

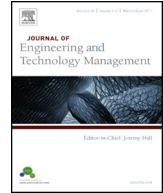


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Bridging firm-internal boundaries for innovation: Directed communication orientation and brokering roles



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ABSTRACT

Knowledge flowing across firm-internal (unit) boundaries is an essential contribution to an organization's innovative performance. Knowledge, unfortunately, does not cross firm-internal boundaries as a matter of course. The different contacts an individual maintains in a firm's instrumental-formal and expressive-informal networks defines their personal communication profile – a profile that may or may not match their formal position within the firm. Through the contacts individuals maintain, they can entertain five different communication roles as they transfer knowledge within their firm; either internal to their own unit or brokering to other units. From among the five different roles, two are (unit) internally oriented and three are oriented toward others outside the unit, crossing firm-internal boundaries. We find that individuals who in their formal (but not in their informal) contacts are predominantly externally oriented will particularly contribute to innovative activity within the firm. Detailed case analysis of knowledge flows at a large European electronics and engineering multinational, provides evidence that certain combination of roles are more likely than others to be successful at bridging firm-internal boundaries as basis for innovative knowledge transfer, allowing individuals who combine these roles to play a special role in stimulating innovation.

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Introduction

Innovation results from the combination and recombination of existing and newly developed knowledge (Schumpeter, 1942; Fleming, 2001). Having the knowledge that is available within a firm accessible at a moment's notice to the right people thus ensures that a firm can be innovative, allowing it to respond quickly to the highly dynamic environments it operates in (Volberda, 1996). Even as firms are urged to more readily allow innovative knowledge to cross firm boundaries, innovative knowledge may not easily move to where it can be used in the firm, however (Cross and Cummings, 2004; Aalbers et al., 2013). A firm that can improve the diffusion of knowledge internally will benefit from enhanced innovative activity (cf. Paruchuri, 2010; Whelan et al., 2011). However, at the same time, research has particularly pointed to knowledge as one of the most difficult resource to manage at an organizational level (Szulanski, 1996). Reflecting on the governance of knowledge sharing in organizations, Foss et al. (2010) suggest that knowledge may *come to be* sticky and difficult to transfer because of ingroup–outgroup dynamics. These ingroup–outgroup dynamics can create a reluctance to share knowledge with individuals from other units. While stickiness of knowledge is related to the social embeddedness of those who might partake in knowledge transfer, how knowledge exactly crosses firm-internal boundaries has not been the subject of much scholarly attention.

Exploring knowledge transfer at a major subsidiary of an electrical engineering multinational headquartered in Europe, we study antecedents of individuals' position in the instrumental-formal and expressive-informal networks that determine if and how knowledge flows across unit boundaries. We consider the consequences of these network antecedents in terms of their impact on a firm's internal innovative activity. Studying network antecedents at the individual level, our objective is to answer the question: *How does the orientation of individuals with regard to knowledge transfer, through their instrumental-formal and the expressive-informal networks, affect their innovative activity within the firm?* Contacts employees maintain in a firm's instrumental-formal network and the expressive-informal network are antecedents, we suggest, for the transfer of innovative knowledge (Aalbers et al., 2014). Responding to recent calls for further research, we argue that close attention must be paid to the *exact* direction knowledge flows into when understanding innovative activity within a firm (Shi et al., 2009; Boari and Riboldazzi, 2014). We submit that not only *if* firm-internal unit boundaries are crossed, but particularly *how* this crossing takes place is of managerial and scholarly importance.

Our findings show that individuals who have a more external orientation, in the sense of initiating communication across firm-internal boundaries with others in other business units, will also be more likely to contribute to innovative activity within the firm. By including the different contacts an individual maintains in both the instrumental-formal and the expressive-informal networks in our analysis we shed light on how these conceptually distinct networks congrue (Aalbers et al., 2014; McEvily et al., 2014; Henttonen, 2010). Our study thereby contributes to an integrated theoretical understanding of organizational functioning, conceiving an organization as a combination of *both* formal and informal social structures, instead of studying either structure in isolation.

Our paper is organized in a classical manner. We first present and elaborate on relevant literature in the Theory section. The next section provides the details on the methodology, followed by the results. The preultimate section discusses managerial implications, while the last section concludes.

Theory

Transfer of knowledge within the organization to stimulate innovation and gain competitive advantage has attracted a fair share of attention in the literature (Moorman and Miner, 1998; Hansen, 1999). Studies show that effective transfer of knowledge between employees within an organization indeed increases the creativity and innovative activity within the firm (Tushman, 1977; Ghoshal and Bartlett, 1988; Amabile et al., 1996; Moorman and Miner, 1998; Kanter, 1983; Hargadon, 1998; Perry-Smith and Shalley, 2003; Aalbers et al., 2013). Transfer of innovative knowledge is not self-evident, however (Cross et al., 2002; Cohen and Levinthal, 1990; Szulanski, 2003; Ballinger et al., 2011; Aalbers et al., 2014). Knowledge can be organizationally sticky (Von Hippel, 1994; Szulanski, 1996). Simply attempting to stimulate transfer of knowledge, especially that of the innovative kind, is unlikely to be easy, especially across organizational boundaries inside of the firm (Szulanski, 1996). Rather than the

Open Innovation literature that looks at knowledge crossing firm boundaries, this paper thus seeks to better understand the social mechanisms for exchange of innovative knowledge within a firm, in particular when such knowledge crosses unit boundaries.

Knowledge across unit boundaries: direction of knowledge flows

Research on innovation activity within the organization has primarily focused on brokerage and bridging ties. Tushman and colleagues (c.f. Tushman, 1977; Tushman and Katz, 1980; Tushman and Scanlan, 1981a; Kleinbaum and Tushman, 2007) mention the necessity of boundary spanners in the innovation process, receiving knowledge from the outside and disseminating it inside a unit or in some instances even concurrently mediating knowledge flows into several directions (c.f. Tushman, 1977). Individuals occupying boundary roles within the firm provide an important information processing mechanism within the innovation process of an organization, and are (considered) more competent (Tushman, 1977; Tushman and Scanlan, 1981a). Kahn et al. (1964) were one of the first to emphasize the importance of “boundary positions” within an organization, referring to the maintenance of in-depth contacts of an employee with employees from other organizational units, or even outside the company. Early research on boundary spanning already found that internal communication stars were strongly connected to a firm’s external environment, taking advantage of ideas entering from outside, enabling them to solve problems inside their own unit (c.f. Tushman, 1977; Tushman and Scanlan, 1981a,b).

Internal versus external orientation

The focus of much research on knowledge flow inside a firm has been on individuals irrespective of their position in the organization, in effect often ignoring firm-internal unit boundaries as possible hurdles for knowledge to be transferred (Hansen, 1999; Cross et al., 2002). Acknowledging unit boundaries, indicates that some may be involved with knowledge transfer that crosses unit boundaries more than others. In the multiple networks that constitute a firm, an individual employee may be relatively more internally orientated in one network while being relatively more externally oriented in another (Henttonen, 2010). There are, importantly, different ways in which an individual unit member can be internally or externally oriented. Individuals in a firm may either mostly *receive* or *send out* information across unit boundaries. Only sending or only receiving knowledge across unit boundaries is likely to be sub-optimal and unsustainable in the longer term: there needs to be *give* as well as *take* in social relationships (Ensign, 2009; Dolfsma et al., 2009). Thus, the direction in which knowledge flows is important. The concept of the network role(s) that an individual maintains is useful to capture this notion (Gould and Fernandez, 1989; Whelan et al., 2011). Over the past decades several authors have categorized network roles by referring to an individuals’ membership of a social groups. Merton (1968) for instance distinguished between the ‘local’ and the ‘cosmopolitan’. The local is mainly oriented toward his direct social environment, promoting social integration, while the cosmopolitan is more interested in the world outside his own community, stimulating social differentiation (Taube, 2003). In an organizational setting, Allen (1971) focused on the technology gatekeeper. Boundary spanners acquire, translate, and disseminate external resources within the organization (Tushman, 1977; Whelan et al., 2011). Individuals who carry out boundary spanning responsibilities gain status and influence through access to unique knowledge, but also experience significant role overload as a result of facing simultaneous and often conflicting pressures (Kahn et al., 1964; Katz and Kahn, 1978; Marrone et al., 2007). What holds for firm boundaries, will hold for unit boundaries within a firm too, especially in large firms.

Brokerage research has largely been phrased in terms of benefits to accrue from what is referred to as structural holes (Burt, 2004). Research on brokerage as an antecedent of knowledge transfer has been restricted to a particular kind of broker: the gatekeeper (Tushman, 1977; Tushman and Katz, 1980; Uzzi and Spiro, 2005; Zaheer and Soda, 2009). A gatekeeper conveys knowledge linking its own group and another group of actors, from which it receives knowledge (Tushman and Katz, 1980; Boari and Riboldazzi, 2014). Therefore, conditions for diverse knowledge drawn from different sources

within the firm, separated by (unit) boundaries, to stimulate innovation remain ill-understood (cf. Tortoriello and Krackhardt, 2010; Whelan et al., 2011). Research on knowledge transfer has almost exclusively focused on individuals either coordinating internally or individuals spreading what knowledge and information they have received from outside of their unit. Individuals who, themselves, take the initiative to send knowledge across the boundaries of their own unit to individuals in other units have not been studied. What is more, the direction into which knowledge flows is ignored. This lack of scholarly understanding restricts one's understanding of the conditions for particular network antecedents to stimulate organization performance (Balkundi et al., 2007; Varella et al., 2012).

An individual's communication orientation – internal or external – will affect his contribution to innovative activity. We pose that individuals who are largely externally oriented, initiating knowledge across firm-internal boundaries to others in other business units, are more likely to provide an innovative contribution to the firm. Our core theoretical argument for this claim draws on theories of agency and network theory.

Agency theory suggests that a broker establishes or maintains relations depending on the benefits derived from one's brokering position (Ahuja et al., 2012). An individual can either reduce his own dependency on others or alternatively can increase dependence of others on him (Gulati et al., 2012). Agency arguments make brokerage an important concept to understand organization network dynamics (Ahuja et al., 2012). Individuals who have an external orientation are more aware of existing knowledge sources within an organization that resides outside their own unit. In contrast to internally oriented individuals, those who initiate boundary spanning responsibilities gain status and influence through access to unique knowledge (Marrone et al., 2007). Network theory suggests that particular network structures yield particular outcomes for individuals and groups (Borgatti and Halgin, 2011). Having the proper people who need to work closely together brought into a single unit, for instance, enhances performance because knowledge flows within a firm more readily between individuals in the same unit. Network theory nonetheless has tended to ignore an important creation of management: unit boundaries.

Surely, knowledge transfer, or the movement of useful knowledge or information between individuals, can, depending on the purpose of the exchange, take place both within and between business units (Appleyard, 1996; Cummings, 2004). However, within a unit, specialized knowledge can more easily develop (Tushman and Scanlan, 1981a; Tsai, 2001). As a result of such clustering of expertise inside a business unit, one would expect most exchanges to take place within unit boundaries, facilitated by proximity as well as common procedures and practices (Leenders et al., 2003). Schumpeter has argued, however, that combining existing knowledge into novel combinations creates innovations. One would expect the development of products and services that offer novel solutions for customers to rely strongly on existing knowledge sourced from different business units. In this way knowledge that crosses unit boundaries contributes to the development of new ideas for products and services, and to innovation in general (Tsai, 2001; Whelan et al., 2011).

Knowledge crossing unit boundaries shows up, in terms of Fig. 1, in the form of boundary spanning roles (cf. Tushman, 1977). Brokers, initiating knowledge transfer from their unit across unit boundaries within a firm to other units, secure access to outside information and are more open to innovation-related activities (e.g., Whelan et al., 2011). These individuals actively engage with individuals and the knowledge that they have about other units. They realize what knowledge other units develop and are in a good position to determine if such knowledge is relevant to themselves and their own unit, as well as generally for the firm. An individual who is externally oriented thus has greater potential to contribute to the innovative capacity of the organization (Perry-Smith and Shalley, 2003). Being known to contribute knowledge to individuals from other units provides reputational benefits. Someone who initiates knowledge to flow from his unit to other units can call upon recipients to return the favor when required, at some point in time in the future (Ensign, 2009; Dolfsma et al., 2009). Having access to knowledge not available in one's own unit makes externally oriented individuals more important compared to internally oriented ones in the earlier phases of the innovation trajectory (Hargadon, 2002; Whelan et al., 2011).






Brokerage role		Description	
Coordinator		Internal orientation	<ul style="list-style-type: none"> The employee that brings two previously unconnected colleagues from his own unit in contact with each other Emphasis is on knowledge dispersion within the own unit
Gatekeeper		Internal orientation	<ul style="list-style-type: none"> The employee that screens and collects knowledge from outside his own unit to disperse this to colleagues within his own unit Emphasis is on knowledge dispersion within the own unit
Representative		External orientation	<ul style="list-style-type: none"> The employee that transfers knowledge received from colleagues from within his own unit to colleagues in another unit than his own, representing his own unit to the outside Emphasis is on knowledge dispersion outside of the own unit
Consultant		External orientation	<ul style="list-style-type: none"> The employee that transfers knowledge between colleagues who both belong to the same unit, which is not the unit of the broker himself Emphasis is on knowledge dispersion outside of the own unit
Liaison		External orientation	<ul style="list-style-type: none"> The employee that acts in a triadic relationship where none of the employees connected belongs to the same unit. Emphasis is on knowledge dispersion outside of the own unit

Fig. 1. Communication roles. Note: Adapted from Gould and Fernandez (1989). Dots indicate individuals, circles indicate business units, and arrows indicate the flow of information and resources between individuals.

Instrumental-formal and expressive-informal communication patterns (networks)

Intra-organizational communication may occur through instrumental-formal as well as expressive-informal relations. Different network structures and positions have been found to constitute different advantages or constraints for the actors embedded in them (Burt, 1992; Ahuja et al., 2012). While boundary roles have received attention in the organization and innovation literatures, there is no acknowledgment that the contribution of individuals in such roles might differ between formal and informal networks (Tushman, 1977, p. 602). Organization studies mainly focus on formal contacts, for instance in an R&D laboratory, or are conceptual in nature (Tushman and Katz, 1980; Tushman and Scanlan, 1981a; Kleinbaum and Tushman, 2007). Individuals can, however, simultaneously, have communication roles in an organization's instrumental-formal network as well as its expressive-informal network (Henttonen, 2010; Aalbers et al., 2013).

Instrumental-formal network ties arise in the course of work-role performance and involve the exchange of job-related resources and information. Expressive-informal ties primarily provide social support and focus on the exchange of identity-related resources (Fombrun, 1982; Tichy et al., 1979; Krackhardt, 1990; Ibarra, 1993; Oh et al., 2004; Varella et al., 2012). An instrumental-formal network can hence be defined as the pattern of task related connections among employees who exchange resources, information, advice, and support that help individuals in carrying out their organizational duties (Ibarra, 1993; Flap and Volker, 2001; Varella et al., 2012; McEvily et al., 2014). Strongly task-oriented in nature, instrumental relations may go beyond the organization chart and can include temporary collaborative structures through which employees carry out their daily tasks (Balkundi and Harrison, 2006; Ibarra, 1993; Lincoln and Miller, 1979; Varella et al., 2012). Whether more temporary or more permanent in nature, instrumental-formal relations allow individuals to act legitimately

toward others and request information and resources based on an employee's specific formal function or role (Simon, 1976).

In contrast to instrumental-formal networks, informal-expressive networks involve relationships based on voluntary interaction and are heavily affective or expressive in nature (Oh et al., 2004; Varella et al., 2012). With the exchange of identity-related resources as a focal point, unlike formal-instrumental networks that are more closely dependent on organizational structures, informal expressive networks can exist independently from organizational structures. Compared to the instrumental-formal network that is highly geared to the exchange of workflow related content, expressive-informal ties offer a higher degree of flexibility, providing the possibility to help one to quickly adapt to changing organizational circumstances and to tap into unconventional and new knowledge sources (Aalbers et al., 2014; Henttonen, 2010; Kratzer et al., 2008). Knowledge may transfer relatively quickly in the informal network (Cross et al., 2002), flowing both vertically and horizontally, which contributes positively to the overall flexibility of the organization (Cross and Cummings, 2004; Aalbers et al., 2016). Hansen (2002) argues that informal networks allow units to tap into knowledge available outside one's own organizational unit more easily.

The informal network may, however, lack accountability and transparency (Cross et al., 2002), and can turn into an "old boys-network". It is not obvious that the correct information and the appropriate resource can be located using the informal network. In addition, given the voluntary nature of contacts in the informal network and even if available and located, information and resources may not be shared. Such potentially negative aspects of exchange in informal networks are not broadly acknowledged in the literature (Fleming et al., 2007; Hansen, 1999; Tortoriello and Krackhardt, 2010; McEvily et al., 2014).

Due to the largely voluntary nature of exchange in the informal network we suggest that the contribution of externally oriented roles in the instrumental-formal network is higher than in the informal network. When exchange of knowledge or information across unit boundaries does not come naturally or is in conflict with individual interests, it may simply not occur (cf. Von Hippel, 1994; Whelan et al., 2011). Task requirements, information needs and knowledge domains differ between units, giving rise to potential confusion (Tushman, 1977; Tushman and Katz, 1980; Tushman and Scanlan, 1981b; Whelan et al., 2011). Lack of a common language and shared meaning can emerge in case of boundary crossing, which is detrimental to knowledge transfer. Trust between individuals from different units is likely to be lower. In case of instrument-formal contacts, information and resources can be demanded, and interaction can be required, but this is not true for informal contacts (Dougherty, 1992; Tortoriello and Krackhardt, 2010).

The organization network literature has largely ignored the formal organizational structures and contacts in a firm (cf. Henttonen, 2010; Aalbers et al., 2014; McEvily et al., 2014). Firms, however, have two related and possibly complementary routes by which to transfer knowledge: the instrumental-formal network and the expressive-informal network. These two networks can both offer organizational antecedents for the transfer of new, innovative knowledge across boundaries inside the firm, but their contribution is likely to be stronger for the instrumental-formal network. This leads us to propose the following:

Hypothesis 1. Individuals who in their instrumental-formal contacts are predominantly externally oriented will particularly contribute to innovative activity within the firm, in comparison to those with a similar orientation in their expressive-informal contacts.

Brokerage occurs when one actor serves as a bridge between two other actors who otherwise lack a direct connection to one another (Spiro et al., 2013). Between any three individuals, in which the middle one is the focal individual, with differing unit membership, an exhaustive list of five communication roles can be defined, presented in Fig. 1 (cf. Gould and Fernandez, 1989). How exactly an individual spans a boundary can then be further detailed. In Fig. 1, the focal individual is the individual at the top (center); the arrow this individual sends out (to the right, bottom) indicates if the knowledge flow that they initiate indicates an orientation that is primarily external or internal. Internally oriented individuals broker toward others in their own unit, even if the knowledge that they broker originates from outside, and externally oriented individuals broker toward individuals in other units. Coordinators and Gatekeepers are thus internally oriented, while Representatives, Consultants

and Liaisons are externally oriented. Individuals can fulfill multiple of these roles, even in a single network. The combination of all roles of an individual, across different networks, is their communication profile.

One would assume that each individual has a particular kind of communication profile depending on one's position within a firm: directors of a unit should coordinate within their unit, but should also represent their unit externally. An innovation manager will mostly *liaise*, certainly in the early phases of a new project, and may even take on the role of consultant, but should strive for others to take over their knowledge transfer activities in due course. A person's expected communication profile can be compared with his actual profile by analyzing network data.

Some argue that clustering of roles, in particular, combining those that are internally oriented with those that are externally oriented, is unlikely (Friedman and Podolny, 1993; Huy, 2002). Conceptually, however, and from the point-of-view of reciprocity in social relations (Coleman, 1988; Ekeh, 1974), one would expect that individuals who combine externally oriented roles with the role of gatekeeper to add innovative value (Bouty, 2000). A social situation in which an individual only provides information and resources, or one in which an individual only receives information and resources, will not be sustainable in the longer term (Ensign, 2009; Dolfsma et al., 2009). Those who give information and resources to a specific other individual may be reciprocated not just by that specific alter (Oetl, 2012), but will also benefit from third parties volunteering information and resources, or responding favorably to requests for this from a focal actor, since they know that the focal actor can be trusted to reciprocate. In addition, it is important for an organization to have individuals who receive knowledge and information from the outside to channel such inputs to the right individuals inside their own organization or business unit (cf. Whelan et al., 2011). This will both be true for connections in the informal network as well as, due to the highly interdependent nature of work in the contemporary firm, in the instrumental-formal network.

Hypothesis 2. Individuals whose communication profile includes externally oriented communication roles as well as the inbound internally oriented role of gatekeeper, will provide a stronger innovative contribution to a firm than those who do not have such a communication profile.

Methodology

Research setting

In this study we analyze the formal and informal contacts between employees working within the different business units of a European subsidiary of an electrical engineering multinational as antecedents for the transfer of innovative knowledge. The subsidiary studied, operating since the late 19th century, covers one of the core markets of the company and employs some 4000 employees; worldwide over 400,000 people are employed. Revenue generated by this subsidiary equals 6.5% of total revenue for the company. At corporate level 6.8% of revenues are spent on R&D, emphasizing the importance of innovation for this firm. The company has a divisional unit structure, and offers integrated and innovative products that draw on technical competencies from different, autonomous units. Internal knowledge transfer crossing unit boundaries is therefore important for this firm to be innovative. The firm organizes its activities according to a number of strategic multidisciplinary themes, one of which is the theme “transportation”, a high-priority theme according to management. This study focuses on the four business units involved with all manner of activities related to transportation, each with their own commercial profit and loss responsibility, as well as staff members tasked to stimulate new business development and innovation more generally. The business units varied from focusing on transportation and industrial logistics, to safety systems and advanced mobile electronics.

Research design

Our case study is of an explorative nature as the knowledge base used is underdeveloped (Doherty and Alexander, 2004; Yin, 1994). Drawing on the interpretive research tradition, we employ

qualitative techniques and an illustrative case study design, using descriptive network data. The qualitative research design, provides a holistic yet focused means of data gathering, analysis, interpretation, and understanding that is particularly suited for research that investigates the “why” and “how” of management decision-making in organizations (Gummesson, 2000). The qualitative analysis of data followed an inductive process and observed the recommendations of both Morse (1994) and Lindlof (1995).

Network data were collected using a network survey methodology (Wasserman and Faust, 1994; Borgatti and Cross, 2003; Aalbers and Dolfsma, 2015). While instrumental, formal interaction among employees may be partially inferred from organization charts and working procedures documented within a firm, information about the informal and especially innovation communities within a firm is less readily available. The largely discretionary, voluntary nature of relations in these networks means that they are difficult to gather data on. As the boundaries of these networks are unknown in advance, due to their discretionary nature, a snowball approach was utilized for our network survey (Wasserman and Faust, 1994; Aalbers et al., 2013; Marsden, 1990, 2002). Using such a data collection method endogenously infers network membership of individuals. While the first individuals to interview in a snowball sampling procedure can be randomly chosen, we used a number of in-company interviews to identify and survey key individuals in the company for the first round of sampling. The interviews allowed to become familiar with the organizational setting as well. Interviews typically lasted 1 h, were recorded, transcribed, and coded separately by each author. The interviews allowed for the design of a tailor-made network questionnaire that takes context-specific terminology into account and. Starting with these key players, name-generating questions, listed in Table 1, generated the names of a second wave of individuals, leading up to subsequent rounds of surveying, until the entire set of individuals engaged with innovation was surveyed (Illenberger and Flötteröd, 2012). After two rounds of snowball surveying a 96% response rate was reached and the *de facto* boundary of the networks was established.

While appropriate to access specific populations that are difficult or even impossible to reach through direct sampling (Heckathorn, 1997; Illenberger and Flötteröd, 2012), snowball sampling has potential drawbacks, one of which is selection bias (Atkinson and Flint, 2001). Since snowball sampling implies that recruiting of new respondents is done, or at least influenced, by the respondents themselves, the researcher has more limited control over which individuals are included in the sample (Atkinson and Flint, 2001). Also, unlike a socio-centric study of, for instance, the complete email traffic within an organization, snowball sampling potentially faces the problem that one may be less sure as a researcher that network closure is reached. To mitigate these restrictions we opted in the first round to target respondents selected in collaboration with key senior innovation and line management of the subsidiary studied. This improves control over which individuals are appropriately included, also reducing the risk of ignoring “isolates”, i.e. isolated persons within the organization who do possess relevant knowledge to a particular subject, but who may not be included in the study as their names are not mentioned in early rounds of surveying (Rogers and Kincaid, 1981).

Measures

It is the extent to which an individual is active in the firm's innovation network that we seek to explain using network antecedents in the instrumental-formal and the informal networks. Along with the innovation network, we collect data on the innovator's formal as well as informal relations maintained within the boundary of the firm.

The dependent variable, involvement with innovation activities, is measured by determining the presence of an individual in the innovative knowledge transfer network. We do this by asking individuals with whom do they exchange *new* ideas, *innovations* and substantial *improvements* to products and services that are not part of their day-to-day activities (Cross and Prusak, 2002; Rodan, 2010; Aalbers et al., 2013). Whereas this name generator question for the innovative knowledge transfer network asks about the transfer of new or complex knowledge, this was specifically *not* perceived by respondents as related to the ongoing business of the organization (Harrison and Laberge, 2002; Aalbers et al., 2013).

The name generator question for the instrumental-formal network measures the connections resulting from exchange of routine issues and day-to-day information. Following Ibarra (1993) and

Table 1

Network survey questions and characterization.

Type	Approach	Characterization	Name generator questions	Sources
Instrumental-formal network	Task-focused, workflow-oriented, professional in nature; designed by management	<p>The pattern of professional, task related connections among employees that:</p> <p>allow to solicit and offer task-focused and workflow-related information and support and help employees perform their roles</p> <p>facilitate access to task-oriented information and support are generally void of affective or expressive content. The connections are strongly task-oriented and cognitive in nature</p>	"With whom do you exchange day-to-day information and routine issues to successfully carry out your usual <i>workflow activities</i> ?"	Ibarra (1993), Balkundi and Harrison (2006), Henttonen (2010), Varella et al. (2012) and Aalbers et al. (2014)
Expressive-informal network	Expressive, personal, spontaneous and voluntary in nature	<p>The pattern of expressive connections among employees that:</p> <p>allow employees to support their professional or personal goals evolve through voluntary socializing, and rely on the affective connections among colleagues</p>	"With whom do you discuss what is going on within the organization to get things done that are of <i>personal relevance</i> to you?"	Ibarra (1993), Oh et al. (2004), Mehra et al. (2001), Smith-Doerr et al. (2004), Henttonen (2010), Varella et al. (2012) and Aalbers et al. (2014)
Instrumental-Innovative knowledge transfer network	Creative, innovation oriented, professional in nature	<p>The pattern of connections among employees that:</p> <p>allow employees to tap into new or complex knowledge that was specifically not perceived as related to the ongoing business of the organization as source for innovative activity</p>	"With whom do you exchange new ideas, innovations and substantial improvements to products and services that are not part of your usual day-to-day activities?"	Cross and Prusak (2002), Rodan (2010), Aalbers et al. (2013) and Aalbers et al. (2014)

Brass (1984) we measured the expressive-informal network by asking respondents with whom they discussed what is going on within the organization to get things done that are of personal relevance to them (Mehra et al., 2001; Smith-Doerr et al., 2004; Aalbers et al., 2014). The focus on one's assessment of *personal* relevance emphasizes the exchange of identity-related resources exemplary to the type of information exchanged through expressive networks (Oh et al., 2004).

Since instrumental-formal ties that relate to one's daily workflow are the prime reference for the respondents, this name generator question was asked first. Next in the survey came another salient question for respondents about their informal expressive personal contacts. The question about individuals' innovation contacts, being perhaps less salient to respondents, was positioned at the very end of the questionnaire. We acknowledge that any sequence of questions in a survey may influence respondents' reply. By staying close to the real world situation of respondents as faced at the electrical engineering company under study, we started name generator questions by enquiring on one's daily work related activity, positioning the more specific network name generator question on innovative activity as a final question, this possible bias is reduced. Recent work on question-order effects in social network name generators substantiates this point empirically (Pustejovsky and Spillane, 2009). Table 1 presents a description of the measures we employ, in the same order as in the network survey.

To reduce ambiguity, network questions were formulated in the native language of the respondents (Dutch). Authors and a native speaker independently translated questions to converge on the proper phrasing in the native language and pilot-tested the questionnaire. No language barriers existed between the researchers and the research participants. Name generator questions can strongly suggest that a number of names should be provided, or it can leave the number of names each respondent provides open. Each approach may introduce a bias. The first might make some respondents with a limited number of contacts list contacts they have tenuous contact with, and might make those with many contacts list only their most important ones. The latter, the free-recall method, relies on respondents' memory, but is suggested to be most suitable in a study in which network boundaries cannot be determined a priori. The free-recall approach is believed to be less biased (Friedman and Podolny, 1993). As an instruction sentence that directly followed up on each of the three name generator questions used in our survey (as summarized in Table 1, column 4), we asked each respondent to "Please name up to six persons", and to focus their attention on their most important contacts. Recent work by Merluzzi and Burt (2013) that empirically explores a cost effective number of socio-metric choices to record for this form of surveying concludes five names as a fitting upper boundary. In our survey we do suggest a maximum of six, yet did not technically restrict a maximum number of contacts respondents could enter in the electronic survey. Such restrictions could unduly affect network structure in case respondents feel the need to be more extensive in their reporting (Friedman and Podolny, 1993). As name recollection for the scope of this study is restricted to only naming those individuals operating within the organizational boundaries of a specific subsidiary of the electrical engineering multinational; the resulting specific sub-set of names for respondents to recall from, lessens the required reporting burden sometimes listed as a drawback of free recollection procedure (Reagans and McEvily, 2003; Pustejovsky and Spillane, 2009). This scope was introduced to the respondents by nature of the introductory email that respondents received introducing them to the survey. After soliciting for contacts on each of the areas summarized in Table 1, our survey then inquired about the strength of each tie mentioned by respondents. This helped address the potential problem of having to rely on respondents' memory so that only the most important contact would be mentioned.

The name generator questions provided insight into the overall network configuration of the instrumental-formal, expressive-informal and innovation network. Individual network characteristics can then be derived from this data at the employee level. Drawing on these full network configurations, we derive brokerage positions and overall engagement with the exchange of innovative knowledge for each individual employee. Engagement with the exchange of innovative knowledge is measured based on the number of ties for each individual employee in the innovation network. Following Freeman (1979) and Tsai (2001), we use the number of times an individual is mentioned by others (also referred to as in-degree centrality), as a measure for this since it is the most reliable and robust measure (Bjork and Magnusson, 2009; Costenbader and Valente, 2003; Carley and Krackhardt, 1996; Casciaro, 1998).

Results

As became clear in the series of interviews, the conditions for close cooperation between business units were not optimal. One employee of business unit A of the company, described the problem of crossing firm-internal unit boundaries in a striking manner: “...it is often easier to collaborate with another firm than with my colleagues in another division.” Although several initiatives existed to facilitate cross-unit knowledge sharing – such as a state-of-the-art intra-firm software platform aimed at sharing current knowledge between employees worldwide, innovation lunches, and dedicated innovation managers – the general feeling among employees and management was that a serious lack of insight existed on who knows what within the company. Incentive structures are geared toward the performance of the individual business units and to short-term performance and profits.

A representative of unit A would, for instance, visit a company to offer the electrical engineering multinational's view on the customer's problems while that same day a representative of unit B would visit the same company talking about the same problem without both representatives (or business units) knowing this about each other. The company's sales force proved inefficiently and ineffectively deployed, leaving sales leads that crossed business unit domains largely disregarded. Subsequently, opportunities to explore and develop new, innovative products and services that could spur future business were unexplored.

External orientation

At the Innovation Management (IM) department, a senior executive saw the lack of bridges between unit boundaries as one of the main concerns. Employees generally lacked (sufficient) insight into each other's activities and knowledge. Several employees working in the sales department of several business units mentioned that inter-divisional cooperation was the last thing they would think of to meet their current sales targets. One employee even stated that her supervisor reprimanded her for participating in an interdivisional meeting that was organized bottom-up by colleagues from another division. Quotes in Table 2 further illustrate.

The interviews made clear that in order to offer total solutions to customers (seen as a prime strategic objective to the company), the way in which individual employees interacted across business unit borders had to change. Up to that moment management had mainly emphasized that bonuses would be earned for reaching goals set by every business unit separately. However, communication between individuals across unit boundaries could lead to the kinds of innovation that provide the electrical engineering multinational with a source of earning in the future. Changing the way in which the firm works, stressing the need for more cooperation between units would be a major change, though: “...inter-divisional cooperation requires a radical change. The way people think needs to be changed: people need to operate more from their motivation of being an entrepreneur.” To determine what to do about the situation, the Innovation Manager had to know what the current situation was. He did so using a social network approach.

Table 2
Collaborative climate.

“There is insufficient knowledge about the possibilities other parts of [...] may offer us. We lack a clear structure and the dynamics for inter-divisional cooperation” (Employee unit A)
“There are two problems, first of all we (colleagues at B unit) have often no idea what other business units can mean for us. Secondly, the cost/benefit structure is not effective. Often internal costs are higher than the external costs. Besides that, there exists some kind of competition between the business units” (Employee unit B)
“There exists a considerable amount of misunderstanding about each other's competences, unfamiliarity and incomprehension about each other's goals. Furthermore, there are too many impediments for a total profit view where the loss of one division will be compensated by the loss of the other” (Employee unit A)
“It is time for an overall ‘stock-taking’ of who knows what within this organization” (Employee unit C)
“People in key positions should be granted more responsibility and trust instead of constantly having to justify their daily contribution regarding hours, turnover and so on. These people however need to be able to carry this responsibility” (Employee unit B)

Our quantitative analysis makes clear what qualitative analysis cannot: individuals who have an external orientation, actually passing on knowledge to others outside of their own unit, are more engaged with the brokerage of innovative knowledge. Those externally oriented in the instrumental-formal network, are more engaged in brokering innovative knowledge too. This, however, and notably, is true only for external orientation in the instrumental-formal network. Applying a Mann–Whitney test, since the dependent variable is not normally distributed, shows that external orientation in the instrumental formal, but not in the expressive-informal network means that people are more innovation active (for the instrumental-formal network: Mann–Whitney $U=6.50$, $p=0.016$, effect size $r=0.632$; for the expressive-informal network: Mann–Whitney $U=13.50$, $p=0.279$, effect size $r=0.30$). Comparison amongst these Mann–Whitney outcomes for degree of external orientation in the instrumental-formal and expressive-informal network suggests support for [Hypothesis 1](#). Individuals who in their instrumental-formal contacts are predominantly externally oriented will particularly contribute to innovative activity within the firm. Individuals who in their expressive-informal contacts are predominantly externally oriented will not particularly contribute to innovative activity within the firm.

Communication roles

The data we collected at the Dutch subsidiary of an electrical engineering multinational on the contacts in the instrumental-formal and expressive-informal network can be used to visualize these distinct social structures ([Borgatti et al., 2002](#); Ucinet 6.0; peripheral nodes of individuals who did not have further contacts are removed from the figures for clarity). [Figs. 2 and 3](#) present these networks. Node colors combined with distinctive node shapes represent distinct unit membership. Arrows indicate (directed) contact.

The majority of business unit members are not externally oriented, neither in the instrumental-formal nor in the expressive-informal network, focusing instead on colleagues within their own unit. Prior research on the costs of knowledge search and exchange may offer an explanation. Most people, in both the expressive-informal as well as in the instrumental-formal network do not pass on knowledge that they receive from others. Many stop the flow of information or knowledge from moving on, while only some initiate such a flow. A limited number of individuals within the engineering subsidiary bear the brunt of the inter-unit transfer of knowledge, as [Table 3](#) indicates. There is a strong dependence on a few employees for exchange across unit boundaries.

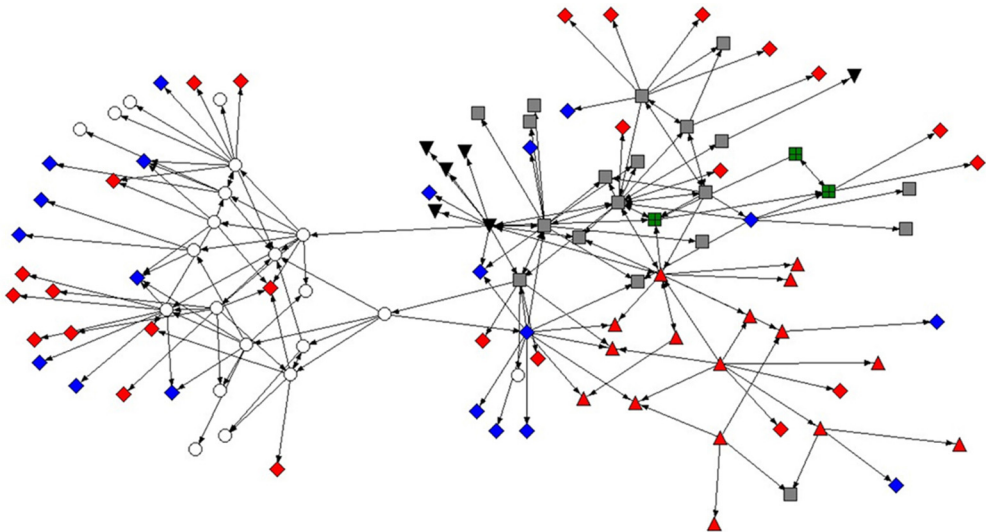


Fig. 2. The instrumental-formal (workflow) network in 'transportation' ($N_{\text{total}}=110$). (For interpretation of the references to color in text citation, the reader is referred to the web version of the article.)

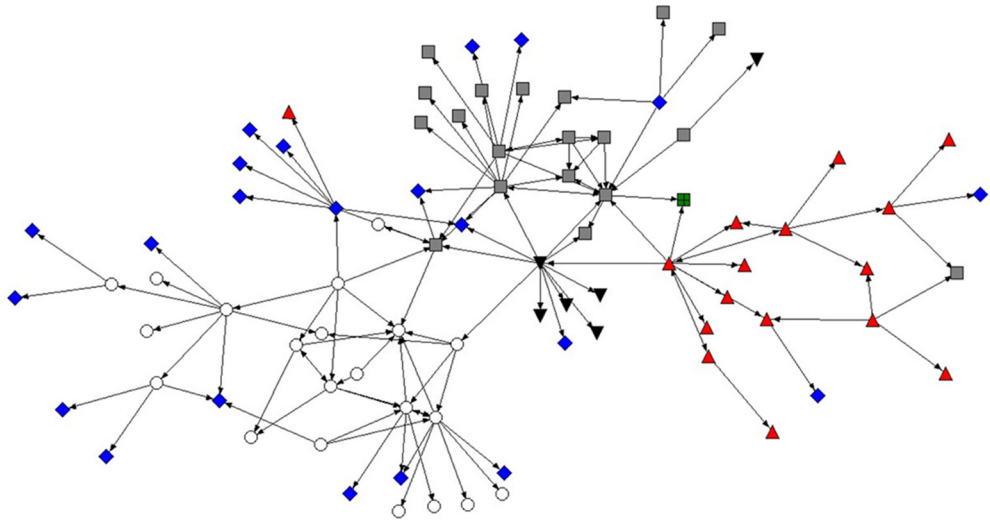


Fig. 3. The expressive-informal network in ‘transportation’ ($N_{\text{total}}=87$). (For interpretation of the references to color in text citation, the reader is referred to the web version of the article.)

Communication profile

In addition to determining the brokerage score for each employee in the instrumental-formal and in the expressive-informal network, we look at what roles individuals combine into a distinct communication profile. The exact innovation contribution that can be expected of individuals will derive in part from their communication profile. Only a few combinations of communication roles are present in a statistically significant manner, as Table 4 indicates.

The significant clustering of gatekeeper-liaison and coordinator-representative indicate that combining an internally oriented role with an externally oriented one – both in the formal as well as in the informal network – is possible and can be relatively attractive for the individual and the firm. Individuals combining internally and externally oriented communication roles will be more likely to find the most appropriate user of a piece of information or knowledge, either within their own unit or in another unit. A coordinator is more likely to also represent their unit – most likely the unit leader and a limited number of others will do this (cf. Aalbers et al., 2016). The combination of Gatekeeper and Liaison suggests that gatekeepers can both be selectors at the gate of their unit determining what comes in and passing that on to the right alters, as Allen (1971) suggested, but can also actively pass what knowledge they have on to others in other units. Individuals who combine a role as Consultant with one of Liaison are super-connectors in terms of facilitating the flow of knowledge even outside of the boundaries of their own unit. These indications about the clustering of roles, is suggestive of partial support for Hypothesis 2.

Table 3
Number of times an individual takes on one of five communication roles.

Network	Coordinator (i)	Gatekeeper (i)	Representative (e)	Consultant (e)	Liaison (e)
Instrumental-formal network	105	95	106	8	25
Expressive-informal network	74	27	44	2	16
Instrumental-innovation network	60	35	57	3	24

Notes: total number of individuals in each role, in each network – individuals can have more than one role at the same time, in the same network; (i) internally orientated and (e) externally oriented role.

Table 4

Clustering of five communication roles, in the formal and informal networks.

Communication roles in network	Communication roles in the instrumental-formal and in the expressive-informal networks							
	Coordinator (i)		Gatekeeper (i)		Representative (e)		Consultant (e)	
	Formal	Informal	Formal	Informal	Formal	Informal	Formal	Informal
Gatekeeper (i)	0.068	−0.055						
Representative (e)	0.398***	0.321*	−0.124	−0.113				
Consultant (e)	0.164	−0.233	0.324	−0.119	0.260	0.237		
Liaison (e)	−0.118	−0.119	0.653***	0.648***	−0.06	0.069	0.596***	0.453**

Correlations using non-parametric Kendall's tau.

Note: (i)/(e) means internal or external role orientation.

* Correlation significant at 0.10 level; 2-tailed.

** Correlation significant at 0.05 level; 2-tailed.

*** Correlation significant at 0.01 level; 2-tailed.

Managerial implications

We know that within-firm knowledge transfer crossing firm-internal unit boundaries is conducive to innovative activity within an organization. Perceiving an organization as consisting of a number of different networks, offers managers the possibility to purposefully intervene to foster innovative activity (Ballinger et al., 2011; Balkundi et al., 2007; Varella et al., 2012; Aalbers et al., 2014). Managers can, however, do more than simply increase the number of interactions and exchanges, indiscriminately. Communication can be costly, and additional communication must be weighed against additional costs (Hansen et al., 2005).

Individuals in a network are often members of exogenously-defined business units. Recognizing this helps us understand what is going on in a firm. The instrumental-formal contacts between people in a firm, and the way both these types of connections are impacted by unit boundaries that compartmentalize a firm is, surprisingly, largely ignored (Reagans and McEvily, 2003). Studying the actual rather than the planned connections, in the instrumental-formal and the expressive-informal networks, separately and in their interactions, offers insights for academics and managers alike.

Managers should seek to enhance employees' awareness of each other's expertise so that knowledge can transfer across unit boundaries (Cross and Cummings, 2004). We show that when unit boundaries are crossed, individual innovative activity increases: external orientation in the instrumental-formal (but, notably, not the expressive-informal) network contributes to innovation. Managers can stimulate individuals to be more oriented toward people in other units as sources for and recipients of useful knowledge. While unit boundaries in a firm are there for a good reason, allowing for close collaboration and the development of specialized knowledge within them, managers should be aware, at the same time that *directed* transfer of knowledge across unit boundaries will improve firm innovation. Since managers are best able to intervene in the formal structures of their firm, the finding that employees' position and orientation in the instrumental-formal network stimulate their innovation activities more than those in the expressive-informal network is a vindication of the role of management. Management can seek to alter the internal or external orientation of units and individuals, or, in even more detail, seek to adapt individual communication profiles, in both the expressive-informal network but particularly in the instrumental-formal network.

Five different communication roles can be distinguished, roles which employees can adopt, in each network. Indeed, employees can combine different communication roles into a communication profile, and innovation can be a benefit of this combination of roles. Communication profiles can differ between employees depending on their position and tenure. A question managers are keen to ask is: What communication profile could someone in a particular (formal) position be expected to have? An ideal communication profile can be compared with the profile someone actually has. More senior positions tend to have more contact with others in different units (Stevenson and Gilly, 1991; Carroll and Teo, 1996). More junior employees and those who have been hired more recently are likely to be

Table 5

Average brokerage scores, by network role, and by position in the firm, in the instrumental-formal and in the expressive-informal networks.

Roles ^b	Unit member ^a		Staff		Unit director ^a	
	Formal	Informal	Formal	Informal	Formal	Informal
Coordinator (i)	5.75	5.15	0	0	13	7
Gatekeeper (i)	10.43	5.33	8	4	14	7
Representative (e)	5.67	3.82	0	0	4	2
Consultant (e)	1.75	2	0	0	1	0
Liaison (e)	3.71	3	8	6	1	1

^a Units involved with the 'transportation' theme at the Dutch subsidiary of the electrical engineering multinational.

^b Role orientation – internal (i) or external (e).

more internally oriented and have matching communication roles. A deviation of someone's communication profile compared to what one would expect might, we submit, be an antecedent for someone's performance in the firm.

Table 5 presents information communication profiles in the firm we study. As expected, brokerage activity is lower in the expressive-informal network than in the instrumental-formal network, since informal contacts are voluntary and most likely to exist in the first place between people who are in physical closer proximity. Unit members engage in both internal and external oriented activity, whereas unit directors mainly take up the two internally oriented roles of gatekeeper and coordinator. The Innovation Manager (Staff) indeed does not coordinate much – he discusses within his relatively small innovation management staff department and acts as a go-between for other departments. However, innovation managers and managers of innovative projects are not the only ones to have an externally focused brokerage role. This is in contrast to what Tushman et al. (2010) claim. Unit members represent their unit as well, and more so even, on average, than unit directors do. Unit members also function as consultant. They liaise, although not as much as a staff member such as an innovation manager in absolute terms. Innovation management staff members might be relative outsiders, perhaps hired for the specific purpose, and not necessarily well-placed to best determine who can use what knowledge for their innovative efforts. It is important to note that an organization is not only dependent on staff members for externally oriented communication roles.

As brokerage of knowledge across unit boundaries is undertaken by just a few individuals in a firm, a firm is vulnerable to disruption. Knowing how vulnerable a firm is, and for which positions, is important for a firm. As brokerage does not need to be restricted to senior staff only, management can actively seek to broaden the number of individuals who broker. The unit on the right hand side of Figs. 2 and 3 (in red, triangles pointing upward) is vulnerable to disruption since it has few connections to start with, and at unit-level has a skewed communication profile as well. This is the sort of insight that can only emerge when one oversees the entire network configuration.

Conclusions, discussion and limitations

Prior studies identified the strength of both instrumental-formal and expressive-informal networks, each in their own rights, as the foundation for a firm's innovative activity (Ibarra, 1993; Aalbers et al., 2014). This study answers the question: How does the combined communication orientation of individuals in their instrumental-formal and the expressive-informal networks affect their innovative activity in the firm? Responding to recent calls for further and more substantive empirical evidence in this area, our study quantitatively compares how simultaneous brokerage in different types of intra-organizational networks contribute to innovative knowledge transfer within a firm (see Gulati and Puranam, 2009 for such a call). We also find that individuals who are predominantly externally oriented in their brokerage activity contribute to innovative activity within the firm – individuals who in their formal (but *not* in their informal) contacts are externally oriented will particularly contribute to innovative activity within the firm. Five different communication roles can be distinguished to provide more analytical depth for the concept of brokerage (Fig. 1). In addition,

and of both managerial and theoretical importance, we submit and define the concept of communication profile. The different contacts an individual maintains in the instrumental-formal and the expressive-informal networks determines an individual's communication profile. Based on detailed case analysis of knowledge flows at a large European electronics and engineering multinational, we provide evidence that some combinations of communication roles in a communication profile are more likely than others to be successful in bridging firm-internal boundaries for innovation. Individuals who combine these roles stimulate innovation more than others.

Brokerage activities – such as locating suitable knowledge sources, querying, engaging in the actual transfer, maintaining relations, and integrating acquired knowledge – preclude work on other tasks and result in search and opportunity costs for a broker (Levitt et al., 1999; Szulanski, 2000; Perlow and Weeks, 2002; Haas and Hansen, 2005; Levine and Prietula, 2012). Such costs are real, but the presence of brokers in a unit ensures that others in the unit can contribute to benefits from specialization of knowledge development. The costs of brokering are subject to scale economies according to Marrone et al. (2007): concentrating brokerage activity among a select group of individuals reduces overall transaction costs. Nonetheless, since such activities tend to be underappreciated, few have an appetite to engage in brokering (Ryall and Sorenson, 2007; Sasovova et al., 2010; Aalbers et al., 2013). Bridges are not easy to build, costly to maintain, and susceptible to decay (Burt, 2004; Kossinets and Watts, 2009; Ryall and Sorenson, 2007; Sasovova et al., 2010).

The overall costs of brokerage from the perspective of a unit decrease if brokerage occurs with a single other unit. Costs may further diminish if only a few individuals broker. Such individuals can use their absorptive capacity, built up in the past, can triangulate more efficiently, and can combine knowledge received more purposefully. Having only a limited number of dedicated brokers poses a risk as well (cf. Granovetter, 1973). An firm can, however, become dependent on the intentions of a few individual brokers, and is vulnerable for those individuals to leave or turn out malignant. Addressing such concerns, we suggest in line with Tushman (1977) and more recently McEvily et al. (2014), a firm can make use of its information about individual boundary-spanning activities in the informal network. Such activities can be relied upon to complement boundary spanning in the formal network, but can also be formalized. In addition, some combinations of communication roles are more likely than others to be successful in bridging firm-internal boundaries for innovation. Individuals who combine these roles to play a special role in stimulating innovative activity within the firm. Social network analysis of a firm allow managers to identify such individuals, and targeted interventions can increase their numbers and enhance their contribution.

Limitation and future research

This study has a number of limitations. Our data does not permit us to determine the stability of an individual's brokerage activities over time (Ahuja et al., 2012). Future research could also consider the psychological underpinnings for some individuals more than others to engage in and benefit from the brokerage contacts they fulfill. Opportunity to fulfill brokerage positions in the formal or informal networks may, for instance, vary depending on the cognitive capabilities of an individual as well (Sasovova et al., 2010; Aalbers et al., 2013). Unfortunately we cannot determine the substantive contribution of innovative knowledge transfer to actual innovation at the firm level and, subsequently, to actual firm performance. This would entail a research design encompassing an exceptionally long period of time. Establishing the contribution of the position and orientation in networks that an individual maintained at one point in time held to a firm's innovative outcome at a later point in time can be exceedingly difficult. The extent to which our findings are generalizable is unknown. Future research aimed, for instance, at understanding the role of contextual factors in determining the incidence and impact on innovation of knowledge bridging firm-internal boundaries would help determine generalizability of the findings we offer in this article.

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