Journal of Strategic Information Systems 28 (2019) 292–309

Contents lists available at ScienceDirect

Journal of Strategic Information Systems

journal homepage: www.elsevier.com/locate/jsis

How employees gain meta-knowledge using enterprise social networks: A validation and extension of communication visibility theory

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ARTICLE INFO

Keywords:
Enterprise Social Networks
Communication Visibility Theory
Communication Awareness
Meta-knowledge

ABSTRACT

Employees' knowledge about their coworkers' knowledge (i.e., meta-knowledge) is central for organizations to create competitive advantages. According to Communication Visibility Theory, enterprise social networks (ESNs) have the potential to foster long-term formation of meta-knowledge. However, research about this potential is still limited. Using a quantitative study, we improve the understanding of how ESNs facilitate the development of meta-knowledge in three ways: we (1) show that the creation of meta-knowledge through ESNs works across contexts, (2) find that ESNs can lead to rather immediate increases in meta-knowledge, and (3) reveal that managers can gain more meta-knowledge using ESNs than can non-managers.

Introduction

In today's quickly changing economies, knowledge is central for organizations to gain and maintain competitive advantages (e.g., Arend et al., 2014; Barney et al., 2001; Nag and Gioia, 2012). Usually, an organization's knowledge is widely distributed across its employees who operate in different teams, departments, and locations (e.g., Sambamurthy and Subramani, 2005; Tsoukas, 1996). Thus, significant effort is required to coordinate, transfer, and use this distributed knowledge (e.g., Gold et al., 2001; Holsapple and Joshi, 2000; Orlikowski, 2002). All in all, leveraging knowledge to create a competitive advantage is not a trivial task for organizations.

A well-established conceptualization of how organizations can leverage their distributed knowledge comes from the literature on transactive memory systems (TMSs) (e.g., Lewis, 2003; Lewis and Herndon, 2011; Ren and Argote, 2011). TMS research highlights the importance of meta-knowledge as a key requirement needed by employees to coordinate, transfer, and use subject-specific knowledge (such as how to implement a mobile app or how to run a marketing campaign) that is distributed across their coworkers (e.g., Argote and Ren, 2012; Griffith et al., 2003; Wegner, 1995). Meta-knowledge is knowledge *about* others' subject-specific knowledge (such as knowing who can implement a mobile app or who can run a marketing campaign) (Lewis, 2003; Ren and Argote, 2011). Without meta-knowledge, employees would not be able to make use of their coworkers' subject-specific knowledge, because they would not know what others know (Lewis and Herndon, 2011). This would render a company's activities highly inefficient.

How can organizations develop meta-knowledge to realize the strategic value residing in their distributed knowledge? Although this question has not received sufficient attention in TMS research (e.g., Leonardi, 2014; Ren and Argote, 2011), it has been suggested that enterprise social networks (ESNs) might be particularly suited for this purpose: helping organizations to create meta-knowledge,

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https://doi.org/10.1016/j.jsis.2019.04.001
Received 30 October 2017; Received in revised form 1 April 2019; Accepted 4 April 2019
Available online 09 April 2019
0963-8687/

as these systems make employees' regular communications visible (Fulk and Yuan, 2013; Leonardi et al., 2013; Majchrzak et al., 2013a). Based on this observation, Leonardi (2014, 2015) developed Communication Visibility Theory (CVT), which states that the visibility of communications in ESNs reveals information about the communicators' knowledge. This information enables others who read the communications to learn what and whom the communicators know and thus to develop meta-knowledge (Leonardi 2014, 2015). So far, Leonardi (2014, 2015) has offered first empirical evidence of ESNs' potential to improve organizations' meta-knowledge. Although CVT offers remarkable insights for theory and practice, Leonardi (2014, p. 814) emphasized that "a good deal of work is needed to refine this theory, introduce scope, and test its predictions in varied organizational contexts." Therefore, the present research aims to validate and extend CVT in three ways in order to gain a better understanding of how ESNs enable the development of meta-knowledge.

First, Leonardi (2014, 2015) developed CVT by comparing two groups of employees in a financial services institution, but no study has since validated the theory in other contexts. Thus, the scope of CVT's validity is at present unclear, as it is not known whether ESNs also help to increase employees' meta-knowledge in other contexts or whether the theory will collapse when applied to different samples. CVT's impact would be severely limited if its propositions could not be confirmed for other populations (e.g., different departments, companies, and industries). Exploring the boundaries of newly generated theories is essential for reducing uncertainty regarding their applicability in different contexts (e.g., Busse et al., 2017; Lee and Baskerville, 2003). This is especially true for inductively generated theories such as Leonardi's (2014) theory that are constructed based on observations in a particular context (Whetten, 1989). We thus formulate the following research question (RQ):

RQ1: Does the development of meta-knowledge through ESNs as proposed by CVT work in different organizational contexts?

Second, CVT's perspective regarding how meta-knowledge develops in ESNs is limited to an indirect and barely goal-oriented process: through exposure to the conversations of others, ESN users incrementally extract and combine different bits of information about other employees' knowledge (Leonardi 2014, 2015). As Leonardi (2015, p. 758) states, "passive exposure to ambient communications occurring between others, over time, can provide the material out of which a person can assemble an understanding about what and whom others know." We argue that CVT's sole focus on this passive and rather long-term process is problematic for two reasons. On the one hand, the development of meta-knowledge is a "moving target," as a company's employees and the knowledge they have can frequently change (e.g., Helfat and Peteraf, 2003; Nevo and Wand, 2005). For instance, new employees might join a company, and existing employees might participate in training to acquire new knowledge. Thus, employees should update their meta-knowledge sooner rather than later to adapt to these changes and profit from their colleagues' new subject-specific knowledge. On the other hand, a wealth of studies have shown that individuals only use information systems (ISs) if they perceive them as being useful (e.g., Davis, 1989; Venkatesh et al., 2003). Thus, if benefits derived from an ESN take too long to materialize, employees—whose limited attention is already challenged by their daily tasks—might stop using these systems (Leonardi, 2018). In addition, managers might not only stop using ESNs, but also discourage their subordinates from using ESNs or even shut down the systems (Leonardi, 2018).

We argue that, in addition to passive exposure to the communications of others as a way to develop meta-knowledge, ESNs should also afford their users to actively increase their meta-knowledge. For instance, actively searching for content (Oostervink et al., 2016) or purposefully screening other users' profiles (Ellison et al., 2015) might directly increase an ESN user's meta-knowledge. We seek to investigate whether ESNs indeed lead to such direct and therefore more immediate increases in meta-knowledge, which would complement the indirect and rather long-term process proposed by CVT. Therefore, we pose the following question:

RQ2: Can the use of ESNs lead to direct increases in meta-knowledge?

Third, as presently formulated, CVT suggests that all ESN users are equally able to develop meta-knowledge, since the theory does not account for individual differences. However, like other entities, ESNs can afford different things to different people (e.g., Ali-Hassan et al., 2015; Ellison et al., 2015; Gibson 1986; Wakefield and Wakefield, 2016). For example, two individuals might have the same tool (e.g., a hammer) but differ in their ability and motivation to build something with this tool (e.g., a chair). Thus, we should not assume that different ESN users are equally able and motivated to build meta-knowledge.

In this study, we consider differences between ESN users based on their management responsibilities (i.e., managers vs. non-managers). Managers have wide-ranging information needs, as acquisition and dissemination of information are among their most important tasks (e.g., De Alwis et al., 2006; Fleishman et al., 1991; Mumford et al., 2007). Since ESNs are a vital source of information, managers might be more motivated than non-managers to pay greater attention to conversations occurring in ESNs in order to meet their particular information needs and, in this way, develop more meta-knowledge.

Examination of the development of managers' meta-knowledge is essential, as managers exert a strong impact on their company's success. Specifically, managers are involved in a variety of strategic tasks (e.g., Adner and Helfat, 2003; Helfat and Martin, 2015; Helfat and Peteraf, 2015), which require that they oversee and access others' subject-specific knowledge (e.g., Argote and Ren, 2012). Since their meta-knowledge enables managers to locate and make use of others' subject-specific knowledge, managers' meta-knowledge is crucial for their company's performance (e.g., Foss and Jensen, 2018; Rulke et al., 2000). Therefore, raise the following question:

RQ3: Are the relationships proposed by CVT subject to individual differences between managers and non-managers?

We conduct a quantitative study among 206 employees from different organizational contexts to address our research questions, and we make three main contributions. First, our study lends credence to the validity of CVT across different departments, companies, and industries. This suggests that organizations from different contexts can utilize ESNs to make better use of their distributed knowledge and, in this way, increase their performance and potentially gain competitive advantages. Second, we extend CVT by showing that ESN use has a direct effect on meta-knowledge, which implies that ESNs can help users to actively develop meta-knowledge rather than merely indirectly through passive exposure to others' communications, as Leonardi (2014, 2015) suggested. As a consequence, ESNs help employees to keep up with the ongoing changes in their companies' subject-specific knowledge even more than CVT currently suggests. Third, we reveal that managers' use of ESNs is more beneficial than that of non-managers in terms of the development of meta-knowledge. This suggests that ESNs are well suited to help managers foster their company's success, since their meta-knowledge enables them to consider and access the company's subject-specific knowledge within their strategic tasks (e.g., Argote and Ren, 2012; Foss and Jensen, 2018; Rulke et al., 2000). Our third contribution also offers a new perspective on the benefits managers can obtain through ESNs. Prior research indicates that managers are often concerned about ESNs' true business value (Denyer et al., 2011; Koch et al., 2012; Leidner et al., 2010). Hence, these studies suggest that managers' ESN use might not provide substantial benefits. However, our results paint a different picture, which is that managers' ESN use entails meta-knowledge increases that are even greater than those resulting from non-managers' ESN use.

The remainder of this article is structured as follows. In section two, we provide a theoretical background for meta-knowledge and explain how it impacts an organization's success through its central role in TMSs. In addition, we offer details about ESNs and the development of meta-knowledge through ESNs, which is the core concern of CVT. In section three, we formulate our hypotheses and develop our research model. In section four, we describe our methodology. In section five, we present the results of our study. In the final section, we discuss our theoretical contributions, our study's limitations, suggestions for future research, and the practical implications of this study.

Theoretical background

In this section, we provide a background for our research. First, we illustrate the role of meta-knowledge in TMSs to situate meta-knowledge in its larger theoretical context and show its importance for organizations. Second, we give a brief overview of ESNs, and third, we provide a more detailed description of how ESNs can contribute to the development of meta-knowledge.

Meta-knowledge and its role in transactive memory systems

Meta-knowledge has been formally defined as an individual's "memory with label and location information about what other members [of a group] know" (Ren and Argote, 2011, p. 192)—it is knowledge *about* others' knowledge. Meta-knowledge allows employees to utilize more knowledge than they personally possess by helping them locate and thereby access others' subject-specific knowledge (e.g., Argote and Ren, 2012; Griffith et al., 2003; Wegner, 1995). To illustrate the value of meta-knowledge for organizations, consider the following example of Jill, who knows how to develop mobile apps but not how to market them. If Jill knew that her colleague Jack was an expert in marketing (i.e., if Jill had meta-knowledge), she could consult him to develop a marketing approach for her app. In this case, Jill's meta-knowledge would enable her to tap into the potential of Jack's subject-specific knowledge. But if Jill did not know about Jack's knowledge (i.e., if Jill had no meta-knowledge), she could not ask for his support and might fail to market her app.

This role of meta-knowledge in leveraging the subject-specific knowledge that is distributed among members of a group has been intensively discussed in the context of TMS research (e.g., Brandon and Hollingshead, 2004; Lewis and Herndon, 2011; Ren and Argote, 2011). A TMS is the "shared division of cognitive labor with respect to the encoding, storage, retrieval, and communication of information" (Hollingshead 2001, p. 1080). Put simply, a TMS is a collective system that is used by a group to effectively handle distributed knowledge. The elements of a TMS include the group members' subject-specific knowledge and their meta-knowledge (these constitute the "structures" of the TMS), as well as the processes that the group members use to manage these structures (e.g., Wegner, 1995).

Many studies have shown that well-functioning TMSs facilitate the use of distributed knowledge to achieve a common goal and enhance employees' performance (e.g., Faraj and Sproull, 2000; Littlepage et al., 2008; Rau, 2005). Indeed, a TMS can create competitive advantages that are sustainable, as such systems are hard for competitors to copy (Argote and Ren, 2012). However, the benefits of a TMS cannot be reaped without meta-knowledge as a key element and, as we will argue below, more research on how meta-knowledge can be developed is needed (e.g., Leonardi, 2014; Ren and Argote, 2011).

The meta-knowledge of an organization's managers has a unique role vis-à-vis the effective use of distributed knowledge within the company. While managers can leverage their meta-knowledge to apply their colleagues' knowledge to a particular task (like Jack's knowledge helping Jill in the above example), they also benefit from simply having an overview of what others know without necessarily applying this knowledge themselves (e.g., Foss and Jensen, 2018; Rulke et al., 2000). In particular, managers use their meta-knowledge to oversee their company's expertise when developing and executing its strategy, and these two responsibilities substantially affect the firm's performance and competitiveness (e.g., Adner and Helfat, 2003; Helfat and Martin, 2015; Helfat and Peteraf, 2015). Rulke et al. (2000) outlined the positive effect of managers' meta-knowledge on organizational learning. Foss and Jensen (2018) pointed out that managers' meta-knowledge helps them to manage their company's partnerships. Heavey and Simsek linked top managers' meta-knowledge to their ability to create an ambidextrous orientation (Heavey and Simsek, 2017) and increase firm performance (Heavey and Simsek, 2015). Finally, Argote and Ren (2012) emphasized that meta-knowledge improves the orchestration of a company's value creation, which is particularly relevant to managers (e.g., Adner and Helfat, 2003; Helfat and Martin, 2015; Helfat and Peteraf, 2015). In sum, meta-knowledge is crucial for managers to engage in their daily business, which is to facilitate organizational success. Thus, the question of how

managers can improve their meta-knowledge to exploit these benefits is of particular relevance.

Enterprise social networks

We define ESNs, based on Leonardi et al. (2013, p. 2), as "platforms that allow workers to (1) communicate messages with specific coworkers or broadcast messages to everyone in the organization; (2) explicitly indicate or implicitly reveal particular coworkers as communication partners; (3) post, edit, and sort text and files linked to themselves or others; and (4) view the messages, connections, text, and files communicated, posted, edited and sorted by anyone else in the organization at any time of their choosing."

ESNs can be used for various purposes (e.g., Ali-Hassan et al., 2015; Kügler and Smolnik, 2014), such as broadcasting information (Schlagwein and Hu, 2016), fostering employees' communication (Leonardi et al., 2013), managing knowledge (Majchrzak et al., 2013a), supporting collaboration (von Krogh, 2012), and connecting employees to one another (Koch et al., 2012). Prior literature suggests that ESN use can lead to improved productivity (Kügler et al., 2015; Wu, 2013), higher innovation performance (Kügler et al., 2015), positive emotions (Koch et al., 2012), and increased social capital (Ali-Hassan et al., 2015). Given these benefits, ESNs have become a vital part of many companies' information technology (IT) portfolios and strategies (Karoui et al., 2015).

Despite these findings, the extant literature suggests that some managers are skeptical about the benefits that can be obtained from ESNs (Denyer et al., 2011; Koch et al., 2012; Leidner et al., 2010). This can be problematic, as the success of ESNs depends on managers' attitudes toward these systems (Koch et al., 2013). If managers do not perceive ESNs to be valuable, they might prevent their introduction or integration into their organization, since they are often directly involved in the latter processes (Chin et al., 2015). In addition, managers might discourage others from using ESNs by instructing them not to spend too much time on ESNs or by expressing the view that ESN use is not valued (Choudrie and Zamani, 2016; Leidner et al., 2010).

The development of meta-knowledge through enterprise social networks

Given the aforementioned benefits of meta-knowledge and TMSs, an important question is how meta-knowledge can be developed. While this question needs more attention (e.g., Leonardi, 2014; Ren and Argote, 2011), earlier studies have suggested that face-to-face communication (e.g., He et al., 2007; Lewis, 2004) and mutual training are important for the creation of meta-knowledge (e.g., Gino et al., 2010; Liang et al., 1995). Furthermore, Kanawattanachai and Yoo (2007) showed that even purely digital communication (i.e., communication that lacks face-to-face interactions) can foster the development of meta-knowledge if it occurs between employees collaborating in a team. However, because not everybody can collaborate with everyone else in a very large team, these ways of developing meta-knowledge hardly scale in organizations with hundreds or thousands of employees (Leonardi, 2014).

Thus, prior research has emphasized the potential of knowledge management systems (KMSs) for fostering the development of meta-knowledge. For instance, Majchrzak et al. (2013b) and Nevo et al. (2012) reasoned that Wikis enable employees to identify their coworkers' expertise, as these systems show individuals' knowledge contributions. Further, Alavi and Tiwana (2002) proposed that KMSs can facilitate users' meta-knowledge by offering codified knowledge and information about employees' experiences. Likewise, Choi et al. (2010) provided evidence that knowledge repositories, bulletin boards, and search engines can improve employees' meta-knowledge. However, these KMSs require employees to actively document their knowledge (e.g., Leonardi, 2017), and practice shows that employees are often unwilling to do this because of the effort that is required (e.g., Ardichvili et al., 2003; Hahn and Subramani, 2000; Huber, 2001).

Some scholars have argued that ESNs might be suited to overcome this challenge associated with KMSs, as ESNs can enable the creation of meta-knowledge without requiring employees to actively document their knowledge. Specifically, these researchers suggest that ESNs provide insights into their users' knowledge by making visible routine communications that contain information about the communicators' knowledge (Fulk and Yuan, 2013; Leonardi et al., 2013; Majchrzak et al., 2013a; Trier and Richter, 2015)—reflecting the idea of directly connecting people instead of documenting knowledge (Kaschig et al., 2016). However, while these researchers' valuable suggestions are purely conceptual or anecdotal, Leonardi (2014, 2015) offered a theory and first empirical evidence for the relationship between ESN use and meta-knowledge. He developed CVT based on a study of two groups of employees in a financial services institution (one with and one without access to an ESN) that showed that an ESN fostered its users' meta-knowledge based on communication visibility.

To attain this communication visibility, employees are only required to communicate about their work within an ESN, as this should entail implicit disclosures of their knowledge (Leonardi, 2014). Although the extent to which employees communicate in ESNs is subject to different influencing factors (e.g., Leonardi and Neeley, 2017; Leonardi, 2017; Rode, 2016), the barriers to such communication should be lower than those associated with knowledge sharing in traditional KMSs, because the informal nature of ESNs should invite employees to openly talk about their work content and activities. Chin et al. (2015, p. 295) describe the "open communication nature" of ESNs as one of their important characteristics. Thus, by making "everyday conversations" visible, ESNs might have an advantage over KMSs with respect to the development of meta-knowledge.

CVT states that employees develop meta-knowledge in ESNs by reading other ESN users' conversations and, in this way, gaining an *awareness* of what these conversations are about (Leonardi 2015). Therefore, a central construct of CVT is individuals' *communication awareness*, which mediates the effect of ESN use on meta-knowledge. Communication awareness has been defined by Leonardi (2015, p. 747) as "awareness of ambient communications occurring amongst others in the organization." As Leonardi distinguishes between two dimensions of meta-knowledge (i.e., "who knows what" and "who knows whom"), CVT also includes two corresponding dimensions of communication awareness, namely employees' awareness of (a) the content of coworkers' messages, and (b) their coworkers' connections.

Gaining meta-knowledge based on communication awareness, as described by CVT, is a passive and rather long-term process

(Leonardi, 2014, 2015). Leonardi (2015, p. 758) explains that "routine communications seen by third-party observers contain some dribs of information that can only be turned into metaknowledge when they are assembled with other dribs of information from different observed communications." Therefore, becoming aware of the content of a single conversation is usually not sufficient to acquire meta-knowledge (Leonardi, 2014). It is only when more conversations become visible that different bits of information can complement each other and enable employees to make meaningful inferences (Leonardi, 2014, 2015).

Although CVT is of high theoretical and practical value, Leonardi (2014) pointed out that it still needs validation and refinement. Responding to this call, we now develop a research model that is based on CVT to validate and extend existing knowledge about how ESNs foster employees' meta-knowledge.

Hypotheses

Communication visibility theory across organizational contexts

We begin our hypothesis section with the theoretical relationships included in CVT, which asserts that employees' ESN use increases their communication awareness, which in turn leads to an increase in their meta-knowledge. As readers might be unfamiliar with these relationships, we describe them in more detail below.

First, Leonardi (2014) argued that the permanent visibility of conversations facilitated by ESNs enables employees to become aware of others' communications. This communication visibility has two aspects. On the one hand, it involves *message transparency*, which means that ESNs make the content of others' messages accessible (Leonardi, 2015). If the content of the conversations of others is accessible, employees can become aware of that content. On the other hand, communication visibility involves *network translucence*, which means that ESNs make employees' social networks apparent (Leonardi, 2015). If the social networks of others are apparent, employees can develop an awareness of their coworkers' connections. The more often employees use an ESN, the more they see both the content of the messages of others and their communication partners, which should lead to an increase in their communication awareness (Leonardi, 2014, 2015).

Second, Leonardi (2015) found that employees' awareness of the content of their coworkers' messages increased their knowledge of "who knows what," while their awareness of coworkers' connections facilitated their knowledge of "who knows whom." Explaining these results, Leonardi (2015) emphasized that routine communications among employees involve several fragments of information that complement each other. Thus, if employees become aware of the complementary information fragments, they can aggregate them to form a proper perception of "who knows what" and "who knows whom" (Leonardi, 2015). The more communications employees become aware of, the more information fragments they should have available for combination and the development of meta-knowledge (Leonardi, 2014, 2015).

Together, these arguments constitute a mediating relationship: employees' ESN use increases their communication awareness, which leads to an increase in their meta-knowledge. Leonardi (2014, 2015) developed and tested these propositions based on a study among 94 employees of a financial services firm in the US, but no study has since validated the theory in other organizational contexts. To increase the theory's usefulness, it is important to determine whether its theoretical relationships can also be observed in other contexts (e.g., Lee and Baskerville, 2003). Thus, we hypothesize:

H1a. Employees' ESN use positively influences their knowledge about "who knows what" through an increased awareness of the content of their coworkers' messages.

H1b. Employees' ESN use positively influences their knowledge about "who knows whom" through an increased awareness of their coworkers' connections.

A direct effect of ESN use on meta-knowledge

As stated in H1a/b, CVT conveys that meta-knowledge in ESNs develops through an indirect effect, almost accidentally, based on passive exposure to others' conversations (Leonardi, 2014, 2015). This rather long-term perspective is problematic for two reasons. First, organizations' employees and their knowledge frequently change (e.g., Helfat and Peteraf, 2003; Nevo and Wand, 2005), which requires individuals to regularly update their meta-knowledge. Second, employees might feel that the benefits of ESNs in the form of meta-knowledge take too long to materialize, which could cause them to reject these systems (Leonardi, 2018; Venkatesh et al., 2003) or, in the case of managers, even pull the plug on these systems (Leonardi, 2018). Both issues would be addressed if ESN use could directly increase a user's meta-knowledge, leading to more immediate benefits.

We argue that ESN use can indeed directly increase a user's meta-knowledge, complementing the long-term increases facilitated by communication awareness as described by Leonardi (2014, 2015). We propose that this is possible because ESNs afford *goal-directed* information seeking. Information seeking is an established concept in the information sciences and can be defined as "a conscious effort to acquire information in response to a need or gap in your knowledge" (Case and Given, 2016, p. 6). Although other definitions differ slightly, they all agree that information seeking is a purposeful and active behavior that is aimed at changing the information seeker's knowledge in order to satisfy an information need (e.g., Choo, 2005; Spink and Cole, 2006).

Employees who require information regarding "who knows what" or "who knows whom" can use ESNs to satisfy their information needs through different ways of seeking information. First, employees can use ESNs' search functions to actively search for content on a specific topic or person and view his or her connections (Oostervink et al., 2016). Second, employees can look through

ESN user profiles to seek information about topics or people (Ellison et al., 2015). Third, employees can actively post messages within ESNs and ask questions about a topic or person (van Osch et al., 2016). Consequently, we argue that ESN use can also lead to direct increases in meta-knowledge without requiring employees to have communication awareness as hypothesized by CVT (Leonardi, 2014, 2015). This leads to the following hypotheses:

H2a. Employees' ESN use positively influences their knowledge about "who knows what" via a direct effect.

H2b. Employees' ESN use positively influences their knowledge about "who knows whom" via a direct effect.

The moderating effect of management responsibility

At present, CVT does not account for individual differences, which suggests that all employees are equally able to develop meta-knowledge using ESNs. We challenge this assumption based on prior research that views ESNs from an affordance perspective (e.g., Ali-Hassan et al., 2015; Ellison et al., 2015; Wakefield and Wakefield, 2016). This perspective suggests that ESNs afford different things to different people, depending on their abilities and motivation. Thus, individuals might differ in their motivations regarding their ESN use, which could result in differences in their development of meta-knowledge as well. This is in line with Karoui et al. (2015), who suggested that ESNs' communication visibility affects different users in different ways. In this research, we analyze whether managers differ from non-managers in terms of the extent to which their ESN use leads to the development of meta-knowledge.

Managers possess wide-ranging information needs, since information has a significant meaning for them. In particular, the acquisition and dissemination of information are among the most important activities tied to the managerial role (e.g., De Alwis et al., 2006; Fleishman et al., 1991; Mintzberg, 1971; Mumford et al., 2007). For instance, managers require information to gain an understanding of their subordinates' capabilities and maintain an overview of their activities (Rulke et al., 2000). Such information about their subordinates' jobs is also important insofar it serves as a source of power for managers (e.g., Finkelstein, 1992; Hersey et al., 1979; Ward, 1998). Overall, "managers are considered sources of external and internal information and are frequently referred to as 'boundary spanners', gatekeepers of information, knowledge brokers, cognitive authorities, and 'information stars'" (De Alwis et al., 2006, p. 363).

Given the importance of information for managers, we argue that their ESN use should be associated with a greater communication awareness than non-managers' use of these systems. To address their particular information needs, managers have to listen to what is going on (i.e., acquire information) in their organization (e.g., Garvin, 1998; Helms and Haynes, 1992; Tagiuri, 1995). ESNs provide users with information about their colleagues' activities and the network that connects them (e.g., Leonardi, 2014, 2015). Thus, managers can use ESNs to access such information and listen to what is happening in their company. This is in line with Karoui et al. (2015, p. 30) who emphasize that ESNs "are an opportunity for managers to collect various data on their employees." Given that ESNs afford managers to address their increased information needs, we argue that managers should pay more attention than non-managers to information that is available in an ESN. As attention is crucial for developing awareness (Ocasio, 2011), greater attention to communications in an ESN should lead to greater communication awareness resulting from ESN use. Consequently, an employee's management responsibility should moderate the relationship between ESN use and communication awareness and thus moderate the mediated effect of ESN use on meta-knowledge transmitted through communication awareness (i.e., H1a/b)[1]:

H3a. The indirect effect of employees' ESN use on their knowledge about "who knows what" is stronger for managers than for non-managers because of a stronger relationship between managers' ESN use and communication awareness.

H3b. The indirect effect of employees' ESN use on their knowledge about "who knows whom" is stronger for managers than for non-managers because of a stronger relationship between their ESN use and communication awareness.

Fig. 1 illustrates our research model based on our hypotheses.

Methods

Data collection and sample

To test our research model, we conducted a cross-sectional survey among working individuals from different departments, companies, and industries who had access to an ESN. To recruit our participants, we consulted the services of a professional survey firm. In order for an individual to qualify as a participant for our study, three selection criteria had to be met. First, the individual had to have access to an ESN. As CVT is bound to the context of ESN use, individuals without access to an ESN were ineligible for our study. Second, the individual had to be working on mostly non-physical tasks, in order to avoid inviting participants who had access to ESNs but did not use them due to their task specialization. Third, the individual had to work in a company that had at least 500 employees, because the main potential of ESNs unfolds in companies where many new connections across different organizational boundaries can be made (Ali-Hassan et al., 2015).

[1] Please note that we do not hypothesize a moderating effect for the direct link between ESN use and meta-knowledge. As stated above, the direct effect between ESN use and meta-knowledge is based on the argument that ESN users can actively search for information they need in an ESN. In this case of active information seeking, managers' higher information needs would simply lead to more active information seeking, i.e., an increase in the independent variable.

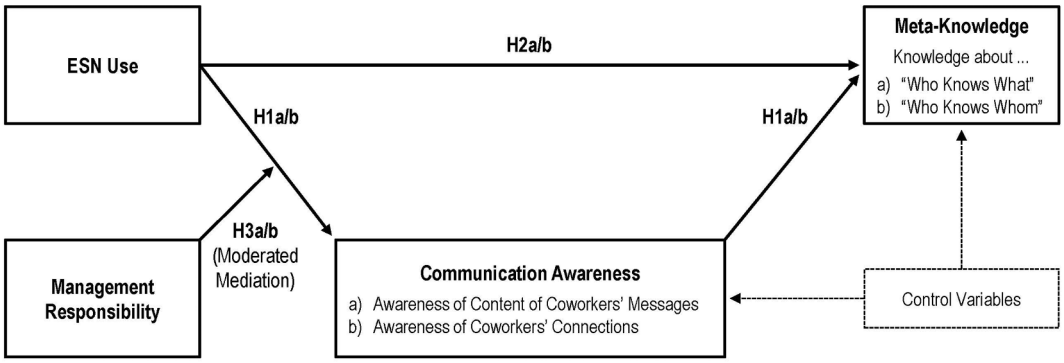


Fig. 1. Research model.

While we hosted the survey ourselves, the survey firm contacted eligible respondents—thus assuring all participants' anonymity. We collected data during the first quarter of 2017 and worked closely with the survey firm to achieve a well-distributed sample in terms of age, gender, management responsibility, company size, industries, and the departments in which the individuals were working. Overall, the survey firm invited 10,457 employees from two German-speaking countries (Germany and Switzerland) to participate in our study, of which 2219 answered the screening questions. Applying the selection criteria described above, we immediately screened out 1550 participants. Further, we dismissed data from 150 participants due to missing values. As distracted participants can cause critical issues in survey studies (Maniaci and Rogge, 2014; Meade and Craig, 2012), we further removed 313 participants who either failed attention checks, exhibited excessive straight-lining, completed the survey in an unrealistic amount of time, or provided contradictory responses. Consequently, our final sample consisted of 206 participants working in various organizational contexts. Specifically, we collected data from individuals employed by companies of different sizes, in a variety of departments and a wide range of industries. Table 1 provides a descriptive overview of our participants.

Measurements, control variables, and empirical pretest

All scales are listed in Appendix A. Whenever possible, we relied on established scales from previous research. Accordingly, ESN use was measured using a reflective three-item scale for social ESN use (Kügler and Smolnik, 2014) that reflects the extent to which ESN users establish and maintain social relations with their colleagues. To measure the two dimensions of communication awareness (i.e., regarding the content of coworkers' messages and coworkers' connections), new items had to be developed, since the two-item scales offered by Leonardi (2015) did not satisfy the recommendation of using at least three items in survey studies (e.g., Hoyle, 2012). Thus, based on Leonardi's (2015) items, we generated a pool of items that captured the meaning of communication awareness as outlined by Leonardi (2015). To ensure high content validity, the coauthors thoroughly discussed all newly developed items among ourselves and with professionals who had ESN-related expertise to iteratively improve the wordings of the items. These efforts resulted in reflective three-item scales for both awareness dimensions. Further, we used the scale developed by Kanawattanachai and Yoo (2007) to measure employees' meta-knowledge about "who knows what," as others (Leonardi, 2015; Lewis, 2003) have not provided meta-knowledge scales that fulfill the requirements of quantitative studies. For measuring employees' meta-knowledge about "who knows whom," we adapted the items developed by Kanawattanachai and Yoo (2007), since no other scale was available. Again, the coauthors discussed the newly developed

Table 1
Descriptive overview of our sample.

Gender	Female	72 (35.0%)	**Firm Size** (Number of Employees)	501–1000	2 (1.0%)
	Male	134 (65.0%)		1001–5,000	70 (34.0%)
Age	18–33	40 (19.4%)		5001–20,000	54 (26.2%)
	34–44	43 (20.9%)		20,001–100,000	25 (12.1%)
	45–55	81 (39.3%)		> 100,000	55 (26.7%)
	56–65	40 (19.4%)	**Industry** (Multiple Choice)	Automotive	17 (8.3%)
	> 65	2 (1.0%)		Banking & Insurance	21 (10.2%)
Management Responsibility	No	134 (65.0%)		Chemicals & Pharma	11 (5.3%)
	Yes	73 (35.0%)		Communication	13 (6.3%)
Department	Communications	14 (6.8%)		Consumer Goods	8 (3.9%)
	Finance & Controlling	23 (11.2%)		Electrics & Electronics	7 (3.4%)
	Human Resources	15 (7.3%)		Engineering	18 (8.7%)
	IT	33 (16.0%)		Healthcare	8 (3.9%)
	Marketing	2 (1.0%)		IT	20 (9.7%)
	Production	18 (8.7%)		Service Providers	20 (9.7%)
	Purchasing & Sales	31 (15.0%)		Transportation	19 (9.2%)
	Research & Development	13 (6.3%)		Utility	8 (3.9%)
	Other	57 (27.7%)		Other	54 (26.2%)

items among ourselves and with professionals to ensure their content validity. Finally, management responsibility was measured by a single item that asked whether participants did or did not have such a responsibility.

Building on Leonardi (2015), we added different control variables to our research model. While Leonardi (2015) investigated employees of a single organization (thus keeping organizational and ESN-related factors constant), RQ1 required us to study individuals from different companies that might use different ESNs. Thus, besides individual differences, we had to control for organizational and ESN-related differences. Each individual, organizational, and ESN-related control variable included in our study was selected due to its potential influence on the number of communications employees were exposed to in their specific ESN contexts. Prior research strongly suggests that the extent of this exposure affects the amount of communication awareness and meta-knowledge that ESN users can gain (Krancher et al., 2018; Leonardi, 2014, 2015; Leonardi et al., 2013). The extent of communication exposure depends on both the number of communications that occur in an ESN (e.g., Leonardi, 2015, 2017) and the extent to which users individually follow (i.e., have subscribed to) such communications (e.g., Boyd and Ellison, 2007; Wakefield and Wakefield, 2016). Thus, we describe our control variables in relation to one of these two components of communication exposure. First, the following organizational and ESN-related control variables might affect how much communication occurs in an ESN: the number of a company's employees, its geographical distribution (which increases the need for electronic communication), its community identification (which increases employees' willingness to share information) (Chiu et al., 2006), its innovative climate (which improves employees' attitudes towards new forms of communication such as ESNs) (van der Vegt et al., 2005), the share of the company's employees who are intended to use the ESN, the share of its employees who actually do so (i.e., coworkers' average ESN use), and the time elapsed since ESN adoption. Second, building on Leonardi (2015), the following control variables might affect the extent to which an employee follows (i.e., has subscribed to) others' communications in an ESN, as well as the individual's overall level of meta-knowledge: age, gender, time elapsed since the employee started to use the ESN, management responsibility, job tenure, number of other ESN users working in close proximity, and interactions with other ESN users outside of the system. Based on these considerations, we linked all control variables to both the communication awareness and the meta-knowledge constructs. All control variables were measured as metric or ordinal variables except for gender and management responsibility, which were measured as binary variables.

Since our measurement instrument included several newly developed measures, we performed a quantitative pretest to ensure the validity and reliability of these scales. To this end, we recruited participants via the authors' professional networks and also via professional online social networks such as LinkedIn. We asked all participants with access to an ESN (N = 155) to answer a questionnaire that included our newly developed scales. Although the pretest revealed good properties for our measurements with respect to all standard quality criteria (i.e., internal consistency reliability, indicator reliability, convergent validity, and discriminant validity), it also helped us to fine-tune the new items before our main data collection took place.

Results

To test our model, we utilized partial least squares structural equation modeling (PLS-SEM), which is widely used in IS research, implemented by the software SmartPLS3 (Hair et al., 2016). Hair et al. (2016) and Rigdon et al. (2017) have emphasized that the use of PLS-SEM, rather than covariance-based SEM, is particularly suited for research that tends to be exploratory. In addition, Preacher and Hayes (2004, 2008) and Hayes (2015) have suggested that it is well suited for testing mediation and moderated mediation. As our study extends a novel theory and includes mediation and moderated mediation hypotheses, PLS-SEM fits our purposes well. Next, we elaborate on our measurement model before presenting the structural model.

The measurement model

We computed the values of different criteria to assess the quality of our measurement model. For the model's internal consistency reliability, we calculated Cronbach's alpha and the composite reliability measure for each reflective multi-item scale. All values met the recommended thresholds of 0.7 (Hair et al., 2016; MacKenzie et al., 2011). Regarding the model's indicator reliability, it has been proposed that each indicator's loading on the associated construct should exceed a threshold of 0.7 (Hulland, 1999), which was met in our study. Further, we accounted for convergent validity by checking whether each construct's average variance extracted (AVE) exceeded the recommended threshold of 0.5 (Bagozzi and Yi, 1988). Again, our measurement raised no concerns. To assess discriminant validity, we applied the Fornell-Larcker criterion, which requires that the square root of the AVE of a construct exceeds the construct's bivariate correlation with any other construct (Fornell and Larcker, 1981), and this was met for all variables. Henseler et al. (2015) showed that the heterotrait–monotrait ratio (HTMT) surpasses traditional assessments of discriminant validity in terms of precision and can therefore be regarded as a rather strict criterion. Therefore, we also assessed HTMT values, which were lower than 0.85 for all construct pairs, suggesting excellent discriminant validity (Hair et al., 2016). Finally, to address potential multicollinearity concerns, we calculated variance inflation factors (VIFs) for all possible combinations of constructs. All values were well below the recommended threshold of 5 (Hair et al., 2016), ranging between 1.08 and 3.44. Accordingly, we concluded that multicollinearity should not be of concern in our study. Appendices B and C provide an overview of the major measurement criteria and the item factors as well as cross-loadings. Appendix D shows the bivariate correlations for all study and control variables. All study variables were positively correlated.

We followed different procedures to address the potential for common method bias (CMB) in our data (Podsakoff et al., 2003). Regarding procedural remedies, we assured all participants that their data would be analyzed and stored anonymously. Also, we asked them to respond spontaneously and honestly, and we explained that there were no right or wrong answers. In addition, we used three statistical procedures to assess whether our results might be biased by common method variance. First, we applied Harman's single-factor

test (Podsakoff et al., 2003). An exploratory factor analysis revealed that no single factor accounted for the majority of the variance occurring in our model. Second, we used a marker variable approach, as proposed by Lindell and Whitney (2001). We used an item measuring the company's "relevance of digitalization" as a marker variable, as this should not be theoretically related to employees' ESN use, their awareness, or their meta-knowledge. A correlation analysis revealed that there were no significant correlations between the marker variable and our model variables (the average correlation was 0.04). Further, a comparison of the zero-order and partial correlations, in which the marker variable had been partialled out, revealed no significant differences. Third, we followed Liang et al. (2007) and added an unmeasured common method variable to our model. This test revealed that the average indicator variance caused by the substantive constructs was 0.81, while the method variable caused less than 1% of the variance. Accordingly, the ratio between the variance caused by substantive constructs and by the method was around 270:1. Moreover, all but one of the method factor's loadings were insignificant. Overall, these analyses suggest that CMB should not have significantly affected our results.

To account for a possible non-response bias, we followed Armstrong and Overton (1977) and compared the first 25% of our respondents with the last 25% using *t*-tests. The last 25% included the individuals who answered the questionnaire with the largest delay after being invited to participate. As we could not observe significant differences between these two groups, it is unlikely that non-response bias is an issue in our data.

Overview of the structural model

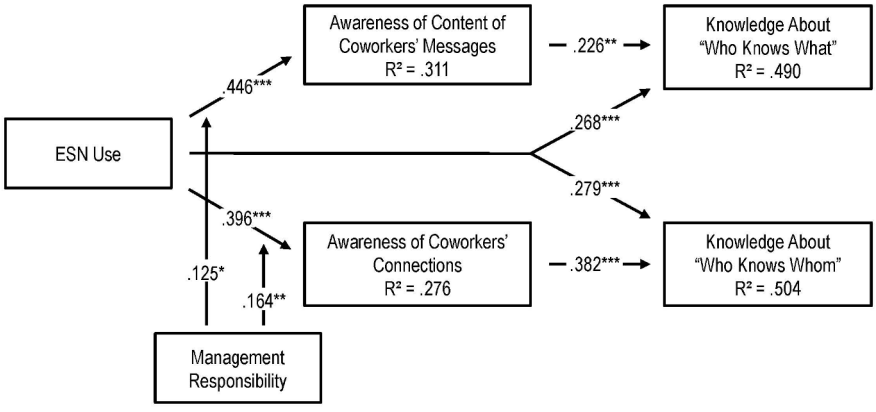
We calculated the significances of our model's path coefficients by running PLS's bootstrapping procedure with 5000 samples. Fig. 2 shows an overview of the results. We now elaborate on these paths and describe the model's predictive power and relevance. Then we discuss our mediation and moderated mediation hypotheses.

Based on the bootstrapping results, we obtained p-values for our model's paths. As shown in Fig. 2, all paths were significant. According to these results, which include significant direct paths between ESN use and both dimensions of meta-knowledge, we found immediate support for H2a/b.

We assessed R2 values to evaluate the model's predictive power. Regarding employees' meta-knowledge, the R2 value was 0.490 for knowledge of "who knows what" and 0.505 for knowledge of "who knows whom." The R2 values for employees' awareness were 0.311 regarding the content of coworkers' messages and 0.276 regarding coworkers' connections. Next, we assessed the predictive relevance (Q2) of our structural model using the blindfolding procedure. Following Henseler et al. (2009), a set of exogenous variables is relevant in predicting an endogenous variable if the Q2 value is larger than zero. All Q2 values satisfied this criterion (0.204 for awareness of the content of coworkers' messages, 0.182 for awareness of coworkers' connections, 0.356 for knowledge of "who knows what," and 0.405 for knowledge of "who knows whom"). Regarding our control variables' effects on the main study variables, we found significant effects of coworkers' average ESN use (coefficient = 0.130, p = .024) and employees' interactions with other ESN users outside of the ESN (coefficient = 0.203, p = .001) on their knowledge about "who knows what." Additionally, the number of other ESN users working in close proximity (coefficient = 0.159, p = .035) significantly affected an employee's knowledge about "who knows whom." For clarity of presentation, we excluded the effects of our control variables from Fig. 2.

Mediation and moderated mediation analysis

To test our mediation (H1a/b) and moderated mediation (H3a/b) hypotheses, we performed mediation, moderation, and moderated mediation analyses. Regarding the mediating effects, we utilized the PLS bootstrapping procedure to examine whether the indirect effects of ESN use on meta-knowledge transmitted through communication awareness were significant. Table 2 shows the results. As the 95% confidence intervals do not include the value zero, we can conclude that both indirect effects are significant at the 0.05 significance level. Therefore, we found support for H1a/b. As the direct effects of ESN use on meta-knowledge (shown in Fig. 2)



Notes: *p < .05; p** < .01; p*** < .001; N = 206; control variables were linked to both awareness and meta-knowledge constructs (see 4.2).

Fig. 2. Model results.

Table 2
Results of mediation analysis.

Indirect Path	Indirect Effect	95% Confidence Interval
ESN Use → Knowledge About "Who Knows What"	0.101	[0.046, 0.176]
ESN Use → Knowledge About "Who Knows Whom"	0.151	[0.086, 0.233]

were significant, the two mediating effects represent complementary mediations (Zhao et al., 2010).

Next, we analyzed whether management responsibility moderates the links between ESN use and communication awareness. As shown in Fig. 2, these moderating effects were significant. Concerning the moderators' effect sizes, we calculated an f2 value of 0.022 for management responsibility's influence on the relationship between ESN use and awareness of the content of coworkers' messages, and a value of 0.035 for its influence on the relationship between ESN use and awareness of others' connections. Therefore, we conclude that these effects have a medium and large effect size, respectively (Hair et al., 2016). To support the interpretation of these moderation effects, we visualized them in Fig. 3. We used one standard deviation below and one above the mean to respectively represent low and high values of ESN use, as recommended by Aiken et al. (1991) and Dawson (2014).

As part of the moderation analysis, we also conducted a multi-group analysis to see how the paths between ESN use and communication awareness differ in their coefficients and significances depending on employees' management responsibility. The results in Table 3 show that the effects of ESN use on both awareness dimensions are smaller for non-managers than for managers. All relationships were significant.

Finally, we tested for moderated mediation, which "occurs when the strength of an indirect effect depends on the level of some variable, or in other words, when mediation relations are contingent on the level of a moderator" (Preacher et al., 2007, p. 193). As this is the case in our model, we examined whether employees' management responsibility significantly influences the indirect effect of ESN use on the meta-knowledge that is transmitted through communication awareness. To do this, we assessed the index of moderated mediation, which represents "a direct quantification of the linear association between the indirect effect and the putative moderator of that effect" (Hayes, 2015, p. 3). If the index of moderated mediation is significantly different from zero, we can conclude that the indirect effect systematically varies depending on the moderator (Hayes, 2015). Table 4 shows the index of moderated mediation and the 95% confidence intervals. As the confidence intervals do not include the value zero, we can conclude that employees' management responsibility moderates the indirect effect of ESN use on their knowledge of "who knows what" at the 0.05 significance level. Similarly, employees' management responsibility moderates the indirect effect of ESN use on their knowledge of "who knows whom." Therefore, we also found support for H3a/b.

Discussion

Knowledge is a key resource that companies require in order to develop competitive advantages (e.g., Arend et al., 2014; Barney et al., 2001; Nag and Gioia, 2012), but it is usually widely distributed across an organization's employees. Theory on TMS states that meta-knowledge is vital for enabling the effective coordination, transfer, and use of such distributed knowledge (e.g., Argote and Ren, 2012; Griffith et al., 2003; Wegner, 1995). In this research, we have extended the understanding of how ESNs can contribute to the development of meta-knowledge (as an essential ingredient of TMS) in organizations.

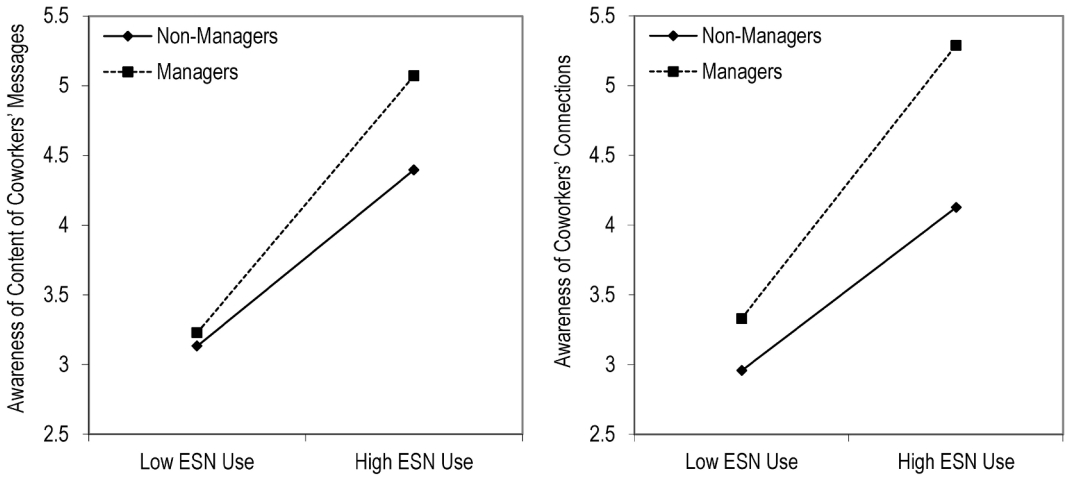


Fig. 3. Interaction plots.

Table 3
Results of multi-group analysis for the moderated paths.

Path	Coefficient		p-Value	
	Non-Managers	Managers	Non-Managers	Managers
ESN Use → Awareness of the Content of Coworkers' Messages	0.325	0.593	0.002	0.000
ESN Use → Awareness of Coworkers' Connections	0.292	0.568	0.004	0.000

Table 4
Results of Moderated Mediation Analysis.

Indirect Path	Index of Moderated Mediation for Management Responsibility	95% Confidence Interval
ESN Use → Knowledge About "Who Knows What"	0.028	[0.005, 0.070]
ESN Use → Knowledge About "Who Knows Whom"	0.063	[0.018, 0.132]

Theoretical contributions

Our research contributes to theory in several ways. First, while Leonardi (2014, 2015) developed CVT by comparing two groups of employees in a financial services institution, our study is the first to apply and test CVT across different organizational contexts. As our results confirm Leonardi's (2014, 2015) findings, our study lends credence to the theory's external validity. More broadly, this adds to the TMS research that is concerned with how meta-knowledge can be developed by supporting the sparse empirical evidence that ESNs indeed help employees to gain meta-knowledge (Leonardi, 2014, 2015). To date, this relationship between ESN use and meta-knowledge had been suggested by several researchers, but sound empirical evidence was missing (Fulk and Yuan, 2013; Leonardi et al., 2013; Majchrzak et al., 2013a; Trier and Richter, 2015).

Second, while CVT has focused on the development of meta-knowledge through communication awareness—a passive and barely goal-oriented process that usually takes time (Leonardi, 2014, 2015)—we show that ESN use can also lead to direct increases in meta-knowledge. Specifically, by considering that ESNs allow users to actively search for content (Oostervink et al., 2016), scan others' profiles (Ellison et al., 2015), and post questions (van Osch et al., 2016), we provide evidence for a direct effect of ESN use on meta-knowledge that has been overlooked so far. This finding contributes to a more holistic view of how ESNs facilitate the creation of meta-knowledge, one that goes beyond the impact of communication awareness. It implies that meta-knowledge not only develops indirectly over time, as suggested by Leonardi (2014, 2015), but can also be developed more immediately through ESN use.

Third, whereas CVT has assumed that all ESN users are equally able to develop meta-knowledge, our study considered individual differences by hypothesizing that managers' ESN use leads to more meta-knowledge than non-managers' use. As our findings show that management responsibility indeed moderates the indirect effect of ESN use on the meta-knowledge transmitted through communication awareness (i.e., the marginal value of using an ESN is higher for managers than for non-managers), we confirm our hypothesis and extend CVT through an individual-differences perspective. In this way, we provide insights into CVT's mostly unexplored boundary conditions and underscore that ESNs' communication visibility affects different individuals differently (Karoui et al., 2015). Beyond CVT, this finding also extends the limited number of studies that have empirically investigated how the outcomes of ESN use vary among different users (e.g., Leidner et al., 2018). Further, on a higher level of abstraction, our answer to RQ3 contributes to the discussion of "individual-based IS strategies," that is, how an individual uses an IS "to carry out and develop his or her role" (Ward, 2012, p. 152). In particular, Wakefield and Wakefield (2016) have argued that considering users' motivations is important for understanding their individual-based IS strategies in the context of social media. Our research supports this view, showing that managers' particular information needs motivate them to allocate more attention to ESNs, which is why they are able to develop more meta-knowledge than non-managers, and this helps them to carry out their managerial role.

Finally, our finding that the marginal value of using ESNs is higher for managers than for non-managers also contributes to the discussion of the extent to which managers can profit from ESNs. To date, studies have suggested that managers are often concerned about the value that can be derived from ESNs (Denyer et al., 2011; Koch et al., 2012; Leidner et al., 2010). Thus, these studies suggest that managers' ESN use might not entail significant benefits. Our findings complement this perspective, showing that managers' ESN use can actually lead to improvements in meta-knowledge that are even greater than those emerging from non-managers' use.

Limitations and future research

This section points to several limitations of our study and discusses avenues for future research. A first limitation concerns our cross-sectional data set, which does not account for changes in employees' ESN use, their communication awareness, or their meta-knowledge over time. Although we controlled for both the time that had elapsed since the ESN's introduction and the beginning of each participant's ESN use, future research could investigate the long-term effects of using an ESN based on longitudinal data sets with lagged or panel data. This might be particularly interesting since prior research points to complex dynamics underlying the development of meta-knowledge as part of a TMS (e.g., Brandon and Hollingshead, 2004; Lewis, 2004).

A second limitation is associated with our measurement of meta-knowledge. As we studied employees across different companies

and industries, we relied on a survey-based measurement of meta-knowledge. Such self-reported measures are subject to a general limitation of all survey-based studies: they are prone to potential biases (e.g., MacKenzie et al., 2011; Podsakoff et al., 2003). However, we took great care to counteract such biases and ensure scale validity. Specifically, we built on an established scale offered by Kanawattanachai and Yoo (2007), conducted a comprehensive pretest among working professionals (N = 155), rigorously filtered our data to exclude inattentive participants, and conducted several procedures for avoiding and testing for common method variance. Despite our efforts to mitigate potential measurement bias, future research should verify our results by using measurement techniques that overcome the subjective nature of self-reported measures associated with survey-based studies.

Moreover, our study's participants might not be representative of all kinds of employees. As all employees surveyed in our study worked in German-speaking countries, our results are limited to this cultural context. Therefore, future research should validate our results using data from different cultural contexts. Likewise, future studies based on larger samples should examine cross-industry differences, as it is possible that industries might differ in terms of how employees communicate with one another.

Several other opportunities for future research also exist. For instance, examining the content that employees communicate in ESNs could be interesting. So far, we do not know how different types of content contribute to the development of meta-knowledge. For example, distinguishing between routine and non-routine communications might be useful, as non-routine communications (such as one-time strategy announcements) may attract special attention and be surrounded by additional context information (compared to many routine communications). The special attention and additional context information might enhance the development of meta-knowledge (Leonardi, 2015). Additionally, the design of recommendation algorithms in ESNs could be an intriguing area to study. If future research succeeds in developing algorithms that support the visibility of the "right" fragments of information needed for the formation of meta-knowledge, this could help organizations to further improve their performance through ESNs.

Beyond these opportunities, future research could contribute to a more holistic understanding of how meta-knowledge evolves by also considering factors originating from contexts other than ESNs. For instance, Jarvenpaa and Majchrzak (2008) have shown that dialogue practices (i.e., how people reflect on and discuss knowledge and its sources) can influence the creation of meta-knowledge in the context of communication channels such as meetings, phone calls, and e-mails. In a similar vein, trust (Ashleigh and Prichard, 2012; Simeonova, 2018) and task constellations (Brandon and Hollingshead, 2004; Zhang et al., 2007) have been emphasized as relevant for the emergence of meta-knowledge in contexts other than ESNs. By considering additional constructs such as these in a holistic research model based on the use of ESNs, the amount of variance in the meta-knowledge that is explained might further increase.

Practical implications

Our study has several practical implications as well. First, our results indicate that ESNs can increase employees' meta-knowledge beyond the particular case of the financial services institution analyzed by Leonardi (2014, 2015). Thus, different companies should be able to profit from ESNs in terms of increased meta-knowledge, which facilitates the coordination, transfer, and use of distributed knowledge (e.g., Argote and Ren, 2012; Griffith et al., 2003; Wegner, 1995) and thus fosters the creation of competitive advantages (e.g., Arend et al., 2014; Barney et al., 2001; Nag and Gioia, 2012). This corresponds to the proposition that social software might have strategic implications for a company's competitive position (von Krogh, 2012). Therefore, companies that have not yet implemented ESNs should consider introducing them to foster their employees' meta-knowledge, and companies that have already implemented ESNs should ensure that their employees use these systems regularly to unleash their benefits.

Second, our results suggest that the development of meta-knowledge using ESNs happens not only indirectly over time, but can also be achieved directly and thus more immediately through goal-directed information seeking. Based on this finding, we argue that ESNs can help in keeping employees' meta-knowledge up to date, even when coworkers and their knowledge change, as is often the case (e.g., Helfat and Peteraf, 2003; Nevo and Wand, 2005). In particular, ESNs allow employees to update their meta-knowledge through goal-directed information seeking and, in this way, enable them to leverage their coworkers' latest subject-specific knowledge. Furthermore, employees' possibility of adapting to changes in coworkers' knowledge through goal-directed information seeking might render it less likely that an ESN is rejected due to the absence of short-term benefits—a challenge that Leonardi (2018) has emphasized. This is particularly important for managers, who might even shut down ESNs if they do not perceive them to be useful in the short term (Leonardi, 2018).

Third, our findings reveal that managers' ESN use contributes more strongly to the development of meta-knowledge than does non-managers' use. Against this background, we suggest that ESNs are well suited to facilitate a company's success. This is because managers' meta-knowledge influences their organizations' strategic actions by enabling them to better consider and leverage the company's subject-specific knowledge within their strategic tasks (e.g., Argote and Ren, 2012; Foss and Jensen, 2018; Rulke et al., 2000). Moreover, if managers recognize these benefits of ESNs, they should be more likely to endorse these systems by encouraging their use by subordinates, further promoting the impact of these systems (Choudrie and Zamani, 2016; Leidner et al., 2010). Hence, organizations should ensure that they motivate their managers to participate in ESNs. To this end, organizations can highlight ESNs' potential to increase managers' meta-knowledge and the importance of such knowledge.

Conclusion

Knowledge is crucial for organizations to gain and maintain competitive advantages (e.g., Arend et al., 2014; Barney et al., 2001; Nag and Gioia, 2012). In today's fast-changing economies, companies must therefore continually advance their knowledge and facilitate its use (e.g., Argote and Miron-Spektor, 2011). However, the coordinated use of knowledge is challenging, because it is usually distributed across hundreds or thousands of employees working in various locations (e.g., Sambamurthy and Subramani,

2005; Tsoukas, 1996). Thus, modern approaches that enable fast access to distributed knowledge are needed. Whereas traditional KMSs are limited in this regard, given employees' reluctance to actively document their knowledge (e.g., Ardichvili et al., 2003; Hahn and Subramani, 2000; Huber, 2001), our study validates and extends CVT in a way that emphasizes the potential of ESNs to overcome this problem. We show that ESNs can foster the direct development of meta-knowledge, on the one hand, and in particular managers' increased meta-knowledge, on the other. Organizations can use the resulting meta-knowledge to improve the coordination, transfer, and use of their subject-specific knowledge (e.g., Argote and Ren, 2012; Griffith et al., 2003; Wegner, 1995). In this way, we highlight that ESNs are well suited to address current knowledge management challenges and can contribute to the knowledge-based creation of competitive advantages.

Appendix A. Measurements

Awareness of Content of Coworkers' Messages (ACM) (based on Leonardi, 2015)	
ACM1	I happen to notice the things colleagues communicate within the ESN.
ACM2	I notice the titles of the documents colleagues are posting within the ESN.
ACM3	I am aware of what colleagues speak about within the ESN.
Awareness of Coworkers' Connections (ACC) (based on Leonardi, 2015)	
ACC1	I happen to notice the names of persons with whom colleagues communicate within the ESN.
ACC2	I notice the names of persons that are mentioned in colleagues' posts within the ESN.
ACC3	I am aware of with whom colleagues are interacting within the ESN.
Community Identification (CI) (based on Chiu et al., 2006)	
CI1	I feel a sense of belonging towards the company I work in.
CI2	I have the feeling of togetherness or closeness in the company I work in.
CI3	I have a strong positive feeling toward the company I work in.
CI4	I am proud to be a member of the company I work in.
ESN Use (USE) (Kügler and Smolnik, 2014)	
USE1	I use the ESN to maintain social relationships with my colleagues.
USE2	I use the ESN to create social relations with my colleagues.
USE3	I use the ESN to get to know people in my organization.
Innovative Climate (IC) (based on van der Vegt et al., 2005)	
IC1	In the department I work in, people are encouraged to come up with innovative solutions to work-related problems.
IC2	The department I work in has established a climate where employees can challenge traditional ways of doing things.
IC3	In my experience, the department I work in learns from the activities of other departments in the company.
IC4	In my experience, the department I work in learns from the activities of other companies.
Knowledge About "Who Knows What" (KWA) (based on Kanawattanachai and Yoo, 2007)	
With regard to the colleagues whose posts are displayed to me within the ESN, …	
KWA1	… I have a good "map" of their talents and skills.
KWA2	… I know which task-related skills and knowledge they possess.
KWA3	… I know who of them have specialized skills and knowledge that is relevant to my work.
Knowledge About "Who Knows Whom" (KWO) (based on Kanawattanachai and Yoo 2007)	
With regard to the colleagues whose posts are displayed to me within the ESN, …	
KWO1	… I have a good "map" of their contacts to other colleagues.
KWO2	… I know which contacts they have to other colleagues.
KWO3	… I know with which other colleagues they are in contact.
Management Responsibility (MGM)	
MGM	Do you possess managerial responsibilities in your company?

Appendix B. Measurement quality

	ACM	ACC	MGM	KWA	KWO	USE	AGE	CI	ECU	EMP	EOI	EPS	ESU	EUI	EUP	IC	LOC	G	TEN
M	3.73	3.59	0.34	3.58	3.27	3.14	3.61	4.75	4.25	5.30	4.98	4.19	8.13	3.59	3.29	4.48	2.59	1.35	3.60
SD	1.42	1.48	0.48	1.41	1.53	1.64	1.04	1.47	1.54	1.22	1.66	2.01	2.27	1.91	1.74	1.32	0.55	0.48	1.30
CA	0.857	0.878	–	0.896	0.946	0.908	–	0.940	–	–	–	–	–	–	–	0.850	–	–	–
CR	0.913	0.925	–	0.935	0.965	0.942	–	0.956	–	–	–	–	–	–	–	0.896	–	–	–

(M = mean, SD = standard deviation, CA = Cronbach's alpha, CR = composite reliability, ACM = awareness of the content of coworkers' messages, ACC = awareness of coworkers' connections, MGM = management responsibility, KWA = knowledge about "who knows what", KWO = knowledge about "who knows whom", USE = ESN use, CI = community identification, ECU = coworkers' average ESN use, EMP = company's number of employees, EOI = time passed since ESN adoption, EPS = time passed since individual ESN use started, ESU = share of company's employees intended to use the ESN, EUI = interactions with other ESN users beyond the system, EUP = number of other ESN users working in close proximity, IC = innovative climate, LOC = company's geographical distribution, G = gender, TEN = job tenure).

Appendix C. PLS item factor loadings and cross loadings

	ACM	ACC	MGM	KWA	KWO	USE	AGE	CI	ECU	EMP	EPS	ESU	EOI	EUI	EUP	IC	LOC	G	TEN
ACM1	**0.858**	0.591	0.042	0.364	0.390	0.440	0.115	0.077	0.039	0.067	0.054	0.011	−0.046	0.151	−0.028	0.099	0.110	−0.001	0.108
ACM2	**0.876**	0.555	0.053	0.435	0.435	0.418	0.084	0.073	0.194	−0.037	0.103	0.041	−0.038	0.280	0.113	0.154	0.010	0.021	0.069
ACM3	**0.912**	0.630	−0.011	0.441	0.479	0.481	0.027	0.096	0.154	0.010	0.013	0.032	−0.108	0.226	0.082	0.136	−0.012	0.060	0.043
ACC1	0.591	**0.889**	0.035	0.339	0.482	0.392	0.052	0.163	0.115	0.118	0.060	−0.029	−0.027	0.087	0.093	0.135	0.090	0.000	0.091
ACC2	0.609	**0.887**	0.081	0.343	0.467	0.379	0.085	0.082	0.238	0.004	0.121	0.043	−0.016	0.095	0.116	0.122	0.009	−0.041	0.096
ACC3	0.606	**0.912**	0.108	0.496	0.553	0.456	0.078	0.128	0.235	0.108	0.091	−0.077	−0.018	0.199	0.090	0.125	0.050	−0.007	0.099
MGM	0.030	0.085	**1.00**	0.186	0.255	0.138	0.222	−0.017	0.080	−0.045	0.164	−0.191	0.103	0.221	0.140	−0.039	−0.061	−0.174	0.170
KWA1	0.440	0.430	0.209	**0.897**	0.564	0.529	0.106	0.135	0.301	0.024	0.168	−0.034	0.086	0.383	0.298	0.262	0.092	−0.079	0.107
KWA2	0.391	0.377	0.170	**0.921**	0.520	0.459	0.055	0.153	0.272	−0.030	0.079	0.075	−0.007	0.411	0.282	0.202	0.028	0.070	0.034
KWA3	0.448	0.401	0.131	**0.911**	0.569	0.511	0.111	0.143	0.325	−0.065	0.172	0.062	0.043	0.461	0.281	0.290	0.072	0.020	0.037
KWO1	0.488	0.544	0.209	0.570	**0.933**	0.490	0.077	0.139	0.276	0.005	0.126	−0.091	0.025	0.338	0.310	0.136	0.045	−0.048	0.041
KWO2	0.468	0.521	0.264	0.576	**0.960**	0.535	0.055	0.093	0.262	0.002	0.069	−0.079	−0.042	0.346	0.291	0.134	−0.016	−0.057	0.046
KWO3	0.453	0.535	0.254	0.584	**0.957**	0.519	0.073	0.080	0.274	−0.034	0.094	−0.056	0.004	0.349	0.324	0.101	−0.032	−0.020	0.072
USE1	0.403	0.378	0.048	0.497	0.455	**0.896**	−0.016	0.189	0.246	−0.059	0.098	−0.031	−0.018	0.329	0.226	0.197	0.014	0.032	0.020
USE2	0.498	0.451	0.140	0.545	0.514	**0.967**	0.052	0.145	0.241	−0.041	0.091	−0.039	−0.055	0.342	0.196	0.223	0.041	0.006	0.057
USE3	0.489	0.432	0.186	0.478	0.523	**0.893**	0.097	0.150	0.215	0.010	0.106	−0.032	−0.029	0.271	0.114	0.226	0.147	−0.007	0.069
AGE	0.083	0.080	0.222	0.102	0.072	0.051	**1.00**	−0.040	0.081	−0.010	0.305	−0.022	0.224	−0.023	−0.067	−0.013	−0.031	−0.289	0.571
CI1	0.103	0.189	0.017	0.164	0.134	0.155	0.032	**0.930**	0.077	0.081	−0.057	−0.035	−0.029	0.075	0.131	0.527	0.138	−0.040	0.047
CI2	0.077	0.107	0.004	0.117	0.112	0.184	−0.040	**0.886**	0.031	0.067	−0.131	0.001	−0.093	0.116	0.123	0.558	0.125	−0.010	−0.102
CI3	0.093	0.085	−0.030	0.147	0.080	0.155	−0.058	**0.939**	0.047	0.030	−0.154	0.105	−0.096	0.163	0.174	0.594	0.083	0.039	−0.128
CI4	0.061	0.101	−0.074	0.143	0.057	0.150	−0.120	**0.922**	0.052	0.060	−0.130	0.066	−0.082	0.104	0.142	0.529	0.088	0.005	−0.090
ECU	0.149	0.220	0.080	0.331	0.285	0.254	0.081	0.059	**1.00**	−0.075	0.330	0.059	0.251	0.239	0.213	0.043	−0.069	0.094	0.054
EMP	0.014	0.088	−0.045	−0.026	−0.010	−0.032	−0.010	0.067	−0.075	**1.00**	0.005	−0.065	0.071	−0.193	−0.150	0.028	0.511	−0.070	0.106
EPS	0.063	0.101	0.164	0.156	0.101	0.107	0.305	−0.121	0.330	0.005	**1.00**	0.058	0.780	0.071	−0.038	−0.119	0.058	−0.099	0.412
ESU	0.032	−0.027	−0.191	0.037	−0.079	−0.037	−0.022	0.029	0.059	−0.065	0.058	**1.00**	0.115	−0.054	0.010	0.036	0.028	0.074	−0.073
EOI	−0.074	−0.023	0.103	0.046	−0.004	−0.038	0.224	−0.076	0.251	0.071	0.780	0.115	**1.00**	−0.022	−0.072	−0.076	0.139	−0.038	0.222
EUI	0.250	0.146	0.221	0.461	0.362	0.341	−0.023	0.120	0.239	−0.193	0.071	−0.054	−0.022	**1.00**	0.446	0.173	−0.040	0.007	−0.017
EUP	0.066	0.111	0.140	0.316	0.325	0.193	−0.067	0.153	0.213	−0.150	−0.038	0.010	−0.072	0.446	**1.00**	0.185	−0.128	0.035	−0.052
IC1	0.128	0.119	−0.023	0.221	0.125	0.155	−0.057	0.649	0.078	0.052	−0.144	−0.011	−0.094	0.119	0.147	**0.824**	0.198	0.027	−0.099
IC2	0.054	0.021	−0.083	0.171	−0.040	0.113	0.034	0.560	0.030	0.056	−0.143	0.109	−0.056	0.035	0.162	**0.767**	0.191	−0.063	−0.059
IC3	0.163	0.173	−0.054	0.274	0.135	0.205	−0.030	0.437	0.065	0.059	−0.092	0.041	−0.045	0.144	0.191	**0.891**	0.187	0.034	−0.096
IC4	0.103	0.095	0.010	0.224	0.132	0.270	0.042	0.399	−0.043	−0.070	−0.042	0.019	−0.058	0.226	0.114	**0.817**	0.081	−0.033	−0.043
LOC	0.037	0.056	−0.061	0.072	−0.001	0.075	−0.031	0.121	−0.069	0.511	0.058	0.028	0.139	−0.040	−0.128	0.195	**1.00**	−0.061	−0.019
G	0.032	−0.017	−0.174	0.002	−0.044	0.010	−0.289	−0.006	0.094	−0.070	−0.099	0.074	−0.038	0.007	0.035	0.003	−0.061	**1.00**	−0.294
TEN	0.081	0.106	0.170	0.066	0.056	0.054	0.571	−0.061	0.054	0.106	0.412	−0.073	0.222	−0.017	−0.052	−0.094	−0.019	−0.294	**1.00**

(ACM = awareness of the content of coworkers' messages, ACC = awareness of coworkers' connections, MGM = management responsibility, KWA = knowledge about "who knows what", KWO = knowledge about "who knows whom", USE = ESN use, CI = community identification, ECU = coworkers' average ESN use, EMP = company's number of employees, EOI = time passed since ESN adoption, EPS = time passed since individual ESN use started, ESU = share of company's employees intended to use the ESN, EUI = interactions with other ESN users beyond the system, EUP = number of other ESN users working in close proximity, IC = innovative climate, LOC = company's geographical distribution, G = gender, TEN = job tenure).

Appendix D. Construct correlations

	ACM	ACC	MGM	KWA	KWO	USE	AGE	CI	ECU	EMP	EOI	EPS	ESU	EUI	EUP	IC	LOC	G	TEN
ACM	**0.882**																		
ACC	0.671	**0.896**																	
MGM	0.030	0.085	**1.00**																
KWA	0.470	0.444	0.186	**0.910**															
KWO	0.494	0.561	0.255	0.607	**0.950**														
USE	0.506	0.459	0.138	0.551	0.542	**0.919**													
AGE	0.083	0.080	0.222	0.102	0.072	0.051	**1.00**												
CI	0.093	0.139	−0.017	0.158	0.109	0.174	−0.040	**0.920**											
ECU	0.149	0.220	0.080	0.331	0.285	0.254	0.081	0.059	**1.00**										
EMP	0.014	0.088	−0.045	−0.026	−0.010	−0.032	−0.010	0.067	−0.075	**1.00**									
EOI	−0.074	−0.023	0.103	0.046	−0.004	−0.038	0.224	−0.076	0.251	0.071	**1.00**								
EPS	0.063	0.101	0.164	0.156	0.101	0.107	0.305	−0.121	0.330	0.005	0.780	**1.00**							
ESU	0.032	−0.027	−0.191	0.037	−0.079	−0.037	−0.022	0.029	0.059	−0.065	0.115	0.058	**1.00**						
EUI	0.250	0.146	0.221	0.461	0.362	0.341	−0.023	0.120	0.239	−0.193	−0.022	0.071	−0.054	**1.00**					
EUP	0.066	0.111	0.140	0.316	0.325	0.193	−0.067	0.153	0.213	−0.150	−0.072	−0.038	0.010	0.446	**1.00**				
IC	0.148	0.142	−0.039	0.279	0.130	0.234	−0.013	0.597	0.043	0.028	−0.076	−0.119	0.036	0.173	0.185	**0.826**			
LOC	0.037	0.056	−0.061	0.072	−0.001	0.075	−0.031	0.121	−0.069	0.511	0.139	0.058	0.028	−0.040	−0.128	0.195	**1.00**		
G	0.032	−0.017	−0.174	0.002	−0.044	0.010	−0.289	−0.006	0.094	−0.070	−0.038	−0.099	0.074	0.007	0.035	0.003	−0.061	**1.00**	
TEN	0.081	0.106	0.170	0.066	0.056	0.054	0.571	−0.061	0.054	0.106	0.222	0.412	−0.073	−0.017	−0.052	−0.094	−0.019	−0.294	**1.00**

(ACM = awareness of the content of coworkers' messages, ACC = awareness of coworkers' connections, MGM = management responsibility, KWA = knowledge about "who knows what", KWO = knowledge about "who knows whom", USE = ESN use, CI = community identification, ECU = coworkers' average ESN use, EMP = company's number of employees, EOI = time passed since ESN adoption, EPS = time passed since individual ESN use started, ESU = share of company's employees intended to use the ESN, EUI = interactions with other ESN users beyond the system, EUP = number of other ESN users working in close proximity, IC = innovative climate, LOC = company's geographical distribution, G = gender, TEN = job tenure).

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