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Bridging with Meaning: An Empirical Study of Organizational Vocabularies and Communication Networks in Organizations

Stefano Tasselli
Erasmus University
Rotterdam School of Management
tasselli@rsm.nl

Paola Zappa
Maynooth University
School of Business
paola.zappa@nuim.ie

Alessandro Lomi
Università della Svizzera Italiana
Faculty of Economics
alessandro.lomi@usi.ch

Abstract
We examine how communication networks within organizations are structured by organizational vocabularies -- sets of words used by organizational participants to describe, interpret and share their personal experiences within hierarchically structured domains of activity. The basic question we explore asks: how does the overlap in organizational vocabularies affect communication and information sharing relations across formal organizational boundaries? We reconstruct the bipartite network between organizational participants and the words they use to describe their subsidiary company within a multi-unit group, and examine how dyadic patterns of association between participants and words affect interpersonal communication networks. In an analysis of the multilevel network linking managers both directly, as well as through their affiliation to words, we find that organizational members adopt similar vocabularies to describe their organizational units. However, overlapping organizational vocabularies per se do not imply that organizational members will be more likely to establish relations of task-related communication. Typically, organizational members tend to restrict communication ties within rather than between formal boundaries. Yet, overlapping vocabularies make organizational members significantly more likely to communicate and share information across the formal boundaries of their units. We discuss the role that organizational vocabularies play in sustaining knowledge transfer across organizational boundaries, thus bridging cultural holes within organizations.
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ABSTRACT

We examine how communication networks within organizations are structured by organizational vocabularies -- sets of words used by organizational participants to describe, interpret and share their personal experiences within hierarchically structured domains of activity. The basic question we explore asks: how does the overlap in organizational vocabularies affect communication and information sharing relations across formal organizational boundaries? We reconstruct the bipartite network between organizational participants and the words they use to describe their subsidiary company within a multi-unit group, and examine how dyadic patterns of association between participants and words affect interpersonal communication networks. In an analysis of the multilevel network linking managers both directly, as well as through their affiliation to words, we find that organizational members adopt similar vocabularies to describe their organizational units. However, overlapping organizational vocabularies per se do not imply that organizational members will be more likely to establish relations of task-related communication. Typically, organizational members tend to restrict communication ties within rather than between formal boundaries. Yet, overlapping vocabularies make organizational members significantly more likely to communicate and share information across the formal boundaries of their units. We discuss the role that organizational vocabularies play in sustaining knowledge transfer across organizational boundaries, thus bridging cultural holes within organizations.

KEYWORDS: Organizational vocabularies, Organizational social networks, Exponential Random Graph Models (ERGMs), Organizational communication, Knowledge sharing
Communication between formal organizational boundaries is widely acknowledged as an important determinant of knowledge sharing and organizational effectiveness (Argote and Ingram 2000). A considerable body of research shows that organizations whose subunits are able to absorb knowledge from different, and possibly distant sources tend to attain higher levels of performance, productivity, and growth (Argote 1999, Hansen 1999, Hargadon 2002). However, the difficulties associated with sharing knowledge across organizational subunits, i.e. across bounded repositories of specialized expertise, competencies and resources (Dougherty 1992), make this learning process unlikely to happen naturally in organizations (Tsai 2001). Socialization processes encourage members of organizational subunits to develop specialized language that allows them to communicate effectively with colleagues. A common specialized language, in turn, sustains a shared awareness of problems, solutions, and the repertoire of actions that are appropriate in various situations. Enacting this logic of identity (March 1991) makes organizational subunits both more internally cohesive and efficient, as well as less permeable to extramural information and knowledge stored in different and possibly distant sites within the organization (Tortoriello and Krackhardt 2010, Tsai 2002).

This tension between processes of “differentiation” and “integration” (Haas, 2010) has been known to students of organizations at least since Lawrence and Lorsch (1967) and possibly much before then (Barnard 1938). More recent studies have tried to resolve this tension by focusing on the specific relational mechanisms that may sustain the infrequent but important boundary crossing ties recurrently observed in actual organizations (Caimo and Lomi 2015, Reagans and McEvily 2003). This line of work builds on – and extends – the classic insight about the duality of individual in groups (Breiger 1974), implying that “when two individuals interact, they not only represent an interpersonal tie, but they also represent the groups of which they are members” (Brass et al. 2004: 801). Despite the emphasis on individuals’ action and interaction, attention has been mostly paid to the structural side of boundary
spanning (Tortoriello et al. 2012). But boundaries among subunits also imply boundaries around “zones of meaning” (Berger and Luckmann 1966), and hence around organizational vocabularies, i.e. systems of words that individuals use to make sense of their organizational experience (Loewenstein et al. 2012). Because of their novelty, concepts of organizational vocabularies are not yet well-integrated in mainstream organizational research. However, we think that organizational vocabularies offer important “opportunities for theoretical integration and novel extensions for organizational research and practice” (Loewenstein et al. 2012:35). The specific opportunity that we have identified in this paper concerns the unexplored question of how patterns of similarity and difference in organizational vocabularies affect communication networks within organizations. How does the overlap in organizational vocabularies affect communication and information sharing relations across formal organizational boundaries? This is the question that we address in this paper.

We think that asking this questions opens new possibilities for integrating research on organizational vocabularies focused on institutional logics (Ocasio and Joseph 2005; Phillips et al. 2014, Thornton et al. 2012), and organizational social networks focused on structural logics (Rank et al. 2010, Tortoriello et al. 2012). Following almost independent developments, these two literatures have rarely explored their multiple intersections (Mohr and Duquenne 1997, Mohr 2000). We do so in this paper by showing that formal boundaries between organizational units contribute to the development of within-units social communication patterns and within-unit homogeneity of vocabularies and meanings. Yet, sharing common vocabularies allows organizational members to span those boundaries and communicate meaningful information across different organizational units.

A new emphasis on organizational vocabularies allows us to make three contributions to theory and research on knowledge sharing in organizational networks. First, we move beyond a purely structural interpretation of intra-organizational boundary spanning ties (Blau 1977a) and
consider organizational subunits in an organization (or subsidiaries in a multi-unit group, in the
specific case we analyze) as local foci of activities that are associated with the formation of
idiosyncratic systems of meanings and distinctive local identities (Feld 1982). Because
“understanding actors’ meanings – including vocabularies – is crucial for any analysis of social
structure” (Fine and Kleinman 1983: 106), we focus on how organizational vocabularies shape
social networks in organizations. Previous research has tended to neglect consideration of the
words people use to describe their experience in the workplace, arguing that social structures
and processes "vastly transcend the individual consciousness of actors" (Lorrain and White
1971: 50). In this paper, we incorporate organizational vocabularies to balance the structural
emphasis of previous research on boundary spanning.

Second, we contribute to research on the interdependence between formal organizational
boundaries and informal structures of interpersonal interaction within organizations. With its
emphasis on informal relationships between actors, social network research has progressively
downplayed the fundamental role that formal organizational structure continues to play in
processes of knowledge creation, reformulation and exchange (Hansen 2002). We build on
recent insights (Kleinbaum et al. 2013, McEvily et al. 2014) to argue that the “company behind
the chart” (Krackhardt and Hanson 1993) interacts with the formal organizational “chart” in
explaining knowledge sharing across boundaries. We suggest that how organizational structure
affects communication patterns, and hence the individuals’ likelihood to communicate across
unit boundaries, is likely to be contingent on the systems of shared organizational vocabularies
that individuals adopt to describe their organizational units.

Third, we contribute to contemporary research on meaning, culture and social networks
(Mische 2003, Pachucki and Breiger 2010) by examining the intersection between meaning
structures (as instantiated by the association between organizational participants and
organizational vocabularies), and social structure (emerging from task-related communication
networks among organizational participants). As Pachucki and Breiger (2010: 206) suggest, “contemporary work on culture and social networks can (…) be usefully seen as mutually constitutive and coevolving with common roots in relational thinking.” However, much empirical analysis has “tended to treat these domains as discrete realms rather than together” (Pachucki and Breiger 2010: 206). We seize upon this opportunity for integration by framing organizational vocabularies and social networks as connected sub-components of a more general system of meaning within organizations. The hope is that research on organizational vocabularies will benefit from a more systematic attention on the social structure of vocabularies. Research on organizational social networks will benefit from a broader concern with issues of meaning carried, produced and reproduced by network ties.

We find empirical evidence for the theoretical arguments we develop in a study of task-related communication networks among members of the top management team of a multinational industrial group including five distinct subsidiary companies. Building on consideration that “network structure can be studied as a proxy for the distribution of variably sticky information in a population” (Burt et al. 2013: 529), task related communication captures knowledge sharing processes between managers in the organization. In line with recent research analyzing the multilevel arrangement of network ties within organizations (Zappa and Lomi 2015), we specify and estimate Exponential Random Graph Models (ERGM) for multilevel networks (Wang et al. 2013) that allow us to represent simultaneously communication networks among managers and affiliation networks linking manages and words they use to describe their subsidiary company.

THEORY AND HYPOTHESES

Task-related communication in multi-unit organizations
Task-related communication across the boundaries of organizational subunits is relevant for organizational functioning, including decision-making, knowledge recombination, development of new ideas and generation of innovation (Argote 1999, Burt 2004, Tortoriello 2015, Reagans and Zuckerman 2001, Tortoriello and Krackhardt 2010). Interpersonal networks among coworkers play a fundamental role in facilitating this process (Reagans and McEvily 2003). However, previous research on social networks in organizations has rarely taken into account the intimate ‘organizational’ nature of these networks. Despite a clear understanding of how informal network structures explain processes of intra-organizational knowledge transfer, the question remains of whether and how the formal, organizational structure is associated with these processes.

Prior research has unveiled a number of factors hampering the formation of cross-boundary knowledge sharing ties that can help answer that question. First, common membership in organizational subunits provides frequent opportunities and stronger incentives to form within-subunit ties. Organizational subunits provide social platforms that stimulate newcomers’ interaction (Morrison 2002), facilitate interpersonal familiarity (Hinds et al. 2000), offer a repertoire of shared experiences (Marsden 1988), and also generate the development of common memory and elaboration of past events among subunit members (March and Olsen 1975). Second, the intended aim of organizational design is to provide a within-subunit solution to a make-or-buy dilemma, such that sharing knowledge across subunit boundaries becomes more costly, in terms of time and effort to cultivate and maintain cross-boundary relations, than transferring knowledge within the subunit. Thus, organizational design emphasizes crucial interdependences within purpose-built organizational subunits (Thompson 1967). Third, organizational subunits (subsidiaries in the empirical case of this paper) tend to generate specialized language that reflects the nature of each subunit’s tasks or activities (Uzzi 1999). Individuals may find it difficult to transfer knowledge, ideas and other resources when
they lack a common language or knowledge base. The fragmentation of knowledge inherent in the successful implementation of organizational design solutions systematically increases the difficulty of integrating heterogeneous resources (Tortoriello and Krackhardt 2010). Taken together, these factors reduce the permeability of subunit boundaries to communication and knowledge available elsewhere in the organization. The first baseline hypothesis summarizes this line of argument.

Baseline Hypothesis 1 (H1): Task-related communication ties are more likely to be observed between members of the same organizational unit than between members of different units.

We consider this hypothesis “baseline” because its role is to root our study more firmly in the extensive network literature on knowledge sharing within organizations (Tortoriello and Krackhardt 2010), and to provide a starting point for the hypotheses that we develop next.

**Organizational vocabularies**

The formal organization plays an important role in explaining patterns of intra-organizational task-related communication. However, organizational boundaries do not have agency onto themselves and we still know relatively little about the mechanisms through which organizational boundaries affect the structure of knowledge sharing networks in organizations (Lomi et al. 2014). The presence of exogenously determined boundaries between subunits may be the main element distinguishing networks in organizations from other kinds of social networks that have been extensively studied (Newman and Park 2003), and from social groups (Freeman 1992). Formal boundaries around organizational units identify discursive entities or “zones of meaning that are linguistically circumscribed” (Berger and Luckmann 1966: 55). Membership of organizational subunits, therefore, entails the absorption and construction of systems of meanings and identities that individuals develop and share to make sense of the social environment in which they live and work (Weick 1993, Weick et al. 2005). What makes
these sense-making processes inter-subjectively meaningful is the development of shared organizational vocabularies or: “socially constructed sets of linguistic categories used by social groups both to make sense of organizational reality and to bring attention to available sources of organizing activities” (Ocasio and Joseph 2005: 165). It is through the use of vocabularies that organizational members develop and share meanings that define their workplace (Loewenstein et al. 2012): the words that they use to describe their organization also influence their ability to think about the organization, and subsequent to these thoughts, to interact with coworkers and enact (Gartner 1993: 231). We argue that organizational vocabularies may help explain the meaningful interpretations that organizational participants develop of their organizational units (Baseline Hypothesis 2), thus activating the effects of formal cross-unit boundaries on the development of shared meanings (Hypothesis 3) and the effects of such meaningful boundaries on interpersonal, task-related communication patterns (Hypothesis 4).

These arguments are grounded in a longstanding tradition of sociological research examining the “individualistic coloring” (Simmel 1971: 257) that people provide to their social settings. From this view, social networks are “stories” about the meaning of social structure; networks can be conceived as “systems of meanings” (White 2008), in which mechanisms of meaning formation help understand how individuals maintain and move between different social positions. Social interaction in networks is indeed deeply embedded in local micro-cultures (Collins 2003), leading in turn to processes of identity formation and change (McFarland and Pals 2005). Building on this perspective, we suggest that organizational vocabularies provide the foundation for explaining the micro-mechanisms by which organizational members develop shared meanings in the workplace. Through vocabularies used to describe their organizational units, individuals build shared interpretations of their workplace (Argote and Kane 2009) and can make sense of the formal structures in which their work activity is organized (Weick 1995). Therefore, vocabularies may help establish common grounds that
facilitate the understanding of coordination within the organizational units in which people work (Cramton 2001). The more two individuals develop and assign similar words to their units, the more they are expected to share the repository of interpretations, ideas and beliefs upon which knowledge is shared within organizations (Loewenstein et al. 2012). For these reasons, we hypothesize that organizational members will tend to share similar vocabularies to define and represent their subunits.

Baseline Hypothesis 2 (H2): Organizational members tend to adopt similar words to describe their organizational unit.

This second baseline hypothesis is consistent with the interpretation of organizational vocabularies as institutionalized categories of thoughts, or repertoires for action proposed by Meyer and Rowan (1977) and developed more recently by Ocasio and Joseph (2005). In turn, this institutionalization process makes organizational members progressively more similar in terms of the vocabularies they use to describe and interpret their work experience, and hence in terms of the institutional logic that they espouse (Thornton and Ocasio 2008). Both H1 and H2 are “baseline” because they help to interpret the effects that we postulate in H3 and H4 that we now discuss.

**Similarity in vocabularies within organizational units**

The two baseline hypotheses start from differing assumptions to analyze the relevance of subunit boundaries in organizations. Treating subunits as different social settings around which individuals organize activities and interactions (Homans 1950), the first hypothesis suggests that members in a particular subunit tend to form a distinctive “cluster” around shared vocabularies (Feld 1981: 1018). Looking at individuals as distributed in the continuum of words and meanings that they assign to their organizational subunits, the second hypothesis argues that people tend to use shared vocabularies to define their organizational subunits.
We suggest that formal structure, in terms of subunit boundaries, matters in organizations because it enables processes of meaning development by the sharing of common vocabularies. Through idiosyncratic, shared meanings assigned by organizational members to their organizational units, formal boundaries contribute to the formation of ‘cultural holes’ that make the understanding of knowledge transfer across the organizational social space both difficult and necessary (Pachucki and Breiger 2010). We argue that formal boundaries themselves become resonant in organizations because they involve systems of words and meanings that professionals develop and share to make sense of the social space in which they exert their activities (Maitlis and Christianson 2014). The clusters formed by members of the same organizational subunit may induce social bonds that activate, and reinforce, the effects on social interaction of the words and related meanings that people assign to their subunits. Through the sharing of common vocabularies, joint membership enables processes of meaning formation and identification among subunit members, reinforcing within-group interaction patterns as distinguished from interaction with others in organizational out-groups (Ashfort et al. 2011). According to Loewenstein et al. (2012: 35), organizational vocabularies may be viewed as “generators of meanings within social collectives.” Therefore, we expect that managers in the same organizational units will adopt common vocabularies to describe their units. This expectation is also consistent with socio-psychological research showing that clustering in a formal network is associated with cognitive consistency. Individuals tend to perceive people in their same social group as more similar to themselves than people outside their group, irrespective of whether or not they are (Festinger and Aronson 1960, Leinhardt 1972). Building on these arguments, we expect the following:

Hypothesis 3 (H3) Members of the same organizational units are more likely to adopt similar vocabularies to describe their unit.

**Similarity in vocabularies and boundary spanning across organizational units**
The image of organizations implied by the first three hypotheses seems that of the “cavemen world” described by Watts (1999: 102), where members live in dense isolated clusters (or “caves”) of strong, frequent, and redundant relations. Meaningful caves, we argue, but caves nonetheless. However, organizations are rarely decomposable into isolated caves: the formal boundaries of organizational units might contain the majority, but typically not all of the observed ties among their members. So, what makes these “distant” ties bridging organizational subunits possible?

We suggest that sharing similar organizational vocabularies to describe their subsidiary companies is a factor likely to facilitate interpersonal task-related communication across organizational boundaries. Formal organizational structure, in terms of subunit boundaries, makes resonant the importance of similarity in vocabularies and meanings in explaining processes of cross-boundary interaction. Recalling Feld (1981: 1019), “interaction is typically focused rather than uniform, and unless the similarities of attitudes, attributes and social positions are translated into the structuring of focused interaction, their selective effects on tie formation will be overwhelmed by structural features that do focus the interaction.” Sharing similar vocabularies can provide opportunities of structuring social relations among people who share the same ‘focus’, as well as opportunities to develop common interpretations and even sentiments (Laumann 1973, Newcomb 1961). Sharing common vocabularies can facilitate the formation of a superordinate social identity (Argote and Kane 2009, Kane 2010) that previous studies have shown to facilitate knowledge transfer ties in organizations (Lomi et al. 2014). Sharing organizational vocabularies is a source of ‘homophily’ that can reduce the perceived cost of interacting with others across the social space of the organization (Duncan et al. 1968). This argument extends the findings of classical experimental research showing that the presence of goals and meanings compellingly shared by members of different social groups is associated with reduced inter-group conflict and enhanced likelihood to cooperate (Sherif
Building on these arguments, we argue that sharing such vocabularies can facilitate task-related communication between managers working in different subsidiary companies.

Hypothesis 4 (H4): Two members in separate organizational units are more likely to entertain task-related communication relations if they share similar organizational vocabularies.

DATA AND METHODS

Setting and data
We examine the role of organizational vocabularies on how organizational participants communicate across formal boundaries in the context of data we have collected on task-related communication relations among the top management team of a multiunit industrial group (henceforth, simply the ”group”). The corporate group contains five independent subsidiary companies (henceforth, subsidiary companies, or simply the “subsidiaries”) involved in the design, manufacturing, and sale of high quality products in the market for leisure motor yachts. The central company in the group plays the double role of independent company and corporate headquarters. The subsidiaries are independent because they manufacture products with distinct brand identities, they are present in different segments in the global market for motor yachts, they have different dealers’ networks, and – more importantly for our purposes – they have independent management teams.

In the context of more general fieldwork activities, we asked the president and the CEO of the corporate group to identify organizational members they would consider the key decision makers across all the subsidiary companies of the group. After some discussion, the final list included 47 members of what the President and the CEO jointly recognized as the top management team of the group. This list included, among others, the corporate COO, CFO and HR director, the chief engineer and designer, and the VP for marketing and sales. The list also contained the name of five naval engineering, design and architecture consultants working closely with new product development teams.
As it is common in research on interpersonal relations within organizations, we collected information on social networks among the members of the top management team using the roster method (Kilduff and Krackhardt 2008). Each respondent was asked to report the presence of a relation of task-related communication with each of the other members of the top management team. Respondents confronted the following task:

“It is not unusual to communicate and exchange information with colleagues about work-related matters. In this section of the questionnaire we are interested in obtaining information about colleagues with whom you exchange information about work-related matters in the course of a typical work week. Please indicate your answer by placing a check next to the names of those colleagues with whom you typically exchange work-related information. If there is only one person you might communicate with, then just check that one person’s name. If there are several people you might communicate with, then check these several names. If there is no one you communicate with for work-related matters, then do not check any name.”

The task of reconstructing the personal communication networks was specified further and made more contextually relevant by asking respondents to think about: “communication about information that you believe your contacts may consider useful, but to which they may not have direct access,” and “communication to let your contacts know about information that you might consider useful, but to which you do not have direct access.” The outcome of this roster questionnaire was a binary adjacency matrix of size 47×47 representing work-related communication and information exchange among the members of the top-management team. The response rate was 100%.

To reconstruct the social structure of organizational vocabularies, we focused on the association between managers and keywords describing the work units (Burke 1989, Hirsch 1986, Mills 1940, Mohr 1994, Suddaby and Greenwood 2005). We carried out qualitative interviews with the CEOs of the subsidiary companies to extract words that might describe their sentiment toward their company. Examples of words recurring in the interviews with our
key informants included technology, luxury, team, and trust. We then validated the relevance of the set of words that we identified as particularly resonant with the President and the CEO and the corporate group. The result was a consensus on a restricted list of 30 words. Using the method of semantic differentials (Heise 2010, Osgood 1964, Osgood et al. 1957) we asked participants to identify the words that they would associate to their subsidiary company. Participants were presented with the list of 30 words arranged in alphabetical order, and were asked to indicate the degree to which each word described their subunit on a Likert scale ranging from 1 to 5 (where 1 = Not at all; and 5 = Very much). The data were arranged in a “47 × 30” (“managers × words”) rectangular array where each cell contained the value (1 to 5) assigned by each individual manager (i) to each word (l). For the purpose of the analysis that we present in the next section, we dichotomized the manager-words valued affiliation matrices to produce binary affiliation matrices whose cells $a_{ij} = 1$ if the corresponding value in the original matrix was equal to five. We chose this cutoff value because we wanted to emphasize the words that participants considered more resonant and distinctive, and about which they expressed unambiguous sentiments. Because they were actively involved in the creation of the organizational vocabulary, we could not treat the President and the CEO as respondents and we had to accept the loss of two nodes in the network. Three participants did not turn in usable semantic differential questionnaires. Therefore, the number of nodes in the network decreased from 47 to 42. Table 1 summarizes the basic descriptive statistics of the communication network.

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Table 2 reports the basic descriptive statistics of the 2-mode networks associating managers to the organizational vocabulary used to describe the subsidiary companies.
In the analysis of social networks, the number of nodes affects but does not define uniquely the number of observations. The results that we report in the empirical part of the paper are based on

\[N(N-1)+N\times W = 2982\] non-independent dyadic observations, where \(N = \) number of managers (42) and \(W = \) number of words (30). Figure 1 plots the mixed-mode network of communication between the managers and their affiliation relations with words in the organizational vocabulary. The network is “mixed mode” because it contains different types of entities (managers and words) linked different types of relations (communication and affiliation).

Dependent Variables

In the empirical part of the paper we report estimates of models for the probability of observing communication ties between managers, and association ties between managers and words as a function of (i) actor- specific variables – or “covariate effects,” and (ii) configuration of network ties - or “network effects.” The dependent variables of the study (social relations between managers, and association relations between managers and words) take the form of binary tie variables.

Actor-specific variables control for the effect of the main individual differences among participants on the presence of ties. Because similarity is a basic organizing principle for social relations (McPherson et al. 2001: 415-17), it is important to account for how individual attributes may affect the propensity to communicate (Ibarra 1999) as well as to develop similar patterns in the organizational vocabularies adopted. Local dependencies are predictors
controlling for tendencies of subsets of network ties to self-organize into “local configurations” (Pattison and Robins 2002). Capturing the effects of these dependencies on the formation of social relations is the distinctive feature of contemporary statistical models of social networks (Snijders 2011: 132-137). Because ties of information or knowledge sharing among organizational participants are unlikely to be independent on one another, failure to include network effects in the modeling of empirical social networks may result in mis-specified models and invalid inferences (Krackhardt 1987, 1988, Lusher et al. 2013). Actor-specific variables and local dependencies corresponding to configuration of network ties are included in the empirical models both as independent and control variables.

**Independent Variables**

Hypothesis 1 claims that participants are more likely to develop task-related communication ties with colleagues affiliated to the same subunit. To test this baseline hypothesis, we create a categorical variable recording the affiliation of participants to subunits. Consultants are considered as a separate subunit. We then use information on membership to build a Same subunit covariate. It is a dummy variable, with value 1 if two organizational participants are members in the same subunit, and zero otherwise.

We assess the baseline likelihood that organizational participants adopt similar words to describe their subunits (Hypothesis 2) by specifying a network effect capturing the tendency of pairs of managers to select the same multiple words. These managers are defined as structurally equivalent with respect to words and are likely to develop convergent interpretations of experience in the workplace. The network effect is named Structural equivalence managers.

To test Hypothesis 3 that members of the same organizational subunits are more likely to adopt similar words to describe their subunit we use Same subunit (words). This may be
viewed as an extension of the tendency of similar individuals to be connected to the case of connections to the same words. Same subunit (words) is captured as a configuration consisting of ties between pairs of participants, who are members in the same subsidiary, and a word they both adopt to describe experience in the workplace.

Finally, the main prediction of the study is that the adoption of similar organizational vocabularies sustains task-related communication across subunit boundaries (Hypothesis 4). This core theoretical concept is captured by a configuration consisting of a communication tie between pairs of organizational participants in different subsidiaries but affiliated to the same words. Task-related communication between pairs of participants may take two forms: directional or reciprocal. To account for this feature of communication ties, we specify two network effects. In Communication and affiliation to same words – Different subunit information flows in one direction only, while in Reciprocal communication and affiliation to same words – Different subunit information sharing is mutual. Table 3 summarizes our discussion of the core independent variables.

Control Variables

According to research on organizational and work group demography, sharing demographic traits strengthens social relationships between individuals (Hinds et al. 2000, O’Reilly et al. 1989). We control for similarity in terms of: (i) Education, (ii) Nationality, and (iii) Tenure. Education is measured in terms of the highest academic title obtained and accounts for the likelihood that participants with similar educational profiles are more likely to communicate. Education is a categorical variable ranging between high school (4.76%) and postgraduate education (23.81%). Nationality is measured as a dichotomous variable, with 85.71% being
Italian and 14.29% other nationalities (North and South American). Tenure in the group is arranged in five categories based on the number of years since the manager joined the organization.

Membership in the same broadly defined professional family (Organizational function) is expected to influence positively the propensity to communicate. We expect this to be the case because members in the same function are more likely to share a common set of concepts and face similar problems – factors that tend to decrease communication costs. Organizational function consists of five categories, from Production (26.19%) to Finance (16.67%) and a residual category of Others (33.33%). Shared membership in a professional family enters the model specification as Same function.

Manager propensity to communicate is likely to be affected also by forms of local dependencies between network ties (Lomi et al., 2014). The most basic form is Reciprocity, which models the likelihood that the existence of a communication tie in one direction leads the receiver to build a communication tie in the opposite direction. Activity spread and Popularity spread model the tendency of the communication network toward centralization. Transitivity is included to account for the tendency of managers connected to the same partners by communication relations to be directly connected. Multiconnectivity captures potential presence of managers who are likely to be both sources and recipients of communication ties. Since these managers connect colleagues who would be otherwise disconnected, Multiconnectivity controls for brokerage (Burt 2004).

A second set of control variables captures patterns of similarity in the adoption of organizational vocabularies. Manager activity captures the baseline tendency of managers to choose words. A positive parameter would suggest the presence of a limited number of managers choosing many words, and a larger number of managers choosing only very few words to describe their subsidiary. The likelihood that a word is not used by any manager is
accounted for as Isolates (words). Preferential affiliation to words models the centralization in preferences received by words (i.e. indegree of words). The higher the number of managers who use a word, the higher the likelihood that additional managers will use the same word: this preferential affiliation mechanism will produce centralization in the bipartite network that affiliates managers to words. The consequence will be the presence of a restricted number of popular words. The propensity of the same pairs of words to be used by multiple members is captured as Structural equivalence words. Finally, we account for the tendency of members in the same organizational function to use the same words to describe their experience in the workplace. Same function (words), the variable controlling for this propensity, is defined in a similar way as the Same subunit (words) corresponding to Hypothesis 3.

The third set of control variables accounts for forms of association between communication and patterns of similarity among organizational vocabularies different from what postulated by Hypothesis 4. Managers may be likely to communicate with each other and adopt the same organizational vocabulary no matter their membership in subunits. Communication and affiliation to same words accounts for this tendency, which is captured as co-presence of a communication tie between two managers, and an affiliation tie of them both to the same word. A more complex form of association is captured as Reciprocal communication and affiliation to same words. It is included to account for the likelihood that the adoption of the same organizational vocabulary co-exists with the presence of a reciprocal communication tie. We specify Communication and affiliation to same words – Different function and Reciprocal communication and affiliation to same words – Different function to capture the likelihood that developing a shared work experience makes managers more likely to establish communication ties with partners who have different competences. Table 4 summarizes our
discussion of the control variables that we expect to be present in the data and that we incorporate in the empirical model specification that we discuss next.

Empirical Model Specification and Estimation

The interdependence between observations typical of network data makes standard statistical modeling inappropriate to test association between communication and affiliation ties. To account explicitly for these interdependences we adopt Exponential Random Graph Models (Robins et al. 2009, Snijders et al. 2006, Wasserman and Pattison 1996). ERGMs are statistical models for social networks (Lusher et al. 2013) that are becoming increasingly popular in studies of inter- and intra-organizational relations (Lomi et al. 2014, Lomi and Pattison 2006, Rank et al. 2010, Srivastava and Banaji 2011). The specific class of ERGMs that we adopt - Multilevel Exponential Random Graph Models (Wang et al. 2013) - represent the only available approach that affords direct modeling of interdependences between different types of network ties.

MERGMs can be broadly conceived as a class of logit models for network data. Let us assume that $M$ is a network consisting of $i=1,...,n$ managers and $l=1,...,w$ words. $M_{ij}$ - the generic network tie between $i$ and $j$ – is conceived as a random variable with observed value $m_{ij}$. $M_{ij}=1$ if there is a tie from $i$ to $j$ and $M_{ij}=0$ otherwise. More precisely, $m_{ij}$ is a communication tie from manager $i$ to manager $j$, while $m_{il}$ is an affiliation tie from manager $i$ to word $l$. MERGMs model the probability that a tie from $i$ to $j$ exists as a linear probability function of predictors. Each predictor corresponds to an actor-specific factor or a local configuration of ties - of the type described in the previous section - involving $i$, assumed to generate the predicted tie $m_{ij}$. Each predictor is associated with a parameter that may be
estimated from data. Formally:

\[
\Pr(M = m \mid Y = y) = \frac{1}{\kappa(\theta)} \exp \sum_{Q} \{a_Q z_Q^m (m) + \theta_Q z_Q^{m,y} (m, y)\} \tag{1}
\]

where:

- **M** is the set of all possible networks of size \((n \times w)\) and \(m\) is the observed network. In our case, **M** consists of the combination of the communication network and the organizational vocabulary network. **M** corresponds to the matrix of all the random variables \(M_{ij}\), with observed value \(m\).

- **Y** is the set of vectors of manager specific covariates and \(y\) is the observed set.

- **Q** indicates the potential network configurations. The summation \(\Sigma\) is over all different configurations included in the model.

- \(z_Q^m (m) = \sum_m \prod_{M_{ij} = q} m_{ij}\) and \(z_Q^{m,y} (m, y) = \sum_m \prod_{M_{ij} = q} m_{ij} y_i\) are statistics for respectively network effects and manager-specific covariates corresponding to configuration \(Q\). For each manager and each word in the network, the statistics count number of configurations of each type in which they are involved – e.g. the number of reciprocal ties including manager \(i\).

- \(a_Q\) and \(\theta_Q\) are respectively network and manager-specific covariate parameters corresponding to configuration \(Q\).

- \(\kappa(\theta)_Q\) is a normalizing constant included to ensure that the sum of probabilities in (1) over all possible \(m\) equals 1.

Parameter estimates \((\theta_Q)\) in MERGMs may be interpreted similarly to log-odds for the presence of a tie. A parameter equals zero if the number of the corresponding configurations in the observed network is equal to the number that would be expected by chance alone. In this case the configuration does not significantly affect the probability of observing a
communication tie (i.e. establishing a communication tie with j) or an affiliation tie (i.e. the probability of i using the word l). A positive (negative) and statistically significant parameter estimate indicates that the corresponding configuration appears more (less) frequently in the data than it would be expected by chance alone.

Reliable parameter estimation for MERGMs requires Markov chain Monte Carlo maximum likelihood (MCMCML) estimation, a simulation based technique (Hunter and Handcock 2006, Snijders 2002. See also Wasserman and Robins 2005 for a review).

RESULTS

Table 5 reports the results of our analysis. Model 1 is the baseline model. It incorporates both manager-specific covariates and local dependencies that are likely to affect engagement in communication relations.

We focus our discussion on Model 2 - the full model. The estimates are stable across model specification. The baseline model does not display significant differences and is reported for comparison only\(^1\). Hypothesis 1 is strongly supported. The positive and significant parameter of Same subunit indicates that the formal organizational structure bounds task-related communication. Other conditions being equal, the odds of observing communication ties between organizational participants in the same subunit are more than four times (exp[1.455]=4.285) the odds of observing a tie between participants in different subunits.

Hypothesis 2 is also supported. The parameter of Structural equivalence managers is

\(^1\) Specifications of ERGMs usually include the Density configuration, accounting respectively for the baseline propensity of managers to establish communication ties and to be affiliated to words. Density corresponds to the intercept of standard logit models. In ERGMs the parameter estimate for Density is typically negative to reflect the relative sparsity (i.e. low density) of the network. To aid model convergence, we adopted the common practice of fixing density of both communication and organizational vocabulary networks – i.e. we did not include a configuration for baseline Density.
significantly positive ($\exp[0.155]=1.168$) to indicate that pairs of managers are likely to share multiple words. Organizational vocabularies tend to support convergent interpretations of experience in the workplace.

The significantly positive value of the Same subunit (words) parameter indicates that also Hypothesis 3 is supported. Members of the same subunits are slightly more likely ($\exp[0.082]=1.086$) to adopt similar organizational vocabularies to describe their subunit than members of different subunits.

Hypothesis 4 receives substantial support when communication is reciprocated. Reciprocal communication and affiliation to same words - Different subunit is the only variable carrying a significantly positive parameter value. This suggests that sharing similar organizational vocabularies sustains reciprocal communication across formal subunit boundaries. The odds of observing this tendency are more than four times ($\exp[1.440]=4.221$) the odds of not observing it.

The behavior of the control variables is mostly in line with expectations. Similarity between pairs of managers makes them more likely to communicate. This evidence holds true for Same tenure and Same function. The significantly positive parameter of Same tenure ($\exp[0.607]=1.835$) suggests that communication is stratified by group tenure, with experienced managers talking with other experienced colleagues, and newly hired managers talking with similarly tenured others. The positive and significant parameter of Same function ($\exp[0.645]=1.906$) indicates that communication ties are likely to be bounded by affiliation to the same functional area. Task-related communication is also shaped by local dependencies. The positively significant parameter of Reciprocity ($\exp[2.002]=7.404$) suggests that the existence of a communication tie between two managers makes the manager who is recipient of information more likely to engage in a communication tie with the source of information. Popularity spread parameter is negative and significant ($\exp[-0.667]=0.513$),
to suggest a tendency against centralization in the distribution of communication ties received. Managers are fairly homogeneous in the tendency of being selected as receivers of information. The positively significant parameter of Transitivity ($\exp[0.757]=2.132$) indicates that communication tends to occur within small groups of managers, who are likely to be exposed to the same amount of similar information. This evidence is strengthened by the Multiconnectivity effect. Its significantly negative parameter ($\exp[-0.233]=0.792$) points to a tendency against the presence of managers who are linked to one another by communication ties only indirectly. Considered together with the non significant parameter of Activity spread, these results indicate that the communication network displays a flat structure. The network is better explained in terms of similarity, reciprocity and transitivity configurations than in terms of degree-related configurations. Information is likely to flow homogeneously within small groups instead of being centralized around few managers, consistently with previous findings on knowledge-based relations (Lomi et al. 2014).

The parameter values of the second set of control variables indicate the presence of patterns in the association of managers to vocabularies. The positive and significant Manager activity parameter ($\exp[0.607]=1.835$) points to centralization in the word choice activities expressed by managers. A restricted number of managers use many words to describe the work experience in their subunit, while many managers use only a few words. The Preferential affiliation to words parameter ($\exp[0.432]=1.540$) indicates that also the attractiveness of words is centralized. This provides some insights into the composition of organizational vocabularies. A limited number of words is used by a large number of managers, while a large number of words is used by a small share of managers only.

The control variables related to the association between interpersonal communication and patterns of similarity in the organizational vocabularies are all not significant, strengthening the evidence provided by Hypothesis 4. Since similar organizational vocabularies promote
interpersonal communication only across the boundaries of subunits, communication within subunit boundaries could be explained by a different motivation than sharing similar organizational vocabularies.

DISCUSSION AND CONCLUSIONS

If what organizations do better than markets is “sharing and transfer of the knowledge of individuals and groups” (Kogut and Zander 1992: 383), then few issues might be more important than understating the factors that facilitate instrumental communication and effective knowledge sharing within organizations. We designed this study to address one main question: Under what conditions is knowledge embedded in idiosyncratic, dyadic relationships likely to reach across intra-organizational boundaries and thus be shared between distant organizational members? Through the analysis of task-related communication networks between managers working in subsidiary companies within a multi-national corporate group, we found that the effects of organizational structure on the likelihood to observe informal communication relations spanning subunit boundaries are contingent on the similarity of vocabularies that managers use to describe their subsidiary units. We have shown that the long-established insight that organizational boundaries tend to be impermeable to crosscutting knowledge sharing relations holds true only when taking a structural perspective and neglecting the vocabularies that organizational members adopt to construct and share meaningful interpretations of their organizations.

In the case we examined, we found a strong tendency of task-related communication relations to be constrained within the boundaries of organizational units. This baseline result confirms results of prior research on knowledge transfer and sharing within organizations (Reagans and McEvily 2003, Tortoriello and Krackhardt 2010). However, when vocabularies shared by individual managers are taken into account (Loewenstein et al. 2012), more nuanced relations emerge between formal organizational structure and informal knowledge sharing patterns.
(Argote and Kane 2009). We found that managers tend to use similar words in describing their subsidiary company. Organizational members tend to share common vocabularies to make sense of the organizations where they live and work (Weick 1995). Moreover, similarity in vocabularies adopted by managers to describe their subsidiaries complements and completes the influence of the formal organizational structure on the informal social structure of task-related communication relations. Specifically, we observed that the more managers shared words associated with their subsidiary companies, the more they were likely to communicate across subsidiaries’ boundaries.

Clearly, our empirical setting contains many idiosyncratic features limiting the empirical extension, and thus the generalization, of these results. Our motivating question, however, remains as important as it is general because the ability to create and share knowledge between individual managers and groups is one of the defining features of organizations vis a vis alternative institutional arrangements. We depict organizations as distinctive social settings not only because they are defined by the presence of goal-oriented and relatively stable patterns of interaction over time, as the literature in organizational design has extensively suggested (March and Simon 1958). We argue that the idiosyncratic nature of organizations also derives from evidence that their formal structure (in terms of interconnected, quasi-independent subunits composing the overall organization) makes resonant patterns of similarity and difference in the meanings that organizational members attribute to the distinct layers of the organizational settings in which they live and work.

Within subunits (subsidiary companies in our empirical setting), it is likely to expect people as trying to reproduce the structure of social groups (Lin 1999). Individuals tend to make sense of the social space that they inhabit, and search for interactions that facilitate interpersonal communication, social support and the development of trust (Mardsen 1988). We show that individuals are more likely to forge dyadic ties within subunits with coworkers who are similar
to themselves in the vocabularies that they share to describe their companies (Kleinbaum et al. 2013). We suggest therefore that focusing on organizational vocabularies can help better understand processes of organizational coordination and knowledge sharing in organizational contexts. Through homophilous relationships based on similar words, but also common meanings, managers activate social-cognitive associated with group membership choices that might lead to network interactions that can span the formal boundaries of organizational activities (Hogg and Terry 2000: 121).

Similarity in the vocabularies adopted to describe the subunits crates the opportunity for connection between managers separated by formal organizational boundaries. Similarity reduces the risk that organizations face to become similar to what Watts (1999) described as a “caveman world” – a set of dense isolated clusters (the “caves”) inhabited by organizational members (the “cavemen”) linked exclusively by strong, frequent, and redundant interaction within their “caves” – but isolated from outside contact. Similarity in organizational vocabularies allows modern, organizational “cavemen” to reach out and communicate across the boundaries of their otherwise relatively unconnected formal “caves.” The delicate balance of these mechanisms determines the observed structure of task-related communication networks in organizations, and the extent to which knowledge can cross the internal boundaries of organizational structures. In this study, we contribute therefore to research on organizational knowledge sharing postulating, specifying and revealing the nuanced interaction of organizational structure and vocabularies in specific empirical settings – let alone shown how these mechanisms concatenate to produce the task-related communication network that was actually observed. For this reason, this study invites further research on how organizations as hierarchical multilevel social settings affect communication and knowledge sharing ties across social networks and social groups.
Conversely, we also envisage prospects for further research on the role that heterophily in organizational vocabularies plays in allowing individuals to share knowledge in organizations. As one empirical investigation demonstrated, "the greater the heterogeneity the greater are the chances that any fortuitous encounter involves persons of different groups" (Blau et al. 1982: 47). Given the differentiation of work tasks between subunits, employees working in different subunits tend to develop heterogeneous knowledge and abilities (Katz and Khan 1966) that can lead them to build different systems of words and meanings assigned to their subunits and to the overall organization. Individuals might be likely to bridge cross-unit boundaries to seek advice from colleagues with complementary, rather than similar, knowledge and abilities (Casciaro and Lobo 2008); and it is from these cross-unit encounters among individuals with different languages and meanings that important organizational outcomes, including innovation and knowledge transfer, can follow (Tasselli 2015). We also expect future analysis of whether and how interpersonal relationships between heterophilous others across the social space of the organization can lead to higher-level relationships such as alliances, in a striking example of how micro-level diversity in individuals’ activities can affect outcomes at a higher level of analysis, including multi-unit or multi-organizational networks.

A first limitation of this study that we want to acknowledge concerns network delineation. In this empirical setting, we have focused on task-related communication ties between managers. Yet people in social settings interact in other ways as well (Lomi et al. 2014: 454). Other networks that have attracted the interest of organizational researchers include informal, expressive friendship networks and adversarial networks of dislike (Klein et al. 2004). We call for further empirical work investigating the role of individual differences in organizational vocabularies in relation to other networks with potentially important implications for organizational functioning (Caimo and Lomi 2015). A second limitation of the study concerns the cross-sectional nature of our research design. Clearly, our results are associational and do
not lend themselves to a strong causal interpretation. Future studies based on longitudinal designs are possible as direct extensions of our current work. Longitudinal designs will have to confront directly the question of change in meaning of the organizational vocabularies over time – a problem that is likely to benefit more from in-depth case studies. In longitudinal studies, the turnover of organizational members cannot be ignored as a source of change in meaning structures, organizational culture, and hence in organizational vocabularies (Harrison and Carroll, 2006).

In conclusion, publications referencing “social networks” have been increasing exponentially over the last four decades (Burt et al. 2013). In the broadly defined field of organization and management theory most of these publications have examined how social networks affect organizations (McEevily et al. 2014). Relatively few studies, however, have examined the reverse pattern of how organizations affect social networks by guiding and shaping, but also circumscribing and separating local areas of meanings. The overriding message of this study is that organizational structure combines with the organizational vocabularies jointly to affect the extent to which members communicate and share knowledge across organizational boundaries. This study makes an important first step toward a better understanding of the role of “vocabularies of organizing” as generators of meaning and relations may play in closing the ‘cultural holes’ that prevent knowledge sharing and transfer in organizations.
References


Figure 1  Network Diagram of Communication Relations and Manager Affiliation to Organizational Vocabularies (White circles are managers, grey squares are words. Black lines are communication ties among managers. Dark grey lines are affiliation ties of managers to words).
Table 1  Descriptive Statistics for Communication Network.

<table>
<thead>
<tr>
<th>Communication Network</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>0.076</td>
</tr>
<tr>
<td>Average degree</td>
<td>3.119</td>
</tr>
<tr>
<td>Degree variance</td>
<td>6.057 (out)/ 3.179 (in)</td>
</tr>
<tr>
<td>Reciprocity</td>
<td>0.672</td>
</tr>
<tr>
<td>Average (geodesic) distance</td>
<td>2.900</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>42</td>
</tr>
<tr>
<td>Number of dyads</td>
<td>1722</td>
</tr>
</tbody>
</table>

Table 2  Descriptive Statistics for Organizational Vocabulary Network.

<table>
<thead>
<tr>
<th>Organizational Vocabulary Network</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>0.160</td>
</tr>
<tr>
<td>Average degree</td>
<td>4.809 (out)/ 6.733 (in)</td>
</tr>
<tr>
<td>Degree variance</td>
<td>20.739 (out)/ 29.583 (in)</td>
</tr>
<tr>
<td>Average (geodesic) distance</td>
<td>2.776</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>72</td>
</tr>
<tr>
<td>Number of dyads</td>
<td>1260</td>
</tr>
</tbody>
</table>
Table 3  Summary Table of Independent Variables.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Configuration</th>
<th>Included to control for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same subunit (H₁)</td>
<td></td>
<td>Tendency of managers to communicate with colleagues within the same subunit</td>
</tr>
<tr>
<td>Structural equivalence managers (H₂)</td>
<td></td>
<td>Tendency of pairs of managers to use the same multiple words</td>
</tr>
<tr>
<td>Same subunit (words) (H₃)</td>
<td></td>
<td>Tendency of managers who are member in the same subunit to use the same word</td>
</tr>
<tr>
<td>Communication and affiliation to same words – Different subunit (H₄)</td>
<td></td>
<td>Tendency of managers to communicate with colleagues who are member in other subunits based on shared words</td>
</tr>
<tr>
<td>Reciprocal communication and affiliation to same words - Different subunit (H₄)</td>
<td></td>
<td>Tendency of managers to reciprocate communication with colleagues who are member in other subunits based on shared words</td>
</tr>
</tbody>
</table>

Notes. White circles are managers, grey squares are words. Black lines are communication ties among managers. Dark grey lines are affiliation ties of managers to words. Black/white circles are managers with a different value of a covariate.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Configuration</th>
<th>Included to control for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same covariate (i.e. education, tenure,</td>
<td></td>
<td>Tendency of managers to communicate with colleagues with the same value of a covariate</td>
</tr>
<tr>
<td>nationality, function)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reciprocity</td>
<td></td>
<td>Tendency of managers to communicate with reciprocating colleagues</td>
</tr>
<tr>
<td>Activity spread</td>
<td></td>
<td>Tendency of managers to communicate with many colleagues</td>
</tr>
<tr>
<td>Popularity spread</td>
<td></td>
<td>Tendency of managers to be sought as communication partners by many colleagues</td>
</tr>
<tr>
<td>Transitivity</td>
<td></td>
<td>Tendency of managers to communicate with colleagues of colleagues</td>
</tr>
<tr>
<td>Multiconnectivity</td>
<td></td>
<td>Tendency of managers to communicate with and to be sought as communication partners by</td>
</tr>
<tr>
<td></td>
<td></td>
<td>colleagues</td>
</tr>
<tr>
<td>Manager affiliation to organizational vocabularies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manager activity</td>
<td></td>
<td>Tendency of managers to use a set of words</td>
</tr>
<tr>
<td>Isolates (words)</td>
<td></td>
<td>Tendency of words to be used by no managers</td>
</tr>
<tr>
<td>Preferential affiliation to words</td>
<td></td>
<td>Tendency of multiple managers to use the same word</td>
</tr>
<tr>
<td>Structural equivalence words</td>
<td></td>
<td>Tendency of the same pair of words to be used by multiple managers</td>
</tr>
<tr>
<td>Same function (words)</td>
<td></td>
<td>Tendency of managers who are member in the same function to use the same word</td>
</tr>
<tr>
<td>Association between communication and manager affiliation to organizational vocabularies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication and affiliation to same words</td>
<td></td>
<td>Tendency of managers to communicate with colleagues based on shared words</td>
</tr>
<tr>
<td>Reciprocal communication and affiliation to</td>
<td></td>
<td>Tendency of managers to reciprocate communication with colleagues based on shared words</td>
</tr>
<tr>
<td>same words</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication and affiliation to same words –</td>
<td></td>
<td>Tendency of managers to communicate with colleagues who are member in other functions</td>
</tr>
<tr>
<td>Different function</td>
<td></td>
<td>based on shared words</td>
</tr>
<tr>
<td>Reciprocal communication and affiliation to</td>
<td></td>
<td>Tendency of managers to reciprocate communication with colleagues who are member in</td>
</tr>
<tr>
<td>same words – Different function</td>
<td></td>
<td>other functions based on shared words</td>
</tr>
</tbody>
</table>

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Table 5  Maximum Likelihood Estimates of ERGMs.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same subunit ((H_1))</td>
<td>1.484 (0.268)**</td>
<td>1.455 (0.315)**</td>
</tr>
<tr>
<td>Structural equivalence managers ((H_2))</td>
<td>0.155 (0.024)**</td>
<td></td>
</tr>
<tr>
<td>Same subunit ((words) ((H_3)))</td>
<td>0.082 (0.028)**</td>
<td></td>
</tr>
<tr>
<td>Communication and affiliation to same words - Different subunit ((H_4))</td>
<td>-0.512 (0.385)</td>
<td></td>
</tr>
<tr>
<td>Reciprocal communication and affiliation to same words - Different subunit ((H_4))</td>
<td>1.440 (0.781)c</td>
<td></td>
</tr>
<tr>
<td>Same education</td>
<td>0.161 (0.162)</td>
<td>0.150 (0.181)</td>
</tr>
<tr>
<td>Same tenure</td>
<td>0.620 (0.169)**</td>
<td>0.607 (0.177)**</td>
</tr>
<tr>
<td>Same nationality</td>
<td>0.242 (0.180)</td>
<td>0.295 (0.207)</td>
</tr>
<tr>
<td>Same function</td>
<td>0.612 (0.215)**</td>
<td>0.645 (0.268)*</td>
</tr>
<tr>
<td>Reciprocity</td>
<td>2.163 (0.465)**</td>
<td>2.002 (0.481)**</td>
</tr>
<tr>
<td>Activity spread</td>
<td>0.279 (0.290)</td>
<td>0.309 (0.282)</td>
</tr>
<tr>
<td>Popularity spread</td>
<td>-0.723 (0.323)*</td>
<td>-0.667 (0.336)*</td>
</tr>
<tr>
<td>Transitivity</td>
<td>0.772 (0.182)**</td>
<td>0.757 (0.166)**</td>
</tr>
<tr>
<td>Multiconnectivity</td>
<td>-0.243 (0.070)**</td>
<td>-0.233 (0.068)**</td>
</tr>
<tr>
<td>Manager activity</td>
<td>0.607 (0.183)**</td>
<td></td>
</tr>
<tr>
<td>Isolates ((words))</td>
<td>0.223 (0.843)</td>
<td></td>
</tr>
<tr>
<td>Preferential affiliation to words</td>
<td>0.432 (0.141)**</td>
<td></td>
</tr>
<tr>
<td>Structural equivalence words</td>
<td>0.100 (0.059)</td>
<td></td>
</tr>
<tr>
<td>Same function ((words))</td>
<td>-0.029 (0.063)</td>
<td></td>
</tr>
<tr>
<td>Communication and affiliation to same words</td>
<td>-0.061 (0.187)</td>
<td></td>
</tr>
<tr>
<td>Reciprocal communication and affiliation to same words</td>
<td>-0.078 (0.389)</td>
<td></td>
</tr>
<tr>
<td>Communication and affiliation to same words - Different function</td>
<td>-0.011 (0.196)</td>
<td></td>
</tr>
<tr>
<td>Reciprocal communication and affiliation to same words - Different function</td>
<td>0.097 (0.428)</td>
<td></td>
</tr>
</tbody>
</table>


*p <0.10; *p <0.05; **p <0.01 (two-sided test).