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# Impact of ESN implementation on communication and knowledge-sharing in a multi-national organization

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ABSTRACT

Organizations often focus on their employees' abilities to effectively communicate and share knowledge in online collaborative activities. Social media technologies facilitate that process in organizations, where they are known as Enterprise Social Networks (ESN). To increase potential benefits, organizations may run an implementation process to increase the ESN's acceptance and use. This study focused on one such platform, Yammer, which is making inroads into numerous industries. Specifically, we addressed Yammer's impact on communication and knowledge-sharing among organizational units in a multinational organization. This study unobtrusively assessed communication patterns before and after an ESN implementation process to measure impact. Data analysis performed on message interactions between employees on the Yammer platform suggested the implementation process had a positive impact on the number of messages, number of users, and weighted-degree SNA metric. This study also revealed that the implementation process positively impacted inter- and intra-organizational unit interactions.

## 1. Introduction

Widespread personal use of social network systems such as Facebook and LinkedIn (McHaney & Sachs, 2016; Valenzuela, Park, & Kee, 2009), has pressured corporate entities to adopt similar platforms to facilitate communication and knowledge-sharing. Recent research shows how social media impacts individuals. For instance, Shiau, Dwivedi, and Lai, (2018) determined aspects of Facebook's core knowledge including how it modifies user behavior; impacts privacy risk and interpersonal impression; and, its social impact. Research such as this emphasizes how computerized social networks can affect change but must be carefully understood to mitigate any unexpected difficulties in implementation from an organization perspective. In the corporate domain, these entities are called Enterprise Social Networks (ESN) (Treem & Leonardi, 2012). ESNs enable a new method of communication between colleagues, encouraging both personal and professional exchanges within the protected walls of a company intranet (DiMicco et al., 2008; Mäntymäki & Riemer, 2016). Whereas most information gathering and sharing in traditional enterprises is done via email (Bennett, 2012), the growing use of ESNs within organizations enables new forms of interaction (Subramaniam et al., 2013).

An ESN platform encourages employees or team members to share their thoughts, activities, and expertise (Janhonen & Johanson, 2011). Since an ESN collects and stores exchanges, employees' knowledge becomes available and searchable (Mäntymäki & Riemer, 2016). This reduces the need to interrupt colleagues with routine inquiries. If answers are not found, questions can be posted quickly in informal ways without causing disruptions (de Sousa, Wagner, Ormancey, & Grzywaczewski, 2015). For example, new employees deeply benefit from ESN platforms and use them to acquire corporate information at a rapid pace. Besides knowledge transfer and collaboration benefits, the use of ESNs results in large repositories of organizational data (Kane, 2017). These repositories include both structured data such as user details, messages, likes, and follows; and, unstructured data such as text message bodies, that can be analyzed by researchers or managers (Stieglitz, Dang-Xuan, Bruns, & Neuberger, 2014). As a result, ESNs are a source of important data used by researchers to evaluate opportunities for organizational improvement (Alimam, Bertin, & Crespi,

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2017).

In the current study, we investigated an ESN implementation process, and its impact on communication and interaction levels between employees of various units in an organization. Access to this organization's ESN data repository enabled us to base this study on actual communication data rather than data elicited from surveys or interviews. Specifically, we extracted data from a Yammer ESN platform implemented and used by employees of a multinational software company which develops and provides software systems and services for large companies and has more than 26,000 employees in different countries.

A main feature of this ESN was enterprise microblogging: the exchange of messages in conversation streams. This study analyzed extracted message data that covered a period of approximately 2 years and included more than 50,047 messages written by 5972 users. This time frame included the system implementation process. Quantitative data analysis and social network analysis techniques served to primarily investigate usage and establish relationships between employees of various organizational units in the company and allowed direct measures of implementation effectiveness. To do this, we first performed an analysis on the full data set. Next, to offer richer insights on the implementation process, we divided the data into six cumulative periods for analysis. These six periods represented key phases that enabled us to observe the implementation process impact as it progressed, and was consistent with theoretically grounded implementation lifecycles (Markus & Tanis, 2000).

## 2. Literature review

### 2.1. Enterprise social networks (ESN)

The success and popularity of social network tools such as Facebook and Twitter (Boyd & Ellison, 2007; Kaplan & Haenlein, 2010; Ngai, Tao, & Moon, 2015) have motivated many corporations to seek similar advantages with ESNs for their employees. ESNs refer to technologies that include foundational features associated with public social network sites, but are implemented within organizations, are sanctioned by management, have the ability to manage access permissions, and provide a means for accumulating organization data (Ellison, Gibbs, & Weber, 2015). An ESN platform enables interaction and information sharing among the employees (Aoun & Vatanasakdakul, 2012), and creates business value by allowing the users to form groups on specific topics or projects, post messages, conduct surveys and add announcements. In addition, ESNs can improve employee agility including proactivity, adaptability, and resilience (Cai, Huang, Liu, & Wang, 2018); and information management capabilities including knowledge sharing (Pee, 2018). Alimam et al. (2017) provide a comprehensive review of ESN research and offer future research directions in this growing area.

ESNs must be differentiated from general social media use by organizations. For instance, social media marketing (Alalwan, Rana, Dwivedi, & Algharabat, 2017; Aswani, Kar, Ilavarasan, & Dwivedi, 2018) and advertising with social media (Dwivedi, Kapoor, & Chen, 2015) entail an organization reaching out with social media to create recognition and enhance sales, customer contacts and so forth. Likewise, an organizational social media business profile as proposed by Chung, Andreev, Benyoucef, Duane, and O'Reilly, (2017) is different from typical ESN use. Shiau, Dwivedi, and Yang, (2017) provide a comprehensive analysis of extant literature on social networks.

Like social media used by individuals for personal networking, an ESN connects members of an enterprise through profiles, updates, and notifications; and develops a sense of community (Li, 2012). ESNs allow users to publish messages in an emerging, undirected message stream. Messages appear in chronological order in a combined view on the users' starting pages. Users may subscribe to other users' messages, join groups, or subscribe to keywords. This allows them to configure personalized message *activity streams*. Therefore, ESNs leverage the establishment of social relationships, interactive communication, and ad-hoc information sharing; and further put emphasis on user-generated content and preferences (Riemer, Scifleet, & Reddig, 2011).

While relationship building via *friends* in Facebook or *followers* in Twitter networks is at the heart of personal social networking (McHaney & Sachs, 2016), the main focus in ESNs is on messaging capability and knowledge sharing. However, as Kapoor et al. (2018) point out, a number of areas exist for research into social media use and implementation and these can be extended into ESNs. For instance: risks associated with use; the value created; and, negative stigma attached to social media within workplaces. Further, the use of social media for information sharing during critical events, seeking help and providing expertise are all areas where research has been conducted but opportunities for more work exists, particularly in the context of ESNs (Kapoor et al., 2018).

Interacting via messaging by posting work-related content, or by asking work-related questions, is considered among an ESN's main features for knowledge sharing between employees (Majchrzak, Faraj, Kane, & Azad, 2013). There are various ESN platforms available such as Yammer (Microsoft), Tibbr, Jive, Workplace (Facebook) and Connections (IBM). As enablers of social workflow, and by facilitating work-related communication and collaboration, ESNs comprise components such as message activity streams, wikis, microblogs, blogs, discussion forums, groups, recommendation engines, tagging and secure communities (McAfee, 2009; Stocker, Richter, Hoefler, & Tochtermann, 2012). The current study specifically investigated a Yammer implementation.

### 2.2. Yammer

Yammer launched in September 2008. In 2012, it was acquired by Microsoft and in 2017, published that over 85% of Fortune 500 companies utilized its services (Microsoft, 2017). The Yammer platform is organized on the concept of networks with one network representing one company (Riemer & Richter, 2012). An organization joining the Yammer platform creates a network for itself, and the company's users can register with their corporate email addresses (Riemer, Diederich, Richter, & Scifleet, 2011).

The Yammer front-end resembles Twitter's interface (McHaney & Sachs, 2016), with the posting stream as the main element. Like Twitter, Yammer is based on the *follower* principle where users choose which users to follow. When new users join a company network in Yammer, they initially subscribe to message streams of all users within that network (Riemer, Scifleet et al., 2011). The Yammer platform provides other Twitter-like functions, such as bookmarks of posts, tags, mentions, and replies (McHaney & Sachs, 2016). A primary Yammer feature is *groups*, like Facebook groups (Farrow & Yuan, 2011), which can contain different users within the network and can be created by a user according to specific requirements (e.g. for a topic area or project team). Users can choose whether to post their update to all followers, or to a group where only members can see the update.

### 2.3. ESN implementation

Encouraging employee use of an ESN platform is a primary challenge for organizations hoping to improve work-related communication, collaboration and knowledge-sharing (Krischkowsky, Fuchsberger, & Tscheligi, 2014). Although ESNs offer new possibilities, rules, and modes of communication (Ulmer & Pallud, 2014), effective deployment of an ESN platform in a formal organization is not straightforward. ESNs differ from conventional IT implementation in terms of content generation flexibility, voluntariness of use, many-to-many interactions, high intuitiveness, low degrees of governance, and unstructured quality assurance (Chin, Evans, & Choo, 2015; Steinhuser, Smolnik, & Hoppe, 2011). Past research suggests a good way to activate an ESN platform is with an implementation process intended to increase the platform's use—this will, in turn, help employees during the adoption process (Turban, Bolloju, & Liang, 2011). Organizations implementing ESN platforms should involve senior management and key users from various departments to ensure success (Chin, Evans, Choo, & Tan, 2015).

The present research studied a Yammer ESN platform introduced within a multinational organization which invested substantial resources to plan and manage the implementation process. A specialized team from the organization's IT department executed and managed this effort. It included several steps designed to increase adoption levels and employee engagement (usage) of Yammer across the organization. A key activity focused on managerial involvement and engagement early in the implementation process. To increase employee adoption levels in Yammer, managers posted messages or answered employee messages, or conducted other activities using the platform. In a later stage of the process, the implementation team identified active *power users* (Kawasaki & Fitzpatrick, 2014) within organizational units and encouraged them to publish even more content to increase participation among employees.

### 2.4. Organization unit level

In complex organizations, units can benefit from knowledge developed by peer groups (Tsai, 2001). The resulting knowledge transfer provides multiple opportunities for synergy to emerge that results in new knowledge; contributes to organizational innovation (Lefebvre, Sorenson, Henchion, & Gellynck, 2016; Tsai & Ghoshal, 1998); and, facilitates knowledge-sharing (Evans, Ahumada-Tello, & Zammit, 2017). For these reasons, understanding and improving ESN implementation is important to corporate managers and can result in empowerment (Zhong, Huang, Davison, Yang, & Chen, 2012).

## 3. Theoretical basis and hypotheses

The current study focused on the impact of an ESN implementation process on communication and interaction within the Yammer network of a multinational company. More specifically, we sought to determine whether the implementation approach used to roll out the ESN was successful. Therefore, we had to address success from a theoretical perspective. Due to the real-world nature of this study, our success measure was, by necessity, a multidimensional composite consisting of business performance factors (Barua & Mukhopadhyay, 2000) and critical success factors for enterprise systems (Nah, Lee-Shang Lau, & Kuang, 2001). We approached our study from the perspective of a relative improvement in success factors important to management rather than an optimal success measure, which is consistent with prior practical implementation research (Markus & Tanis, 2000).

To theoretically frame our research, we briefly review broad categories of enterprise implementation success measures. We then provide a framework for analysis within which to describe our implementation outcome and describe the business value of our outcome in a practical sense. We fit our hypotheses into this framework. Two aspects are important to the research: first, ESN critical success factors (CSF) and second, an ESN implementation lifecycle.

### 3.1. ESN critical success factors

CSFs are items necessary to ensure a positive outcome in system implementations. A variety of CSFs have been proposed in information system implementation literature (Hong & Kim, 2002; Nah, Zuckweiler, & Lee-Shang Lau, 2003). Several of these were used as metrics in the current research and described in terms of our research hypotheses. Markus and Tanis (2000) suggest categories for CSFs that include the following:

#### 3.1.1. Project metrics

Factors that measure the performance of the enterprise system project team against planned schedule, budget, and functional scope (Markus & Tanis, 2000, p. 185). These are metrics commonly associated with typical project management success items (Atkinson, 1999; Cooke-Davies, 2002).

#### 3.1.2. Early operational metrics

These factors describe how business operations perform in the period after the system becomes operational until "normal operation" is achieved (Markus & Tanis, 2000, p. 185). These metrics often are unique to a specific ESN implementation itself and reflect broader management objectives (Delone & McLean, 2003).

#### 3.1.3. Longer-Term business results (186 markus & Tanis, 2000)

These factors describe characteristics that ensure the system was not a temporary phenomenon but rather affected a permanent, desirable change for the organization (Shang & Seddon, 2002).

CSFs determined by ESN-related research can be organized using the Markus and Tanis (2000) framework, and for the current study, the *Early Operational Metrics* category. For example, Lehner and Haas (2010) concentrate on behavioral models to explain success from a knowledge management perspective. This approach looks at the individual improvement of employees' knowledge within an organization to develop an overall organizational success measure. Similarly, Muller, Freyne, Dugan, Millen, and Thom-Santelli, (2009) draw from business value concepts to suggest Return On Contribution (ROC), as a way to understand how well an ESN operates. ROC looks at human collaboration, knowledge creation, and knowledge consumption among ESN users. Muller et al. (2009) also illustrate the importance of usage patterns, performance levels of users, and the importance of "lurkers" and others receiving hidden benefits from system implementation. They offer insight on *Longer-Term Business Value* measurements that are meaningful to different stakeholders such as employees, managers, and system administrators.

Using a broader viewpoint, Richter, Heidemann, Klier, and Behrendt, (2013) look at ESN success factors in two broad categories. The first dimension is usage which "describes the extent of use of the ESN and demonstrates the activity of users on the platform at a very concrete level" (p. 6). This fits into the Markus and Tanis (2000) framework at both the *Early Operational Metrics* and *Longer-Term Business Value* levels. Richter et al.'s (2013) second dimension aligns better with Markus and Tanis' (2000) *Project Metric* category. Whereas Richter et al.'s (2013) second dimension considers long term business value, they also state their second dimension "encompasses the business value of social software use" (p. 6) and typically seek to understand business goals supported by social software implementation, and whether these goals have been achieved.

Other more general enterprise resource planning (ERP) system implementation research provides a comprehensive look at CSFs. While these are specific to ERP system implementation, they translate well to most enterprise implementations, including ESNs, and can be mapped to Markus and Tanis' (2000) framework.

According to Nah et al. (2001), a number of critical success factors for ERP implementation are described in the literature. Among the eleven factors identified by Nah et al. (2001), ones that relate to *Project Metrics* are: 1) teamwork and composition considering implementors, vendors and consultants; 2) top management support; 3) business plan and vision; 4) effective communication; 5) project management considerations; 6) project champion; 7) appropriate business and legacy systems; 8) change management program and culture; and 9) business process reengineering and minimum customization. For the *Early Operational Metrics* phase, Nah et al. suggests: 10) software development, testing, and troubleshooting. Finally for *Longer-Term Business Value*, Nah et al. (2001) report that 11) monitoring and evaluation of performance are key. These factors were used to varying degrees to form our research hypotheses.

### 3.2. ESN lifecycle

To achieve success, as measured by a set of metrics, Markus and Tanis (2000) further recommend using a lifecycle which builds on process theory as an implementation guide. Their research suggests four phases which include:

(1) The chartering phase: business case, resource constraints, management support;
(2) The project phase: system roll out, end user training, and system use;
(3) The shakedown phase: moving from implementation into normal operation and finetuning;
(4) The onward and upward phase: maintenance, support, upgrades, enhancements.

Lifecycles help provide an implementation structure and further add to the project management aspect of a project. Due to the multi-dimensional nature and complexity of enterprise-wide software implementation, success is complex. Projects can suffer setbacks from various perspectives. Recent research suggests lifecycles can help mitigate a variety of issues (Alimam et al., 2017). The current research utilized a lifecycle called an implementation roadmap derived from Markus and Tanis (2000).

### 3.3. Research question and hypotheses

The current ESN implementation utilized a roadmap developed internally to the subject organization that incorporated most CSFs suggested by Nah et al. (2001) relevant to *Project Metrics* including top management support, business plan, project champion and so forth. Since these remained constant through implementation and many were inaccessible to the researchers, the current study focused on several specific success metrics with managerial significance. In general, we examined communication and interaction levels within the organization using data extracted from an operating ESN platform to coincide with managerial objectives (McKenna, Myers, & Newman, 2017). Then, we narrowed the study's focus to the organizational unit level to address managerial objectives and determined how success metrics were impacted through actions at the individual unit level. The following research question motivated this study:

*How did the Yammer implementation process in an organizational unit impact the level of interaction for that organizational unit?*

Therefore, our research investigated how the Yammer implementation process impacted communication and interaction levels for each organizational unit. To assess our expectations, our research hypotheses incorporated ESN success measurements for engagement as suggested by Richter et al. (2013) and others (2003, Friedman, Burns, & Cao, 2014; Nah et al., 2001).

The first hypothesis focused on a managerial objective which was to promote employee use of the ESN at the organizational unit level. Therefore, hypothesis one became:

**H1.** The number of users will significantly increase over the period of implementation.

This hypothesis can be viewed in terms of the Markus and Tanis (2000) lifecycle as part of the project phase where systems are rolled out, end users trained, and system use becomes crucial. Further, this item was considered a CSF by management and was measured initially as an early operational metric and eventually used as a longer-term business result metric. In the first instance, system use was used to describe the levels of system adoption. In the long term, it became a measure of system usefulness (Davis, 1989).

Measuring system use is consistent with prior research that describes ESN and other enterprise software success factors. Nah, Tan, and Teh, (2004) suggests that end-users' symbolic adoption can later be used to understand their acceptance. For instance, initial system use may result from managerial pressure. Long term use is more indictive of the system's value to users in non-mandatory settings (Sørebø & Eikebrokk, 2008; Venkatesh & Davis, 2000).

The second hypothesis focused on system use and whether communication across organizational units increased due to the ESN implementation. Like the first hypothesis, this measure had a managerial objective at its center which was to promote and enhance employee knowledge sharing. Therefore, hypothesis two became:

**H2.** The number of messages will significantly increase over the period of implementation.

In earlier studies, Friedman et al. (2014) measured items related to interactions, between different organizational units, on an ESN platform. This research suggests that appropriate tools and methodologies, measured through ESN usage data, provides insights into the degree to which ESN applications break down geographic and/or organizational boundaries.

As with the first hypothesis in this study, the second one can be viewed in terms of the Markus and Tanis (2000) lifecycle as part of the project phase where systems are rolled out, end users trained, and system use becomes crucial. Likewise, it can be measured initially as an early operational metric and eventually used as a longer-term business result metric to indicate a managerial objective of knowledge sharing appears to be taking place.

The study's third hypothesis expanded on hypothesis two. Rather than look at only the volume of messages, this hypothesis provides insight into the dispersion and type of communication that takes place. According to Friedman et al. (2014) who discovered employees in the middle levels of the company hierarchy used ESNs the most, and that more inter-country communication occurred when using an ESN, social media network analysis can reveal the changes in interaction patterns. This is consistent with a managerial objective to improve intracompany interaction. Therefore, our third hypothesis became:

**H3.** The SNA measure for weighted degree will significantly increase over the period of implementation.

In general, our third hypothesis assesses the implementation process by investigating the change in interaction levels over time using weighted degree SNA metrics. Similarly to H1 and H2, H3 can be viewed in terms of the Markus and Tanis (2000) lifecycle as part of the project phase where systems are rolled out, end users trained, and system use becomes crucial. It is measured initially as an early operational metric and eventually can used as a longer-term business result metric.

Overall, the three hypotheses will help understand active users, number and dynamics of messages and posts, and various SNA metrics that describe knowledge sharing and communication levels. These items will be used to better understand the social network formed in the organization (Richter et al., 2013) within the theoretical context of process theory (Markus & Tanis, 2000) and critical success factors considerations (Nah et al., 2001, 2003).

## 4. Methods

Social network analysis (SNA) is a research methodology used to identify and understand underlying patterns of social relations-based interconnections between actors (Wasserman & Faust, 2009). SNA enables researchers to investigate structural characteristics of online communities, which are created based on participant interaction patterns accumulated over time (Trier, 2008). We proposed using SNA to map and explore interactions among participants in an ESN. We posit that doing so offers useful analytical data and insights about the activity and relationships of the ESN users. Traditional social network studies use manual methods, like questionnaires and interviews, to reconstruct social networks' patterns. That approach, since it relies on secondary and remembered details, can result in validity issues. In the current study, data extracted from an ESN platform formed the social network used for applying the SNA methodology. This gives a valid and very accurate approach since all interactions are captured.

ESNs, in the context of SNA, can be represented as a graph with nodes (users) and edges (ties) linking pairs of nodes (Wasserman & Faust, 2009). The edges are either directed or undirected. Edges may represent either social links like social relationships (social network) or communication activities like messages among users (activity network) (Heidemann, Klier, & Probst, 2010). In a social network, nodes represent users and directed edges represent *follows* between pairs of users. For example, an edge from node A to node B exists if user A follows user B. In the activity network, *nodes* represent users and directed edges represent communication activities between pairs of users. For example, an edge from node A to node B exists if and only if nodes A and B interact directly with each other, meaning a communication activity was initiated by node A and received by node B or vice-versa. The activity graph is a visual representation of communication activities among the nodes in the activity network, irrespective of their social relations. This means users without links in the social graph still can be connected by an activity link, if they engage in communication activity.

One approach to SNA relies on mapping group interactions, thus visualizing and quantifying certain characteristics of interaction processes within a community. This technique is commonly used in sociology and organizational studies (De Laat, Lally, Lipponen, & Simons, 2007), enabling studies of group interaction, communication, and dynamics. The current study utilized this approach and analyzed data at the organizational level. This means the social network graph was based on the activity graph network concept, and the company's organizational units became nodes in the network and edges represented interaction between different organizational units.

SNA required calculation of measures that compared different nodes in the network. These node level measures included the most common measure, *centrality*, measured via three aspects: *degree*, *betweenness*, and *closeness*. Degree represented a nodes' total number of ties. In a directed network, a node may have different numbers of outgoing and incoming ties, and therefore, degree is split into *out-degree* and *in-degree* (Opsahl, Agneessens, & Skvoretz, 2010). In weighted networks, node strength considers the weights of the ties (Barrat, Barthelemy, Pastor-Satorras, & Vespignani, 2004). Betweenness denotes the number of times a specific node falls on the shortest path between two other nodes (de Freitas, 2008). Finally, closeness represents how far a node is from all other nodes in the network (Opsahl et al., 2010). The current study measured the interaction level in Yammer before and after the ESN implementation process. Specifically, we measured message replies between users within organizational units (user A replied to a post by user B, and vice versa). This indicated that a directed network existed. In addition, we checked the frequency of replies between users, at the organizational level, to capture the network weight. The weighted degree, weighted in-degree, and weighted out-degree were the primary SNA measures used to assess the differences between nodes in the network. These SNA measures are preferred measures for analyzing weighted networks (Barrat et al., 2004).

### 4.1. Data collection and preparation

The study gathered data from a Yammer network of a multinational company, with more than 26,000 employees in 105 countries, that develops and provides software systems and services to communication, media, and entertainment companies all over the world. The company is NASDAQ traded and has existed more than 35 years. Currently its yearly revenue is more than 4 billion dollars. The organization requested anonymity when this study was released.

Data collected from the ESN were filtered appropriately. The company's organizational units became the level for the message data analysis. In general, researchers used data analysis and social network analysis techniques to examine interaction instances between the users of different organizational units in the Yammer ESN. Researchers segmented the pool of messages into 6 periods. Each period contained an implementation launch for at least one organizational unit. This was one of the reasons that the data was divided into six periods. The other reason was to remain consistent with the Markus and Tanis process theory lifecycle (Markus & Tanis, 2000). Thus, the Yammer implementation adoption process could be closely monitored. The following sections offer more details about the process used.

### 4.2. Yammer message data set

The subject company provided a data set extracted from their Yammer platform that held messages from October 1, 2014, to September 17, 2016. The data were stored in a Microsoft (MS) Excel file with 82,941 entries (e.g. one message per line). The data set included messages posted in the main Yammer message stream, and messages exchanged in open and closed groups, as well as private messages (one-on-one chat). The data file also held metadata information such as message ID, replied-to ID, thread ID, group ID, group name, private group indication, user ID, indication if the message was in a private chat, time stamp, and the content (text body) of the message. The data were sufficient to determine the type of message contained in the data, because if a message was a reply, it inherited the thread ID of the original message. Otherwise, a new thread ID identified a post as a new message.

Researchers removed automatically-posted, system-related messages, and messages created by software tools. After the filtering process, the final data set held unique 50,047 messages, written by a total of 5972 users. These included 21,059 threads with an average count of 2.26 messages per thread. This meant that 21,059 messages were first-post messages, while 28,988 messages were replies. Of the first-post messages, 8511 were conversations (threads that had at least two messages), while the rest (13,587 messages) remained single posts without replies.

### 4.3. Employee data set

A separate dataset held employee information, such as job title, organizational unit, and geographic location. Researchers mapped Yammer users to organizational units in the company with this data. Table 1 lists the organizational units in the company together with unique user counts derived from the Yammer message data set. Among these, 420 users had no mapping to messages. Researchers excluded these users and their messages from the study. These users were external employees (e.g. temporary help, consultants).

The last column in Table 1 provides the final mapping used after consolidation, merging, and filtering. The interaction data analysis

**Table 1**
Mappings between users and organizational units before and after filtering.

| Organizational Unit | # Users | # Messages | Final # Users | Final # Messages |
|---|---|---|---|---|
| Services | 1,815 | 11,431 | 1,815 | 11,431 |
| Delivery | 1,344 | 10,012 | 1,344 | 10,012 |
| Research and Development (R&D) | 740 | 5,809 | 740 | 5,809 |
| Sales | 531 | 6,267 | 531 | 6,267 |
| Finance | 486 | 4,533 | 486 | 4,533 |
| Human Resources | 350 | 6,510 | 350 | 6,510 |
| Network | 255 | 1,690 | 255 | 1,690 |
| Management & Corporate | 31 | 231 | 31 | 231 |
| No Mapping (External Employees) | 420 | 3,564 | 0 | 0 |
| Total | 5,972 | **50,047** | 5,552 | **46,483** |

**Table 2**
Implementation times for organizational units.

| Implementation Month | Organizational Units |
|---|---|
| March, 2015 | Network |
| June, 2015 | Delivery |
| November, 2015 | Human Resources (HR) |
| February, 2016 | Research and Development (R&D) |
| March, 2016 | Services |
| September, 2016 | Finance |

included a total of 5552 users.

### 4.4. Implementation time for organizational units

Implementation period for each organizational unit was a key metric for analysis. The data were compared across six periods to provide a visualization of changes. Table 2 lists the periods mapped to each organizational unit.

### 4.5. Dataset classification

Researchers structured the data set according to period. As described, the entire data set from 10/01/2014 until 09/17/2016 was classified into six periods, following the Chung and Paredes (2015) approach. The first period started with message data from the first four months (e.g.10/01/2014 through 01/31/2015) and each subsequent four months period held the next set until the collection period was terminated. See Table 3.

## 5. Results

Researchers calculated communication levels using several measures, starting with the number of posts from different users in their associated organizational units. SNA calculations yielded the weighted degree for each unit in the network. The weighted degree of an organizational unit was its weighted out-degree added to its weighted in-degree. Weighted out-degree comprised the number of replies posted by a unit's users to messages posted by others from the same or other units. Weighted in-degree comprised the number of replies posted by users from the same or other units, to messages posted by a specific unit's users.

### 5.1. Messages and users analysis

Table 4 displays high-level statistics for the overall number of messages and users in each organizational unit.

The organizational unit Services had the most messages with 11,431 messages (24.59% of the total). This unit also had the most users with 1815 employees posting messages. This represented 32.69% of the total. On average, each user posted 6.29 messages in the Services organizational unit. In another example, the Human Resources organizational unit was in third place for number of messages with 6510 posts which represented 14.01% of the total. But the same organizational unit was in sixth place for number of users with 350. This represented 6.30% of the total users, and means, on average, each user posted 18.60 messages. This example highlights the importance of the "Message / User" statistic.

### 5.2. Social network analysis

Social network analysis (SNA) evaluated interactions between organizational units in the Yammer network. The open source tool, Gephi (Bastian, Heymann, & Jacomy, 2009), was used for these analyses. For example, Fig. 1 shows a social network graph generated by Gephi depicting unit-to-unit interactions from October 1, 2014 through September 16, 2016. The directed edges represented replies from one unit to messages made by employees in either the same unit or other units. Node size represented the weighted degree of the organizational unit. Darker, thicker edges indicated more messages between connected organizational units.

First, all organizational units interacted with all other units. Intra-unit interaction also occurred, as indicated by edges that loop back into the same unit. In most instances, the edge that loops back to the same unit is darker and thicker than the edges between units. This indicated Yammer-based communication within a unit is higher than communication with other units. Services and Delivery are the dominant units on the graph, based on the weighted degree metric. Table 5 displays the social network metrics derived with Gephi for each organizational unit.

### 5.3. Hypotheses evaluation

We evaluated the hypotheses with SAS 9.4 using data from the organizational units that conducted an implementation process during the collection period to ensure a pre- and post- dataset existed. Network, Delivery, Human Resources (HR), Research and Development (R&D), and Services organizational units fit this constraint. The analysis excluded other units (e.g. Sales, Management & Corporate, and Finance) due to their implementation timing.

#### 5.3.1. Hypothesis 1

We examined the implementation data for relevant organizational units. Table 6 displays the number of new messages for each organizational unit in each of the 6 periods. Researchers evaluated the data using an ANOVA. The analysis looked at the data in terms of three classifications for each unit: pre-implementation, implementation, and post-implementation.

The ANOVA was significant meaning that the number of messages significantly increased during the implementation process ($F(227) = 6.85$, $p = 0.004$). Subsequent analysis indicated significant differences existed between pre-implementation and implementation process message numbers, and between pre-implementation and post implementation message numbers ($p < .10$). No significant differences existed between implementation process and post-implementation for the numbers of new messages. This indicated message use increased during implementation and remained at the higher level. For this reason, we accepted H1 and concluded that the number of new messages significantly increased during the implementation process.

**Table 3**
Periods for dataset classification.

| Period | From | To | Cumulative no. of new messages | Cumulative total no. of messages | Organizational Unit that completed implementation process |
|---|---|---|---|---|---|
| 1 | 10/01/2014 | 01/31/2015 | 4,774 | 4,774 | N/A |
| 2 | 10/01/2014 | 05/31/2015 | 3,923 | 8,697 | Network |
| 3 | 10/01/2014 | 09/30/2015 | 6,096 | 14,793 | Delivery |
| 4 | 10/01/2014 | 01/31/2016 | 8,431 | 23,224 | HR |
| 5 | 10/01/2014 | 05/31/2016 | 15,324 | 38,548 | R&D, Services |
| 6 | 10/01/2014 | 09/17/2016 | 7,935 | 46,483 | Finance |

**Table 4**
Messages and user statistics per organizational unit.

| | Messages | % messages | Users | % users | Message / User rank | Message / User |
|---|---|---|---|---|---|---|
| Services | 11,431 | 24.59% | 1,815 | 32.69% | 1 / 1 | 6.29 |
| Delivery | 10,012 | 21.54% | 1,344 | 24.21% | 2 / 2 | 7.44 |
| Human Resources | 6,510 | 14.01% | 350 | 6.30% | 3 / 6 | 18.60 |
| Sales | 6,267 | 13.48% | 531 | 9.56% | 4 / 4 | 11.80 |
| Research and Development (R&D) | 5,809 | 12.50% | 740 | 13.33% | 5 / 3 | 7.85 |
| Finance | 4,533 | 9.75% | 486 | 8.75% | 6 / 5 | 9.32 |
| Network | 1,690 | 3.64% | 255 | 4.59% | 7 / 7 | 6.62 |
| Management & Corporate | 231 | 0.50% | 31 | 0.56% | 8 / 8 | 7.45 |
| Total | **46,483** | **100%** | 5,552 | **100%** | | |

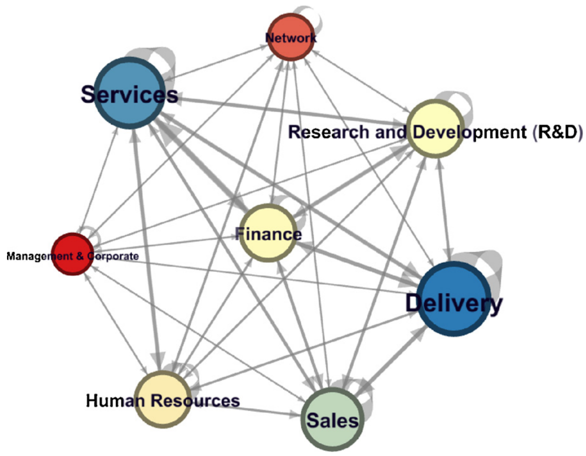


**Fig. 1.** Social network analysis graph of unit-to-unit interactions.

**Table 5**
SNA metrics for each unit.

| Organizational Unit | Weighted In-degree | Weighted Out-degree | Weighted Degree |
|---|---|---|---|
| Services | 15,376 | 15,520 | 30,896 |
| Delivery | 17,086 | 16580 | 33,666 |
| Human Resources | 8,635 | 8,117 | 16,752 |
| Sales | 11,232 | 10,322 | 2,1554 |
| Research and Development (R&D) | 8,732 | 8,874 | 17,606 |
| Finance | 7,410 | 9,383 | 16,793 |
| Network | 3,070 | 2,926 | 5,996 |
| Management & Corporate | 520 | 339 | 859 |

**Table 6**
New messages per unit in each period.

| Organizational Unit | Number of New Messages | | | | | |
|---|---|---|---|---|---|---|
| | P1 | P2 | P3 | P4 | P5 | P6 |
| Services | 1199 | 876 | 1982 | 1106 | 7712 | 3719 |
| Delivery | 469 | 297 | 2904 | 2897 | 6070 | 3942 |
| Human Resources | 257 | 447 | 563 | 2114 | 2978 | 3532 |
| Research and Development (R&D) | 498 | 342 | 934 | 1386 | 3466 | 2343 |
| Network | 137 | 233 | 438 | 642 | 797 | 893 |

### 5.3.2. *Hypothesis 2*

Next, we examined implementation data for increased users within the relevant organizational units. Table 7 displays the number of new users for each organizational unit in each of the 6 periods. This data was analyzed with an ANOVA. As before, the analysis looked at the data in terms of three classifications for each unit: pre-implementation, implementation, and post-implementation.

**Table 7**
New users per unit in each period.

| Organization Unit | Number of New Users | | | | | |
|---|---|---|---|---|---|---|
| | P1 | P2 | P3 | P4 | P5 | P6 |
| Services | 174 | 115 | 292 | 356 | 1071 | 744 |
| Delivery | 111 | 59 | 445 | 331 | 902 | 442 |
| Human Resources | 48 | 51 | 78 | 176 | 149 | 201 |
| Research and Development (R&D) | 78 | 44 | 189 | 187 | 469 | 271 |
| Network | 24 | 58 | 72 | 125 | 111 | 144 |

The ANOVA was significant meaning that the number of new users significantly increased during the implementation process ($F(2,27) = 3.99$, $p = 0.03$). Like data analyzed for H1, subsequent analysis indicated significant differences existed between pre-implementation and implementation process user numbers, and between pre-implementation and post implementation user numbers ($p < .10$). No significant differences existed between implementation process and post-implementation user number growth. This indicated new user numbers increased during implementation and continued to increase at a higher level. H2 was accepted and we concluded that the number of users significantly increased during the implementation process.

### 5.3.3. *Hypothesis 3*

The third hypothesis assessed the implementation process by investigating the change in interaction levels over time using weighted degree SNA metrics. Table 8 displays these values for each organizational unit in each of the 6 periods. An ANOVA provided the comparison. As before, the analysis looked at the data in terms of three classifications for each unit: pre-implementation, implementation, and post-implementation.

Again, the ANOVA was significant. The increase in weighted degree significantly increased during the implementation process ($F(2,27) = 7.42$, $p = 0.003$). This was the largest impact of the ESN implementation success metrics measured. Like data analyzed for H1 and H2, subsequent analysis indicated significant differences existed between pre-implementation and implementation weighted degree values, and between pre-implementation and post implementation weighted degree values ($p < .05$). No significant differences existed

**Table 8**
Increase in weighted degree statistics per unit each period.

| Organizational Unit | Increase in Weighted Degree | | | | | |
|---|---|---|---|---|---|---|
| | P1 | P2 | P3 | P4 | P5 | P6 |
| Services | 1,151 | 1,851 | 3,780 | 6,100 | 12,916 | 17,980 |
| Delivery | 627 | 945 | 4,512 | 7,684 | 14,715 | 18,951 |
| Human Resources | 201 | 544 | 1,005 | 3,355 | 6,430 | 10,322 |
| Research and Development (R&D) | 612 | 959 | 2,073 | 3,718 | 7,544 | 10,062 |
| Network | 131 | 374 | 889 | 1,636 | 2,513 | 3,483 |

between implementation process and post-implementation changes in weighted degree values. This suggested the increase achieved during the implementation process remained constant and had a lasting effect. For this reason, we accepted H3 and concluded the weighted degree values significantly increased during the implementation process.

*5.3.4. Post hoc exploratory analysis*

We conducted a post hoc analysis to further explore findings appearing during the primary analysis. Specifically, we investigated whether the Yammer implementation process impacted interaction levels within organizational units (intra - interaction inside the unit) and between organizational units (inter - interaction with other units). This was a natural follow-up question meant to specifically investigate the dynamics behind the increase in messages.

As described earlier, Yammer users can either post a new message or reply to an existing message. When a user responded to an existing message, an interaction instance was created. We consider the interaction as a directed connection between a user pair (e.g. a directed interaction from user A to B implies that user A responded to the content originated by user B). One high-level way to consider the extent of inter-organizational unit interactions in Yammer is to look at the proportion of reply messages made by people in one organizational unit to people in another organizational unit, compared to the total number of reply messages made by people in the original organizational unit. A higher number would indicate a greater propensity for inter-organization unit interactions, with any number greater than 0.5 showing that there are more replies to thread messages started outside the responder's organizational unit than inside (Friedman et al., 2014). The following equation illustrates:

$$\textit{Proportion Of Inter Organization}\ \text{Replies} = \frac{\text{Inter Unit Replies}}{\text{Inter Unit Replies} + \text{Intra Unit Replies}}$$

Table 9 displays the level of inter-unit interaction, the amount of intra-unit interaction, and the proportion of inter-organizational unit replies for all organizational units during each period.

The data collected indicated a higher level of intra-units replies. Apart from Finance, and Management & Corporate, all organizational units replied to messages posted internally more than they did to messages posted outside by other organizational units. This tends to make sense since many times employees work more closely with those in their functional area. However, a desired benefit from ESN implementation would be an increase in inter-unit communication, and to create new pathways between individuals with less opportunity to communicate in face-to-face ways. We investigated whether the proportions of intra- to inter-unit communications changed over time using the proportion of inter-organizational unit replies. Table 10 displays these values for each organizational unit in each of the 6 periods. Researchers used an ANOVA to analyze the data. The analysis looked at the data in terms of three classifications for each unit: pre-implementation, implementation, and post-implementation. An increase in the proportion of inter-unit replies meant reply messages were more likely to respond to users from the other units. A decrease meant that intra-unit communication grew more.

**Table 9**
Inter- and intra-unit replies.

| Organization Unit | Inter-unit replies | Intra-unit replies | Proportion of inter-organization unit replies |
|---|---|---|---|
| Services | 4748 | 10772 | 0.31 |
| Delivery | 3370 | 13210 | 0.20 |
| Human Resources | 2143 | 5974 | 0.26 |
| Sales | 2668 | 7654 | 0.25 |
| Research and Development (R&D) | 2942 | 5932 | 0.33 |
| Finance | 5305 | 4078 | 0.56 |
| Network | 657 | 2269 | 0.22 |
| Management & Corporate | 238 | 101 | 0.70 |

**Table 10**
Proportion of inter-unit replies.

| Organizational Unit | Proportion of inter-organizational unit replies | | | | | |
|---|---|---|---|---|---|---|
| | P1 | P2 | P3 | P4 | P5 | P6 |
| Services | 0.31 | 0.32 | 0.35 | 0.33 | 0.32 | 0.31 |
| Delivery | 0.23 | 0.31 | 0.23 | 0.19 | 0.20 | 0.20 |
| Human Resources | 0.43 | 0.36 | 0.36 | 0.24 | 0.24 | 0.26 |
| Research and Development (R &D) | 0.22 | 0.31 | 0.35 | 0.36 | 0.34 | 0.33 |
| Network | 0.17 | 0.24 | 0.23 | 0.23 | 0.23 | 0.22 |

The ANOVA was significant. The proportion of inter-unit message increased by an average of 14.25% during the implementation process ($F(2,22) = 4.10$, $p = 0.001$). This meant significant differences existed between pre-implementation and implementation levels of inter-unit communication. More organization-wide communication occurred following implementation.

## 6. Discussion

In general, this research focused on message-based interactions within the ESN platform before and after an ESN implementation process to help illustrate several CSFs. More messages and more users indicated the platform enhanced the potential for better communication and knowledge sharing between the employees. According to the results, the ESN implementation process had a positive impact. In most organizational units, the implementation process significantly improved use of the ESN in terms of increased percentage of the number of messages exchanged, number of users, and weighted degree SNA metric. Although a slight decrease followed the implementation period, it was not significant and the implementation process yielded long term improvement in long-term business value. The increased use of the ESN demonstrated this effect. Both the implementation period and subsequent usage periods were significantly higher than the pre-implementation phases in all cases.

The post hoc analysis indicated the ESN implementation process positively affected the intra-organizational unit interaction as well as the inter-organization unit interaction. In general, communication increased throughout the firm, particularly between units. This is a highly desirable outcome.

We explored the implementation process closely to understand the reasons for this improvement. It is important to remember this process was an internal organizational effort. This was not a staged experiment with theoretical grounding, so the steps used in the implementation were all conceived by the organization's management creating a process they believed best suited to increasing ESN usage to achieve communication and information sharing goals within their company. The process used to implement the ESN had to consider the social collaboration aspect of encouraging use rather than treat it as a tool introduction. In general, the approach was top down and completed business unit by business unit. Fig. 2 illustrates the general approach used.

No single, official launch date existed. Instead, management invited all employees, unit by unit, to sign in. Senior leader requests, together with organizational needs, determined unit implementation order. The implementation team first invited Network and Delivery to take part. Later, Human Resources, Research and Development, Services, and Finance joined in, adding traffic and engagement with more units and other niche groups. The implementation team approached each unit to secure senior leaders' sponsorship and a community manager (CM)

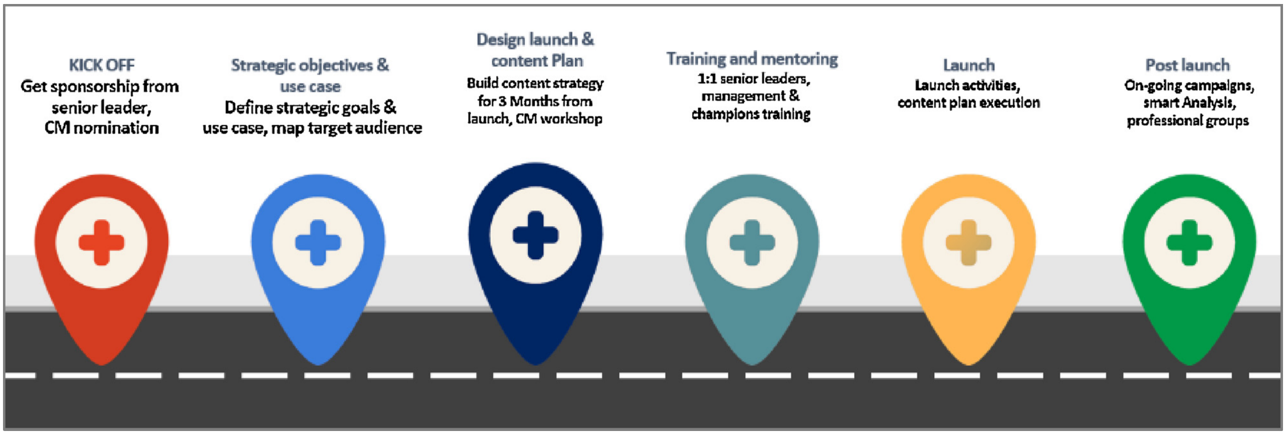


**Fig. 2.** Implementation Roadmap.

assignment. The CM was usually the business operations lead or field IComm (internal communications). These individuals acted as the initial ambassadors and adoption owners.

Based on information from the organization, their ESN implementation process had three stages of activities: pre-implementation activities stage, the launch activities stage and the post-launch activities stages. The pre-implementation process started with a workshop held for the organizational units' key stakeholders to define the main goals and purposes for implementing the Yammer ESN platform. These stakeholders defined goals and decided how these could be achieved during the Yammer ESN implementation process. Measurements for determining the success of these goals was also defined, as was the evaluation criteria. The pre-implementation process also included steps to assign and train administrative users responsible for all Yammer ESN activities in their organizational unit, and especially for developing and improving the terms and conditions for employee use. It was important to offer training to ensure employees did not breach any laws or raise any ethical issues. Another activity during the pre-implementation stage was recruiting "power users" which they called champions, and to establish a group of publisher users. These user groups received special training to learn effective ways to publish material and stay active in organizational unit ESN activities. Another activity during the pre-implementation process was to engage and train unit managers. Involving managers in the implementation process was an important factor, so proper training and mentoring enabled managers to support the process and encourage employees taking part in ESN activities. With knowledge of the expected benefits of the ESN, managers bought into the process and offered crucial backing. Training included the 4 key success factors for leveraging Yammer – how to build profile, how to build the enterprise network, how to create engagement, and how to integrate the tool into work routines. Senior leaders received one-on-one social and reverse-mentoring sessions.

After completing pre-implementation activities, the implementation team released a formal, organization-wide announcement. This stated the Yammer ESN platform was available to all employees. The launch included a variety of activities such as a kick-off meeting, an executive greeting and an announcement. Managers published relevant information via both the Yammer ESN platform, and email to ensure all employees were aware they could use the Yammer ESN platform for communication and knowledge sharing purposes. Likewise, these announcements provided information about access to the platform.

Organizational support did not end with the launch. All employees received training, and the implementation team constructed formal processes for continued engagement with Yammer ESN stakeholders such as administrators, managers, champions and publisher users. The team set continued engagement as a high priority and worked to ensure key users had a voice in long-term goals. Other important steps during post launch included: monitoring use, improving support, and evaluating the process to ensure reaching main goals.

The current research produced several interesting findings. Among these were that new groups emerged within organizational units. These groups increased communication since employees found new ways to interact regarding routine daily tasks. In other words, a new tool offered better methods to accomplish existing processes. To investigate the post-implementation process deeper, we added a post hoc exploration to determine if communication increased beyond organizational units. Our analysis suggested this did happen. In fact, new communication channels between units emerged at a significant level. After the implementation process, employees continued to use the system at a significantly higher level, and more inter-organization and intra-organization communication emerged.

### 6.1. Theoretical implications

The current study offers several important theoretical implications that need to be reported. First, process theory was used as a basis for understanding an ESN system implementation process. Although the current study was practical in nature, use of this key concept represents a step in a worthwhile direction for examining enterprise social network implementations through the lens of broader theory. This has not been done before and thus contributes to the ESN literature. Likewise, the current study took steps to contextualize ERP implementation critical success factors in ESN settings. While this study did not have that objective at its center, it did provide useful movement in this worthwhile direction. This suggests more theoretical work can be done in this area and calls for further understanding. Similarities between ERP and ESN implementations are implied in this study for the first time to our knowledge. ESNs are less formal and more likely to hinge on individual users than business processes encoded in ERPs, but nevertheless have similar characteristics.

Specifically, based on the current study, we believe process theory from Markus and Tanis (2000) and its categories of project metrics, early operational metrics, and longer-term business results can be extended from Nah et al.'s (2001)) use as a framework for investigating ERP system CSFs to a framework to investigate ESNs.

Other theoretical implications relate to the use of SNA to investigate the success of an ESN implementation. We believe metrics derived from weighted degree provides a mechanism for understanding more than the count of messages being passed through the network. We feel this research incrementally contributes to using SNA as a tool for understanding corporate use of ESNs.

### 6.2. Practical implications

From a practical perspective, the current study provides several implications. First, any organization wishing to start using an ESN should utilize a formal implementation process. This study decisively provides evidence that formal implementation considering CSFs makes a significance difference in the number of messages exchanged, the number of users and the type of communication that occurs. Second, this study offers useful findings that prior experience implementing an ERP system may offer helpful insight into the ESN implementation process. Likewise, software system implementation offers useful background to organizations seeking to utilize ESNs. Third, this research shows how post implementation evaluation, in general—not only for ESNs, can use real data extracted from the system instead of a traditional evaluation method based on users' surveys.

## 7. Conclusions

Most existing ESN studies rely on survey or interview data because actual ESN data is rarely available to researchers. Fortunately, we had an opportunity to assess our research questions based on real-world ESN data. Ensuring a new ESN platform is accepted and used by employees is a primary challenge for organizations implementing these platforms to support better communication, collaboration and knowledge-sharing at work (Krischkowsky et al., 2014). Organizations which use ESNs can achieve success with a directed and carefully managed implementation process as intervention to increase the ESN's acceptance and use. Done properly, this can impact and increase communication, collaboration and knowledge sharing between employees. The current research examined how an implementation process as an intervention significantly affected the interaction levels in an ESN platform, and led to increased usage.

Little research exists on ESN implementation processes and the impact on users. The present study contributes to this stream of research by studying actual impact, using real data extracted from an ESN platform during a carefully managed implementation process. The ESN was available prior to the implementation but an intervention stimulated usage and achieved organizational goals. Some employees in the organization already used the Yammer platform before running the implementation process and so it was possible to determine the impact of the implementation process. Both number of messages and number of users significantly increased, and usage remained significantly higher in the periods following the implementation. The increase in posting messages demonstrated the increase in knowledge sharing via the ESN both inside organizational units and, more importantly, between users in different units. The findings of this study provide evidence of the role and importance of an implementation process in increasing interactions between employees using an ESN platform, which will allow better communication and knowledge sharing within an organization.

### 7.1. Limitations

This study had several limitations. First, we used existing data from a single organization, which has its own characteristics, potentially reducing the generalizability of the results. Management determined both the form and timing of the implementation process. It was not theoretically derived. Therefore, further research into other organizations is needed to ensure the applicability of the research questions discussed and the related results to other organizations.

### 7.2. Future research directions

This study provides a number of ideas for future study. For instance, ERP CSFs (2003, Nah et al., 2001) could form a basis for determining ESN CFSs. Likewise, process theory (Markus & Tanis, 2000) could be formally tested for use in an ESN implementation. Other research could investigate particular aspects of ESN implementation such as top management support levels, training and so forth to provide more information about successful ESN implementation. Other future research can utilize semantic analysis of ESN message content to better understand repost patterns (Luo, Pan, & Zhu, 2017) and user interactions.

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