THE BLESSING OF GIVING: KOWLEDGE SHARING AND KNOWLEDGE SEEKING IN ENTERPRISE SOCIAL NETWORKS

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Research

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Abstract

Whereas more and more companies use Enterprise Social Networks (ESN) for internal knowledge management, there is still a lack of understanding how employees communicate their knowledge in ESN to support their colleagues. We approach this gap by analysing users' roles and knowledge exchanging behaviours in a rich data set comprising more than two years of ESN usage. We identify three user roles, namely givers, takers, and matchers, regarding knowledge sharing and seeking behaviour and analyse their position in the organisational hierarchy. By applying means of Social Network Analysis, we contribute to a clearer picture of the significant role of givers and confirm findings of other studies that the majority of users behave as takers. Generally, our findings help to come to a more refined understanding of ESN usage and its role in knowledge practices.

Keywords: Enterprise Social Network, Social Network Analysis, Knowledge sharing, Knowledge seeking.

1 Introduction

In recent years, many organisations have started implementing Enterprise Social Networks (ESN) to foster internal collaboration, communication, and knowledge-sharing (Aral et al., 2013; von Krogh, 2012). According to a recent study the worldwide ESN market revenue is expected to grow from $1.24 billion in 2013 to $3.5 billion by 2018 (Thompson, 2014). Many organisations have recognised the potential of ESN with respect to the creation of competitive advantage by serving as a driving force to build effective and efficient business (Riemer et al., 2015a; Turban et al., 2011) as well as the generation of social capital within organisations, for instance by enhancing an employee's reputation in the company (Riemer et al., 2015a; Wasko and Faraj, 2005). At the same time, there is an increasing demand to better understand the role and impact of these social technologies in knowledge practices like information seeking, knowledge sharing or expert finding (Bharadwaj et al., 2013; Herzog et al., 2013; Richter et al., 2013a; Richter et al., 2013b).

In this line of argument, there are calls to research different actor roles in ESN usage (Trier and Richter, 2015) to better understand the potential of ESN for knowledge transfer and the network structures that influence, for instance, information dissemination (Chau and Xu, 2012) and contribution behaviour (Zhang and Wang, 2012). However, social networking behaviour in ESN with respect to employ-

ees' knowledge practices, i.e. how users share and seek knowledge in ESN, is still widely unexplored. More specifically, analysing the users' reciprocities in terms of giving and taking knowledge within an ESN and their structural characteristics have not yet been subject of academic discussion.

Therefore, our objective in this paper is to investigate the knowledge exchanging behaviour of users in ESN. Based on a Social Network Analysis approach, we classify users with respect to their amount of sharing and seeking knowledge. Moreover, we analyse the structural characteristics of user groups in each category. In so doing, we consider two aspects for characterising the user categories: knowledge sharing and seeking behaviour in a knowledge base (i.e. wiki) as well as communication activities and connectedness between users. In so doing, we address the following research questions: 1) How can users be classified with respect to their knowledge exchanging behaviour in ESN? 2) How can users in the different categories be distinguished with respect to their structural position in the ESN and in the organisational hierarchy?

Our results indicate that the users who outstandingly contribute knowledge for other users in the ESN without receiving respective return are amongst the most connected users in terms of writing messages to and having social relationships with other users. We also find that the allocation of the users in the different categories changes within hierarchical levels which implies a change in some users' characteristics over time, depending on how long he or she is within one level.

From a theoretical perspective, our findings contribute to the development of a more refined understanding of ESN usage in knowledge-intensive work. From a practical point of view, our insights can help organisations to better understand the social networking behaviour of their employees and thereupon take measures to improve in knowledge exchange. Moreover, we suggest to and illustrate how to refine methodology, namely "Absolute Distance Measure" and "Relative Distance Measure" to identify user groups in ESN based on their knowledge sharing behaviour.

The remainder of this paper is structured as follows: In Section 2, we provide an overview of the existing literature on knowledge sharing and knowledge seeking in ESN. Section 3 describes the research method, the case setting, and the data collection and analysis process. In Section 4, we present the findings of our analysis of the dataset. In Section 5, we discuss implications and limitations of our work and provide directions for further research. Finally, we conclude with a brief summary.

2 Theoretical Background

2.1 Enterprise Social Networks

In recent years, organisations discovered the growing need of their employees to be connected through an internal network in terms of information exchange, easier expert finding, ideation or team coordination (DiMicco et al., 2008; Thom-Santelli et al., 2011). ESN can facilitate easy corporation-wide knowledge exchange without being subject to departmental or geographic boundaries (Aoun and Vatanasakdakul, 2012) and contribute to more open and participative communication practices (Denyer et al., 2011; Holtzblatt et al., 2010; Ip and Wagner, 2008). Meanwhile ESN are a crucial means for companies to stay competitive (Aral et al., 2013).

The increasing usage of ESN also led to an increasing scholarly interest. Prior research addressed amongst others the adoption of ESN in organisations (Overfeld et al., 2012), the development of relationships between employees (DiMicco et al., 2009; Zhang and Wang, 2012), and the potential benefits of ESN in the corporate realm, including expert finding, problem solving, work coordination, and opinion sharing (Brzozowski, 2009; Richter and Riemer, 2013; Thom-Santelli et al., 2011). Researchers also showed that ESN usage does not only affect company performance, but also the career paths of employees. For instance, Wu (2013) revealed that ESN transfer the network positions of employees over time and found significant correlations with job performance and job security. In addition, the emergent network structures of ESN can transform power relations and hierarchies (Bobsin and Hoppen, 2013). In this context, research shows that formal organisational hierarchies (Behrendt et al.,

2015) and the level of communication activity (Riemer et al., 2015b; Stieglitz et al., 2014) significantly influence ESN networking behaviour. Muller et al. (2012) examined how diversity influences collaboration, teaming, and innovation, and Matthews et al. (2013) aimed at understanding how leaders enhance the value of their communities. Other research (Herzog et al., 2015; Herzog et al., 2013; Richter et al., 2013a) analysed how the use of these technologies can be evaluated.

2.2   Knowledge sharing and seeking in Enterprise Social Networks

Sharing and demanding with others is deeply rooted in human nature. Every time individuals interact with others, they have to decide within the two extremes of whether to claim as much value as possible or contribute value without expecting anything in return (Grant, 2014). Over the past decades, social scientists have discovered that people differ tremendously in their preferences for reciprocity – their desired mix of giving and taking. Grant (2014) classifies people as givers (i.e. people who give more than they get), takers (i.e. people who get more than they give) and matchers (i.e. people who try to trade evenly). This framework helps us to differentiate between people with preferences for sharing knowledge or seeking knowledge and can serve as an important basis of our study.

There is an increasing demand to understand the behaviour of users in ESN (Koo et al., 2011; Kuegler and Smolnik, 2014), especially in respect of information diffusion (Stieglitz et al., 2014) and knowledge exchange in ESN (Ortbach and Recker, 2014; Recker and Lekse, 2015), since ESN influence information dissemination (Chau and Xu, 2012) and contribution behaviour (Zhang and Wang, 2012). In this context, research focuses in particular on exploring the individuals' rationales behind online knowledge sharing (e.g., Phang et al., 2009; Schroer and Hertel, 2009) and seeking (e.g., Kankanhalli et al., 2005; Wasko and Faraj, 2005; Zhang and Wang, 2012). Further studies investigate the relation between online sharing and seeking knowledge (Phang et al., 2009; Yan and Davison, 2013).

Concerning knowledge exchanging behaviour in networks, Wasko and Faraj (2005) analyse why some users contribute more than others. They identify four reasons: 1) users perceive an enhancement of their professional reputation, 2) they enjoy helping others, 3) they are structurally embedded in the network, and 4) they have experience which is worth sharing with others. In this context, Kankanhalli et al. (2005) find that knowledge self-efficacy and enjoyment in helping others significantly impact knowledge contribution to electronic repositories whereas the loss of knowledge power and image do not appear to have any impact. Moreover, a person's position in the network influences the decisions about his or her total contribution and also the allocation of his or her efforts on the platform (Zhang and Wang, 2012). Referring to the example of Wikipedia, Schroer and Hertel (2009) examine predictors of contributors' engagement and satisfaction and show that satisfaction of contributors is determined by perceived benefits, identification with the community, and task characteristics, whereas their engagement depends on their tolerance for opportunity costs and the experienced characteristics of their tasks which again is partially mediated by intrinsic motivation. Other studies argue that collaborative norms (Bock et al., 2006), identity management (Ma and Agarwal, 2007), and knowledge validation processes (Durcikova and Gray, 2009) also influence knowledge contribution. Prior research has shown that approximately 90% of online community members take over a passive role – they are so-called lurkers (e.g., Katz, 1998; Mason, 1999). Nonnecke and Preece (2000) found that lurking varies and can range from as much as 99% to a low of 1%. In another study they revealed that there are many reasons for lurking in online social communities (e.g. reluctance or usability problems) but many lurkers are no selfish free-riders (Nonnecke and Preece, 2001). Schneider et al. (2013) draw the connection between epistemic curiosity as personality trait and emotional-motivational state to lurkers' contribution behaviour in online communities and find that the psychology of curiosity generally holds great promise for research on online communities in information systems. Understanding users' knowledge exchanging behaviour is especially important with respect to ESN, as users largely differ in terms of their connectivity (e.g. number of friends), their communication activity (e.g. number of messages) as well as their frequency, volume, and quality of the user-generated content (Trusov et al.,

2010). Trier and Richter (2015) identify two different and interrelated actor roles as an explanation for uneven levels of user contributions to ESN. They call them discourse drivers and information retrievers as two mutually interdependent actors which together shape the dynamics of the online interaction. Moreover, Berger et al. (2014) find that users who add value to the organisation by sharing their knowledge in the ESN are amongst the best connected users and thus enable a more effective and rapid exchange of information between different working groups.

Research focussing on knowledge seeking on platforms addresses either knowledge seeking behaviour of individuals (Bock et al., 2006; Kankanhalli et al., 2005) or its relation to knowledge sharing (Phang et al., 2009; Yan and Davison, 2013). For instance, Kankanhalli et al. (2005) examine electronic knowledge repositories (EKR) that serve the purpose of storing codified knowledge for future reuse within companies and investigate potential antecedents to EKR usage for knowledge seeking. Their results reveal that EKR usage for knowledge seeking is influenced by perceived output quality, resource availability, and incentives. Moreover, knowledge seeking and knowledge contribution in online communities are influenced by different aspects of usability and sociability (Phang et al., 2009). For instance, ease of use and system reliability are considered as more important for usability when individuals seek knowledge, whereas tracking fulfilment is more important for usability when individuals contribute knowledge. In addition, Yan and Davison (2013) analyse the mediating role of an individual's intrinsic motivation for the behavioural transfer from knowledge seeking to knowledge contribution in knowledge management in Web 2.0 applications.

From a management perspective it is essential to know which users outstandingly contribute their knowledge, allowing others to benefit from their experience, and which users primarily acquire knowledge without contributing much themselves. Therefore, the aim of this paper is to 1) propose two methods to classify users based on their knowledge sharing and seeking behaviour as givers, takers, and matchers (cf. Grant, 2014) and 2) investigate their structural characteristics as well as their position in the formal organisational hierarchy.

3 Research Method

3.1 Setting

We approach our research objective with the case of the medical service unit (MSU) of the German Armed Forces (Deutsche Bundeswehr). MSU is composed of, amongst others, 2,700 medical officers and 1,600 trainee medical officers for military medicine, military pharmacy, veterinary medicine, and dental medicine. They are distributed amongst five major military hospitals in Germany, 37 German universities offering medical studies, and 200 other facilities. In 2009, MSU decided to implement an ESN, MSU-Net, with the following aims: (1) encouraging knowledge transfer and collaborative learning among colleagues, (2) creating a collaborative knowledge base, (3) improving the quality of education as well as the in-service training of new colleagues, and (4) strengthening the corporate identity and the networking of the employees. MSU-Net, which was launched in November 2010, enables the employees to become virtual friends, write messages to other users, and post blog entries which can be commented by others. To foster the knowledge transfer, MSU-Net also includes a knowledge base to which employees contribute publically available (scientific) content.

A preliminary analysis of the dataset showed a high amount of information available about the users' communication (i.e. written and received direct messages) and knowledge exchange behaviours (i.e. written, modified and read articles in the knowledge base) so that the dataset is ideal for our research objective. As the activities in the knowledge base deliver us information about users' write accesses (i.e. written and modified articles) and read accesses (i.e. read articles), we can see who shares and who seeks knowledge. This enables us to classify the users as people who predominantly give knowledge, people who predominantly take knowledge, or people who give and take to a relatively balanced extent.

3.2 Data collection and preparation

The dataset contains the users' military ranks which follow the formal organisational hierarchies of the German Armed Forces. In our case, the military hierarchies are divided into six levels: enlisted soldier (level 1), non-commissioned officer (NCO) (level 2), officer candidate (level 3), officer (level 4), staff officer (level 5), and general (level 6). During data export, all personal information (such as user names) was removed to guarantee confidentiality. The dataset, referring to the time period between November 2010 and February 2015, was supplied in table format. It contains, amongst others, information about each user's confirmed contact requests to other users (in the following referred to as "social relationships"), direct messages exchanged with other users (written and received messages) as well as written, modified, and read articles in the knowledge base in MSU-Net. Of the 2,941 users, 1,732 users have at least one social relationship (total number of social relationships: 7,679). Furthermore, the data contains 19,571 direct messages between two users. Read accesses as well as write accesses in the knowledge base were provided on a monthly base ranging from January 2013 to March 2015. 2,034 users were active in the knowledge base: among those, 114 users wrote at least one article, 152 users made at least one article modification. A total of 1,041 articles were authored, 5,577 modifications were undertaken. Altogether, we observe a total of 6,618 write accesses and 91,082 read accesses.

3.3 Data analysis

To classify the users of the ESN as givers, takers, or matchers we focus on their knowledge sharing and seeking behaviour in the knowledge base. Indeed, the knowledge base in MSU-Net was created to support the knowledge exchange among employees. On the one hand, it allows users to write and modify articles to share their knowledge with others; on the other hand it allows users to read articles from other users to acquire knowledge. Against this background, those users of MSU-Net are regarded as givers who outstandingly share their knowledge in the knowledge base thus enabling others to gain more knowledge. Takers are regarded as users who outstandingly seek knowledge to their own benefits, whereas matchers share and seek knowledge to a relatively balanced extent. To assess each user's amount of knowledge shared and acquired in the knowledge base, we focus on his or her number of write accesses and read accesses in total and for each of the observed periods (i.e. 2013, 2014 and 2015), respectively. On this basis, we classify them as givers (users whose relative amount of write to read accesses is comparably high), takers (users whose relative amount of write to read accesses is comparably low), and matchers (users with a comparably balanced amount of write and read accesses). Write accesses potentially reach multiple users whereas read accesses refer to only one single user. Indeed, the total number of read accesses is much higher compared to the total number of write accesses. Therefore, for further analyses we use a factor to weight the number of write accesses to enable 1:1 comparisons. For 2014, for instance, the total number of read accesses is 47,067 and the total number of write accesses is 3,001 and we used the factor 15.68 (= 47,067 / 3,001) for weighting. We define a "pure giver" as a user with no read but one or more write accesses and a "pure taker" as a user with no write but one or more read accesses. A perfect matcher is characterised by an equal number of weighted write and read accesses.

Based on his or her number of read accesses and weighted write accesses each user can be represented in a Cartesian coordinate system (cf. Figures 1 and 2). The x-axis refers to the user's number of read accesses; the y-axis refers to his or her number of weighted write accesses. Thereby, pure givers and pure takers are directly located on the y-axis or the x-axis, respectively; perfect matchers can be found on the bisectrix. In the following, we propose two different methods to classify a user as giver, taker, or matcher. Methodically, both methods are founded on users' Euclidean distance to the lines representing pure givers (cf. y-axis), pure takers (cf. x-axis), and perfect matchers (cf. bisectrix) in this Cartesian coordinate system.

The first method is based on whether a user u is closest to being a perfect matcher, to being a pure giver, or to being a pure taker, respectively. Therefore, we determine his or her Euclidean distance to

the bisectrix (see $d_M(u)$ in Figure 1), the y-axis (see $d_G(u)$ in Figure 1) and the x-axis (see $d_T(u)$ in Figure 1) and classify the user according to the minimum absolute distance. Thus, in the following this method is referred to as "Absolute Distance Measure". Figure 1 provides illustrative examples of users classified as giver, taker, and matcher, respectively.
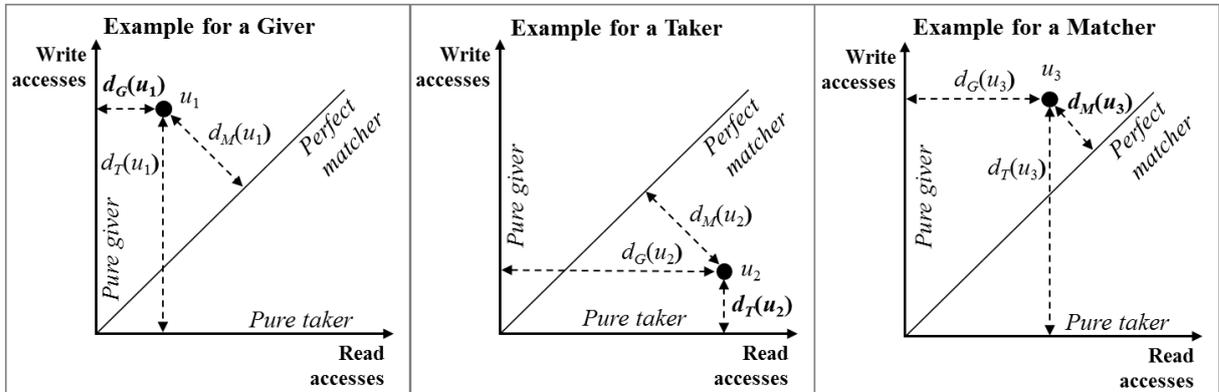

Figure 1.   "Absolute Distance Measure" to classify users as givers, takers, or matchers.

The "Absolute Distance Measure" allows to classify a user independent from other users. To classify users as givers, takers, or matchers considering the knowledge exchanging behaviour of the other users of the ESN in comparison as well, we propose a second method, in the following referred to as "Relative Distance Measure". Thereby, we calculate each user's Euclidean distance (see $d_M(u)$ in Figure 2) to a perfect matcher in relation to his or her respective greatest possible Euclidean distance to a perfect matcher (see $d_{max}(u)$ in Figure 2). Here, $d_{max}(u)$ corresponds to the Euclidean distance of a perfect matcher to a pure giver or pure taker lying on a perpendicular to the bisectrix through user u. Putting $d_M(u)$ in relation to $d_{max}(u)$ allows us to compare users with high and low values of weighted write or read accesses. We then calculate the average of these relative distances. In our case, due to the large number of pure takers, this results in a value of 0.958 for all periods aggregated, 0.967 for 2015, 0.969 for 2014, and 0.953 for 2013. Based on this average and the respective user's individual relative distance to the perfect matcher, he or she is then classified as giver, taker, or matcher accordingly. Thereby, users whose individual relative distance differs less than average from the perfect matcher are classified as matchers; users whose individual relative distance differs more than average from the perfect matcher are classified as givers (more weighted write than read accesses) or takers (more read than weighted write accesses), respectively. Figure 2 provides illustrative examples of users classified as giver, taker, and matcher, respectively.
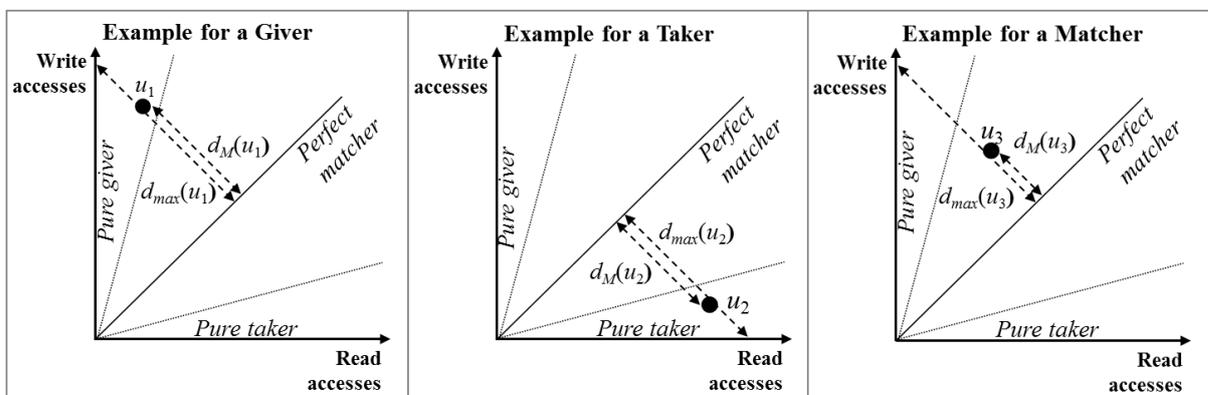

Figure 2.   "Relative Distance Measure" to classify users as givers, takers, or matchers.

We applied both methods to all users in our dataset who participated (i.e. they had read and/or write accesses) in the knowledge base. The reason is that users who are only enrolled in the ESN without reading or writing in the knowledge base would influence the resulting allocations and finally distort our findings. Therefore, we conduct our further analyses focussing on the participating users only (2,034 for all periods, 690 in 2015, 1,673 in 2014 and 1,066 in 2013).

To investigate the structural characteristics of givers, takers, and matchers in ESN, we apply Social Network Analysis (SNA) (Wasserman and Faust, 2009). SNA was prior used in IS research to analyse for instance users' social networking behaviour in OSN and ESN (Behrendt et al., 2015; Krasnova et al., 2010), social capital as a result of the usage of OSN (e.g., Ellison et al., 2007), and the characteristics of key users in ESN (Berger et al., 2014). According to Freeman (2000, p. 350), SNA "involves theorizing, model building, and empirical research focused on uncovering the patterning of links among actors" by, for instance, quantifying the centrality of nodes within a network. In this context, there exists a variety of centrality measures, whereby the most common centrality measures are degree centrality, closeness centrality, and betweenness centrality (Freeman, 1979) as well as eigenvector centrality (Bonacich, 1972). Degree centrality assumes that a node with many direct connections to other nodes is central to the network. Closeness centrality expands the definition of degree centrality by focusing on how close a node is to all other nodes in the network. These nodes can, for instance, contribute to a fast exchange of ideas and information in the network. The idea behind betweenness centrality is that a node which is on many shortest paths between other nodes is central to the network. Users with high betweenness centrality are supposed to control the information flows in networks. Eigenvector centrality extends the logic of degree and closeness centrality and incorporates a node's connectivity in the whole network. Here, a node is more central to the network, if it is connected to other central nodes.

ESN can be represented as a graph with a set of nodes (users) and a set of edges (ties) linking pairs of nodes (Wasserman and Faust, 2009). The edges can be either directed or undirected and represent either social links like social relationships (social graph) or communication activities like messages among the users (activity graph) (Adamic and Adar, 2003; Bampo et al., 2008; Heidemann et al., 2010). We ground our research on both graphs in order to get profound insights into the structural characteristics of givers, takers and matchers in ESN. The social graph representing the social relationships comprises 2,941 nodes and 7,679 undirected edges (confirmed contact requests). The activity graph is inferred by the direct messages exchanged between a pair of users. It consists of 2,941 nodes and 4,830 directed and weighted edges (messages sent between two users). For the network analysis, we use Gephi (https://gephi.org/) to calculate degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality for each node of the social graph as well as of the activity graph. In addition, to gain deeper insights into the characteristics of givers, takers, and matchers with respect to their participation in the knowledge base, we also analyse their average numbers of written or modified articles (write accesses) and read articles (read accesses).

Finally, we also investigate the hierarchical positions of givers, takers, and matchers based on their level in the formal hierarchy of the organisation. To make our results transferable to a non-military organisational setting, we categorise levels 1 and 2 as lower hierarchical level, 3 and 4 as middle hierarchical level, and 5 and 6 as higher hierarchical level and compare them to common organisational roles based on the Administrative Order on the Position of the Military Superior (Bundesministerium der Verteidigung, 1956). Against this background, level 1 is the lowest level where the persons have no authority over others, whereas persons in level 2 can be compared to team leaders who give commands to level 1 employees with decision making power only in their own team. Level 3 can be compared to managers who lead a collection of teams (e.g., a department) and level 4 to business unit managers with responsibility for the management, training and staffing of a business unit or subdivision and authority over all lower levels of hierarchy. Level 5 can be compared to executive directors who are typically not involved in the daily business but lead divisions. They have authority over all lower levels and decide on strategic aspects. Level 6 can finally be compared to board members in

the top management that have authority over all lower levels. They fulfil representative and strategic tasks covering the entire organisation.

4 Results

4.1 Classification of givers, takers, and matchers

In this subsection, we classify the users of the ESN as givers, takers or matchers. Table 1 shows the resulting allocations of givers, takers and matchers for the Absolute Distance Measure as well as for the Relative Distance Measure and illustrates that for both measures the majority of the users are classified as takers. This holds for each of the observation periods.

Category	**2015** ($n = 690$)		**2014** ($n = 1,673$)		**2013** ($n = 1,066$)	
	Distance Measure		**Distance Measure**		**Distance Measure**	
	Absolute	**Relative**	**Absolute**	**Relative**	**Absolute**	**Relative**
Givers	3% (19)	1% (4)	1% (22)	0% (0)	2% (22)	0% (0)
Takers	95% (655)	95% (654)	95% (1,595)	95% (1,586)	93% (995)	92% (979)
Matchers	2% (16)	4% (32)	4% (56)	5% (87)	5% (49)	8% (87)

Table 1.   Allocation of givers, takers, and matchers.

Similar results can be observed for the aggregation of all periods (cf. Table 2): only 2% or 0% of all users are classified as givers, while more than 90% of all users are takers. The Bowker-Test (Bowker, 1948) reveals that the results of both methods, the "Absolute Distance Measure" and the "Relative Distance Measure", do not differ significantly ($\alpha = 0.05$). Therefore, as well as for reasons of clarity and the page length restriction we base our further analyses on users' classification based on the "Absolute Distance Measure" and for the aggregation of all periods.

Category	**Absolute Distance Measure**	**Relative Distance Measure**
Givers	2% (30)	0% (3)
Takers	94% (1,917)	93% (1,882)
Matchers	4% (87)	7% (149)

Table 2.   Allocation of givers, takers, and matchers for all periods.

4.2 Structural characteristics of givers, takers, and matchers

To investigate the structural characteristics of givers, takers, and matchers in ESN, we first analyse how they are characterised with respect to their average numbers of write accesses and read accesses in the knowledge base as well as written and received direct messages, and social relationships.

The results (cf. Table 3) reveal that givers are very active users in the knowledge base of MSU-Net with an average of 141 written or modified and 464 read articles. Takers on the other hand write no articles on average but still read 31 articles. In average, matchers also read a lot of articles with 201 articles per user, whereas their write access is moderate with 23 written or modified articles per user. Concerning the communication in the ESN (i.e. direct messages), givers are very active with 151 written and 117 received messages per user, closely followed by matchers with 97 written and 99 received messages per user, while takers seem very passive in the ESN with only three written and four received messages. As far as social relationships are concerned, givers and matchers are amongst the best connected users, with on average 24 or 23 social relationships, respectively, whereas again takers only have 6 social relationships on average. Summing up the results of these analyses, givers are the highest contributors to the knowledge base by writing and modifying most articles per user. Moreover,

givers and matchers are amongst the most active users concerning communication activity and have most social relationships per user. Takers show opposite characteristics. They are amongst the least active users concerning their participation in the knowledge base as well as their number of social relationships and direct messages per user.

Category	Average no. of write accesses	Average no. of read accesses	Average no. of written direct messages	Average no. of received direct messages	Average no. of social relationships
Givers	141	464	151	117	24
Takers	0	31	3	4	6
Matchers	23	201	97	99	23

Table 3.   User behaviour of givers, takers, and matchers.

To get further insights into users' connectedness in the ESN, we further analyse the centrality of givers, takers, and matchers in the social graph (i.e. social relationships based on confirmed contact requests) and the activity graph (i.e. communication based on direct messages). We apply closeness centrality, betweenness centrality, and eigenvector centrality to both graphs whose nodes represent all 2,941 users in MSU-Net (i.e. users who participate in the knowledge base as well as users who do not participate in the knowledge base). We do not consider users' degree centrality, since it represents the number of social relationships in the social graph and the number of direct messages in the activity graph respectively, which we already analysed before. We then rank all users in the network for each centrality measure in a decreasing order and classify them with respect to quartiles, with quartile 1 containing the 25% of the users with the highest and quartile 4 containing the 25% of the users with the lowest centrality scores. Tables 4 and 5 show for each category (givers, takers, and matchers) the percentage of the respective users belonging to the quartiles 1, 2, 3, and 4 (please note that all users of the ESN are considered for the ranking of the users and the quartiles for reasons of comprehensibility).

Category	Closeness Centrality				Betweenness Centrality				Eigenvector Centrality			
	Quartile				Quartile				Quartile			
	1	2	3	4	1	2	3	4	1	2	3	4
Givers	77%	10%	10%	3%	83%	13%	0%	3%	73%	12%	10%	3%
Takers	30%	30%	22%	18%	29%	28%	25%	18%	30%	30%	22%	18%
Matchers	80%	14%	5%	1%	87%	11%	1%	0%	79%	14%	6%	1%

Table 4.   Closeness, betweenness, and eigenvector centrality in the social graph.

The results for the social graph indicate that givers and matchers are very well connected. Indeed, more than 70% of givers and matchers belong to quartile 1 for closeness centrality, betweenness centrality, and eigenvector centrality. For instance, regarding betweenness centrality 83% of the givers and 87% of the matchers are in quartile 1, only 3% of the givers and 0% of the matchers are in quartile 4. This shows that nearly three out of four of the givers and matchers are amongst the best connected users in the social graph. Takers are in general less well connected (at most 30% in quartile 1). Again, this can be observed for closeness, betweenness as well as eigenvector centrality.

Similar to the social graph, givers and matchers are very well connected in the activity graph with more than 80% of the givers and matchers being in quartile 1 whereas takers again show lower centrality regarding all observed centrality measures. For instance, 83% of the givers and 82% of the matchers are in quartile 1 with respect to closeness centrality. In keeping with the social graph, at most 30% of the takers are in quartile 1.

Category	Closeness Centrality				Betweenness Centrality				Eigenvector Centrality			
	Quartile				Quartile				Quartile			
	1	2	3	4	1	2	3	4	1	2	3	4
Givers	83%	10%	4%	3%	83%	10%	4%	3%	83%	10%	3%	4%
Takers	30%	27%	25%	18%	30%	27%	25%	18%	29%	28%	25%	18%
Matchers	82%	17%	1%	0%	84%	15%	1%	0%	87%	11%	2%	0%

Table 5.   Closeness, betweenness, and eigenvector centrality in the activity graph.

In summary, the results underline that givers and matchers are better connected than takers in terms of social links (cf. social graph) and communication activities (cf. activity graph) in the ESN. This holds for all analysed centrality measures. Taking also into consideration that givers are amongst the most active users who share most knowledge by writing most articles in the knowledge base, they can be identified as most important users for distributing and sharing knowledge in ESN.

4.3   Hierarchical levels of givers, takers, and matchers

To get further insights into the representation of givers, takers, and matchers in the hierarchy of organisations, we finally investigate the allocation of each user category in the higher, middle, and lower hierarchy.

As depicted in Figure 3, the majority of the members in all hierarchical levels are takers, for instance 99% in level 1, 85% in level 2, or 99% in level 3. There are similar patterns within the lower hierarchy (i.e. levels 1 and 2) and the middle hierarchy (i.e. levels 3 and 4): whereas there are nearly only takers in the lower sublevel within the hierarchies (i.e. levels 1 and 3), there is an increase in givers and matchers in the next higher sublevels (i.e. levels 2 and 4). Whereas levels 1 and 3 can be compared to newly qualified members or candidates, levels 2 and 4 signify members who have already been within the lower or middle hierarchy for a certain time. In the higher hierarchy, the share of matchers also increases from 9% to 17% between level 5 and level 6, while the share of givers in contrast decreases from 2% to 0%, respectively. In sum, the share of takers decreases steadily after the lower hierarchical level, starting with 99% in level 3 and ending in 83% in level 6.
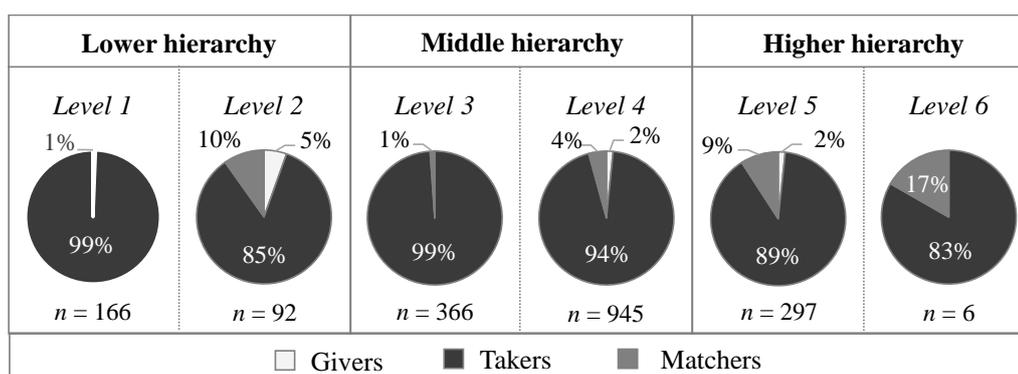

Figure 3.   Allocations of givers, takers, and matchers within hierarchical levels.

5   Discussion, Limitations, and Future Research

5.1   Implications for theory and practice

In this study, we investigated knowledge exchanging behaviour in ESN as well as the structural characteristics of knowledge sharing and seeking users. In doing so, we used data about read and write accesses in the knowledge base of MSU-Net as indicator for sharing and seeking knowledge.

First of all, we proposed two novel methods to distinguish between givers, takers, and matchers in ESN. To do so, we developed the "Absolute Distance Measure" and the "Relative Distance Measure". We could show that both methods lead to very similar results. Indeed, we observed no statistically significant change in the assignment of users to the categories. Since the "Relative Distance Measure" is more complex to apply, one may tend to apply the "Absolute Distance Measure" when classifying users based on their role in the ESN's knowledge sharing activities. On this methodological basis, we found that the clear majority of all users of the ESN behave as takers. This is in keeping with Nielsen (2006) who states that only 10% of all users of a social community create 100% of its content and Katz (1998) who identified 90% of online community members as lurkers. In addition, Trier and Richter (2015) state that a smaller group of information contributors in organisational network domains competes for a large group of retrievers in order to grow their topic. The large number of takers in the knowledge base might be due to an uncertainty of the users if their knowledge is important enough to be published. Also a lack in experience in how to correctly author articles which are accessible by all other users can be a barrier, as in the case of errors it could redound upon the author. Moreover, writing an article always involves effort which some users might not be willing to make. From a practical point of view, our results imply that the small group of "givers" needs to be identified and addressed individually as key users in order to support an effective and successful exchange of knowledge within the organisation.

Second, the classification of users as givers, takers, and matchers allows us to investigate the structural characteristics of each category. Our analysis shows that givers and matchers are characterised by a high amount of written direct messages as well as a large number of social relationships and therefore are very active users. Concerning the knowledge base, givers are by far the highest contributors by writing more than six times the amount of articles than matchers do. Surprisingly, takers have only few read accesses as well as written and received messages and social relationships and therefore are overall rather passive users. They could have been expected to be more active in order to gain knowledge from the network. Our study is the first considering two aspects for characterising the user categories: knowledge sharing and seeking behaviour in the knowledge base as well as communication activities and connectedness between users. Prior studies in other contexts like tagging (Thom-Santelli et al., 2008) or blogging (Jackson et al., 2007) focussed on only one aspect for the classification of user groups. For instance, Thom-Santelli et al. (2008) investigated merely the use of tags, or Jackson et al. (2007) only considered writing and commenting blogs of users, without taking into consideration network structures. Our study does not only support the identification of important users for the knowledge exchange within an organisation, but also helps to understand how these users are characterised in terms of their connectivity and activity in ESN. Additionally, givers and matchers are well connected with respect to different centrality measures both in the social as well as in the activity graph. As regards practitioners, this means that givers and matchers are not only important for knowledge exchange in the ESN, but they can also help for example to effectively distribute information in an ESN (due to high closeness centrality). Moreover, they can for instance contribute to bridging structural holes (Burt, 1992) between sub-networks in the ESN which do not or only little overlap (due to high betweenness centrality). Hence, givers and matchers can enable a more effective and rapid exchange of information between different working groups which are for instance only sparsely connected, or more generally speaking are crucial for the diffusion of innovative ideas which essentially depends on how people are connected and influence each other (Ciriello and Richter, 2015; Ciriello et al., 2013). For this part, our results are also in accordance with Berger et al. (2014) who showed that users adding value for others are amongst the best connected users in ESN.

Third, our results also indicate that the allocations of the user categories change within hierarchical levels. Although the majority in all levels are the takers, their percentage decreases whereas the matchers' percentage increases, the higher the position in the formal organisational hierarchy is. This holds true for all observed periods. Whereas the decrease of the takers is in accordance with Grant's findings, we cannot confirm his statement that givers are the most likely to reach the end of the success ladder for the context of ESN. This might be due to the fact that ESN are an environment in

which contents can be shared easily and thus the consumption of knowledge is facilitated which in turn leads to rather a matching than a pure giving mentality. Although the share of givers increases within the lower and middle hierarchy, which shows that having a giving mentality may benefit promotions to the next hierarchical level, this does not hold true for the higher hierarchy. A reason for the shift from a taking to a giving or matching behaviour within hierarchical levels can be that at the beginning, they are careful and uncertain about the competitive situation and thus aim at gaining knowledge themselves without caring about others, yet as they want to prove themselves in a first step. But the longer they are within a hierarchical level, the more confident they become to post relevant knowledge and the more they give to others. Therefore, they lose the fear of actively contribute to the knowledge base but still mostly expect knowledge in return (i.e. these people rather behave as matchers than as givers). For practice this means that it is the members of the higher hierarchical levels that need to be addressed in order to spread knowledge through the organisation. An exception can be recognised in level 3 where the proportion of givers and matchers decreases back compared to level 2. The reason may be that right after being promoted to the next higher hierarchy for the first time (i.e. after the lower hierarchy) the willingness to share knowledge decreases but increases again after being a member of this hierarchy for a certain time. Another prominent observation is the exceptional portion of givers in level 2 which we explain in such a way that new members in level 1 are still very uncertain whereas they gain their first self-confidence in level 2 after being member for a while and start giving even more than they expect in return. But already after being promoted to the next higher level (i.e. level 3) this giving mentality decreases back and rather turns into a matching mentality due to an increasing competitive environment in higher levels which finally even culminates in a 0% share of givers in the highest level (i.e. level 6).

5.2   Limitations and further research directions

Although our results provide first interesting insights into the classification and characteristics of givers, takers, and matchers in ESN, there are several limitations, which can serve as starting points for future research. First, we only considered one single organisation, which provided us with the relevant data needed to conduct this research. Nevertheless, the ESN was actively used by a large number of users for sharing and gaining knowledge. Thus, we assume that our findings also hold for other organisations. Second, military organisations might differ from business organisations in some points. But according to the work descriptions in the Administrative Order on the Position of the Military Superior military ranks can be seen as equivalent to formal job titles in organisations like upper, middle, and lower management. Hence, we do not think that users' behaviour in MSU-Net differs from users' behaviour in other ESN. Third, we classified users as givers, takers, and matchers based on their number of write and read accesses in the knowledge base. Obviously, the participation in the knowledge cannot completely reflect users' knowledge exchanging behaviour in the whole ESN, which also takes part in direct messages. Moreover, we did not consider the extent and quality of write accesses as well as the length of read accesses. However, it may well be assumed that the knowledge base is the main feature for knowledge sharing in the ESN. While in a first step it seemed appropriate to use users' write and read accesses for the classification, further studies are needed to analyse this aspect in-depth. Besides these limitations, we see promising starting points for future research. First, we focused on users' hierarchical level as a first indicator for the professional performance of givers, takers, and matchers. Further in-depth analysis on this topic seems to be a promising starting point for future research. Are givers the most successful employees in the organisation? Does it pay off being a giver or is it more beneficial to behave as a taker (e.g., are there differences in wages or bonuses)? Do givers really reach the next hierarchical level more easily? Second, it would also be of interest to analyse if givers, takers, or matchers in the online context change to another category in the offline context. In the course of this development it would also be of interest to incorporate further characteristics of each user category beyond the social embeddedness (e.g., demographics) in order to get a more comprehensive picture.

6   Conclusion

Ever more organisations have been adopting ESN to foster collaboration, communication, and knowledge sharing among their employees (Aral et al., 2013; von Krogh, 2012). While there is a growing body of literature on ESN in general and knowledge sharing in ESN in particular, we still observe a lack of research on employees' knowledge exchange practices in ESN, for instance how users share and seek knowledge in ESN. Thus, the aim of this paper is to investigate how users can be classified based on their knowledge exchanging behaviour and how users in each category are characterised with respect to their structural characteristics as well as their position in the organisational hierarchy. Our analysis is enabled by a plethora of data generated when users interact and connect with others (Giles, 2012). Against this background, we analyse a large scale dataset of ESN usage.

First, we show how users can be classified based on their participation in the knowledge sharing process in ESN. Here, we were able to show that most users in the ESN can be classified as takers and therefore, acquire disproportionately much knowledge compared to the amount of knowledge they contribute for others. Second, by applying SNA (Wasserman and Faust, 2009) we found that givers, who share more knowledge in the ESN than they acquire from it, are characterised by a high number of written direct messages and social relationships in the ESN. Moreover, they are also well connected both in the social and the activity graph, giving them, from a structural perspective, a central position in the ESN. Therefore, organisations are well recommended to identify and address their givers for an effective knowledge management within the organisation.

With our results, we hope to contribute to a better understanding of ESN and the online knowledge exchange within organisations in particular. Summing up, we believe that our study is a first but indispensable step with regard to studying users' knowledge exchanging behaviour in ESN. We hope that our present results will stimulate further research on that fascinating topic and support practitioners to better understand and use ESN for knowledge management.

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