25 (0.14) †	0.06 (0.06)	-0.07 (0.06)	-0.02 (0.06)			
H1: (Ct int boundary-span ties) ²		0.05 (0.02) •						
H2: Ct ext boundary-span ties		0.07 (0.11)	0.04 (0.11)	-0.31 (0.25)	-0.24 (0.15)			
(Ct ext boundary-span ties) ²				0.08 (0.04) †				
H3: Ct int*ct ext boundary-spanning ties					0.13 (0.05) •			
Ct int boundaries spanned						-0.51 (0.28) †	0.09 (0.15)	-0.16 (0.15)
(Ct int boundaries span) ²						0.20 (0.08) •		
Ct ext boundaries spanned						0.05 (0.21)	-0.33 (0.41)	-0.50 (0.30) †
(Ct ext boundaries span) ²							0.13 (0.09)	
Ct. int*ct. ext boundaries spanned								0.42 (0.13) ••

R-squared	0.16	0.24	0.18	0.20	0.23	0.22	0.18	0.25
Fit	4.71**	4.64***	4.21**	17.34***	6.52***	4.84***	8.09***	13.70***

^aOrdinary least square regression. Dependent variable is knowledge exploration. Robust standard errors adjusted for clustering on rater number. N = 79. †p < .10, *p < .05, **p < .01, ***p < .001 (two-tailed test for variable coefficients).

Table 3. Test of the U-shaped effects of boundary spanning on knowledge exploration^a

Variable	Slope		Extreme point	Overall presence of u-shape (t-test)
	Downward	Upward		
(Ct. int. boundary spanning ties) ²	-0.247*	0.579**	2.69	1.72 (p=0.0508)
(Ct. int. boundaries spanned) ²	-0.515*	1.04**	1.32	1.85 (p=0.0397)
(Ct. ext. boundary spanning ties) ²	-0.314	0.829*	1.92	1.24 (p=0.114)
(Ct. ext. boundaries spanned) ²	-0.339	0.690*	1.32	0.83 (p=0.207)

*p<0.05, **p<0.01

^aThe test of the u-shape was conducted using *u-test* in Stata14 as developed by Lind and Mehlum in 2007 (see also Lind and Mehlum, 2010) and recommended by Haans et al. (2016).

Figure 1. Internal and external boundary spanning ties.

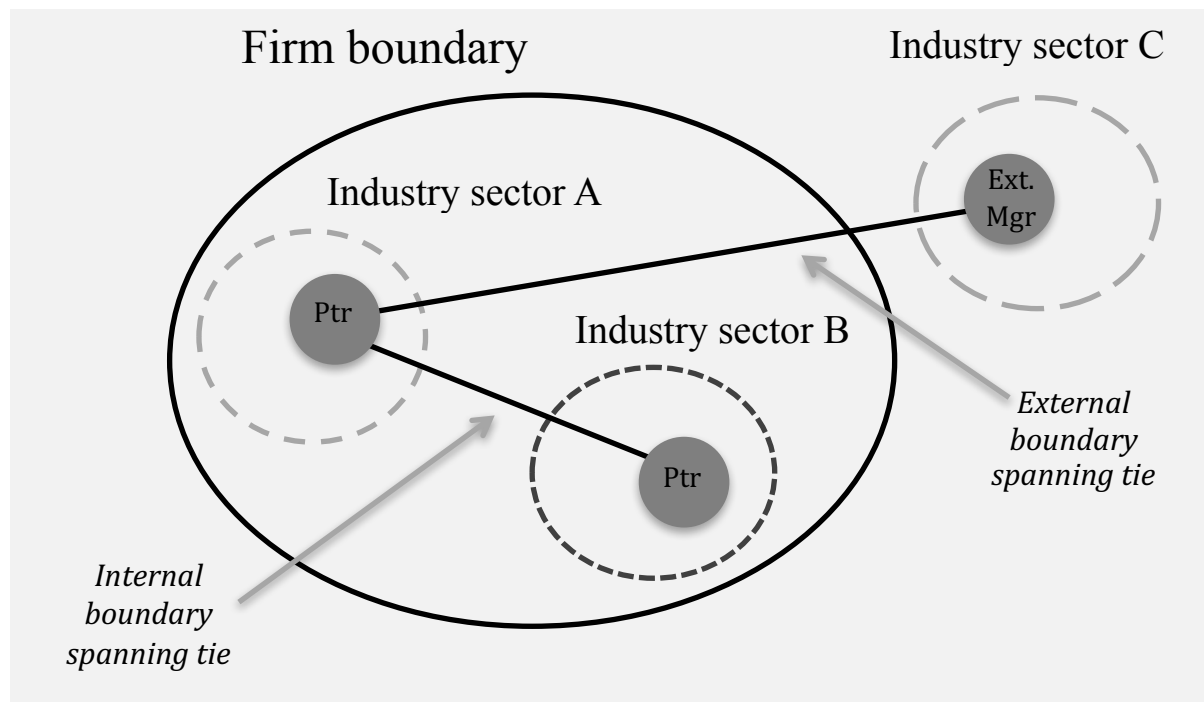
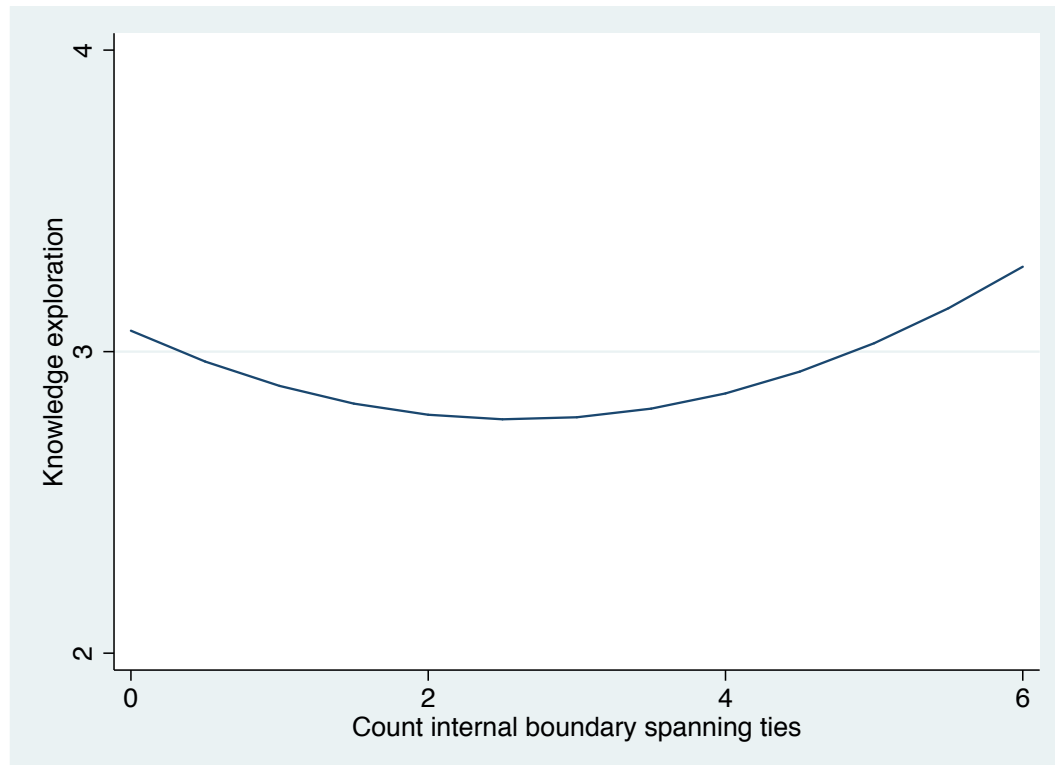
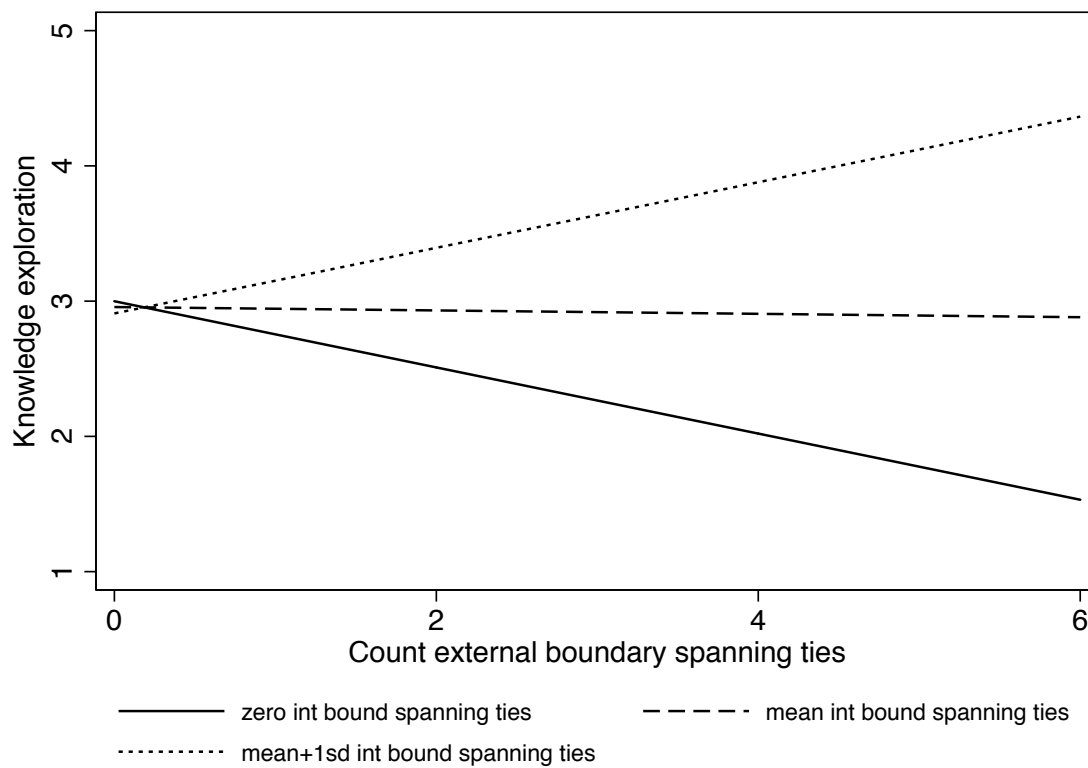


Figure 2. Internal boundary spanning ties and knowledge exploration^a



^aThe graph is based on the coefficients in Model 2, Table 2. The variables are valued at their means, except for internal boundary spanning ties (indicated on the x-axis). The dependent variable (on the y-axis) is knowledge exploration.

Figure 3. Interaction between internal and external boundary spanning ties and knowledge exploration^c



^cThe graphs are a plot of the marginal effects of the results in Model 5, Table 2. The variables are valued at their mean, except for external boundary spanning ties (indicated on the x-axis) and internal boundary spanning ties, which are set at zero, the mean (1.82) and 1 standard deviation above the mean (3.82). The dependent variable (indicated on the y-axis) is knowledge exploration.