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From Top to Bottom

Investigating the Changing Role of Hierarchy in Enterprise Social Networks

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Abstract Social media, such as social networking platforms, are increasingly gaining importance in enterprise contexts. Enterprise social networking (ESN) is often associated with improved communication, information-sharing and problem-solving. At the same time, ESN has been argued to diminish the role of formal influence in that users increasingly derive authority from their contributions to the network rather than from their position in the organizational hierarchy. Others argue that ESN will diminish influence considerably by producing more democratic and inclusive communication structures. Yet, these assertions have so far remained largely unexplored empirically. Against this background, we explore what influence both a user's position in the organization's hierarchy and a user's contributions on the network have on the the ability to elicit responses from other ESN users. We draw on a unique data set of more than 110,000 messages collected from the ESN platform used at Deloitte Australia. While we find evidence for both kinds of influence, our data also reveals that informal influence has a stronger effect and that, as the ESN community matures over time, communication structures become indeed more inclusive and balanced across hierarchical levels. We contribute a set of propositions that theorize the ways in which influence and communication pattern are shaped during the process of ESN emergence. Our results further underline the potentials of ESN to improve organic, user-driven communication and knowledge sharing within firms.

1 Introduction

Following the popularity of Facebook and Twitter in the public space, social media technologies have made fast inroads into the workplaces of corporations, often applied with the intention to improve communication practices (Smith and Pigni 2014; Bughin and Chui 2013; Meske and Stieglitz 2013; Stieglitz et al. 2013; Stocker et al. 2012; Richter et al. 2011; Riemer et al. 2010). Social media platforms in a business context may include functionality such as microblogging, wikis, blogs, and social intranet features. Recently, companies have started to support enterprise social networking (ESN) via platforms that facilitate light-weight communication via short messages and that are said to make it easier to find, connect, and interact with colleagues (Aoun and Vatanasakdakul 2012).

Proponents of ESN have long argued that as ESN communities emerge the role of formal hierarchy will diminish, and people will increasingly derive authority from what they contribute to the network (e.g., Tapscott and Williams 2006), as well as from reciprocity in communication behavior (Shi et al. 2014; Kane et al. 2012;

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Kankanhalli et al. 2005; Gu and Jarvenpaa 2003). Others have argued that ESN will lead to more egalitarian communication structures, diminishing the influence of hierarchical structures and particular individuals more generally (e.g., Tapscott and Williams 2006; Cook 2008; McAfee 2009). While these views are widely shared among vendors and commentators in the blogosphere, actual research investigating the relationship between hierarchy, user influence, and communication patterns in ESN has not yet been forthcoming, except for some notable exceptions (e.g., Riemer and Richter 2010).

Against this background, in this explorative, theory-development case study we aim to unpack and understand how both formal and informal influence unfold within ESN platforms over time. In particular we set out to explore the relationship between users' hierarchical positions, their contributions to the network and the associated influence, as measured by the ability to elicit responses from other users in the ESN.

Access to a unique data set enables us to base this study on actual communication data rather than data elicited from surveys or interviews. Our data set was extracted from the ESN platform used at Deloitte Australia[1]. One of the main features of this ESN platform is enterprise microblogging, the exchange of short messages in conversation streams. Our data covers a time frame of almost 4 years and comprises more than 110,000 messages written by 6,212 users. We employ regression analysis to investigate the relationship between two independent variables, (1) a user's *hierarchy position* (formal influence) and (2) a user's *contributions* to the network (informal influence) as well as a dependent variable *response outcome*. Response outcome is measured by the likelihood, quantity and speed of responses of other users to an initial message. We first carry out these analyses for the full data set. Then, in order to provide richer insights and a better understanding of the communication and interaction patterns over time, we separate the data set into three periods, each containing equal amounts of messages.

We find changes in formal and informal influence over time. While organizational hierarchy is a source of influence early, this influence can be seen to dissipate as the ESN community becomes more egalitarian and independent from existing organizational structures over time. We formulate a set of theoretical propositions to grasp the ways in which influence changes over time and becomes more evenly shared among the user group, as the community builds up its own, balanced communication structures.

Our study contributes to the ongoing quest for a better understanding of communication in ESN in general and the changing role of formal and informal authority in social media in particular. Understanding the structure and dynamic nature of enterprise communication networks is crucial, because they influence information diffusion (Stieglitz and Dang-Xuan 2013; Aral et al. 2007) and the performance of knowledge-centric organizations, such as our case company (Cleveland and Ellis 2014; Wu and Chang 2013; De Ridder 2004; Fischbach et al. 2004).

This paper begins by providing background on ESN and microblogging and the role of (formal and informal) hierarchy in enterprise communication. After a description of the case company and our data set, we then formulate constructs and derive a research model. We employ regression analysis on both the full data set and individual data sets for three time periods. In addition, we present descriptive data such as the level of user activity and interaction between different levels in the hierarchy over time. This allows us to theorize the changing role of the different types of influence over time. We derive a set of theoretical propositions as the main contribution of this study, and conclude by outlining implications and limitations.

2 Literature Review

In this section, we discuss the concept of microblogging in the context of ESN. We then review literature that focuses on formal and informal hierarchy in organizations, which we subsequently apply to the context of ESN.

2.1 Microblogging in Enterprise Social Networks

In the wake of what has been termed the Web 2.0, a new breed of Internet platforms has emerged: social platforms that provide easy-to-use features that encourage participation, social networking, and the exchange of short messages (e.g., Huberman et al. 2009; Richter et al. 2011). Given the widespread use of social media in the public domain, corresponding platforms have made fast inroads into organizations. These services comprise a wide range of features, such as wikis, blogs, social bookmarking, user profiles, messaging and discussion features. They are commonly associated with practices of information sharing, communication and group work, and collectively referred to as Enterprise 2.0 (McAfee 2009).

Early research in the field has investigated the associated potentials of deploying various kinds of platforms within the workplace (e.g., Ip and Wagner 2008; DiMicco 2008). In the wake of the popularity of Wikipedia, many early studies concentrated on the application of Wikis in the

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[1] Please note that in order to avoid any conflict of interest, the case company has asked not to name the particular ESN product that is employed within the company.

workplace and explored particular aspects, including the type and volume of contributions, the relationship between consuming content and contributing, the quality of user generated content, user motivation, the benefits for the individual and the organization, or the perceived barriers or rules of use (e.g., Holtzblatt et al. 2010; Stocker et al. 2012).

More recently, organizations have begun employing social networking technologies, platforms that mimic the features of Twitter and Facebook, but that are designed for application within organizations; examples are Yammer, Tibbr, Sitrion, Mumba Cloud or Jive. In general, social networking sites are defined as those that connect users by way of creating relationships and facilitating interactions through the exchange of short messages (Boyd and Ellison 2007). More specifically, ESN platforms have been defined as web-based platforms that allow workers to (1) communicate messages by way of broadcasting or direct messaging; (2) explicitly indicate or implicitly reveal particular co-workers as communication partners; (3) post, edit, and sort text and files; and (4) view messages, connections, text, and files created by anyone else in the organization (Leonardi 2013).

In essence, the functionality of ESN revolves around relationship building and short message communication. Yet, while relationship building via friend (Facebook) or follower (Twitter) networks is at the heart of public social networking, due to their focus on the rather bounded nature of the network of colleagues, in ESN the main focus is on the messaging capability. The short messaging feature of ESN is generally referred to as enterprise microblogging (e.g., Zhao and Rosson 2009; Riemer et al. 2010). In the following we will concentrate on the microblogging aspect of ESN.

An emerging body of scholarly work has already investigated various general aspects of enterprise microblogging, such as adoption (e.g., Riemer et al. 2012; Schöndienst et al. 2011; Meyer and Dibbern 2010; Günther et al. 2009) as well as usage and associated benefits (Zhao and Rosson 2009; Zhang et al. 2010; Riemer et al. 2011a). Williams and Schubert (2011) investigated the motivation, supported work and activities as well as the contributions of the ESN platform in a large consultancy as part of an empirical study of enterprise social software. Cleveland (2012) aimed at determining the user acceptance of ESN as a tool for knowledge creation and reuse in ICT projects, applying the UTAUT framework by Venkatesh et al. (2003).

A number of case studies have found that microblogging has been incorporated in very different user practices within organizations when compared with the public sphere. In a detailed comparison of multiple cases Richter and Riemer (2013) found that EMB use cases are diverse,

and include problem-solving, information sharing, information storage, social praise, and work coordination. Importantly, microblogging in an enterprise context was found to be much more conversational and less unidirectional in nature. Whereas Twitter is generally seen as a broadcasting medium, with only about a quarter of messages part of a conversation (Honeycutt and Herring 2009), ESN has been described as a conversational platform with more than 75 % of messages found to be part of a conversation (with two or more messages) in one study (Riemer et al. 2011b).

Drawing on this observation, in this study we investigate the extent to which users are able to elicit responses from other users via ESN conversations. In doing so, we explore the influence of a user's hierarchical position, vis-à-vis a user's contributions to the network on the ability to elicit responses. In other words, we investigate both the role of formal organizational structure, in terms of hierarchical position, and emerging structures within the ESN, in terms of user activity, on the ways in which users gain influence within the ESN platform, as measured by the ways in which they elicit responses from others.

2.2 Hierarchy and Communication in ESN

One of the main aims of organizations is to coordinate complex activities among large numbers of people in order to accomplish work and achieve business goals (Fritz et al. 1998). One aspect of dividing and organizing people in business organizations is by way of forming a hierarchy. Weber (1921) described hierarchy as a "vertical formal integration of official positions within one explicit organizational structure".

It is widely accepted that hierarchies represent a natural organization mechanism in that almost all social systems are structured as group-based social hierarchies (Diefenbach and Sillince 2011; Sidanius et al. 2004; Scott 1990; Laumann et al. 1971). In general terms, a hierarchy can be described as an "ordered set of entities that can be classified as being inferior, superior or on the same level as one other" (Putzke et al. 2010). Hierarchical structures are not only linked to the formal monitoring and controlling of employees but also said to organize the official flow of information within the organization, maintaining hierarchical communication patterns (Friebel and Raith 2004; Johnson et al. 1994).

At the same time however, actual communication structures will often differ as people establish informal relationships. In particular, the emergence of new information technologies has provided people with new and easy ways to communicate and interact digitally within organizations at a larger scale. The results are self-creating structures and processes (Bögel et al. 2014) that might form

informal hierarchies (Oberg and Walgenbach 2008; Ugbah and Dewine 1989).

Diefenbach and Sillince (2011) define informal hierarchy as "person-dependent social relationships of dominance and subordination, which emerge from social interaction and become persistent over time through repeated social processes, especially routine behaviour."A plethora of studies has demonstrated the existence of informal hierarchies, for example by analyzing the emergence of informal hierarchy in different types of organizations, such as hybrid and network organizations (Schwarz 2006; Ekbia and Kling 2005; Nelson 2001) or by descriptive analysis of formal and informal network organizations (e.g., Rank 2008; Allen et al. 2007; Guimerà et al. 2006). In their meta-analysis, Diefenbach and Sillince (2011) discovered that informal hierarchies often emerge unrecognized and that they can become the dominant structure, referred to as the principle of communicative dominance.

Authority and influence in organizations are generally thought to be legitimately derived from one's position within the formal hierarchy. Yet, according to Aghion and Tirole (1997) "formal" authority needs to be distinguished from "real" authority. According to Kleinnijenhuis et al. (2011), authority and influence in networks is more likely based on expertise and connectedness than on formal specifications. This observation is supported by Hirokawa and Johnston (1989) who state that authority and power are constructed through and based on social interactions among group members. Consequently, in addition to formal influence, people derive significant influence from their position in informal, social hierarchies that often complement or contradict formal hierarchies.

Against this backdrop, proponents of ESN and Enterprise 2.0 have long argued that the application of social technologies in the workplace has the potential to change the dynamic of authority and influence, in the process diminishing the role of formal hierarchy and giving more weight to people's contributions within the network. Accordingly, in recent studies scholars have argued that formal hierarchy has a decreasing influence on communication and collaboration because ESN provides higher social capital benefits for employees in otherwise disadvantaged positions, like new or young employees and others in hierarchically lower positions (e. g., Durst et al. 2013; Steinfield et al. 2009).

What is more, proponents have also argued that communication structures will become more open and democratic, challenging the idea of hierarchy more generally, be it formal or informal. McAfee (2009) stated that the fundamental idea of "Enterprise 2.0 is about giving many more people within the organization a voice, letting them interact as equals…". (p. 207). Tapscott and Williams

(2006) argued that, "as self-organization becomes accepted as a viable method of production, more processes within the organization will move from being hierarchically directed, proprietary and closed to self-organizing, shared and open."

While there appears a general tendency to assume that ESN will diminish influence derived from formal hierarchy, the interplay between formal influence, informal influence or the emergence of more balanced and equal communication structures more general, remains largely unexplored given the typical scarcity of data access in this field. We set out to investigate these matters and formulate the following research questions, which we subsequently investigate in our case study:

1. Does formal influence derived from organizational hierarchy translate into and structure communication within the ESN space?
2. Does ESN afford users to move into positions of influence by way of their contributions to the network, effectively creating informal, social hierarchies?
3. Does ESN indeed produce more egalitarian and inclusive communication structures, diminishing the influence of both forms of hierarchy?

3 Study Overview and Research Methods

In this study we set out to explore the nature and role of various forms of user influence in ESN. For doing so, we make use of the structural features of ESN, such as the fact that message data is stored and preserved, which presents as a source for focused data and social network analyses (Stieglitz et al. 2014). We carry out a case study of Deloitte Australia, the Australian member firm of Deloitte Touche Tohmatsu Limited. The company provided comprehensive access to its ESN data set, which enabled us to undertake this analysis. Consequently, we carry out an exploratory, single case study (Yin 2003) that allows us to investigate the phenomenon of influence through formal and informal hierarchies with a unique data set. According to Stake (2003) our case can thus be classed as instrumental in that it will provide insights into a particular phenomenon, with the aim to contribute theoretical propositions in order to advance our understanding of the phenomenon under study, in our case the existence and proliferation of user influence in ESN.

As such, we aim to investigate the differences in users' formal and informal influence within the ESN, whereby influence is operationalized as the ability to elicit responses to one's messages from the ESN community. In other words, we aim to find out if users derive influence (formally) from their position in the organizational hierarchy

or (informally) from their contributions to the ESN. We reason that users who contribute much to the ESN community will become authoritative by way of being seen as experts or otherwise valuable contributors, thereby creating a social stratification resembling informal, social hierarchy.

We will then further explore how these forms of influence change over time as the ESN community emerges and matures. In doing so, we draw on further descriptive statistics and background information from the case company to paint a richer picture of ESN community emergence and changing influence patterns over time.

3.1 Case Company and ESN Platform

The Australian partnership of Deloitte Touche Tohmatsu is a professional services firm that provides its clients with auditing, consulting, financial advisory, risk management, and tax services. Deloitte Australia has more than 570 partners and 6,000 people located in 14 offices across the country.

The use of ESN in Deloitte Australia emerged bottom-up and organically. ESN was not officially rolled-out to the user base, but rather adopted and diffused by word-of-mouth. However, the service was very early endorsed by senior management and actively promoted. As a result the ESN was widely adopted with more than 90 % of employees registered on the platform as of 2012. A previous, qualitative analysis of ESN data at Deloitte Australia unveiled that the service was used extensively in the context of the knowledge-intensive consulting and tax auditing practices in the company (Riemer and Scifleet 2012). In particular, ESN was used to provide input for other users, for idea generation and brainstorming, problem-solving, and the crowdsourcing of expert advice. Only less than 10 % of communication was found to be non-work related (Riemer and Scifleet 2012).

Deloitte Australia presents as an ideal case for studying the phenomenon of influence through organisational hierarchy and user contributions. On the one hand, Deloitte as a professional service firm features a deep and explicit hierarchical structure. The hierarchy is very present in the day to day business with individuals deriving project roles from their position in the hierarchy; it also acts as a strong motivator as individuals typically aspire to progress to the next higher level. On the other hand, the professional consulting and taxation services offered by Deloitte are highly knowledge-intensive. Hence, work is characterised by knowledge-sharing and new knowledge creation activities and individuals aim to position themselves as knowledge experts. The selection of Deloitte Australia as a single case for studying influence in ESN is thus justified by its revealing nature (Yin 2003), as it features to a significant extent both formal hierarchy and the conditions for studying informal influence based on contributions from information sharing.

The ESN service employed within Deloitte Australia is organised using the concept of networks, with each network typically representing one company. Anyone can create a network by registering with his or her corporate email address and new users can join thereafter. Users can choose to post into or read messages in the general "catch all" stream or join particular groups that any user can create for certain topics, project or other occasions. As such, public groups can be viewed by all network users and are open to join, while communication in private groups is only visible to invited members.

3.2 Data Collection and Preparation

The available data set covers the period between September 2008 and July 2012 and is based on communication of 6,212 unique user accounts who posted at least one message (note that number of users who communicated during the above period is higher than the total number of employees listed in 2012 because of the nature of employee turnover in this industry). During this time 130,503 messages were posted on the platform, across 445 public groups and 277 private groups, as well as the all-network stream. Our study concentrates on the 110,915 public messages, that is those posted in the all-network stream and public groups, for two reasons: Firstly, our questions can only be answered by analyzing a large amount of communication which is accessible by the majority of employees who can potentially respond to such messages. Secondly, private groups and private messages might contain sensitive information and were thus unavailable for analysis in order to protect confidentiality of the ESN users.

Deloitte prepared and provided the dataset in MS Excel format. For our statistical analysis we used "R". Besides the (text-) body of the messages, six more columns comprise the following (meta) information: a reference to the post it replied to, a thread unique identifier (UID), the timestamp, a group name, a user UID and information if a file was attached to the post. Every post has a UID and is automatically part of a thread. If it is not a reply post a new thread UID is created. All messages in a thread share a common thread UID. Due to the possibility to comment on other posts, they can also hold the UID of the post to which they reply. We would like to note that the company removed from the data set any user or client names in order to ensure anonymity. Furthermore, we removed bot postings and messages that only contained meta-information (e.g., "user xyz has joined the Deloitte network").

In addition to the ESN data, the company provided information extracted from its human resources (HR) systems on the users' formal position within the corporate

Table 1 Distribution of ESN users across the seven hierarchy levels

Level	Positions	Share (%)	Number
1	Personal assistants	4	249
2	Graduates	16	994
3	Consultants, analysts, coordinators	19	1,180
4	Senior consultants, senior analysts	19	1,180
5	Managers, client managers	15	932
6	Directors, senior directors, account directors	15	932
7	Partners, principals	12	745
Sum		100	6,212

hierarchy, as well as some additional information. Matching of the HR data with the ESN data resulted in availability of this information for a total of 65 % of the user base. It was not possible to obtain HR data for all users who had previously left the company; moreover, a number of users have specialized roles that do not directly correspond with the common hierarchical positions of the company. Hence, for these users no position data was included. As Table 1 shows, all seven levels of hierarchy are represented in the data, from personal assistants to partners and principals. This snapshot reflects the status at the end of our analysis period in 2012. 94 % of employees in our data set worked full-time, 55 % were male, and 45 % female. According to the company our data is a good representation of the hierarchical user distribution and thus suitable for studying the intended phenomena.

Information on a user's hierarchy position was added directly to the message meta data in Excel so that each message carries not only the standard meta data (such as user ID), but also the hierarchical position. That way we are able to analyze the relationship between user hierarchy level and replies solicited for each message directly, without having to aggregate to the user level.

3.3 Construct Development

In order to explore the influence users derive from their position in the organizational hierarchy and from their contributions to the network we needed to derive suitable constructs and a corresponding research model. As our dependent variable we chose *response outcome*, which we measure at the message level. We operationalize the dependent variable as three separate sub variables comprising (1) the probability to receive a reply, (2) the number of replies, and (3) the time lag until a response is received. The three sub variables are defined as follows:

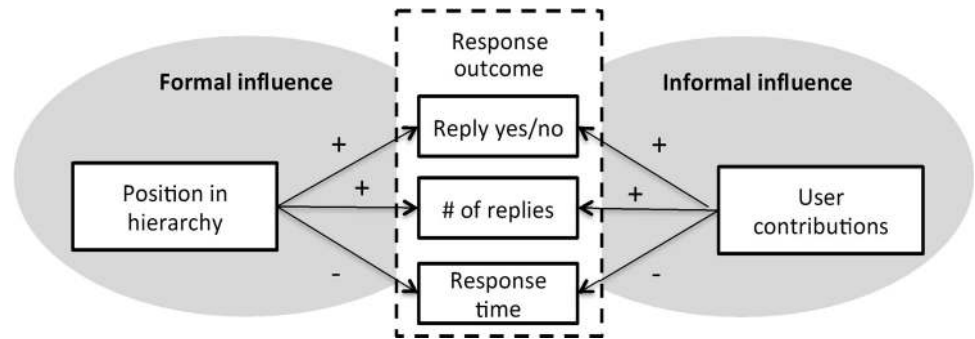1. "reply" is a binary variable: either a message has been replied or not

2. "reply_no" describes the number of replies to a message,

3. "reply_lag" describes the time lapsed before a message receives its first response.

We reason that this three-fold variable is better able to capture the complexities of response behavior than either one of them. Firstly, we reason that influence at the most basic level is signified by whether or not someone's message elicits a reply response at all. Secondly, influence is further signified by the number of responses one's message might elicit, signifying the number of potential contacts one can mobilize and draw on if one needs input to a work task. And finally, considering the particular time-sensitive nature of professional service and consulting work, it is often important to get a timely response to one's message. Hence, we also include the time it takes for one's message to receive the first response.

As already outlined above, our independent variables are (1) a user's position in the organizational hierarchy, which we term *hierarchy level* and (2) a user's contributions to the network, which we term *user contributions*. We determine user contributions based on the number of published messages associated with a user account; due to the disparity in the number of messages sent by the most prolific users and the least active ones, we operationalize the variable as (log contribution). We refer to the relationship between hierarchy level and response outcome as *formal influence* and to the relationship between user contributions and response outcome as *informal influence*.

Regarding formal influence we theorize that users in ESNs are likely to follow communication of their superiors and will aim to respond to their messages quickly and diligently, in particular because such behaviors are publicly visible on the platform. Therefore, we theorize that the hierarchical position of an ESN user might have a positive effect on the response behavior of other employees within the enterprise social network. At the same time we theorize that the emerging informal hierarchy within the ESN might also have an impact. We reason that the number of a user's messages might affect the response behavior of other users. This relationship is backed by works on social reciprocity, in that people tend to share information and knowledge with those in the network from whom they have received help before or assume to get help in the future (Musembwa and Paul 2012; Faraj and Johnson 2011). Moreover, a recent study on communication behaviour in ESNs demonstrated that a user's reputation derived from acting within the ESN is positively related with making new connections through communication within the ESN (Kügler et al. 2015). Therefore we theorize that a user's contributions, as

4 Results

In this section we report on the findings of our regression analyses, first for the full data set, then separately for the three data sets representing the three time periods, as outlined above. We then provide additional descriptive data characterizing the three resulting periods. We will discuss the findings and derive theoretical propositions in the subsequent section.

4.1 Regression Analysis

Table 2 provides the results of the regression analysis for the full data set. Note that b denotes estimated coefficients and $exp(b)$ exponentiated coefficients. Estimated robust standard errors are shown in parentheses. Regarding the influence on *reply_lag*, a total of 28,964 messages received at least one direct reply and were therefore included in this analysis.

The results show that hierarchy level is positively correlated with probability and quantity of received replies, albeit with only small effect sizes. At the same time however, hierarchy level is *positively* correlated with time until first reply, not negative as expected, yet also with a rather small effect size. This means that messages from

Table 2 Regression analysis results (full data set)

Independent variables	Dependent variables				
	reply		*reply_no*		*reply_lag*
	b	$exp(b)$		$exp(b)$	
Hierarchy level	0.01 (0.00)**	1.01	0.01 (0.00)**	1.01	0.17 (0.01)***
Log (*contribution*)	0.07 (0.01)***	–	0.07 (0.01)***	–	−0.11 (0.01)***
(*Pseudo*) R^2	0.08		0.05		0.05
Observations[#]	110,915		110,915		28,964

*, ** and *** indicate significance level at 10, 5 and 1 %, respectively

3.4 Data Analysis

We applied logistic regression for the variable "reply", negative binomial regression for the variable "reply_no", and OLS regression for the variable "reply_lag" to analyze the effects of user-, and message-level characteristics on the probability, quantity and speed (timelag) of replies. Multicollinearity tests suggest that multicollinearity is not a problem in our data.

As mentioned earlier we expected that communication behavior might change over time. In order to provide more information about the potential influence of different stages of the emerging ESN community on the communication behavior and the role of formal and informal influence in the network, we divided the data set into three sub data sets. In order to ensure statistical comparability we divided the data set in three equal batches of approximately 37,000 messages each, even though this results in different time spans for each period. The first batch represents the period from the initial launch of the network on 11th of September 2008 until 28th of April 2011. The second period comprises messages generated from 28th of April 2011 to 11th December 2011 and the third period covers all communication between 11th of December 2011 and 19th of July 2012 (last available day in our data set).

We then repeated the regression analyses separately for each of the resulting three message batches. Together with further descriptive statistical data on each of the periods, and qualitative background information about the developmental stage of ESN in each of the periods, this enables us to compare the results between periods and theorize about the changes in formal and information influence over time and the degree to which people from different hierarchy levels interact with each other.

measured by the total number of a user's messages, will have an impact on the response behavior of other users in the network vis-à-vis said user. Figure 1 summarizes our research model.

users in higher positions elicit slower first responses on average, not quicker ones. We reason that people might need more time to find and formulate an adequate answer or take more care in editing replies to users in higher positions. This might either be due to a perceived social/formal distance between the communication partners or the fact that people on higher hierarchical levels ask more complex questions.

The results further show that user contribution is positively correlated with probability and quantity of replies received. Here, we find a much larger effect size (compared to hierarchy level). As expected, user contribution is negatively correlated with time lag to first reply (i.e., messages from high-contributing users elicit quicker responses).

In the next step, we repeated the above regression analyses separately for the three time periods, each of which consists of approximately 37,000 messages. Table 3 presents and juxtaposes the results.

The results show that hierarchy level initially has a positive effect on eliciting responses from the network, which then subsides over time and turns into a negative effect in the last period. At the same time, there is no clear relationship between hierarchy level and the number of replies over time, since the effect only shows up in period 2 with rather low significance. Finally, hierarchy level shows a consistent yet slightly diminishing effect on *reply_lag* over time.

The results show that user contribution shows a more consistent effect over time. As expected the effect is positively correlated to *reply* and *reply_no*, and negatively to *reply_lag*. While the effects are statistically significant in each of the time periods, it is interesting to see that the effects becomes smaller over time, which means that the influence of user contribution, while existent all the way through, lessens over time.

We would like to note that the effect sizes in our regression analysis are comparatively small. And while our data set does not allow unpacking the influence of other possible factors on response behavior, it is important to note that we are measuring response behavior in reaction to a range of different types of communication messages sent by users (see Riemer et al. 2012 for an analysis and classification), many of which are not intended to directly elicit any user responses. Yet, any reasonably reliable classification of messages, in order to derive a data sample that would likely reveal the measured

effects in a much clearer light, would involve qualitative analysis that is prohibitive given the large message set. As a result we concede that any effects are necessarily less clear or pronounced in our data set than they might otherwise be. But while the nature of our data, and the small effect sizes, do not let us theorize in a rigorous way about the absolute strengths of the measured effects they will nevertheless allow us to draw conclusions by way of comparison of the relative strengths of effects and, most importantly, by analyzing relative changes over time. Therefore, in the next section we present descriptive statistics and background data characterizing the three time periods.

4.2 Descriptive Statistics Characterizing the Three Time Periods

In order to interpret the results derived in the previous sub sections, we will now present descriptive statistics and further observations for the three periods. In particular, we present general user demographics (Table 4), the relative contributions of users on the various hierarchical levels of the organization (Table 5), as well as data on how users on the various hierarchy levels respond to each other and how these patters evolve over time (Table 6).

The descriptive statistics in Table 4 show that the number of active ESN users increases moderately by 10 % in each period. Since each period has the same number of messages this means that they were written by a larger number of users, which points to an increase in participation across the organization, as each user contributes less, but a broader base of users is involved in producing content within the ESN. We would like to point out that these user numbers refer to those users who have posted at least one message in these periods, as derived from an analysis of the messages; they are not merely 'registered' users.

Moreover, we included additional characteristics on both users and messages in order to check for deviations in the make-up of the user cohort or the nature of communication over time. The demographic make-up of the user cohort in terms of gender remains reasonably stable over time, as do the structural message characteristics, in terms of relative number of messages with URLs and message word count. These observations are important. If we observed significant deviations in these statistics over time we

Table 3 Regression results for each of the three periods

Coefficients	Period 1			Period 2			Period 3		
	Reply	Reply_no	Reply_lag	Reply	Reply_no	Reply_lag	Reply	Reply_no	Reply_lag
Hierarchy level	0.025**	0.013	0.246***	0.001	0.016*	0.168***	−0.026***	−0.008	0.146***
log (contribution)	0.084***	0.107***	−0.126***	0.073***	0.085***	−0.145***	0.068***	0.067***	−0.087***

*, ** and *** indicate significance level at 10, 5 and 1 %, respectively

Table 4 Descriptive statistics characterizing the three periods

		Period 1	Period 2	Period 3
Periods		09/11/2008–04/28/2011	04/28/2011–12/11/2011	12/11/2011–07/19/2012
	Messages	36,972	36,972	36,971
	Active users	2,325	2,558	2,734
Gender				
	Male	1,322 (57 %)	1,431 (56 %)	1,542 (56 %)
	Female	1,003 (43 %)	1,127 (44 %)	1,192 (44 %)
Message characteristics				
	Questions	7,091 (19 %)	7,278 (20 %)	7,105 (19 %)
	URL	5,096 (14 %)	4,458 (12 %)	4,588 (12 %)
	Word count average (SD)	32.7 (40.6)	33.1 (41.8)	35.0 (46.8)

Table 5 Contributions per users on each hierarchy level over time

Hierarchy level	Active users			Messages			Messages per active user		
	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3
1	62	89	97	304	528	784	4.9	5.9	8.1
2	272	212	473	847	2,869	4,539	3.1	13.5	9.6
3	396	502	519	7,518	8,479	7,929	19.0	16.9	15.3
4	438	500	458	5,479	5,322	6,365	12.5	10.6	13.9
5	395	469	439	7,414	5,672	6,082	18.8	12.1	13.9
6	412	450	419	6,713	6,780	5,840	16.3	15.1	13.9
7	350	336	329	8,697	7,322	5,432	24.8	21.8	16.5
Sum	2,325	2,558	2,734	36,972	36,972	36,971			

could be less confident in the validity of our comparisons between periods.

Table 5 provides an overview of the relative contributions of active users on each of the seven hierarchy levels. The first table segment shows how many users were active (i.e., they wrote at least one message) on each of the hierarchy levels in each of the periods. The second segment shows how many messages each hierarchy level contributed in each of the periods. Finally, the third table segment provides the average number of messages per user on each of the levels for each of the periods. The latter has been visualized in Fig. 2.

The data allows for a number of interesting observations. Firstly, it is interesting to see that the highest hierarchy level (partners and senior partners) has the most active users across all periods. Secondly, levels one (assistants) and two (graduates) are the least active ones, but their relative contributions increase markedly over time. Finally, and most importantly, it is notable that while in period 1 there are large differences in per-user contributions between the hierarchy levels, these differences decrease and average contributions per user are much more evenly balanced in period 3.

Table 6 provides information on how users across the levels of the hierarchy communicate with each other. The percentages indicate the relative number of responses that one hierarchy level (the entries in the rows) elicits from another hierarchy level (the entries in the columns). Entries in one row across all columns add up to 100 %. Not surprisingly, for each hierarchy level a large proportion of responses comes from users on the same hierarchy level, because users in their daily work have to naturally communicate to a significant extent with their immediate peer group. However, over time communication on the same hierarchy level becomes less pronounced, as responses are elicited more widely from users across the hierarchy. In addition, the table shows that partners (level 7) are no longer relied upon for responses as much by other hierarchy levels, and at the same time are replied to more by other levels, so that the proportion of communication within level 7 decreases from 40.1 % to 31.3 %. Overall, Table 6 points to increases in communication between the hierarchy levels over time.

5 Discussion

In this section we discuss the results in light of our research questions. This discussion will allow us to derive a number of propositions that theorize the relationship between the

Table 6 Which hierarchy level do replies come from in each of the three periods?

PERIOD 1

h. level of message	\ hierarchy level of response						
	1	2	3	4	5	6	7
1	17.6%	1.0%	19.6%	14.7%	10.8%	25.5%	10.8%
2	0.4%	53.4%	25.3%	6.4%	4.6%	4.6%	5.3%
3	0.3%	2.0%	47.3%	13.5%	15.7%	9.4%	11.8%
4	0.9%	1.3%	21.2%	29.7%	19.5%	13.3%	14.2%
5	0.3%	0.6%	16.8%	13.6%	35.8%	15.8%	17.1%
6	0.9%	0.6%	12.5%	12.6%	20.1%	30.8%	22.5%
7	0.6%	1.2%	13.0%	10.9%	15.5%	18.7%	40.1%

PERIOD 2

h. level of message	\ hierarchy level of response						
	1	2	3	4	5	6	7
1	31.4%	4.8%	15.1%	7.7%	14.0%	13.3%	13.7%
2	0.5%	39.0%	23.6%	10.6%	8.0%	10.4%	7.9%
3	0.3%	9.3%	42.5%	14.4%	11.8%	11.4%	10.3%
4	0.6%	7.8%	24.4%	29.9%	12.0%	15.1%	10.2%
5	0.8%	4.7%	20.1%	13.7%	29.6%	17.1%	14.0%
6	1.0%	4.3%	17.6%	13.0%	15.1%	31.5%	17.5%
7	0.7%	4.1%	14.8%	10.8%	13.8%	19.0%	36.8%

PERIOD 3

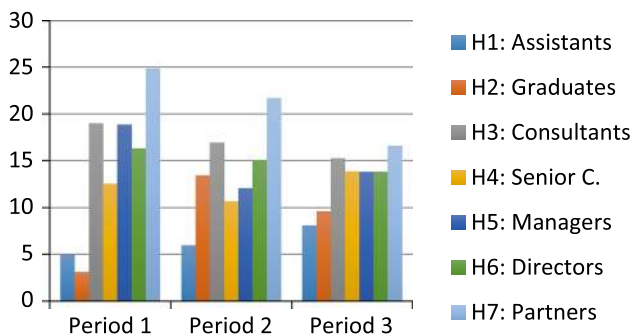| h. level of message	\ hierarchy level of response						
	1	2	3	4	5	6	7
1	27.0%	2.6%	15.1%	15.5%	17.1%	15.1%	7.6%
2	1.0%	34.1%	21.1%	17.1%	11.6%	8.1%	7.1%
3	1.0%	12.4%	41.1%	17.6%	10.7%	11.1%	6.1%
4	1.1%	11.1%	20.4%	27.7%	15.7%	15.4%	8.7%
5	1.6%	9.9%	16.2%	17.8%	29.9%	14.6%	10.1%
6	1.2%	7.5%	15.7%	15.6%	17.7%	29.0%	13.1%
7	1.1%	6.4%	12.8%	14.6%	15.3%	18.4%	31.3%

Fig. 2 Average number of messages per active user

emergence of ESN, the resulting communication patterns and the proliferation of different forms of formal and informal user influence over time. We would like to note that we do not claim that our data allows us to generalize about how influence in ESN proliferates, but that it nevertheless enables us to derive interesting and relevant theoretical propositions as the basis for future enquiry. The resulting set of propositions forms the main theory contribution of our study.

5.1 The Relative Importance of Informal Influence

Results elicited from the full data set show that both hierarchy and communication activity have a significant effect on a user's influence to elicit responses from the ESN user group. However, the influence of a user's hierarchical level is quite marginal and likely not to matter in day-to-day practice. For example, a user who outranks another user by one level in the hierarchy is able to elicit on average 1 % more responses. At the same time, we find a much stronger effect size of 'user contributions' on response behavior, even though the effect size is still quite small. We will thus refrain from drawing any conclusions on the absolute strengths of the effects.

At the same time however, the findings show with some clarity that user contributions to the ESN have a much larger effect compared to hierarchy in relative terms. This lends some support to the long-standing argument put forward by ESN vendors and proponents in the media that the kinds of social networks that emerge from ESN platforms can lead to a re-balancing of influence in organizations – away from formal hierarchy toward recognizing

user contributions. In other words, people who have something to contribute will be recognized by the organizational community and be able to gain influence, even if they do not hold high-level hierarchical positions. At the same time however, the aggregated results suggest that formal hierarchy is not entirely without influence. In the following we look into the ways in which these effects unfold over time.

5.2 Community Building and Changes in Influence over Time

The detailed analysis of our data over the three time periods reveals changes in formal and informal influence as the ESN community emerges and matures. In the following we will draw on the various results presented in the tables above. In order to be able to interpret the results, we further draw on background knowledge obtained from the case company[2] regarding important developments and events that took place during the three periods created by our sampling approach:

1. *Network building*: The first period captures communication from the first message sent in September 2008 until April 2011. This period is obviously much longer than the subsequent two, mainly because in the first 18 months of the network much fewer messages were sent as users across the organization started adopting the network. During this period the organization engaged in activities of formal network building such as the creation of ESN usage policy, founding of a social media steering committee, and first attempts at ESN measurement and analytics. Notably, ESN at Deloitte Australia was very early endorsed, utilized and actively promoted by the CEO and the wider senior leadership group. This is evidenced by the high levels of involvement by users on the highest hierarchy level in our data (Table 5).

2. *Network growth*: The second period is characterized by a number of dedicated campaigns that the organization ran to increase and foster user participation in the ESN. For example, during an internal conference of Deloitte partners a group of partners provided real-time updates via the ESN to the rest of the organization, which led to a new record for the most number of messages sent in 1 day. In another campaign the ESN was utilized to source brand ideas from the organization, which resulted in many users becoming newly engaged with the ESN. Moreover, Deloitte Australia started using the ESN for the on-boarding process of newly hired

graduates, which explains the strong increase in contributions from this group (hierarchy level 2, Table 5).

3. *Network maturity*: According to the information provided by the case company very little significant events with a bearing on the ESN happened during the third period. The ESN service had found its way into productive use across the organization and a number of productive use cases had already emerged for the ESN (Riemer and Scifleet 2012).

5.2.1 Influence of Formal Hierarchy is Prominent in the ESN Initially

Our results presented in Tables 3, 4, 5 and 6 demonstrate that formal organizational hierarchy has a material influence on structuring communication in the ESN initially. Firstly, during the initial period a user's hierarchy position has a significant effect (albeit small on average) on eliciting replies from the network (*reply*). Compared to the effect in the overall data set, the effect is also much larger in period 1. On the other hand, hierarchy has no material effect on the number of responses received (*reply_no*). Together, the results still show that some influence derived from the organizational hierarchy is imported into the ESN during the early stages of the ESN. Secondly, the data in Table 5 shows that users on the higher levels of the hierarchy are the most active in the network as they write more messages per user on average. The group of partners and principles (level 7) in particular are very active, which is in line with the ways in which the Deloitte leadership group endorsed and promoted the ESN early on. Finally, hierarchy is found to have some influence on reply_lag, albeit a positive one. We reason that this finding signifies the social stratification and perceived distance between the users in the ESN, as users take significantly longer to reply to messages sent by higher levels in the hierarchy.

We conclude that as the ESN is adopted, both participation in the network and communication are structured by the existing hierarchical organization structures. This leads us to derive the following proposition:

Proposition 1a In early stages of an ESN, formal influence based on the organizational hierarchy is imported into the network.

While formal hierarchical structures manifest in the communication in the initial period, we find that user contributions have an even stronger effect initially. This result makes particular sense considering how a typical ESN adoption process unfolds, in that early adopters often take on the role of champions who drive much of the

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[2] The company shared with us a figure that showed a time sequence of events relevant to the adoption, diffusion and use of the ESN within Deloitte. However, we are not at liberty to share this figure.

conversation within the ESN space[3]. There are a small number of such individuals in the Deloitte data set, who are also often referred to in stories provided by Deloitte employees when talking about how the ESN was adopted in the organization. Consequently, early adopters who drive the diffusion and participation of the ESN in the early stages, and who are to a significant degree responsible for its successful emergence, are likely to derive positive reputation and influence from their strong contributions to the emerging ESN community, which is consistent with findings in Kügler et al. (2015). As expected, messages from high-contributing users are attended to more reliably, they elicit more responses and are replied to significantly quicker than messages from the average user. This leads us to derive the following proposition:

Proposition 1b   In early stages of an ESN, early adopters will derive informal influence from their status as lead users and role models.

In sum, we theorize that in the early period of ESN existence, individuals derive influence from either their formal hierarchy position or their status as high contributing users. This leads us to derive the following summarizing proposition:

Proposition 1c   In early stages of an ESN, individuals will derive individual influence from either their formal or informal position in the network.

5.2.2 As the ESN Matures, It Builds Out Its Own, Balanced Structures

Over time, interesting changes can be observed in our data. Firstly, the influence of organizational hierarchy dissipates over time. This is again evidenced by a number of results presented above. As Table 3 shows, hierarchy no longer has a positive effect on either *reply* or *reply_no*. We theorize that, as the ESN community becomes established over time, users are no longer able to derive formal influence from their position in the hierarchy.

Proposition 2a   As the ESN matures, formal influence derived from the organizational hierarchy diminishes.

Secondly, the data in Table 5 demonstrates that over time the user groups on lower levels of the organizational hierarchy become more and more active and involved. As a result contributions are much more evenly spread across the hierarchical levels in the later stages of the ESN. This effect has been visualized in Fig. 2, which points to a much more balanced communication landscape with more even

involvement of users on the various hierarchical levels. We thus derive the following proposition:

Proposition 2b   As the ESN matures, user groups across the hierarchy become more actively and evenly involved in the network.

Thirdly, as the data in Table 6 shows, users increasingly communicate across the hierarchy and less only with their peers on the same hierarchy level. Users on lower levels (e.g., graduates) increasingly respond to messages from higher levels. Equally, users on the highest level are less relied upon to provide input for others, but are replied to more by users from lower levels of the hierarchy. We formulate the following proposition:

Proposition 2c   As the ESN matures, communication becomes less hierarchical and more widely spread across the hierarchy levels.

Finally, the effect of organizational hierarchy on *reply_lag* also decreases over time. It is still negatively correlated, which means that messages on higher levels are responded to less quickly, but the effect becomes much smaller over time. We take this as another sign that the ESN community becomes more egalitarian and perceived distances are reduced. Users are spending less time formulating their replies to users on higher levels.

Proposition 2d   As the ESN matures, social distances between the hierarchy levels reduce.

At the same time however, the informal influence derived from one's contributions to the network still exists, even though the effect sizes consistently decrease over time, as is evidenced by the results in Table 3. Consequently, while the community still rewards contributions, and individuals are able to derive influence from being active in the network, the influence of single individuals lessens in relative terms over time. We derive the following proposition:

Proposition 2e   As the ESN matures, the community continues to reward user contributions with informal influence, but the effect is lessened over time.

In summary we theorize that what we observe in our data are the effects of successful ESN community building. While at the beginning communication is structured to a certain degree by both the formal hierarchy imported into the ESN, and the informal hierarchy resulting from the ESN adoption process, in the form of high influence of early adopting "power users", the community becomes much more evenly balanced and egalitarian over time. As the ESN community matures a more and more independent and democratic community emerges. As the network evolves into a functioning community individual influence

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[3] This is also evident in our data. In period 1, the top 10 users by message volume sent 16.4 % of all messages; in periods 2 and 3 this number falls to 10 %.

Table 7 Propositions theorizing the interplay between ESN emergence, forms of influence and communication structures over time

In the early stages of an ESN…		
1		… individuals will derive individual influence from either their formal or informal position in the network
	a	… *formal influence* based on the organizational hierarchy is imported into the network
	b	… early adopters will derive *informal influence* from their status as lead users and role models
As the ESN matures…		
2		… the ESN community becomes more egalitarian and independent from existing organizational structures, as influence is more evenly spread and the community builds out its own, more balanced communication structures
	a	… *formal influence* derived from the organizational hierarchy diminishes
	b	… user groups across the hierarchy become *more actively and evenly involved* in the network
	c	… communication becomes *less hierarchical* and more widely spread across the hierarchy levels
	d	… *social distances* between the hierarchy levels reduce
	e	… the community continues to reward user contributions with *informal influence*, but the effect is lessened over time

in general becomes less pronounced, hierarchy loses its influence and engagement becomes much more evenly spread. We derive the following summarizing proposition:

Proposition 2 As the ESN matures, the ESN community becomes more egalitarian and independent from existing organizational structures, informal influence is more evenly spread and the community builds out its own, more balanced communication structures.

5.3 Summary of Theoretical Contribution

Our study contributes to the literature both a better understanding of the relative effects of formal and informal influence in ESN, and of how influence changes over time during the process of ESN emergence. Regarding our research questions our data allows us to theorize that

1. Formal influence derived from organizational hierarchy translates into the ESN space only in early stages of its emergence
2. ESN does indeed afford users to move into positions of informal influence by way of their contributions to the network, in particular in the case of early adopters during ESN adoption.
3. ESN produces more egalitarian and inclusive communication structures over time with diminishing effects of both formal and informal influence.

Our results are compatible with existing research into the emergence of communities. According to Wenger et al. (2011), as communities emerge and develop a shared identity over time, they progress through certain phases involving early stages of self-selection and trust building, stages of growth and maturing and later stages of productive functioning and eventual transformation in the face of change (Wenger et al. 2002). As such, the role and contributions of individuals change over time. While the "early majority" of innovators is active in early stages, the

group composition changes over time as laggards and the "late majority" join in (e.g., Rogers 2003). We theorized that while formal organizational hierarchy exerts some influence initially its influence weakens over time. Equally, informal influence is stronger in earlier phases, but is generally stronger than formal influence and is present in the data over the entire period. At the same time our data shows that communication patterns are generally becoming more egalitarian and well-balanced as an ESN user community emerges in its own right and all levels of hierarchy contribute to the communication over time. Table 7 summarizes the theoretical propositions as our main contribution to the emerging body of literature on ESN.

6 Conclusion

We set out to investigate influence in ESN using a single case study with a unique data set. In doing so, we investigated whether users in ESN derive formal influence from their position in the organizational hierarchy, or informal influence from their contributions to the ESN community. Moreover, following a discourse unfolding in the Enterprise 2.0 community, we set out to explore if ESNs generally lead to more inclusive communication structures diminishing the effect of hierarchies either formally or informally.

Our results generally confirm the presence of both forms of influence in the ESN, yet with a stronger influence of user contributions on eliciting responses from other users. At the same time, our results show how with the maturing of the ESN community over time, formal hierarchy loses its influence and communication structures become broader and more inclusive. We have summarized our findings as a set of theoretical propositions.

Our study contributes to the on-going stream of research into ESN in particular and social technologies in general. Our findings help derive a better understanding of

communication effects in ESN platforms. To our knowledge, no research has been done on the impact of user-level characteristics on the probability, quantity as well as speed of replies in social media communication. Most existing studies use data from public social media such as Twitter, which are not transferable into workplace contexts, or rely on survey data, because actual ESN data is hard to come by. However, when investigating communication behavior, surveys are much less effective than the use of actual communication data, as the latter enables a more objective analysis.

Our findings have practical implications as well. As companies apply ESN to harness more effective ways of knowledge-sharing between individuals in the organization, our findings provide an understanding of how an active and inclusive ESN community in a knowledge-intensive organization successfully emerged. It is well known that it is difficult for companies to exert formal control on the development of user communities, in that adequate norms need to be cultivated to achieve desired behaviors (Ivaturi and Chua 2013; Gallivan 2008; Thompson 2005). Such norms usually emerge from within the community and are often self-governed (Ivaturi and Chua 2013; Kirsch et al. 2010; Ouchi 1980). In this context, role clarity is said to not only support the management of communities but also enhance the users' participation level (Gonzales et al. 2013). Our findings show that importing formal roles and the associated activities of the formal hierarchy into the ESN early on can act as guiding principles to get the community started until it builds up its own informal structures during the adoption process and by broadening its user base over time. There is also merit in a strong, early involvement of the corporate leadership in order to lead by example and set the tone, which then makes way over time for more equal and wider participation. Only through the broadening of the communication base can the ESN harness the diverse knowledge perspectives offered by members on all levels of the hierarchy.

Our study is circumscribed by certain design choices and the nature of the data set. Firstly, our findings are derived from one case only, albeit one that is well suited for our study as it stems from a knowledge-intensive industry that relies heavily on individuals' contributions and a company that is highly hierarchically structured. Consequently, our generalizations are of a theoretical not statistical nature. Secondly, the data set is based on Australian employees. Therefore, the results might not be directly transferable to other cultures, especially beyond a Western societal context. Future research might investigate influence in a different cultural setting. Finally, our analysis is based on structural data only. A future study could conduct content analysis in conjunction with quantitative analysis to better understand the dialogues and communication

behavior of the employees in deriving influence from the network. This however was out of scope for this study.

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