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Idea Generation in Enterprise Social Media: Open versus Closed Groups and Their Network Structures

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ABSTRACT

Social network theory has produced conflicting results regarding the link between different social network structures—bridging versus bonding—and idea generation. To address this conundrum, we conduct a naturally occurring quasi-experiment of 126 open and 108 closed groups within an Enterprise Social Media (ESM) system of a multinational enterprise. Our findings show that idea generation occurs when the type of social network structure—bridging or bonding—is matched to a group's openness or closedness, respectively. We further show that the reverse is counterproductive: when closed groups display bridging ties and open groups display bonding ties, idea generation is significantly undermined. Theoretically, these findings clarify the conditions and mechanisms by which both bridging and bonding can result in idea generation and provide a deeper understanding of the use of ESM for idea generation. Practically, our findings provide valuable and actionable insights regarding the use of ESM for idea generation in groups.

KEYWORDS

Idea generation; enterprise social media; group openness; group closedness; social networks; network bonding; network bridging; group-level analysis

Introduction

Enterprise Social Media (ESM) technologies make it easier to form groups of individuals with mutual interests and complementary expertise in an organization. For many organizations interested in innovation, the strategic goal of implementing ESM surpasses effective knowledge transfer, and is intended to foster idea generation [77] between previously unknown others in the organization that may have not taken place otherwise [40]. Yet, how ESM affect serendipitous, impromptu, and unstructured knowledge sharing among ESM group users and, in turn, idea generation and innovation, is a subject of only recent research [40, 77, 78, 119].

Idea generation, in the context of ESM, refers to written group conversations that focus on producing novel ideas [97]. Producing ideas that are promising, useful, or valuable [4, 134] is the first step, or front-end, in innovation and new product development [68, 75]. Focusing on idea generation thus allows us to examine a critical antecedent to innovation [7, 82, 127].

Similar to organizational online communities [69], ESM enable employees to form collaborative groups among distributed individuals or teams with shared interests [52, 86] to engage in idea generation. In order to understand what drives idea generation in ESM

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groups, social network theory [6, 22] has provided useful, yet equivocal insights on the effects of two forms of network structures in ESM: bonding and bridging [22].

Bonding refers to the extent to which the group attains full connectedness or maximum network density [22]. Bonding thus emphasizes the internal structure of a group [c.f., 69]—that is, the linkages among individuals within the group and the features that give the group cohesion [1]. *Bridging* refers to the extent to which the members of a focal group collectively establish an external network of connections to other groups, which are separated by "structural holes" [25]. Bridging thus centers on the external structure of relationships of a group—that is, the linkages to others outside the group [22, 69].

The social network literature has produced conflicting findings regarding the importance of bridging or bonding for knowledge sharing and ultimately idea generation [103]. On the one hand, social network studies have emphasized that bonding is likely to increase group members' willingness to engage in idea generation, by establishing strong, informal social ties [136] that display greater solidarity, trust, and reciprocity norms, and thus increase the motivation of members to work cooperatively [103]. Such groups have the trust and psychological safety to constructively respond to new ideas [24, 42, 101]. On the other hand, other social network studies have highlighted that strong ties—those that are likely to underpin bonding networks—result in the sharing of redundant information [51] and rather that it is weak ties—often of an external bridging nature [18]—that provide access to novel insights. These studies have emphasized the benefits of bridging networks for idea generation as a consequence of the influx of heterogeneous perspectives that causes divergent thinking [88, 115, 132] and the production of novel concepts through combination [97].

This study adopts both views while clarifying the context in which either bonding or bridging is likely to increase group members' engagement in idea generation. We theorize that both external bridging and internal bonding may result in idea generation but only when the network structure is aligned with the openness or closedness of the group, respectively. When an open group—one that allows non-members to observe, join, or participate in group activities or interactions [48]—displays external bridging, idea generation increases. Similarly, when a closed group—one that is shielded from the rest of the organization—displays internal bonding, idea generation increases. By contrast, when an open group develops bonding relationships and a closed group develops bridging relationships, idea generation is negatively affected.

ESM provide a unique research opportunity to study this equivocality, which may be hard to solve in the context of offline groups, since it allows groups to self-organize and select whether to be open or closed upon the creation of the group. Consequently, both open and closed groups exist simultaneously within the same organization. This unique ability of ESM allows us to explain why both sets of network structures may increase idea generation in online groups through the interaction of a group's openness versus closedness and its network structure.

By using a naturally occurring quasi-experiment of over 28,000 written interactions of 126 open and 108 closed groups within the same large multinational enterprise, this study answers the following questions: What are the network structures that develop in open and closed groups respectively and how do these network structures—bridging and bonding—specifically influence idea generation content in open and closed groups in Enterprise Social Media? The results provide strong empirical support for the proposed

contingent model: idea generation increases when the type of social network structure—bridging and bonding—is matched with the group's openness or closedness, respectively. Yet, when the opposite occurs,—closed groups display bridging ties and open groups display bonding ties— the group's ability to engage in idea generation is significantly undermined.

These insights contribute to the literature in substantial ways. First, we extend the current theory on idea generation by elaborating on it in an online group context and combining it with a social network perspective to identify the contingencies of the effects of bridging and bonding ties. Second, by studying nature of conversations in both open and closed groups within the same organization, we explore the impact of the ability to choose between openness and closedness as enabled by ESM. Finally, we provide explanations for inconsistent findings of prior social network studies by suggesting that both bridging and bonding may positively affect a group's idea generation, but only when these match with the group's openness setting. As such, the study underscores the importance of recognizing that organizations today have different types of groups and that different strategies for using technology to support these groups are needed, an insight with important practical value for managers of such platforms and the groups using them.

Theoretical Background

In the following, we first offer a conceptualization of idea generation in ESM groups. We then define the two social network structures—bonding and bridging—and group openness or closedness in the context of ESM.

Idea Generation in ESM Groups

Idea generation refers to the production of novel concepts or ideas [92] and is often used synonymously with creativity [c.f., 10]. Although a large body of literature exists of both idea generation (or creativity) and innovation, much confusion surrounds the relationship between the two constructs. There are generally two perspectives on the relation between idea generation and innovation. In one view, innovation is treated as if concerned only with the implementation of ideas [e.g., 31], that is, idea generation is the process immediately *preceding* idea evaluation (i.e., innovation). In the other view, innovation comprises both the generation and implementation of ideas [e.g., 126]. Regardless of the perspective taken, idea generation thus presents the "front-end" of the innovation process [66] and, thus, for organizations interested in innovation, the question of how idea generation occurs through ESM is important.

In ESM, like other forms of computer-mediated communication, all interactions between participants are textually co-constructed [91]. Conversations on ESM consist of contributions made to discussion boards or blogs that can be organized by groups, each with their own purpose or objective. These interactions can be more or less focused on idea generation, depending on the extent to which they result in something novel by combining ideas in new ways, expanding them to different contexts, or fundamentally reframing them [adapted from 7, 127]. Indeed, the implementation of ESM is intended, by many organizations, to foster idea generation by having conversations among employees who do not normally talk to each other [c.f., 77, 78].

Leonardi [77] in discussing the impacts of the vicarious learning—learning through third-party observation—enabled by ESM, highlights the opportunities for recombinant innovation and provides two examples of idea generation in ESM using small-scale anecdotal evidence. The first example [77, p. 809] is from Marta working in the Card-member Marketing department who was researching consumer preferences for specific credit card brands. Her research revealed consumer decision being driven by reward programs. In trying to develop a strategic plan driven by her insights, she recalled a communication exchange in the ESM. She explored the conversation in the archives and it led her to develop a "breakthrough" consumer program. The second example (p. 809) also highlights how access to existing communications gives a third party a "better vantage point" of knowledge to "complement" what they know. As the interviewee in Leonardi's [77, p. 809] example remarks: "That helps you to be more innovative in your job by leveraging off of what others know."

Similarly, Bulgurcu et al. [20, p. 628] in discussing the various types of users in the ESM of a multinational organization highlight how core users believe ESM are effective platforms for "open innovation" and for "allowing free flows of ideas and information […] across the company between people from multiple places and multiple time zones that share similarities." Core users also emphasize that the ESM helps them "move […] more quickly" toward client solutions and avoid the duplication of client-oriented research resulting from being "too siloed … so you will end up repeating research." Hence, these examples illustrate that ESM has the potential to be used for purpose of idea generation.

The value of idea generation for an organization is that such conversations help group members learn about others' perspectives, synthesize different perspectives into new perspectives [14, 122, 127], collaborate creatively in a group setting, and stimulate others' creativity [49]. As such, idea generation has been demonstrated to increase the possibility of innovative ideas emerging [85] and therefore studying it provides insights into an enabler of innovation for an organization.

There has been no research on idea generation in ESM groups; yet, the potential exists because existing research on ESM has found anecdotal evidence, like the examples above [20, 77]. Furthermore, as research on ESM—although not explicitly focused on idea generation—has suggested, the use of ESM broadens the possibilities for collaboration and involvement [11, 131] by attracting many diverse users [19] and by helping users find others with similar interests and relevant expertise [114]. The use of ESM has also been found to foster increased possibility for conversations among employees who would not normally converse, such as those who are virtually distributed [36]. Therefore, these findings provide further evidence that idea generation may occur at least in some ESM groups. However, the factors that explain in which ESM groups such idea generation occurs are not as yet known. In the following, we will draw on the social network literature to discuss the mechanisms that help explain under what conditions ESM groups engage in idea generation.

Two Social Network Structures: Bonding and Bridging

Given that idea generation in the context of ESM is textually co-constructed [91] and thus embedded in the network of relationships of the ESM, social network theory lends itself particularly well to understand how the nature of the relationships that develop in ESM play a role in the enactment of idea generation. Indeed, the social network literature has

brought both theoretical [98] and empirical [24, 99] insights for understanding the generation of new ideas.

In this context, two opposing views have been produced [68]. The first is based on "structural holes" theory [21]. Most scholars in the network literature that have focused on idea generation, creativity, and knowledge exchange have built on this or similar lines of reasoning [24, 30, 98]. This view proclaims that a *bridging* network gives access to non-redundant contacts and therewith generates informational benefits. The second view, which was first introduced by [27], stresses the importance of social cohesion or bonding. In this bonding network structure, benefits for idea generation, creativity, and knowledge exchange stem from trust, support, coordinated action, and clear expectations [27, 92, 104]. These two distinct forms of network structures—bridging and bonding—have been widely studied in the context of online groups [c.f., 69] as critical antecedents to the way in which groups collaborate [1, 22, 44, 69, 104]. In what follows, we will link these *group-level network variables* to idea generation within ESM groups.

Bonding in a group refers to the extent to which the group attains full connectedness or maximum network density such that each group member bi-directionally interacts with each other member in the group [1, 104], that is, the network is said to be fully interconnected [22]. Bonding thus emphasizes the internal structure of a group [c.f., 69]—that is, the linkages among individuals within the group and the features that give the group cohesion [1].

In contrast, *bridging* emphasizes the importance of ties between disconnected heterogeneous entities [1]. Bridging centers on the external structure of relationships—that is, the linkages to others outside the group—as conduits to critical resources [23] and thus focuses on the benefits associated with occupying a brokerage position or spanning "structural holes" [22, 69].

Group Openness versus Closedness

In the context of ESM, openness has been proposed as the most foundational and distinctive feature of this new class of enterprise technologies [48, 79]. Openness refers to the ability of other users of the ESM to observe, join, or participate in activities or interactions of individuals and groups with whom no direct ties are maintained [48]. Openness not only makes exchanges between employees transparent to third parties [53], but also opens up the content of those exchanges [67, 76] enabling a situation of "hypervisibility" [65, 77].

At the group-level, the ability to select an openness setting when creating a place to host team posts is a critical but largely overlooked feature in the ESM literature, in that the same feature may be leveraged to create both open and closed groups. That is, when users establish groups in ESM, they are prompted to select the privacy level of their group, a binary choice to open up the group to the entire ESM community or to shield the group from non-members [128].

An open group is one in which conversations between the members can be seen by any user of the ESM across the organization. Because the group is open, those outside the group are not only aware of the group's existence, ongoing activities, and interactions, but can also join the group without an invitation or participate in group interactions without becoming a member. Although users can read the group's content and contribute without being a member, they may still decide to join the group to receive updates on activities and content through member notifications rather than searching for updates manually.

Furthermore, joining the group could be a mechanism to show affiliation or engagement, which may be important in a workplace setting.

Inversely, a closed group is one in which the existence of the group cannot be seen by non-members. Thus, those outside the group are unaware of its existence, purpose, stage of development, and members. Non-group members may still receive an invitation to join from existing group members, but the serendipitous identification of the group along with the associated disruption of its evolving relationship-building is unlikely.

Table 1 summarizes the conceptualization of constructs underpinning our theoretical model.

Conceptual Model and Hypotheses

Figure 1 presents the proposed theoretical model including our hypotheses concerning the effect of group openness on the social network structures ESM groups develop (H1) and the moderating effects of group openness on the relation between the two network structures and idea generation (H2). We will discuss these relationships in the following sections.

Effect of Group Openness versus Closedness on Social Network Structures

The openness or closedness of a group may affect which of the two social network structures are more likely to evolve in the ESM group.

Table 1. Summary of theoretical constructs and their definitions.

Construct	Definition	Reference
Idea generation	Written group conversations in the ESM that focus on producing novel concepts and ideas	[97]
Bonding	The extent to which a group attains full connectedness such that each group member bi-directionally interacts with each other (i.e., internal structure of the group).	[1, 22, 69, 104]
Bridging	The extent to which ties span between heterogeneous entities (i.e., the external structure of the group).	[1, 22, 23, 69]
Group Openness vs. Closedness	Whether or not non-group members can observe, join, or participate in a group's activities and interactions.	[48]

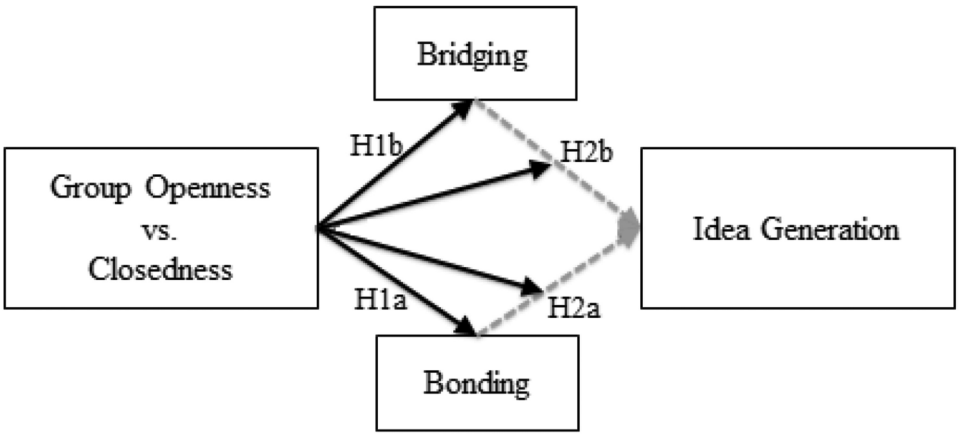

Figure 1. Proposed theoretical model.

From a social network perspective, a group's closedness has two direct implications for the formation of bonding ties. First, because the group is closed, members have a reasonable expectation that their conversations are held privately among the members only. Thus, group members may be less reticent about including personal content within their professional conversations which helps to establish stronger interpersonal relationships [78, 130].

Second, because of the closedness of the group, the relationship building that occurs within the group is unlikely to be disrupted from outside. By having relatively uninterrupted group interactions, members begin to identify similarities [70] and build on them to establish shared identity and understandings, a shared memory system, strong coordination and reciprocity norms, psychological safety, as well as trust and mutual respect [6, 41, 58, 89]. These characteristics enable strong bonding among members of the group. Therefore, we propose:

Hypothesis 1a: Closed groups, when compared to open groups, will display a greater amount of bonding relationships.

Inversely, general consensus exists in the ESM literature that the communication leaks that happen as a result of openness make it easier for employees to establish new and serendipitous social connections with previously unknown others in the organization [19] as well as maintain and leverage them over time [47]. From a social network perspective, then, this openness has two direct implications for the formation of bridging ties.

First, because of the complete transparency of groups, non-members are not only aware of the group's existence, but also makes it easier and more likely for non-members to connect with members of the group, thereby fostering more external ties that span structural holes [64]. Thus openness results in the formation of novel social connections with previously unknown others inside the organization [19] leading to novel weak connections. Second, by opening the content of a group to non-members, non-members can freely participate in group conversations or even join the group. The combination of novel weak connections and the spanning of structural holes that is enabled through openness will foster a bridging structure in the group. Thus, we propose:

Hypothesis 1b: Open groups, when compared to closed groups, will display a greater amount of bridging relationships.

Effects of Social Network Structures on Idea Generation in Open versus Closed Groups

The social network literature has produced conflicting findings on the importance of bridging or bonding for knowledge sharing and ultimately idea generation [103], with one view arguing that bridging ties—by giving access to non-redundant contacts and diverse information [24, 30, 98]—and the other arguing that bonding ties—by enabling trust, support, and coordinated action [27, 92, 104]—result in idea generation [68]. It is important to note that the two arguments are based on different mechanisms, with the former emphasizing *informational* benefits in terms of diversity and non-redundancy of

knowledge stemming from the spanning of structural holes [24, 30, 31, 98] and the latter emphasizing *relational* benefits, in terms of trust, strong coordination norms, and shared beliefs and visions that stem from bonding ties [27, 92, 104].

The unique ability of ESM groups to determine their openness or closedness may offer an explanatory mechanism as to why both sets of network structures may be able to increase the amount of idea generation in online groups. In what follows, we first outline the direct link between both network structures—bonding and bridging—and idea generation and then hypothesize the moderating role of group closedness and openness, respectively.

Bonding, or the dense network of the group, has been examined as indicative of strong and informal social ties [136] that are characterized by trust. The trust emerging from dense networks is theorized to facilitate the sharing of unique ideas [26, 117] and reduce concerns over opportunistic behaviors [50, 61, 63, 72, 73, 74, 80, 124]. Furthermore, trust reduces concerns about having ideas criticized or rejected [87, 118] and as a result, creators feel more psychologically safe to disclose ideas, including counter-normative perspectives, without filtering or changing them [137, 138].

Similarly, bonding increases the motivation of members to display cooperative behaviors toward one another [103] by promoting the development of strong norms of reciprocity within the group [1, 102, 106, 120, 123], which can be effectively developed online [c.f., 45, 69]. The emergence of these norms of reciprocity may facilitate idea generation by establishing heightened cognitive and relational social capital [120], creating a sense of shared ownership and mutual understanding [46], as well as by generating social pressure to help each other [27, 50, 51]. Indeed, Sosa [112] suggests that networks of dense, strong ties have a positive effect on idea generation and creativity because they increase support and motivation to share ideas.

Furthermore, bonding structures of close, dense relationships are associated with emotional support [32, 112]. Emotionally-close contacts, characterized by trust and psychological safety, are more likely to constructively respond to new ideas [e.g., 24, 41, 101], and the feedback provided tends to be more encouraging, informational [29, 105], constructive, and useful [28, 111]. This is in line with the creative synthesis perspective formulated by Harvey [58] where she argues that breakthrough ideas stem from actors engaging with one another intensely to change their understanding and to allow increased novelty to emerge [9, 13].

Nonetheless, it is important to acknowledge that groups characterized by dense, cliquish network structures can also be associated with "groupthink" [62] and information redundancy [25] that may undermine a group's ability to generate ideas. However, these risks seem to be higher in offline than online groups, as computer-mediated communication (CMC) and virtual settings enable users to behave "relatively uninhibited" and less subject to social and status cues [106]. As a result, it has led CMC researchers to conclude that the status equalization that occurs in virtual groups may foster the creation of new ideas [113]. Thus, given the virtual nature of ESM groups, we anticipate that bonding is likely to foster idea generation by enabling a dialectic synthesis [58] through different ways of understanding and reframing a problem [9, 13, 59, 110].

Moreover, by shielding the interactions of a group to disruptions from non-members, the bonding relations that develop in CLOSED groups are likely to result in continuous attempts to understand, appreciate, and integrate each other's cognitive models [9, 10, 13,

58, 82]. These dialectical interactions result in the emergence of new shared understandings [60, 122] and the production of breakthrough ideas [9, 58, 125, 126]. This moderating role of closedness emphasizes that strong bonding alone may not be sufficient for idea generation to emerge. Indeed, for groups with strong bonding ties, openness—which allows outsiders to join or interject—would be disruptive to the ability to leverage the group's strong social and cognitive connectedness and thus would undermine members' willingness to take the risks of offering breakthrough ideas and comments [6, 41, 89] that have been identified as critical conduits to idea generation [58].

Therefore, we hypothesize:

Hypothesis 2a: Within CLOSED groups, the greater the bonding relationships of an ESM-based group, the more idea generation occurs within the group.

For groups characterized by bridging structures, the value made possible by spanning structural holes may extend beyond knowledge sharing to idea generation in two ways. First, spanning structural holes to other individuals and teams within the organization provides access to diverse and original (i.e., non-redundant) information, perspectives, and knowledge [55-57]. Hence, the information accessible through bridging ties is more likely to be novel and therefore can be the source of new perspectives underpinning idea generation. By providing access to non-redundant content [96], bridging facilitates recombination and, ultimately, creativity [96, 100].

Second, the concept of bridging is in line with the majority of literature on idea generation in groups that has relied on an evolutionary perspective, which emphasizes random variation as the key mechanism underpinning the production of breakthrough creative ideas [3, 34, 58, 90, 95, 133]. In this context, it has been theorized that by maximizing the diversity of group composition [88, 132] and of the environmental resources available to group members [43, 117, 121], variety in input produces variety in output [58]. Indeed, bridging structures have been shown to result in access to more diverse information [5]. When groups build on existing ideas from others in the organization [71, 94], divergence is encouraged and opens up new categories for idea generation.

Bridging ties, by allowing disconnected people to share resources, improve access to diverse external resources and enable resources to be leveraged in a more timely and effective manner [24, 101] through relationships with other groups in the organization [1]. Hence, a bridging group can generate novel ideas as a consequence of the influx of heterogeneous perspectives and information [14, 15, 38] enabled through the multitude of weak ties the group maintains in ESM.

When relationships of a group are centered on bridging in *OPEN* groups, interactions become focused on idea generation as bridging ties alone do not generate the diverse nature of external inputs that openness affords. For instance, when groups are open, members are more likely to frame their questions or ideas in such a way that a diverse audience can understand them and respond [16, 103], thus increasing the likelihood of serendipitous and heterogeneous inputs.

Furthermore, Majchrzak et al. [84] found that—in the context of wikis—open interactions allow project members to identify gaps in their expertise where external contributions are helpful. The use of ESM may have a similar effect and may make it easier for

outside users to self-identify their contributions as relevant and hence increases the likelihood of them contributing.

In contrast, when groups are closed, bridging could still occur through being a member of other (possible, open) groups. However, when groups have some degree of bridging but are closed, their ability to use heterogeneous inputs is limited to those they have personally developed (i.e., through past connections) thus lacking the serendipity of new connections and inputs from non-members that is likely for open groups. Since no unexpected external input will occur, closed group members with bridges must become the gatekeeper and boundary spanner for all input from existing connections outside the group [39, 83, 107]. This can cause significant cognitive burden to them, making them less likely to engage in idea generation [8, 83, 108, 109].

Therefore, and in line with the evolutionary perspective on creativity, we suggest that it is the combination of within group diversity—stemming from the bridging ties of the group members—and a focus on external resources and connections—stemming from the openness of the group—that leads to breakthrough ideas. Hence, we hypothesize:

Hypothesis 2b: Within OPEN groups, the greater the bridging relationships of an ESM-based group, the more idea generation occurs.

Research Setting and Methodology

To test our hypotheses, we captured the content and connections formed by 234 groups across approximately 9,000 unique users by using the system log data of the ESM from a single organization. The log data included a total of approximately 6,500 discussion threads (ranging in size from one parent post to 170+ replies) that were collected from across 126 open and 108 closed groups for a total of over 28,000 written interactions produced by these 234 groups. In the organization we study, the management strongly encouraged these groups to leverage the ESM for idea generation, for instance by organizing "innovation jams" through the ESM.

Case Organization

WorkPlace Futures (a pseudonym, as are other names in this article) conducts research and consulting in the domain of human-computer interaction with a focus on design, development, and manufacturing of technology and furnishing products and services for corporate offices as well as healthcare, educational, and government institutions. The services provided by WorkPlace Futures include client consulting, workplace surveys, financial services, performance management, recycling and reuse, as well as the overall design, development, and manufacturing of workplace solutions. WorkPlace Futures has over 11,000 employees with over 80 locations in the Americas, Europe, Asia, Africa, and Australia, and is headquartered in the United States.

WorkPlace Futures launched Inspire, an ESM tool developed by Jive Software. Its purpose was to support business connections, communications, and collaborations among employees worldwide. Given WorkPlace Futures proactive stance toward technology adoption, a plethora of information and communication tools were being used by its teams undermining the

opportunity for effective inter-team knowledge sharing and collaboration. Hence, the primary strategic objective of implementing Inspire was to create an umbrella tool where all forms of interaction, collaboration, coordination, and knowledge sharing could take place. Inspire offers built-in support for creating groups, setting privacy restrictions, communicating using group chat, blogging, social bookmarking, and telephony integration. Following its global launch, adoption and use of Inspire grew quickly at WorkPlace Futures. At the time of the data collection, there had been a stable base of users for five years, totaling over 10,000 of the 11,000 employees.

Over 9,000 unique users in Inspire (91 percent) are members of groups and thus participate in group discussions and activities. Many users are members of multiple groups; the number of groups that Inspire users belong to shown with a histogram in Online Supplemental Appendix 1.

Across all groups in Inspire, the average entropy score of geographic dispersion is .824, hence, across all groups, about 82 percent of members will each come from *unique* geographic locations, highlighting that groups in Inspire tend to be distributed in nature. Open groups can be found through the simple search functionality in the system and require no request to join. Closed groups, in contrast, are secret, even to the community manager. The only way to join a closed group is to receive an invitation from someone who is already a member. Data from the Inspire platform at WorkPlace Futures shows that about 80 percent of all interactions taking place through Inspire are work-related and about 20 percent of all conversations are social (e.g., sharing family, vacation and other personal stories and images, etc.).

Data Collection and Sample

To test our hypotheses, we obtained log data of all interactions produced by all groups. There were initially 711 groups in the dataset; that is, these were the total number of created groups. At the start of our analysis, we examined if any of the groups were comparatively larger than others and found 55 groups that were either all-department or all-division groups, serving more as bulletin boards of events and general questions and answers.

From the remaining 656 groups retained for preliminary analysis, we explored if there was a specific timeframe during which activity levels peaked so that we could capture the group's bridging or bonding structure at the start of that period and the idea generation occurring during that period. In order to determine the timeframe, we plotted activity plots of all 656 groups and found an appropriate one-year timeframe. Within the five-year timespan of our data, groups are much more likely to collaborate for diverse goals than during a one-year period. This timeframe lens resulted in a subsample of 262 groups with a relatively concentrated one-year activity span during the five-year total data period. It is important to note, that it was not the same one-year period for all groups, but the specific timeframe at which each individual group's activity peaked.[1] In Online Supplemental Appendix 2, we provide four sample activity plots representing the activity counts over a one-year period for open and closed groups that were included, as well as groups excluded from the data set due to sporadic activity.

We then examined the 262 groups to ensure they were all work related. We conducted a manual content analysis of the group names and descriptors provided in Inspire and

found that 27 groups were social groups—including groups focused on knitting, cycling, and gardening. We removed these groups, resulting in a final sample of 234 groups, of which 127 groups were open and 108 groups were closed.

Thus, it is important to emphasize that the selection of the 234 groups was based on selecting groups that were work-related and project-focused, but it was not necessary for these groups to be explicitly created for purposes of creativity or innovation. Our reasons for this were twofold. First, we argue that idea generation occurs not only in the course of innovation, but also in problem-solving or decision-making contexts [68], hence, instances of idea generation may occur in a much wider range of groups. Second, the argument of the ESM literature—that we are partially testing here—is that by rendering interactions, communications, and relationships visible, opportunities for idea generation emerge even when this might not be the explicit goal of an exchange or a group. Indeed, our descriptive statistics show that out of the 234 groups in our dataset, only 23 groups (~10 percent) did not have instances of idea generation, underscoring that although many groups in ESM may not be established for the explicit purpose of innovation, idea generation may still happen and does happen in 90 percent of the groups in our dataset.

Following the finalization of our sample of 234 groups, we conducted a comparative analysis of open and closed groups in terms of a set of quantitative and qualitative criteria to establish invariance between them. Online Supplemental Appendix 3 shows that except for group size, number of active users, and hierarchical entropy—which are controlled for in our further analysis—there are no substantial systematic differences between open and closed groups in quantitative terms.

In terms of qualitative assessment, the authors conducted a manual inspection of the group purpose descriptors and found no systematic differences between open and closed groups in terms of their group purpose. This was confirmed through a topic analysis, which revealed that the top 12 keywords discussed in the open groups include: *share, WorkPlace Futures, group, information, team, work, support, ideas, global, best practices, sales, business, discuss*, and the top keywords in the closed groups include *group, team, share, WorkPlace Futures, place, information, projects, ideas, knowledge, sharing, global*, and *business*. Hence, the focal keywords across the two types of groups appear to be highly similar.

Measures

The measurements for our key theoretical constructs are derived from the organizational records embedded in the ESM and all measures are at the group-level. For the operationalization of the dependent variable (i.e., idea generation), we developed a machine-learning algorithm, outlined below. For the independent variables, we calculated network measures (i.e., network density as a proxy for bonding and Kim et al.'s [69] external bridging measure). We determined individual group membership via the ESM log data. Online Supplemental Appendix 4 summarizes the study variables, their operationalization, and descriptive statistics for each variable.

Group Openness

Openness is operationalized as a binary variable reflecting the existing privacy settings of the group. Openness in the context of the ESM in WorkPlace Futures encompasses three dimensions: the ability for non-members to observe (i.e., read content or observe interactions), join

(i.e., become a member without invitation), or participate (i.e., contribute in the form of liking, commenting, sharing, or posting). Open groups enable all three dimensions, whereas closed groups disable them. We validated using the system log data that group openness settings are determined upon the creation of the group space (T0) and are not altered afterwards by comparing the group openness settings at T0 to T365 (i.e., the end of the one-year timeframe). We found that the settings were the same for all 234 groups in the data set, confirming that group openness precedes both the structure and content of the group interactions.

Bonding and Bridging

Both network measures are computed using the data from the ESM, and hence, reflect the level of bonding and bridging of the ESM-based network of a group.

To calculate the amount of *bonding* that characterizes a group, we used network density, that is, the extent to which members of the group were strongly connected to one another, as an indicator, which is in line with established practices in information systems (IS) research examining the internal cohesion of open source development groups [c.f., 69, 109] and one of the most commonly used measures of bonding or cohesion in network research [17]. It is computed by taking the sum of ties divided by the number of possible ties. Given the asymmetrical nature of tie formation inside the ESM, a tie was determined to exist in any of the following three scenarios: A follows B, B follows A, and A and B follow each other. Network density as a social network proxy for bonding is appropriate for group level research since it represents the average strength of ties present across all possible ties in the focal ESM group.

To calculate the amount of *bridging* that characterizes a group, we used Kim et al.'s [69] community external bridging measure, which is an adaptation of Burt's [21] structural holes measure. The connection between two groups was determined by the number of their shared group members. Thus 1 - C_{it} is the measure of external bridging of focal group i on date t, with a value ranging from 0 to 1. C_{it} is calculated by function [1], where n is the total number of groups and c_{ijt} (calculated by [2]) is the measure of focal group i's connection to group j in on date t.

$$c_{it} = \sum_{j=1}^{n} c_{ijt}, \quad i \neq j \tag{1}$$

$$c_{ijt} = \left(p_{ijt} + \sum_{q=1}^{n} p_{iqt} p_{qit} \right)^2, \quad i \neq q \, i \neq j \tag{2}$$

In formula (2), p_{ijt} is the proportional strength of the connection that focal group i had with group j among its connections with other groups on date t. To summarize, p_{ijt} measures the direct connection between focal group i and j, and $\sum_{j=1}^{n} p_{iqt} p_{qit}$ measures the indirect connections.

We also followed Burt's [25] suggestion and calculated the proportional strength rather than the absolute strength of the connection as indicated by function [3], where Z_{ijt} was calculated by summing the number of shared group members between groups i and j on date t.

$$p_{ijt} = \frac{z_{ijt} + z_{jit}}{\sum_{k=1}^{n} (z_{ikt} + z_{kit})}, \quad i \neq k \tag{3}$$

To assess whether the key independent variables fluctuate over the defined one-year study period, both bridging and bonding were regressed longitudinally to measure the within-group (i.e., longitudinal) variance to explore if a one-time assessment of bridging and bonding at the start of the group's activity period was appropriate or if these network variables had to be analyzed longitudinally. Hereto, we ran a fixed-effects model with 12 monthly instances of the bridging and bonding measures. Our results show that the within-group variance is insignificant, indicating that both bonding (mean start: .318; mean end: .285; B = 0.261; p = .535) and bridging (mean start: .318; mean end: .285; B = -0.378; p = .407) do not show a significant change. Hence, given the lack of longitudinal variance, it is appropriate to use a single instance measured at the start of the group's activity period in our final regression models.

Amount of Idea Generation

The amount of idea generation was derived from the content of the interactions. To ensure that there is no confounding between our independent variable (the openness or closedness of the group) and our dependent variable (amount of idea generation), we first examined the topics discussed to determine if they were substantially different between open and closed ESM groups and could not discern any differences. Topics discussed in both types of groups included designs of products, design processes, organizational issues and social media. The amount of idea generation was operationalized as a count variable at the group level. The variable thus measures the total count of instances of idea generation across all content from the group over the one-year period (T_1-T_{365}, where T is number of days).

The variable was computed through a machine-learning algorithm, which involved various stages of development. In the first stage of algorithm development, two graduate students were trained to perform manual coding of a subset (14 percent) of all content data from the 234 groups to ensure the reliable development of the machine-learning algorithm. The students classified the posts as one of three distinct types of idea generation: combination, expansion, or reframing. Example threads for each type are included in Online Supplemental Appendix 5. The codebook (Online Supplemental Appendix 6) provided definitions and examples of the different types of instances of idea generation separately.

Coding was preceded by an elaborate training session to familiarize the coders with the coding manual and coding scheme. Following the training, the coders were supervised in the independent coding of 14 percent of the content to compute interrater agreement. An initial interrater agreement of 89.6 percent with a corresponding .71 Cohen's kappa [i.e., substantial agreement; cf., 74] as calculated following the first round of (independent) coding provided confirmation of coding scheme validity and coding process reliability. Online Supplemental Appendix 6 includes the coding manual.

Within the next stage, the manually coded data was used to create an algorithm for automated text classification. The problem of text data classification belongs to the area of natural language processing, which is one of the most popular applications of machine learning. Compared to machine-learning problems that deal with numerical data, text data mining and classification is more tedious.

In this study, we used a neural network algorithm to develop the prediction model. Neural network algorithm is a supervised learning algorithm. The idea of this algorithm is

based on a collection of connected units or nodes called artificial neurons; a set of units form a layer and one neural network consists of several layers. The simplest network has at least three layers: the input layer, the hidden layer, and the output layer. Layers can transmit signals to the neighbor layers. With the rapid development of Deep Learning, neural network has been demonstrated to be very powerful in solving Natural Language Processing problems [81], such as text classification in our study. In our model, because the training data was not sufficient to run deep neural network with more layers, we used a three-layer basic neural network. The input features are words and two-gram phrases extracted from content, and selected by Gini-index equations [2] using a threshold of 0.2. After several rounds of hyper parameters optimization, the overall prediction of the algorithm reaches to as high as 81.9 percent.

For each group, a score was created by taking the sum of all occurrences across all the content types (e.g., discussions or blogs) and across the different types of idea generation that were coded (i.e., combination, expansion, and reframing) associated with that group. Furthermore, given the high correlation between the amount of idea generation and a group's overall content creation, the dependent variable was log-transformed to control for group level variations in size and overall content creation.[2] Online Supplemental Appendix 7 presents the keywords by the machine-learning algorithm distinguishing idea generation from non-idea generation as well as example sentences classified by the algorithm.

Control Variables

Although we collected data for five important control variables—including group size, active users, as well as group diversity vis-à-vis location, hierarchical level, and functional area—only those that were found to be significant were retained in the final regression model, namely group size, the number of active users in the group, and the hierarchical diversity of the group (hierarchical entropy).

Results

To test the proposed hypotheses, we conducted Poisson regression analyses [40, 130] by using the LME4 statistical package in R.

Our dependent variable (Y_u = Total number of idea generation by group u) is a count variable that is heteroscedastic (i.e., the variance is not constant but depends on the value of the estimate itself). To remedy this situation, we used Poisson regression and modeled the dependent variable as a Poisson-distributed variable. As per our hypotheses, all independent and dependent variables in our Poisson regression model are at the group level.

Our independent variables—group openness/closedness and a group's bridging and bonding—were measured before the dependent variable (the amount of idea generation). Group openness/closedness was determined upon the creation of the group space (T_0), as our system log data suggests that privacy settings are not altered afterwards as discussed in the methodology section. Group bonding and bridging were measured at the start of each group's one-year activity period (T_1). Finally, the amount of idea generation was calculated over the course of the one-year period ($>T_1$-T_{365}), where T is the number of days in our final dataset.

Because it is theorized that group closedness increases the likelihood of bonding, openness increases the likelihood of bridging, and openness/closedness moderates the effects of bonding and bridging on the amount of idea generation, we also had to verify that the moderator (group openness) and the independent variables (bonding and bridging) did not display multicollinearity. The highest of the three VIF score for bridging was 1.717, hence, we can conclude that multicollinearity is not a concern and cannot cause estimation problems. The correlation scores are presented in Table 2.

Results for the Effect of Group Openness versus Closedness on Social Network Structure

For the test of H1a—closed groups display greater bonding compared to open groups—we ran an independent sample t-test. Our results, as shown in Table 3, indicate support for the hypothesis (t = -3.826; p =0.000). The test of H1b—open groups display greater bridging compared to closed groups—was similarly tested with an independent sample t-test. Our results, as shown in Table 3, indicate support for the hypothesis (t = 2.942; p = 0.004).

In summary, our findings indicate that closed groups form significantly greater bonding relationships, whereas open groups display significantly greater bridging relationships.

Results for the Effects of Social Network Structures on Idea Generation in Open versus Closed Groups

To test H2—group closedness versus openness affecting the relationship between social network structures (i.e., bonding and bridging) and the amount of idea generation—we conducted a Poisson moderator regression. Before presenting the moderator effects, we first present the main effects of bonding and bridging.

Our findings show that the main effect of bonding is not significant (B = -1.021, p = 0.306). Furthermore, we found that the main effect of bridging is negative, that is, groups with greater bridging ties display lower amounts of idea generation (B = -5.149, p = 0.000). We conducted an additional analysis to determine the degree of overlap between groups high in each network structure and found no group which was high in both (where "high" was defined as a score of one standard deviation above the mean for either bonding or bridging ties respectively). This suggests that the two network structures are mutually

Table 2. Correlation scores.

	Group Type	Bridging	Bonding	Idea Generation
Group Type	1.000			
Bridging	-0.107	1.000		
Bonding	0.212	-0.137	1.000	
Idea Generation	-0.104	0.118	-0.098	1.000

Table 3. Results of independent sample t-tests for H1.

	Mean	Std. Dev.	t	df	Sig.
Bonding	.269 (Closed) .169 (Open)	.334 (Closed) .201 (Open)	-3.826	233	.000
Bridging	.268 (Closed) .362 (Open)	.412 (Closed) .413 (Open)	2.942	233	.004

exclusive in our dataset; i.e., ESM groups at WorkPlace Futures either develop strong internal bonding or strong external bridging but they are highly unlikely to build and maintain both forms of network structures simultaneously.

Our results indicate support for H2a, namely group closedness moderates the relationship between bonding and the amount of idea generation (B = 2.241; p = 0.000). A graph of the interaction effect (Online Supplemental Appendix 8a), demonstrates that, as bonding increases, the amount of idea generation increases for closed groups and the opposite effect occurs for open groups.

Furthermore, our results provide support for H2b, namely group openness moderates the relationship between bridging and the amount of idea generation (B = -2.241; p = 0.000).[3] A graph of the interaction effect (Online Supplemental Appendix 8b), demonstrates that, as bridging increases, idea generation increases for open groups and the opposite effect occurs in closed groups.

The summary of results for H2a and H2b are presented in Table 4. As aforementioned, geographic entropy and functional entropy were found to be insignificant controls in our model and were removed from the final model.

As a post-hoc validation of our interaction effects, we further validated that the opposite did not also hold true, that is, when closed groups display bridging ties and/or when open groups display bonding ties, the amount of idea generation is not positively affected. Hereto, we repeated our analyses using split datasets, that is, using only open or closed groups, to further test the significance of the slopes in our interaction models. Indeed, we found that when closed groups develop bridging ties, the amount of idea generation is significantly, but negatively, affected (B = -0.904; p = .000) and when open groups display a bonding network structure, the amount of idea generation is significantly, but negatively, affected (B = -3.314; p = .000).

Discussion

Social network theory has been applied extensively in studies of online groups to understand the extent to which different social network structures—in particular bridging and bonding—are associated with various outcomes, including idea generation. However, the extant literature has produced conflicting results about the impacts of bridging and bonding on idea generation.

Table 4. Summary of Results for H2

	B	Std. Err.	Sig.
Intercept	7.131	0.001	p = 0.000
Group Openness vs. Closedness (0 = open; 1 = closed)	2.206	0.003	p = 0.000
Bonding	-1.021	0.097	p = 0.306
Bridging	-5.149	0.015	p = 0.000
Bonding*Group Openness vs. Closedness	1.009	0.195	p = 0.000
Bridging*Group Openness vs. Closedness	-2.241	0.004	p = 0.000
Control Variables			
Size	0.032	0.002	p = 0.000
Active Users	0.016	0.002	p = 0.000
Hierarchical Entropy	0.020	0.003	p = 0.000
Geographic Entropy	0.139	1.312	p = 0.190
Functional Entropy	-0.085	-1.067	p = 0.286

At the same time, the proliferation of ESM technologies has sparked substantial interest among IS scholars [12, 77, 129] with respect to the benefits of the increased openness enabled by these tools. The increased focus on openness has resulted in a general neglect of how this same feature may encourage both open and closed groups. We examined not only how this ability to choose to be "open" or "closed" affects the group's engagement in idea generation, but also used this distinctive ability of ESM groups to address the conundrum in the social network literature.

We found strong empirical support for a contingency hypothesis in our study: idea generation occurs when the type of social network structure—bridging or bonding—is matched to the group's openness setting. That is, high levels of idea generation are likely in groups with either bonding or bridging ties but stem from the intricate interaction of group closedness versus openness and the unique network structures that emerge. However, when the opposite occurs—closed groups display bridging ties and open groups display bonding ties—the group's ability to engage in idea generation is significantly dampened.

The finding that bonding ties would negatively affect the amount of idea generation when enacted by open groups and similarly bridging ties have a negative effect on closed groups' idea generation begs the question why. With regards to the first—why open groups that display strong bonding ties show lower amounts of idea generation—a possible theoretical explanation could include the fact that when open groups focus their time and efforts on building strong internal ties, they undermine their unique aptitude for fostering external ties as conduits to critical resources and information [135] that can aid their idea generation through combination and integration [97]. Another possible explanation could be related to the fact that the external intervention that is inevitable as a result of the inherent public nature of the group makes it impossible to foster the kinds of safe harbors that are necessary for risk-taking [33, 41]. Hence, open groups that develop bonding ties may foster the kinds of strong ties that lead to the sharing of mostly redundant knowledge and information [51]. These might be associated with low levels of risk and vulnerability, and therefore can be publicly shared, but may lack the kinds of novelty and disruption needed for idea generation. Similarly, closed groups that develop strong bridging ties may be at a disadvantage, because—even though they can still search for and seize information from outside the group that might be shared by other groups publicly—they are blocked from the serendipitous, broader, and more inclusive involvement of others [35, 37, 44, 78, 114] due to their secret nature. Such theorization requires validation in future studies.

Furthermore, our theorizing as well as the panel nature of our analysis, suggests that there might be a causal order between ESM implementation and social network formation, and between social network formation and idea generation, specifically, that the relationship between social networks and idea generation is influenced by the way groups use the openness enabled by ESM. Yet, there is likely to be a more complex relationship among these variables that may play out dynamically over time. One possible unfolding could be that groups intending to have a dense network characterized by strong bonding ties choose to be closed in anticipation of the likelihood of these type of relationships developing [128]. Similarly, they may start out as a dense network offline, having idea generation in a mode similar to an old boy network and the closedness of the ESM only serves to reinforce the offline nature of the group. Thus, our theorizing opens up avenues for exploring the strategic choices underpinning the use of specific ESM features and future theorizing should be clearer about affordances "for what". If

group leaders are establishing a group to be closed, their choice may be made pursuant to a different work objective than a group leader establishing a group to be open. For instance, Gibbs et al. [48] have suggested that closing discussions from others in the organization may improve working relationships by avoiding conflict; protect risky information, high-risk projects, self-interests, confidential or proprietary knowledge (for instance, about clients); and avoid "stealing" opportunities [93]. Generic affordances such as reviewability or openness thus need to be considered in light of the strategic work objectives of groups in a workplace setting [128].

Theoretical Implications

We offer four key contributions to the broad literatures on online communities, social networks, and idea generation.

First, by applying a social network perspective [22, 69], we have offered a theoretical lens for explaining the link between ESM use and idea generation, namely that group openness interacts with network structures to foster idea generation within the group. Our theory, then, provides an extension to the existing literature by examining the *structure* of the connections themselves, and the *contexts* in which those connections are located and their joint effect on the extent to which the *content* of those interactions reflect idea generation efforts. By doing so, this study reconciles the inconsistent findings of prior social network studies through clarifying the conditions under which both bridging and bonding can produce high volumes of idea generation, namely when these unique network structures are evoked in particular group types, open versus closed.

Second, in reconciling these inconsistent findings from the social network literature, our theorizing also sheds light on the mechanisms underpinning the links between bridging versus bonding to idea generation conversations and reveals that these may be of a different nature, hence, allowing both to lead to idea generation but for different reasons. In this context, Nahapiet and Ghoshal's [89] three dimensions of social capital—structural, cognitive, and relational—are insightful. The mechanism underpinning the link between bridging ties, as found in open ESM groups, and idea generation conversations stems from the structural dimension—the role of ties spanning structural holes—and the cognitive dimension—non-redundant information—of social capital. Whereas the link between bonding ties, as found in closed ESM groups, and idea generation conversations can be explained primarily through the relational dimension—the development of trust, norms, and strong group identity—and to some extent the cognitive dimension—shared values and beliefs—of social capital.

Third, this study contributes to a deeper understanding of how ESMs might transform workplace interactions by exploring the occurrence of idea generation in ESM groups. Although the ESM literature had argued that the use of ESM broadens the possibilities for collaboration and involvement [11, 131] by attracting many and diverse users, [19], this study is among the first to empirically and systematically examine whether and how idea generation occurs in ESM groups. In this context we contribute not only an understanding of whether idea generation conversations occur in ESM groups, but also advance insights about the boundary conditions for such conversations to occur—by highlighting the roles of bridging and bonding —and elaborate theorizing about idea generation in an online setting through our focus on ESM groups.

Fourth, by showing that the structure of relationships—bridging—that is present in open groups is substantially different from that of closed groups—bonding—this study highlights the importance of understanding technology characteristics, such as the openness/closedness enabled by ESM. Indeed, our findings reveal how the same feature may be used by groups to either establish greater openness—associated with a bridging structure—or greater closedness—associated with a bonding structure—yet, both scenarios lead to increased idea generation. This dual effect depending on the presence of distinct social network configurations—bridging versus bonding—underscores the need to look at configurations of social structures and technology features together, rather than either one alone.

Managerial Implications

Beyond implications for theory, our empirical investigation provides notable implications for practitioners that regard ESM platforms as a possible solution for evoking or improving idea generation in organizational teams. Organizations invest significant resources to adopt such ESM platforms to improve collaboration. Because ESM facilitate knowledge sharing between distributed coworkers [128] which may foster new ideas [116], ESM have been hailed as a promising mechanism to improve idea generation in organizations [77]. However, prior work has been largely anecdotal, thereby limiting our ability to explain the link between ESM use and idea generation and propose mechanisms that fall inside the control of ESM designers or administrators. In contrast, the choice between group openness versus closedness that is at the heart of the current analysis is widely available on all ESM platforms, so our findings provide valuable and actionable insights to both system designers and administration.

First, for administrators, our findings highlight that promoting greater openness may not be the key to improved idea generation, rather it appears important for managers to promote the development of a particular social network structure, bridging or bonding, depending on whether a group has elected to be open or closed. System administrators may thus take on a more active role in nudging the nature of relationship development in open and closed groups, respectively.

For system designers and developers, there are two important implications. First, they should provide not only the mechanism to create open and closed groups, but perhaps afford users a greater understanding of the impacts of their choice. Second, given the importance of matching an openness setting with a network structure, they could design build-in mechanisms that would allow users to foster the types of structures that are more useful given the nature of the group. Hence, given that most ESM systems rely heavily on recommender systems, open and closed groups could potentially encourage users of open groups to explore relationships with unknown others elsewhere in their organization by focusing on contact recommendation. At the same time, the recommender system in closed groups could focus less on encouraging users to explore new relationships, but rather could center on content recommendations to enable users to explore relevant member posts that could strengthen their mutual understanding.

Finally, our insights that idea generation occurs in both open and closed groups poses two important challenges for organizations using ESM, the managers of these platforms, and the groups within them. First, idea generation happening in closed groups poses inherent challenges in terms of making these ideas and the knowledge within them available to the broader

organization. Not only does this finding contrast with the popular opinion that it is chiefly openness of communication and serendipity of discovery in ESM that promote idea generation; it also highlights that the creators of these closed groups need to take on a boundary-spanning role to disseminate the relevant ideas and knowledge that they feel comfortable sharing to the broader organization. Second, although open groups do not pose the same challenge in terms of novel ideas and knowledge being hidden from non-members, the persistence affordance of ESM [75] which causes all generated content to remain available still poses difficulties for users to find content given the ever-growing amount stored in these platforms. Hence, this presents important challenges for designers to consider how to improve the search functionality of ESM to enable users to discover and retrieve relevant content in the most efficient and effective manner.

Limitations

Although we believe this study is among the first to demonstrate that the openness enabled by ESM affects the way in which members of the group structure their networks and the amount of idea generation that emerges within the group, there are limitations associated with this study.

Although we did focus on a subset of groups with a relatively focused group purpose and work-oriented task, we did not differentiate ESM groups based on task type (e.g., new product development versus internal audit) to explore if it influences the amount of idea generation. We also do not know why groups selected the openness setting for their groups; it could have been done strategically, by default, or without obvious thought. An initial comparison of structural and thematic characteristics of the groups did not reveal any substantial differences between open and closed groups.

Furthermore, our network analyses are based exclusively on ESM and do not include other modes of communication that individuals may have used to engage in idea generation during the course of their work; that is, email, face-to-face, or telephone-based communications.

Finally, although our research focuses on idea generation, we used linguistic indicators as a proxy for potential idea generation as deduced by the developed algorithm from the content of the interactions of ESM groups. Relatedly, although existing research has shown that idea generation is a critical antecedent to cognitive reconceptualization and ultimately innovation [54, 58, 85, 122], our study does not measure the extent to which idea generation results in actual new product or process innovations.

Future Research Directions

There are several directions for future research that emerge from our findings. First, our dataset consists of groups with only a strong bonding or a strong bridging structure, yet, the literature on public social media has suggested that given the decreased effort of forming and maintaining relationships, groups can simultaneously sustain bridging and bonding ties [45]. Indeed, Kim et al. [69] found that the community responsiveness of online communities is positively affected when they possess both bridging and bonding as their combination helps to provide both the resources and the motivation for greater community responsiveness. Therefore, future research should explore if there is a substantial difference between public platforms (including social media and online communities) and organizational platforms, where the former allow for the

simultaneous development and maintenance of both forms of relationships—bonding and bridging—but the latter appear to foster groups that develop one or the other. Alternatively, it is worthwhile exploring if within other ESM platforms or other organizations using ESM, groups do exist that maintain high levels of bonding and bridging simultaneously and if this results in even greater amounts of idea generation. Similarly, it would be interesting to examine if groups exist that have very low levels of both bonding and bridging to observe if this interacts negatively to significantly reduce their ability to engage in idea generation.

Second, in addition to understanding the interplay of bonding and bridging structures, future research—from an organizational perspective—should also explore the question of how many closed or open groups are beneficial for a company at large. In this context, understanding important organizational and industry level characteristics may be critical to discerning the unique assemblage of open and closed groups that is required for the optimal performance of the company as a whole.

Third, as aforementioned, openness includes three dimensions—whether non-group members can know if a group exists, view the interactions among group members, and join the group without being invited. Due to the nature of the openness feature of the specific ESM platform in this study, these three dimensions were inseparable. Yet, the literature seems to treat these as distinct [c.f., 77]. Hence, from a technological perspective, an interesting question for future research is whether these three dimensions are truly separable empirically. If we consider Wikipedia as an example, the site locks out new members but maintains its openness through allowing talk pages to be viewed. Alternatively, it might be possible to allow membership but with no prior transparency, thus allowing people to join without any awareness of what the group has been doing prior to their joining. Thus, exploring unusual and distinct combinations of these three dimensions of openness may be worthy of study, not only in the realm of ESM, but also in the context of studying online communities and open-source communities more broadly.

Finally, in this study we measured the content of idea generation of groups as a proxy for their idea generation output and ultimately for innovation. As aforementioned, this is based on prior literature that suggests that idea generation is a critical antecedent of innovation [54, 58, 85, 122]. Hence, future research should aim to validate if the moderating role of openness and the effect of group social networks persist when measuring actual creative output. Furthermore, since creative output may be incremental or radical in nature, future research should discern the nature of the creative output to explore if the different social network structures—bridging versus bonding—result in distinct forms of creative output. Harvey [58] has argued that groups characterized by frequent, within-group interactions and creative synthesis—which is likely to coincide with bonding—tend to produce breakthrough innovations, whereas groups characterized by divergent thinking—which is likely to stem from bridging—are more likely to produce incremental improvements. This would be a valuable avenue for future research. Relatedly, as outlined previously, it appears that the mechanisms underpinning the links between bridging and idea generation versus bonding and idea generation emerge from different dimensions of social capital Nahapiet and Ghoshal's [89]; hence, it would be worthwhile to explore if the different nature of creative output that results from bridging versus bonding—as suggested by Harvey [58]—could be explained by the different dimensions of social capital.

Notes

1. Thus, we did not use a single, universal one-year period (e.g., Jan-Dec 2014), but rather a unique one-year period per group. For example, Group A may have been most active during Feb 2013 to Jan 2014 and Group B from Jan to Dec 2016.
2. We used logarithmic transformation with square scaling. The purpose of taking logarithm is to preserve the range of data and the purpose of the square scaling is to preserve the variance of data.
3. Given that group openness is coded 0 = open and 1 = closed, the negative interaction effect for bridging indicates that when open groups display bridging interactions, the amount of idea generation increases.

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