

# Online Tie Formation in Enterprise Social Media

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## ABSTRACT

We study the antecedents to tie formation on an (Facebook-like) enterprise social media platform implemented to support cross-boundary connections. Research has produced mixed findings regarding the role of social media in cultivating bridging vs. closed networks. We examine the tie formation patterns of 1,386 enterprise social media users over a two-year period. Specifically, we observe who became (or chose not to become) “friends” with whom at the dyadic level and relate the decisions to various mechanisms that affect one’s network to expand, constrain, or bridge. Using logistic and OLS regressions, we find that users tend to form ties via reciprocity and transitivity (with friends of friends), both of which help expand one’s network. We also find strong networking tendency toward functional and hierarchical homophily (same business unit and same rank, respectively), which is likely to constrain one’s network (closed network structure). We find that one’s participation in various online interest groups is likely to open one’s network (bridging network structure) while no evidence found for preferential attachment. Overall, we find that enterprise social media offers features, some of which are likely to foster bridging while others foster closed networks via different mechanisms.

*Keywords:* Enterprise Social Media, Tie Formation, Network Structure, Homophily

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## 1. Introduction

In recent years, companies have begun using social media to support the interactions between members of different boundaries within the enterprise for company-wide knowledge sharing resulting in innovation (Kane et al., 2014a; Suh and Shin, 2012). According to a recent McKinsey’s global survey, 85% of all respondents say their companies use enterprise social

media for internal purposes and 45% report that enterprise social media is very or extremely integrated into day-to-day work at their companies, up from one-third who said so in the previous year (Bughin et al., 2017). In this study, we refer to enterprise social media as a Facebook-like web-based enterprise system that allows users to construct a profile, articulate a list of connections (“friends”) formed through mutual agreement, view and traverse their con-

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nections and those made by others, and create and share content, as well as view and comment on others' shared contents (Fulk and Yuan, 2013; Leonardi et al., 2013; Majchrzak et al., 2009; Stieglitz et al., 2014). One way enterprise social media platforms are intended to support enterprise-wide knowledge sharing is by allowing employees to connect across organizational boundaries. These cross-boundary connections allow employees to access, combine, and exchange knowledge from diverse domains, which lead to the creation of more valuable and innovative knowledge and solutions for common problems (Burt, 1992; Carlile, 2004; Chung et al., 2012; Granovetter, 1973; Wu, 2013).

However, it is not entirely clear whether enterprise social media platforms will actually lead to the cross-boundary connections they are intended to create. A survey shows that 80% of respondents agree that enterprise social media enables them to communicate with other peers more often, but far fewer report that the use of enterprise social media has blurred the boundaries between employees (32%) and made formal hierarchy much flatter or disappeared altogether (29%) (Bughin et al., 2017). Theoretically, there is an ongoing debate on the role of enterprise social media as an "echo chamber," which reinforces the boundaries that set employees apart, or as a "leaky pipe" or a "social lubricant," which increases the opportunities for employees to form cross-boundary ties (Leonardi et al., 2013). Prior studies support either view. On the one hand, enterprise social media assists employees to identify diverse in-house experts and extend their networks in an organization (Wu, 2013). On the other hand, the unprecedented connectivity that enterprise social media offers may reinforce the human tendency to connect with similar others exclusively (Van Alstyne and Brynjolfsson, 2005). Such networks are unlikely

to lead to greater knowledge sharing because the informational benefits of social networks come from having exposure to diverse sources of information through non-redundant ties (Burt, 1992). Furthermore, these networks can even have a detrimental effect by providing the illusion of access to diverse opinions and information, leading to overconfidence in sub-standard outcomes (Janis, 1972; Sunstein, 2001). In this case, an enterprise social media platform might contribute to creating constrained and closed networks for employees.

In this paper, our research objective is to conduct a comprehensive examination of the antecedents to online tie formation in enterprise social media. By doing so, we lay the ground for future research on whether and how enterprise social networking platforms create the types of broad and diverse social networks that would foster knowledge sharing leading to innovation. We draw upon several distinct streams of research that has identified the mechanisms that affect two organizational actors to form a tie and that, by extension, *expands, constrains, or diversifies* one's network in the organization. As for the tie formation mechanisms that help expand one's network, we draw from the network literature that focuses on the structural balance of network formation. Specifically, we hypothesize that online tie formation is driven by reciprocity and transitivity. What underlies these mechanisms is the preference for balanced interpersonal relationships to be friends of each other (transitivity). While these mechanisms lead one to expand one's. It is human nature that people want their friendships to be reciprocated (reciprocity) and want their friends network, there are other tie formation mechanisms that we argue either constrain or diversify one's network. Drawing from the intra-organizational literature on homophily, we hypothesize that online tie formation is still delimited by

existing organizational boundaries such as business unit, job level, and work location despite the cross-boundary connections enabled by enterprise social media. The predominant effect of the system will be to constrain networks as people connect with others with whom they share the same organizational attributes. Drawing from the network literature on cross-boundary spanning, we further argue that two tie formation mechanisms will help to overcome this organizational homophily tendency. The first mechanism is preferential attachment (Barabási, 2002) – the tendency to connect with already well connected others. Organizational members who attract a large number of connections often serve as conduits to allow diverse knowledge to flow across organizational boundaries. By connecting with these prominent users, one may be able to form cross-boundary ties via reciprocity and transitivity. The second mechanism is online interest groups. Serving as “proto-ties,” online interest groups allow people to connect with diverse others based on shared interests that diverge from their everyday work relationships (Borgatti et al., 2009). Co-membership in online interest groups can be critical for cultivating connections that span existing organizational boundaries.

To test our research question, we study an online social networking platform used in a large research and development organization. The main business objective of the platform is to foster interactions throughout the enterprise by enabling cross-boundary connections. We examine the antecedents to tie formation between pairs of 1,386 enterprise social media users over 24 months at the dyadic level. Results from our logistic regression analysis provide good general support for our hypotheses. As for network expansion, we first find that users tend to reciprocate tie initiation (reciprocity) and to form new ties with others who are already connected to their existing

ties (transitivity). Who do they initiate ties with in the first place? We find that people are more likely to connect with others who have the same organizational attributes such as functional affiliation and work location, which would constrain one’s network. We also find that co-membership in online interest groups are likely to lead to new connections that are likely to cross boundaries thus diversifying one’s network while there is no such evidence for preferential attachment. Our supplementary analysis done at the ego-network level verifies that one’s networking tendency toward functional and hierarchical homophily is likely to constrain one’s network (closed network structure) while one’s participation in various online interest groups is likely to open one’s network (bridging network structure). These findings suggest that online interest groups might be key to fostering the types of cross-boundary connections the system is intended to create. We later discuss the theoretical and practical implications of these findings.

## II. Theory and Hypotheses

Much research on enterprise social media suggests that the use of enterprise social media affords organizational actors to expand their personal networks in the organization by forming new ties while maintaining existing ones (DiMicco et al., 2008; Treem and Leonardi, 2012). In a study of enterprise social media use at IBM, Steinfield et al. (2009) found that people used enterprise social media more to connect with existing and former contacts in the company than to connect with entirely new people, although many did both. The authors also found positive relationships between intensive use of enterprise social media and measures of social capital, including tie

strength, access to new people, and interest in global connections. In an interview with selected enterprise social media users of a multi-national company, van Osch et al. (2015) found that enterprise social media was used as the primary means to conduct a “background check” so that users could learn more about people of interest and form new ties with them.

Below, we draw upon several distinct streams of research that has identified various underlying mechanisms that foster online tie formation in enterprise social media and, by extension, *expand, constrain, or diversify* one’s network in the organization. In 2.1., we first survey the tie formation mechanisms that help expand one’s network.

## 2.1. Structural Balance-driven Tie Formation

Social network literature shows that tie formation between actors is shaped by the perceived structure of the social network wherein the actors are embedded (Kilduff and Krackhardt, 1994; Newcomb, 1961). People prefer having balance in interpersonal relationships and the preference for structural balance leads to certain patterns of tie formation (Heider, 1958). Although there are relations such as influence relations that are typically thought of as unbalanced (e.g., De Soto, 1960), structural balance has been long regarded as a fundamental social process found in many types of social relations including friendship. There are two mechanisms that bring balance to relations: reciprocity and transitivity (Cartwright and Harary, 1956; Heider, 1958). According to balance theory, people tend to perceive social relations such as friendship as both symmetric and transitive. It is human nature that people want their friendships to be reciprocated and want their friends to be friends of each other. If P is friends with O, O is likely to be friends with P (reciprocity). If P is friends

with O and O is friends with X, then P is likely to be friends with X (transitivity). Considerable evidence has showed that people prefer balanced relations in both online and offline settings (Faraj and Johnson, 2011; Kilduff and Krackhardt, 1999; Newcomb, 1961).

People prefer balanced interpersonal relationships because they experience cognitive dissonance when perceiving unbalanced friendship relations. Cognitive dissonance causes feelings of uncertainty, instability (Festinger and Hutte, 1954), and nervousness (Sampson and Insko, 1964). When experiencing cognitive dissonance from having unbalanced relations, people are motivated to resolve the resulting emotional tensions by re-establishing structural balance. People often exert their power to impose balance in relationships by making cognitive or behavior changes. If P perceives that his attempts at friendship with O is not reciprocated, emotional tension will prompt P to change cognition (“O does not think me as a friend”) or behavior (“I should try harder to elicit tokens of friendship from O” or “I will sever my friendship tie to O”) in order to establish balance. Similarly, if O finds that her friends P and X are not friends of each other, O is likely to make the friendship relations complete by introducing them to each other via social gathering.

The features of social media platforms are likely to facilitate reciprocity in enterprise social media networks. Where tie symmetry is required, a tie between two users is established only after one’s attempt to form a tie (i.e., sending a friend request) is reciprocated (i.e., accepting the friend request). Balance theory assumes that it is the person whose friendship overture is unreciprocated that makes a cognitive or behavioral change to re-establish balance in a dyad (Heider, 1958). Yet, in enterprise social media networks, the pressure to re-establish balance is more

likely to be on the person who did not reciprocate the other person's attempt to form a tie. Social media platforms allow users to view their own past connection activities including sending, receiving, accepting, and rejecting friend requests. Users can also view their friend requests that were sent out but have not yet been accepted. Furthermore, social media platforms usually remind users of the friend requests to which they have not yet responded. While these features provide users the convenience of tracking past and ongoing connection activities, they also increase mutual awareness of any unbalanced relationship. This mutual awareness leads to an I-know-that-you-know and I-know-that-you-know-that-I-know situation that can intensify the emotional tension induced by an unbalanced relationship. The ability to view the history of a user's "balanced" relationships can further contribute to the feelings of discomfort on both sides if a friendship overture to the user is unrequited. After all, reciprocity is an institutionalized norm in organizations that underlies social cohesion (Gouldner, 1960) and social exchange (Blau, 1964) among employees (Settoon et al., 1996). Negative or dislike tie relationships certainly exist in organizations (Labianca and Brass, 2006) and may lead some users to ignore certain friend requests online. Nevertheless, the aforementioned pressure for balanced relationships, even if negative, should create a strong norm of reciprocity also in enterprise social media networks. Therefore, we propose the following.

*H1: Tie formation in enterprise social media networks is driven by reciprocity.*

Transitivity is another essential driver of structural balance in interpersonal relationships that accounts for the stability and consistency that arise in the

formation of new ties. Transitivity is likely to develop in enterprise social media networks for a number of reasons. First, the relational connections of a user are articulated on his or her digital profile and other users can see whether and how many mutual friends they share with the user. Social media platforms such as LinkedIn and Facebook provide the number of mutual friends when a user accesses another's digital profile. This technical feature fosters mutual awareness of unbalanced relationships in a user's network between the user's friends with no direct connection.

Second, social media platforms allow users to access the digital content of others if the content is shared through their mutual friends. A user's online friends are repeatedly exposed to the interactions (messages) and information flows (trends or shares) that occur between the focal user and her other online friends. Substantial body of research shows that repeated exposure to others could produce feelings of attraction and increase the perceived inter-personal similarity (Bornstein, 1989; Moreland and Zajonc, 1982), which is likely to breed connection (McPherson et al., 2001).

Third, the ability to access or co-create digital content provides opportunities for social interaction between users with mutual friends. Balance theory states that an actor is potentially able to balance relationships between disconnected actors through direct action such as bringing two friends who are not yet friends of each other together over coffee, for instance. In social media networks, a user's online activity such as sharing a photo or a personal story on his or her wall can attract online friends to engage in social conversation and interact with each other. In traditional social network research, relational ties are assumed to facilitate interactions and, subsequently, information flows (Atkin, 1977). Yet, in social media networks, these activities are typically

decoupled from one another (Kane et al., 2014b). Interactions and flows may also facilitate the formation of new ties particularly when mediated by mutual friends. Therefore, we propose the following.

*H2: Tie formation in enterprise social media networks is driven by transitivity.*

Although these mechanisms lead users to *expand* their networks, they do not necessarily create closed networks or bridging networks. Existing social network literature is replete with comparisons between closed networks wherein actors are densely connected to one another (Coleman, 1988) and bridging networks wherein the connections among actors are sparse (Burt, 1992) and their relative outcomes (e.g., Burt, 2000; Walker et al., 1997). Below, we argue that enterprise social media platforms foster both closed and bridging networks in different ways through different mechanisms. In 2.2., we draw upon the literature on homophily in organizations to theorize the tie formation mechanisms that tend to constrain one's network.

## 2.2. Mechanisms Resulting in Closed Networks

### 2.2.1. Homophily-driven Tie Formation

The homophily principle of similarity-breeds-connection has long been regarded as a powerful driver of interpersonal tie formation. Evidence shows that the contact between similar people occurs at a higher rate than between dissimilar people (McPherson et al., 2001). People tend to perceive those with whom they share similar attributes as being more trustworthy (Brewer, 1999) and holding congruent views, attitudes, and beliefs (Clark and Reis, 1988; Huston

and Levinger, 1978), thus preferring to connect with them (McPherson et al., 2001). Homophily theory “leaves unspecified the precise attributes along which similarity matters in a given setting, leaving it to researchers to stipulate relevant attributes based in their particular study context.” (Vissa, 2011, p. 141). Homophily based on organizational boundaries is more salient to tie formation in an organization than the typical demographics sociology focus on. Prior research finds that employees' organizational attributes such as status, seniority, and division of work—rather than demographics such as gender and education—influence their choices of advice ties in a company (Lazega and Van Duijn, 1997). Tie formation among professionals is largely driven by the similarity of their professional roles and specialty (Blau, 1974). In this study, we focus on three organizational attributes as the drivers of homophily in an organizational setting: functional affiliation (i.e., business unit), hierarchy (i.e., rank), and work location.

Below we argue that enterprise social media users are more likely to form ties with other users with whom they share the same organizational attributes.

*Functional homophily:* Employees who work in the same business units have significant similarities in attitudes and perceptions about their jobs (Adams et al., 1977; Roznowski and Hulin, 1985). They not only share similar attributes and skillsets matched to the requirements of their jobs but also experience similar socialization such as through job training and professional membership. Furthermore, employees strive to evaluate themselves by comparing their performance with that of their peers (Kilduff et al., 2010; Menon and Pfeffer, 2003)—e.g., those working in the same business unit. The desire for comparison can, in turn, foster formation of ties that makes the assessment of each other's abilities and opinions more accurate.

The features of enterprise social media platforms make the attributes of a user including functional affiliation, job title and rank so easily viewable and searchable. Similar to the user profile of LinkedIn, a user's digital profile in an enterprise social media platform is an explicit construction of one's professional identity (Treem and Leonardi, 2012). The ability to access and browse another user's digital profile and digital content makes it easy to locate people who have the same functional affiliation. Such access also makes it possible to assess whether these people's perceptions and attitudes, as reflected in their online activities, are congruent with one's own as expected. As a result, ties are more likely to form between users who have the same functional affiliation than those who do not. In support, Brzozowski (2009) found a great overlap between employees' networks of contacts on enterprise social media and their offline networks at HP, suggesting that functional homophily is still prevalent online. In a study at IBM, Wu et al. (2010) found that enterprise social media users felt closer to those with whom they share functional affiliations than those with whom they do not. Therefore, we propose the following:

*H3a: Tie formation in enterprise social media networks is driven by functional homophily.*

*Hierarchical homophily:* Employees who occupy the same hierarchical position in an organization are likely to develop similar perceptions, attitudes, and understanding of the workplace (Ibarra and Andrews, 1993). They also follow a similar assimilation path through job level responsibilities, positional sub-climates, and locus of control given at the job level. For these reasons, employees are more likely to seek tie formation with peers with an equivalent hierarchical position. As previously discussed, enterprise

social media enhances the visibility of and accessibility to individual users with the same hierarchical positions, thus increasing the likelihood of tie formation between users who have the same job ranks. Behrendt et al. (2015) examined how formal hierarchy boundaries affected tie formation and communication on enterprise social media in a medical service unit of the German military. They found that users connected and communicated mostly with others on the same level and rarely did so across different levels, although a longitudinal use of enterprise social media mitigated the tendency of hierarchical homophily. Accordingly, we propose the following:

*H3b: Tie formation in enterprise social media networks is driven by hierarchical homophily.*

*Locational homophily:* Shared work location is another source of tie formation because physical co-presence and shared physical setting are so deeply engrained to establish shared understanding and affiliation among co-located employees (Cramton, 2001; Cramton et al., 2007). The skills and knowledge of employees in an organization are often so dependent on their work locations. Co-located employees are likely to share similar perspectives, experience, and interests because they are exposed to the same set of stimuli, distractions, resources, and pressures present in a given physical setting (Tyre and von Hippel, 1997). Co-located employees are thus more likely to have high levels of common ground and shared understanding of their workplace than those remote. A major reason that distributed collaboration is so challenging is that remote collaborators share little in common in terms of office layout, holidays, customs, equipment, and local information, thus lacking mutual knowledge and a sense of affiliation (Cramton, 2001). Mutual knowledge is important

because it increases the likelihood that communication will be understood (Hinds and Mortensen, 2005). A sense of affiliation can induce confidence among employees who work in the same work site that not only what they know will be relevant to each other, but also what they say will be understood by each other. Users of enterprise social media platforms disclose their work location on their digital profile, allowing people to identify co-located others easily. Gibbs et al. (2015) analyzed the enterprise social media use in a Russian retail corporation. They found that the use of enterprise social media promoted communications across geographical boundaries. Thus, we propose the following:

*H3c: Tie formation in enterprise social media networks is driven by locational homophily.*

Taken together, we believe that enterprise social media helps to facilitate tie formation among employees—but in ways that *constrain* their networks. Ties formed within the same organizational boundaries (e.g., functional affiliation, hierarchy, and work location) are unlikely to provide informational benefits because of the lack of exposure to diverse sources of non-redundant information (Burt, 1992).

### 2.3. Mechanisms Resulting In Bridging Networks

In this section, we draw upon the network literature on cross-boundary spanning to theorize the tie formation mechanisms that tend to diversify one's network. Specifically, we identify two mechanisms that are likely to promote cross-boundary connections that would result in networks with diverse sources of information: preferential attachment and online interest groups.

#### 2.3.1. Preferential Attachment

Preferential attachment operates in a network when actors choose to form new ties with those who are already well connected rather than with average others just because the formers are popular (Barabási, 2002). Preferential attachment-driven tie formation follows a power law distribution, which models the situation in which success breeds success (Barabási and Albert, 1999; Price, 1976). A number of studies find preferential attachment to be at play in a variety of domains (Watts, 2004) including online settings (Capocci et al., 2006; Kwon et al., 2007; Rainie and Wellman, 2012). While research finds that preferential attachment operates in online social networks (Barabási, 2002), others do not find evidence for preferential attachment in knowledge exchange networks in online communities (Faraj and Johnson, 2011; Johnson et al., 2014).

At the core of preferential attachment lies people's desire to identify and connect with those who are most sought after by others, perceiving them to possess the most valuable information in an organization (Perry-Smith and Shalley, 2003). An individual's value or performance is often difficult to assess, so people look for signals of quality. Popularity among peers can be a strong signal of the person's value and reputation in the organization (Sparrowe et al., 2001). Preferential attachment demonstrates "a self-reinforcing process in which collective adherence to socially provided assessments reproduces and thereby validates those very assessments" (Gould, 2002, p. 1148). New entrants who are aware of the preferences of existing members in the network are likely to follow the preferences so that they can share perceived benefits (e.g., access to valuable resources) (Barabási and Albert, 1999).

In addition, the opportunity for "basking in re-



flected glory” can further facilitate preferential attachment. Balance theory posits that people are likely to perceive someone positively, if the person is perceived to be a friend of a positively valued other (e.g., a well-connected, popular person). By doing so, people maintain cognitive balance in their perceptions of others. In general, employees are eager to increase their reputation in their organizations. One way of doing so is to let people know of their social ties to prominent others (Cialdini, 1989). Research finds that being perceived to have a prominent friend in an organization boosts one’s reputation in the organization (Kilduff and Krackhardt, 1994).

Features of enterprise social media can further give rise to preferential attachment when employees seek new ties. This is because enterprise social media allows users to assess easily who is popular and who is connected to prominent actors in the organization. The popularity of a user can be gauged from the number of the user’s friends as shown on his/her digital profile. The user’s popularity can be further assessed from the frequency and volume of interactions the user has had with his/her online friends. Also, the ability to navigate network connections makes it also easy to see who is connected to prominent others in the organization. Therefore, we propose the following.

*H4: Tie formation in enterprise social media networks is driven by preferential attachment.*

The prominent organizational members who attract a large number of connections in an organization can serve as conduits to let diverse knowledge flow across the organization through their likely cross-boundary ties. People who form new ties with these popular users will become aware of diverse

others who are already connected to them. Given the effects of transitivity and reciprocity, this exposure may lead people on the network to initiate and form cross-boundary ties with one another.

### 2.3.2. Co-membership in Online Interest Groups

Another mechanism that is likely to promote cross-boundary connections is online interest groups. Co-membership in groups represents a type of “proto-tie,” a tie that can be developed from the mutual awareness of shared interests and interactions (Borgatti et al., 2009). When one voluntarily joins a group, it often means that one selects into relationships with others who share similar interests (McPherson et al., 2001). The effects of co-membership on tie formation have been studied in a variety of group settings: social events (Davis et al., 1941; Faust et al., 2002), corporate board memberships (Davis, 1991; Westphal and Khanna, 2003), production teams (Uzzi and Spiro, 2005), and open source projects (Hahn et al., 2008; Singh et al., 2011). The more groups or events two individuals are co-affiliated with, not only the more likely that they share similar interests, but also the more likely that they had or will have opportunities for interactions. Repeated encounters are likely to induce shared experience and affinity (Moreland and Zajonc, 1982) and thus increase the chance of forming strong and stable interpersonal relations (Monge and Eisenberg, 1987). For instance, the greater the number of committees on which a pair of legislators served together, the more likely the two were to nominate each other as friends (Caldeira and Patterson, 1987).

Enterprise social media platforms offer employees the opportunities to create or join online interest groups. Online interest groups provide employees

a way to identify and connect with others with shared interests—interests that would have otherwise gone unrecognized in typical offline interactions (McDermott and Archibald, 2010). A user's digital profile lists the online interest groups the user is a member of, making it easy for others to judge the extent and strength of mutual interests between them and the user. Furthermore, users who are co-members of an online interest group can assess and confirm the identity and interests of each other from their past communicative actions preserved in the archives of digital contents produced in the group (Ma and Agarwal, 2007; Treem and Leonardi, 2012). This should help to reduce the problem of attribution differences commonly found in computer-mediated-communication (CMC) settings that discourage interpersonal relationship building and interaction (Cramton et al., 2001; Ma and Agarwal, 2007). Therefore, we propose that enterprise social media facilitates tie formation between users who have co-memberships in online interest groups.

*H5: Tie formation in enterprise social media networks is driven by co-membership in online interest groups.*

### III. Setting and Methods

We collected data from a technology research and development organization that operates in the areas of information technology and systems engineering. The company has over 6,000 employees distributed worldwide, most of whom are considered to be knowledge workers with advanced science and engineering degrees. Because the organization takes on tough technical challenges facing its clients, employees are expected to seek out and leverage the knowledge and experience of technical and domain experts

distributed across the company and beyond. The company is thus keen to foster innovation through knowledge sharing and collaboration across individuals, projects, and centers. In an effort to create an integrative communication and collaboration structure that lets the organization cultivate a network-empowered innovative environment, the company developed an online social networking platform, Connect (pseudo name), in-house in the fall of 2009. Connect was not only open to employees but also to external partners by invitation.

Connect aimed to be a brokering platform that helps employees to identify others across the company with common issues and problems and to solve each other's problems. Connect offered several features such as blogs, wikis, profiles, microblogging, activity feeds, group support, tagging, RSS feeds, and discussion groups. Users could create their own digital profiles, form social connections (friending), establish and/or join online interest groups, and pursue multi-organizational collaboration. Connect also promoted awareness of relationships, discussion topics, and other individual and group activities through the use of email notifications and news feeds on users' profile pages.

There were over 200 online interest groups with a size of 10 or above at the time of data collection. The topical interests of these groups were diverse, ranging from purely social such as music, home brewing, electric vehicle owners, and gardening to general work topics such as Microsoft Excel, IT trends, socio-technical issues, innovation methodology, emotional intelligence in the workplace, healthcare innovation, and public health. In general, online interest groups attracted members from different organizational boundaries. For instance, there was a group over 300 members from 9 different work centers who had a shared interest on using an iPad at work.

### 3.1. Data

The unit of analysis is at the dyadic level. The data we collected contained 1) user information such as user type (i.e., internal, external), time elapsed since a user account was created, and whether receiving email notifications of Connect relationships and activities, 2) user activities such as friending (i.e., sending a friend request, accepting/rejecting a friend request, disconnecting a friending relationship) and online group membership, and 3) organizational information such as the year employed, job level (i.e., junior, middle, senior, external), work center, and work location.<sup>1)</sup>

To test our hypotheses, we analyzed the online tie formation (“friending”) events of Connect users over 2 years on a quarterly basis. This is similar to Faraj and Johnson (2011) who observed interaction ties in online communities for five quarterly periods. We chose quarterly observation to increase the number of events to observe. On average, there are new 544 connections made per month, which are small given the number of potential ties. By making observations at the quarterly level, the proportion of friending events accounts for 1-2% of the total number of potential ties. We identified 1,386 Connect users who had, at least, one connection (an online friend) during the study period. Overall, they were engaged in over 18,000 friending activities during the study period. We had 9 consecutive quarterly observation points. The first observation was based on 641 members, while the last quarterly observation was based on 1,386 members as new members had

joined Connect over time.

We were interested to know if new friendship ties between pairs of users formed at time  $t$  (current quarter) were affected by the pairs’ organizational attributes, network tendencies, and co-membership in online interest groups, as observed at time  $t-1$  (previous quarter). First, by using a lagged dependent variable, we were able to avoid a possible reverse causality effect of the formation of new ties on these mechanisms. Second, we could tease out the effects of different mechanisms on the formation of new ties at time  $t$  by controlling for the user’s social structure (friendship network) observed at time  $t-1$ . Third, by following the formation of new ties over 8 consecutive observation periods, one by one, we were able to assess the consistency of the hypothesized effects. This particular longitudinal approach was also employed in other online network studies (e.g., Faraj and Johnson 2011).

<Table 1> summarizes the operationalization of the key constructs. For each observation, we constructed several one-mode user-by-user matrices. We constructed a directed friendship network based on users’ friending activities where a value of 1 for cell  $(i, j)$  indicates that user  $i$  formed a tie with  $j$ . There are three possible dyadic relationships between users  $i$  and  $j$ : no tie (no friend), an unreciprocated tie (i.e., a friend request was sent but not accepted yet), and a reciprocated tie (a friend request was sent and accepted). We employed a social network analysis tool, UCINET 6, to generate three matrices based on the friendship network (Borgatti et al., 2013). The first matrix was a reciprocity matrix, which was the transpose of the friendship network. To the extent that people tend to reciprocate incoming ties (i.e., accepting friend requests), we should see that a 1 in the reciprocity matrix observed at time  $t-1$  is matched by a 1 in the corresponding cell of the friendship

1) As for an external user, the employee who invited the individual to connect determined the work center and location of the individual. With respect to the year employed, we assigned the year an external user joined Connect.

&lt;Table 1&gt; Key Construct Operationalization

Construct	Definition	Operationalization
Reciprocity	The tendency to reciprocate the incoming tie from another user	1 if the focal user accepts the other user's friending request, 0 otherwise.
Transitivity	The tendency to form a tie with another user with whom the user has mutual ties	1 if the focal user is two degrees or less away from the other user by the shortest path, 0 otherwise.
Functional homophily	The tendency to form a tie with another user who works in the same business unit	1 if both users work in the same business unit, 0 otherwise.
Locational homophily	The tendency to form a tie with another user who works in the same location	1 if both users work in the same location (city), 0 otherwise.
Hierarchical homophily	The tendency to form a tie with another user who has the same rank	1 if both users have the same job level, 0 otherwise.
Preferential attachment	The tendency to form a tie with another user who is popular	The number of incoming ties of the other user to whom the focal user sends a friend request
Co-membership	To the extent that both users have shared interests	The number of co-memberships between both users

network observed at time  $t$ . The second matrix was a transitivity matrix, indicating the friends of friends. A value of 1 for cell  $(i, j)$  indicates that user  $j$  is two degrees or less away from user  $i$  by the shortest path. To the extent that people tend to become friends with the friends of their friends (i.e., by sending (or accepting) friend requests to (from) one's friends' friends), we should see that a 1 in the transitivity matrix observed at time  $t-1$  is matched by a 1 in the corresponding cell of the friendship network observed at time  $t$ .<sup>2)</sup> The third matrix was a preferential attachment matrix, indicating the popularity of users. The value for cell  $(i, j)$  refers to the number of user  $j$ 's incoming ties. To the extent that people tend to become friends with those who are popular (i.e., by sending a friend request to one with a large number of incoming ties), we should observe the following correlation: the larger value in the  $(i, j)$  cell of the preferential attachment matrix (observed at time  $t-1$ ),

the higher chance of the corresponding cell of the friendship network observed at time  $t$  having a 1.

In addition, we constructed a matrix based on users' co-membership in online interest groups at time  $t-1$ . We first formed a two-mode affiliation matrix, where the rows are users and the columns are online interest groups. A value of 1 for cell  $(i, j)$  indicates that user  $i$  is a member of community  $j$ . We then transformed the two-mode matrix into an undirected one-mode co-membership matrix where a value for cell  $(i, j)$  indicates the number of co-membership ties between users  $i$  and  $j$ . To the extent that co-membership in online interest groups increases the chance of developing a social relationship, we should observe the following correlation: the larger value in the  $(i, j)$  cell of the co-membership matrix (observed at time  $t-1$ ), the higher chance of the corresponding cell of the friendship network observed at time  $t$  having a 1.

Finally, we constructed three homophily-related matrices based on users' organizational attributes such as business unit (i.e., functional affiliation), job

2) Note that the transitivity matrix also contained direct ties, but we controlled for them by including the friendship network observed at time  $t-1$  in the regression.

level (i.e., hierarchy), and geographic location where a value of 1 for cell (i, j) indicates that users i and j have the same organizational attribute. To the extent that existing organizational structures define (or limit) people's social relations, we should see that a 1 in these matrices is matched by a 1 in the corresponding cell of the friendship network observed at time t.

### 3.2. Analysis Approach

In order to test the proposed model, we ran a QAP-based logistic regression (LR-QAP) available on UCINET 6. LR-QAP is an extension of the QAP-based multiple-regression (MR-QAP), specifically designed for a binary outcome. The friending structure at time t, which contains dyadic (binary) relations among user pairs, was regressed on the previously described independent matrices observed at time t-1. In addition to the friending structure at time t-1, we added the following controls in the model for both sender and receiver (of a friend tie): user type (i.e., whether external or internal), user tenure (i.e., months elapsed since a user account was created), email digest (i.e., whether received email notifications of Connect relationships and activities), the year hired, 3 dummies for job level (i.e., junior, middle, senior, external), 8 dummies for business unit, and 8 dummies for geographical location.

LR-QAP proceeds in two steps to assess the significance of r-square and regression coefficients using permutations. In the first step, it performs a standard multiple regression across corresponding cells of the dependent and independent matrices. In the second step, it recomputes the regression after randomly permuting rows and columns of the dependent matrix and stores the values of r-squares and coefficients. It is important to run a large number of permutations

so that the p-value is stabilized. We set the number of permutation to be 2,000, meaning this step was repeated 2,000 times in order to estimate standard errors for the statistics of interest. For each coefficient, the program tests its 'p-value,' or statistical significance, by observing the likelihood—by counting the proportion—of random assignments yielding a coefficient as large as the one observed in step 1.

We tested the model of friending formation at time t in a sequential manner. The controls and friending structure observed at time t-1 were first entered into the model (Model 0), followed by the three organizational attributes (Model 1). Next, we entered network structure effects, both reciprocity and transitivity (Model 2). Controlling for these factors, we then turned our attention to the factors that are more likely to yield cross-boundary interactions. We added preferential attachment (Model 3) and then online interest group co-membership into the model (Model 4). For each independent variable newly added to the model, LR-QAP also provides a relative "badness-of-fit" measure, 2 log likelihood (-2LL), - in addition to a regression coefficient and the significance of r-square. A decrease in the -2LL provides further evidence that the added variable improves the fit of the logistic regression model.

## IV. Results

<Table 2> provides the descriptive statistics of Connect users.

The final results of LR-QAP for 8 consecutive quarterly observation periods are shown in <Table 3>. We omit to report the estimated coefficients of control variables because none of them was consistently significant across models and observations except for the friending structure observed at time

&lt;Table 2&gt; Connect User Description (N = 1,386)

Variable	Mean	St. Dev.	Min	Max
User type (1 = internal, 0 = external)	0.72	0.45	0	1
Joined the company (year)	2002.5	9.41	1962	2012
Junior manager (1 = yes)	0.03	0.18	0	1
Middle manager (1 = yes)	0.50	0.50	0	1
Senior manager (1 = yes)	0.15	0.36	0	1
Business unit (# of users working in the same unit)	180	157.28	3	386
Work location (# of users working in the same location)	38.94	136.05	1	598
Joined Connect (in months; 1 = 08/2009)	9.28	8.06	1	34
Email Notification (1 = yes, 0 = no)	0.40	0.49	0	1
Number of online friends*	13.21	21.60	1	241
Number of online group membership*	3.92	6.25	0	124
Number of online group co-membership*	0.20	0.61	0	66

Note: \* as of the last quarter observed during the study period

&lt;Table 3&gt; LR-QAP Results

t-1 \ t	Obs 1	Obs 2	Obs 3	Obs 4	Obs 5	Obs 6	Obs 7	Obs 8
Reciprocity	5.034**	4.739**	4.427**	4.804**	4.262**	3.867**	4.665**	3.663**
Transitivity	1.926**	1.402*	1.672**	2.27**	2.514**	2.163**	2.255**	2.314**
Functional homophily (Same BU)	0.654**	0.701**	0.773**	0.747**	0.594*	1.328**	0.624**	0.308*
Hierarchical homophily (Same Job Level)	-0.16	0.346*	0.092	0.145	0.416*	-0.026	0.066	-0.253
Locational homophily (Same Location)	0.311*	0.389*	0.258*	0.084	0.466*	0.527**	0.28**	0.434*
Pref Attachment	0.012	0.005	0.012*	0.005	0.005	0.008	0.006	0.008
Co-membership	0.830**	0.671**	0.592**	0.545**	0.526**	0.484**	0.559**	0.450**
-2LL	3112.1	3746.0	6362.5	5247.7	4203.1	5416.4	5074.6	4865.5
R2	0.975	0.973	0.959	0.972	0.980	0.977	0.979	0.980
Observed dyads	410,240	557,262	684,756	1,031,240	1,335,180	1,548,780	1,772,892	1,919,610

Note: The standard errors of the reported coefficients are extremely low, all ranging from .000 to .003, and thus omitted from reporting. Unreported controls include friending structure at t-1, user type, user tenure, email digest, hired year, job level, business unit, and geographical location.

t-1. Overall, each of the 8 observations produced almost identical results, thus proving the robustness of the identified network patterns.

We found consistent empirical evidence for most of the hypothesized tie formation tendencies over time, with the exception of hierarchical homophily

(i.e., same job level) and preferential attachment. Not surprisingly, the social structure observed at time t was strongly related to the friending structure observed a quarter earlier. By controlling for the previous friending structure, we could tease out the effects of different mechanisms on the formation of

new ties over the 8 observation periods. Both reciprocity and transitivity coefficients were positive and significant (e.g.,  $\beta = 5.03$ ,  $p < .01$ ;  $\beta = 1.93$ ,  $p < .01$ , respectively) in the first observation and consistently so in the subsequent observations. These results indicate the strong networking tendencies to reciprocate ties (i.e., accepting friend requests) and to make friends with friends of friends. Thus, H1 and H2 were supported.

The same-business-unit and same-work-location coefficients were positive and significant (e.g.,  $\beta = .65$ ,  $p < .01$ ;  $\beta = .31$ ,  $p < .05$ , respectively) in the first observation and consistently so in the subsequent observations. In contrast, the same-job-level coefficient was significant only twice during the 8 observations. So its effect was found to be not so robust. Taken altogether, the results indicate greater-than-chance tendencies to form new ties based on the same business unit and work location but not on the same job level. Thus, H3(a) and H3(c) were supported, while H3(b) was not.

The effect of preferential attachment was not significant, indicating no particular tendency to form ties with those who are popular. H4 was thus not supported. In contrast, co-membership in online interest groups was found to have a significant positive effect on forming new ties over time (e.g.,  $\beta = .83$ ,  $p < .01$ , in the first observation). This result shows that users tend to form ties with those from the same online interest groups. H5 is thus supported.

#### 4.1. Robustness Checks

We tested the robustness of the results above by changing observation periods from three months to two and four months. The results remained largely the same. It is possible that the nature of online interest groups may affect the likelihood of tie

formation. We divided online interest groups into three categories: professional interest groups, casual interest groups, and work groups. Professional interest groups covered various general topics, such as Microsoft Excel, the information-technology trends, sociotechnical issues, emotional intelligence in the workplace, healthcare innovation, and public health. Casual interest groups were mostly hobby-based and social by nature (e.g., music, home brewing, cycling, humor, and gardening). Work groups largely mirrored existing work groups such as committees, project teams and task force teams. As robustness checks, we used only one category in turn when constructing online interest group co-membership while controlling for the other two categories. The three versions of online interest group co-membership did not affect the major findings.

#### 4.2. Supplementary Analysis: Network Structure

In addition, we examined whether the mechanisms we identified to affect tie formation indeed lead to cultivating bridged or closed networks, as we assumed, at the ego network level. Specifically, we test whether people with stronger networking tendencies toward functional homophily and locational homophily have more closed (constrained) network structures while people who participate in more online interest groups tend to have more open (bridging) network structures.

We used Burt's network constraint index (1992) to measure the level of closeness (or openness) of the focal user's network. UCINET 6 computes the extent to which a focal user's network is constrained or densely interconnected. In this study, network constraint captures the extent to which the focal user's online friends are connected to one another, producing an index ranging from 0 (not connected

at all) to 1 (everyone is friends with one another). In calculation of functional and locational homophily scores, we used the formula that was used in prior homophily studies (e.g., Ibarra, 1992; Mollica, et al., 2003). This formula captures a person's tendency of choice homophily, which is what we focus on, while controlling for induced homophily, which results when people are surrounded disproportionately by similar others in the first place. Homophily scores range from -1 to 1, with positive values indicating a tendency to form ties with others within the same organizational boundaries set by business unit and work location and negative values indicating a tendency to form ties with others outside their organizational boundaries (See Mollica et al., 2003 for the details of the formula).

We ran an OLS regression analysis with robust standard errors based on the 1,386 users' network

data from our last quarterly observation period. <Table 4> summarizes the key constructs used in the analysis. We also included in the regression model a number of dummy control variables that capture the focal user's business unit, work location, job rank, and user type. <Table 5> reports the regression results. For brevity, we do not report the results of the aforementioned dummy controls.

A focal user's functional homophily and locational homophily were both positively related to the extent that the user had a closed network (.202,  $p < .001$ ; .160,  $p < .001$ , respectively), while the user's number of online interest group membership was negatively related to the extent that the user had a closed network (-.090,  $p < .001$ ). These findings provide preliminary evidence that enterprise social media is likely to foster both redundant, closed networks and diverse, bridging networks through different mechanisms.

<Table 4> Key Construct Operationalization

Construct	Definition	Operationalization
Network constraint	The extent that the focal user has a constrained (closed) network	Burt's network constraint measure provided by UCINET 6. It ranges from 0 (completely open, bridged) to 1 (completely closed).
Functional homophily	The tendency of the focal user to form ties with users who work in the same business unit	Used the homophily formula used in Mollica et al. (2003). It ranges from -1 (strong tendency to form cross-boundary ties) to 1 (strong tendency to form within-boundary ties)
Locational homophily	The tendency of the focal user to form ties with users who work in the same location	
Online interest group membership	The extent to which the focal user participates in various online interest groups	The number of the online interest groups where the focal user registered as a member.

<Table 5> Effects of the Tie Formation Mechanisms on Network Closure ( $N = 1,386$ )

Variable	Coef.	St. err.
Functional homophily	<b>0.202***</b>	0.023
Locational homophily	<b>0.160***</b>	0.021
Online interest group membership (log)	<b>-0.090***</b>	0.008
Number of days since became a user (log)	<b>-0.091***</b>	0.015
Number of years elapsed since hired (log)	-0.0160	0.08

Note: (log): Log-transformed; Unreported controls include dummies for job level, business unit, geographical location, user type.



## V. Discussion

Companies increasingly employ social media platforms to support the interactions between members of different boundaries within the enterprise for company-wide knowledge sharing and collaboration. In this paper, we explored whether an enterprise social networking platform was likely to lead to the type of bridging networks conducive to this goal or whether it would cultivate closed networks that would create little information value. Testing the online tie formation of 1,386 users over two years, we first find that users tend to reciprocate tie initiation and to form new ties with others who are already connected to their existing friends. In other words, reciprocity and transitivity are the main drivers of online tie formation and they help expand one's network. Who do users initiate ties with in the first place? We find that employees have strong tendency to connect with peers within the same organizational boundaries drawn by functional affiliation and work location. These findings suggest that organizational homophily predominantly drives tie formation in enterprise social media and users consequently tend to have redundant, closed networks.

By contrast, the sole mechanism we identified that would cultivate the types of bridging networks the social media platform was intended to foster was online interest groups. We find that co-membership in online interest groups fosters tie formation between users. Online interest groups are likely to bridge people with shared interests from different parts of the organization and foster connections outside of existing organizational boundaries. Our preliminary finding from the supplementary analysis that a user's membership in online interest groups is positively related to having a diverse, bridging network supports this view. While this mechanism may appear rela-

tively minor with respect to the other forces leading to network closure, research has shown that even a minimal amount of cross-boundary interactions can have considerable impacts on overall knowledge outcomes (Kane and Alavi, 2007).

### 5.1. Theoretical Implications

Perhaps the most important theoretical implication is the simplest - employees tend to network in enterprise social media in ways very similar to the way they network offline in organizations. We demonstrate that tie formation patterns, even online, are strongly influenced by a firm's organizational structure that gives rise to organizational homophily. People are more likely to form online ties with those assigned to the same business unit and work location. These findings suggest that existing social network theory can be used as a powerful lens to understand the networking patterns on enterprise social networking platforms and their outcomes.

These findings should not, however, be taken for granted because enterprise social network platforms could lead to fundamentally different networking behavior (Kane et al., 2014b). Prior research finds that users indeed form structurally diverse networks over time after they adopt an enterprise social media tool designed to locate in-house experts (Wu, 2013). While warning about the tendency to mingle with like-minded people only, another study suggests that locational boundaries no longer matter when it comes to interactions online (Van Alstyne and Brynjolfsson, 2005). In contrast, our study suggests that these formal boundaries are still at play affecting tie formation online in an organizational context. Ironically, the unprecedented visibility of who works where (functional- and locational-wise) within an organization and the greater accessibility seem to solidify, instead of help-

ing to transcend, the organizational boundaries that separate employees. Our findings provide empirical evidence for previous theorizing that online social media platforms might result in the opposite effects from which they were intended (Majcharzak et al., 2013). Researchers cannot assume that platforms will accomplish the types of outcomes such as connecting people across organizational boundaries that social media platforms are intended to accomplish.

Not all organizational boundaries delimit online tie formation, however. The finding that employees form ties across different hierarchical positions suggests that the social media-enabled access to each other's personal and social contents lowers the hierarchical barrier that often exists between junior and senior managers that gets in the way of building relational ties. Future research should further delineate how homophily interacts with different elements of an organization's formal structure in affecting network patterns online.

Interestingly, we find no evidence of preferential attachment-driven tie formation tendency in the enterprise social networks we studied. While this mechanism was originally forwarded as a robust predictor of tie formation in online networks, more recent research has questioned its applicability to different network settings (e.g., Faraj and Johnson, 2011). We provide further evidence that preferential attachment may be a theory of network formation that is limited in its applicability. Our study suggests that there may be a threshold required for preferential attachment to operate in enterprise social networks. The initiation of online ties with popular others may require, for example, existing offline relations, signs of commonality (e.g., functional affiliation, work location, co-membership in online interest groups), or mutual friends. Future research should investigate the conditions under which preferential attachment

operates (or not) in different network settings.

Lastly, we contribute to the emerging literature on technology affordances (Leonardi, 2011; Leonardi, 2013; Markus and Silver, 2008). The core idea of the literature is that the same technology enables different affordances depending on the goals of the users and the set of features they use. Our results demonstrate that the same enterprise social media can constrain one's network or cultivate a structurally diverse network. The implication of the results is that researchers should treat social media platforms not simply as an integrated technology but as a bundle of features. There can be considerable variation in what features people use (DeSanctis and Pool, 1994), leading to different networking behaviors. Specifically, we find that the display of co-membership in online interest groups is a key feature for creating connections outside of the existing organizational boundaries, while standard network features such as recommending someone based on the same organizational attributes are not. Other features, such as network visualization and recommendation engines, might also be helpful in countering the tendency toward network closure. In order to examine the impact of enterprise social media on knowledge sharing and innovation in organizations, researchers need to understand how and why different features lead to different networking outcomes.

## 5.2. Managerial Implications

Our research suggests that companies cannot simply implement social media platforms and expect them to have the desired outcome of making cross-boundary connections that provide informational benefits. Although the platforms have the capability to help users to cultivate bridging networks, we find strong effects of organizational homophily

on tie formation, leading up to closed networks. Managers need to deliberately develop and promote features that support cross-boundary tie formation. Our findings suggest that online interest groups can be one mechanism that facilitates cross-boundary tie formation. For instance, a cycling group may have no direct business purpose but helps to foster connections that yield cross-boundary communications within an enterprise. Managers who do not appreciate the potential benefits of nurturing online informal interest groups should understand that online interest groups provide a mechanism for connecting various employees across the organization.

### 5.3. Limitations and Future Research

Our study has several limitations that need to be addressed in future research. First, we were unable to examine the effects of key demographic attributes such as gender, age, ethnicity, and religion on online tie formation, primarily because the company did not allow us access to that data. We do not expect this omission to affect our results considerably, however. Prior research has shown that users' demographic attributes are much less salient in CMC settings (Kiesler et al., 1984; Sproull and Kiesler, 1986). A recent study finds that it is shared interests, not gender and ethnicity, that have strong effects on new tie formation between Twitter users (Choudhury, 2011). Furthermore, the omission of demographic attributes is common in enterprise social media platforms. For instance, when new users of enterprise social media platforms such as IBM's SNS SocialBlue are asked to create their digital profiles, they are rarely asked to enter demographic information. Doing so can be even prohibited by law. Nevertheless, it would be useful to control for any impact of demographics on tie formation in enterprise social net-

works just to confirm that the previous findings also hold in our setting.

Second, we investigated the enterprise social platform of a single company. While we took a longitudinal analytical approach to identify persistent tie formation patterns, it is possible that there are unobservable contextual factors that might influence tie formation. For example, platform features or organizational culture may be an important factor influencing tie formation that we could not test here. It is also possible that other platforms with different features may behave differently. Future research should examine how our findings generalize to other enterprise social network platform settings.

Lastly, we were unable to take actors' personal characteristics into effect in our examination of the antecedents to tie formation in enterprise social media. Research has shown that several personality characteristics including self-monitoring (i.e., behaving in a manner that is highly responsive to social situations) affect social network patterns (Klein et al., 2004; Mehra et al., 2001). For instance, high-self monitors are more likely than low self-monitors to form new ties including relative strangers who come from different functions within an organization, thus having more bridging networks (Sasovova et al., 2010). For high-self monitors, enterprise social media would be a catalyst for strategically structuring their networks that offer maximum levels of informational benefits. Participant surveys can provide deeper insights into why people form ties with certain others within and cross organizational boundaries.

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