

SUCCESS MEASUREMENT OF SOCIAL CAPITAL IN ENTERPRISE SOCIAL NETWORKS

Research paper

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Abstract

Enterprise Social Networks (ESN) are gaining increasing attention both in academia and practice. ESN enable various benefits in a company, which are assessed in success measurement models. A wide range of benefits focusing on social aspects has recently been identified clustered to an IT capability named Social Capital by Wehner et al. (2017a). For example, using the ESN enables employees to gain influence in the corporate community. Those benefits cannot be assessed using existing ESN success measurement models and can, thus, hardly be managed. Hence, the aim of this paper is to develop a measurement model focusing on the latter-named capability.

We instantiate the Design Science approach and develop a measurement model focusing on the capability Social Capital. As a result, we identify 32 methods and metrics. Their applicability is demonstrated on an ESN dataset provided by a company. As a last step, we evaluate the model in an interview with a board member of this company. Conducting this research, we show that our model analyzes ESN success from a different perspective complementing existing success measurement models. Further, our model discloses social aspects used to make decisions to better manage an ESN.

Keywords: Enterprise Social Network, Success Measurement, Social Capital

1 Introduction

A current survey by the McKinsey Global Institute states that, in the companies interviewed, social technologies “are more integrated into their organizations’ work than ever before and that the most sophisticated of these tools, message-based platforms, are gaining traction” (Bughin et al., 2017). These platforms are often called Enterprise Social Networks (ESN) and besides instant messaging, typical functionalities are micro-blogging, activity streams, building groups and communities, and managing content (e.g. Wikis) (Chin et al., 2015b). Using ESN provides employees with a more efficient and direct way to access expertise (Han et al., 2015, Liu et al., 2013), facilitates the generation of new ideas (Ding et al., 2015, Mäntymäki and Riemer, 2016), reduces geographical boundaries (Silic et al., 2015, Suh and Bock, 2015, Wiesneth, 2016) and helps to solve problems, for example (Richter and Riemer, 2009, Riemer and Scifleet, 2012, Zhang et al., 2010). Thus, an increasing number of companies are adopting ESN (Bughin, 2015, Thompson, 2015) and researchers have started to investigate ESN from various perspectives in recent years (Viol and Hess, 2016, Wehner et al., 2017b).

However, in some cases, ESN do not fulfil the company’s expectations making it question the investment (Li, 2015). Possible reasons are that a company introduces the ESN without any particular use case (Margolis, 2016) or that the so-called “critical mass” of users or content could not be reached, which is a necessary enabler for ESN acceptance in a company (Chin et al., 2015b). In this regard, the question arises which factors determine ESN success (and failure) and how this success can be measured. Traditional Information Systems (IS) measurement models (see e.g., (DeLone and McLean, 1992) and (Gable et al., 2008)) are only partly applicable on ESN, as social software is different from traditional information systems (IS) (Steinhueser et al., 2011). For example, users generate dynamic and rich content voluntarily in social software, while relatively static content is created mostly mandatorily by predefined roles in traditional IS (Steinhueser et al., 2011).

The success of ESN in particular is defined by individual benefits (see examples above), which are assessed using various methods and metrics (Behrendt et al., 2014, Herzog et al., 2013). A comprehensive list of ESN benefits was composed by Wehner et al. (2017a) analyzing 37 ESN case studies. The authors show that ESN enable benefits classified into various IT capabilities, e.g., Knowledge Management, Informational and Geographical. They also define a new IT capability named “Social Capital”, which comprises ESN benefits such as “strengthens social connections”. Social aspects are not included in current ESN success measurement models (e.g., (Richter et al., 2013)). To overcome this weakness, this paper provides a set of methods and metrics to operationalize the benefits in the IT capability Social Capital. The methods and metrics are used (1) to assess the impact of ESN on social aspects, (2) to better manage the ESN and (3) to make decisions on basis of the analysis, e.g., to form socially familiar project teams. To reach this aim, we apply the Design Science approach to develop the measurement model (Hevner et al., 2004, Peffers et al., 2007). The model is demonstrated analyzing log data provided by a company, which shows meaningful results as evaluated by a board member. The remainder of this paper is organized as follows: in section two, we give a brief overview of related work in regard to ESN including ESN success and benefits. In section three, our research method is explained in detail. Section four presents the development of the measurement model resulting in a set of methods and metrics. In section five, the methods and metrics are applied to a dataset of a professional services company and the results are presented. In section six, we evaluate and discuss our findings. Finally, the paper is concluded with a short outlook in section seven.

2 Related Work

2.1 Enterprise Social Networks

ESN have been gaining increasing attention both in academia and practice in recent years (Stei et al., 2016, Viol and Hess, 2016, Wehner et al., 2017b). An established definition of ESN was published by Leonardi et al. (2013): ESN are “*web-based 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*” (p.2).

As such, ESN combine various social technologies, e.g., microblogging, wikis, social networking and instant messaging. They aim to support employees in their everyday business (Wehner et al., 2017b), for example, to communicate, collaborate, innovate, disseminate and share information, and manage knowledge (Turban et al., 2011). Due to this multifacetedness, various researchers started to analyze ESN from different perspectives (Viol and Hess, 2016). Since 2006, more than 150 articles on ESN have been published (Wehner et al., 2017a). An overview of these articles can be found in three literature reviews that have recently been published (see Wehner et al. (2017b), Viol and Hess (2016) and Stei et al. (2016)), pointing out that there is a strong need for further research on the evaluation and success measurement of ESN on both an individual and an organizational level.

2.2 Success Measurement and Benefits of Enterprise Social Networks

In this section, we first provide an overview of IS success measurement in general to identify how social aspects are covered by them. After that, we elaborate on ESN success measurement and benefits, and, third, we present the necessity to measure the IT capability Social Capital in ESN.

(1) Success in the context of IS can generally be measured by established measurement approaches such as the IS success model by DeLone and McLean (1992) or the IS-Impact Measurement Model by Gable et al. (2008). However, those models are only partly applicable to social software as they strongly differ from traditional information systems, e.g., in traditional information systems, the content is created by predefined roles and data quality is assured by standardized procedures. In social

software, which ESN indeed are, users create all types of content and quality is rated via peer feedback in an unstructured way (Steinhueser et al., 2011). The focus of social software is on sociality and not on functionality (Bouman et al., 2007). Steinhueser et al. (2011) thus develop a measurement model for social software using the two success dimensions *quality* and *impact*. In addition, Herzog et al. (2015) provide a framework to evaluate social software in general, which consists of characteristics in several dimensions, e.g., time (ex ante, ongoing, ex post), perspective (user, platform owner, organization). However, this framework does not provide specific measures to assess the success of ESN. Further, social aspects are disregarded in all of these models.

(2) Success measurement models in the context of ESN are defined as well. Muller et al. (2009) define a metric named “return on contribution” to measure the impact of ESN on an employee’s behavior. Lehner and Haas (2011) focus on organizational aspects in the “system of knowledge management”. Richter et al. (2013) define an extensive approach comprising two dimensions: individual employees and organizational success. In addition, Herzog et al. (2013) provide a set of methods and metrics for success measurement of ESN. The latter two specify a set of success factors and metrics, which define success on the basis of individual benefits. Looking at ESN benefits in particular, there are four articles focusing on that topic. Kugler and Smolnik (2013) provide a conceptual model to measure the impact of ESN usage on innovative and employee performance and on decision-making, Majumdar et al. (2013) provide a list of 17 benefits gathered by interviews, and Holtzblatt et al. (2013) conduct interviews, analyze log data and perform a survey to assess the benefits within one enterprise. Wehner et al. (2017a) identify a wide range of different benefits spread across the various ESN case studies. The latter article performs a literature analysis of 37 case studies (including the previously mentioned articles) to gather a list of benefits achievable using ESN. As a result, 99 benefits are identified and similar benefits are grouped and assigned to 18 categories in an inductive categorization process. Five of these categories focus on benefits that are related to social aspects: personnel development, merging of business and private life, trust-based community, disclosure of hidden aspects and common identity.

(3) When matching the benefits with methods and metrics in the context of ESN success, three different areas can be identified. (i) Metrics are applied to measure user activity and satisfaction. When introducing an ESN (see e.g., (Riemer et al., 2012)), it is crucial to reach the critical mass of both users and content (Chin et al., 2015b). Thus, metrics in this area are for example “total number of users”, “number of content created” (user activity) (Richter et al., 2013) and “user satisfaction with the platform” (user satisfaction) (Herzog et al., 2015). (ii) These benefits are the basis for further business-related effects enabling employees to perform their tasks more accurately, for example, employees helping each other to solve problems (Mäntymäki and Riemer, 2016), or the ESN is used as a platform where new ideas are generated (Ding et al., 2015). Exemplary metrics in this area are “number of useful or correct answers” (Richter et al., 2013) and “number of adjusted ideas” (Herzog et al., 2013), respectively. (iii) Finally, further benefits are identified that refer to the value of an individual member in the network (e.g., “empowering employees” (Silic et al., 2015)), the social relationships of individuals (e.g., “strengthens social connections” (Holtzblatt et al., 2013)) and the corporate network itself (e.g., “creates and sustains a user community” (Mäntymäki and Riemer, 2014)). These benefits are categorized to a newly defined IT capability named “Social Capital” (Wehner et al., 2017a). Social Capital is generally defined as the value of social relationships and networks to achieve the actor’s goals (Portes, 2000). Riemer et al. (2015) show that, in an ESN, employees gain Social Capital especially from repeating interactions with other employees and participating in work groups (bridging social capital theory, see (Granovetter, 1978, Granovetter, 1973)).

However, while, in the first two areas of ESN success measurement (*user activity and satisfaction* and *business related effects*), benefits are adequately measured by methods and metrics (see examples above), in the capability Social Capital, benefits are only described (Wehner et al., 2017a). As a consequence, it is difficult to assess the explicit impact of ESN on Social Capital benefits from both an individual and organizational perspective. This makes it difficult to manage the ESN and derive actions for a more targeted ESN use. For example, a homogenous project team that consists of familiar team members can be formed on the basis of ESN data, which leads to better project results as social discrepancies are reduced, or experts for a specific topic can be identified due to their connectivity and

communication logs to colleagues. Therefore, we see a strong need to operationalize the benefits in the IT capability Social Capital by means of methods and metrics, providing, in particular, managers and decision makers with meaningful insights.

3 Research Method

To create a measurement model that operationalizes the benefits in the capability Social Capital, the Design Science approach (see Peffers et al. (2007)) is chosen as a research method. Design Science is a well-known research method used to develop artifacts that address organizational problems (Cleven et al., 2009, Hevner et al., 2004) such as constructs, models, methods and instantiations (Baskerville et al., 2015, March and Smith, 1995). Therefore, it is a suitable approach to structure our research. The Design Science methodology contains six steps (see Figure 1).

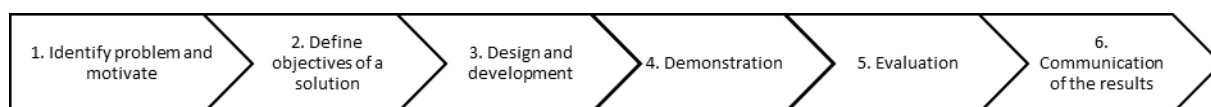


Figure 1. Design Science methodology Peffers et al. (2007)

As a first step, we identify the problem that the capability Social Capital of ESN success can not be assessed and managed, as it is not covered in existing ESN success measurement models (see section 2.2). Thus, the objective is to provide a set of measures to operationalize the benefits in this capability (step two, see section 1). In step three, a measurement model is developed. The benefits of the capability Social Capital are analyzed in detail, as presented in the literature review by Wehner et al. (2017a). Further, to identify the methods and metrics that adequately measure these benefits, we refer to several strands of literature that provide or refer to a range of possible methods and metrics:

- (1) IS success measurement (e.g., (DeLone and McLean, 1992, Gable et al., 2008));
- (2) social software success measurement (e.g., (Steinhueser et al., 2011));
- (3) ESN success measurement (e.g., (Behrendt et al., 2014, Hacker et al., 2017, Herzog et al., 2013, Richter et al., 2013));
- (4) the analysis of social networks (SNA) and online social networks (OSN) (e.g., (Berger et al., 2014a, Chelmiss and Prasanna, 2011, Kane et al., 2014, Kurka et al., 2015, Luo et al., 2017, Moosavi et al., 2017, Smith et al., 2009)), and, finally,
- (5) the analysis of social aspects (e.g., (Burns and Friedman, 2012, Durst et al., 2013, Riemer et al., 2015)).

As a result, a list containing 376 methods and metrics is compiled (e.g., centrality measures, the linear influencing model) including further descriptions and application procedures. Afterwards, the metrics are matched to the benefits using the goal-question-metric approach as described by Caldiera and Rombach (1994). To reduce subjectivity when mapping the methods and metrics to the benefits, we held three discussion panels with three experts in the fields of ESN, SNA and statistical analysis as a first evaluation as proposed by Sonnenberg and vom Brocke (2011). After each panel, the measurement model was adapted until a consensus was found. The results of the complete mapping process are explained in detail in section four. For example, the benefit and goal of ESN to *support employees gaining influence in the corporate community* (Wehner et al., 2017a) dwell on the question of how the influence can be measured for individual employees in regard to a global network perspective (community). Mapping this question to our list of methods and metrics, we choose the indegree centrality – an independent measure of the size of an individual’s advice network (Brass and Burkhardt, 1993) – as actors with a high indegree value have greater access to and control over information and can, thus, be identified as influential users (Sasidharan et al., 2012). Further, there are two distinct ways of measuring these benefits: methods and metrics that can be applied to ESN log-data (direct metrics) and that are based on the perception of ESN users (indirect measures), e.g., questions asked in surveys or interviews (for the distinction between direct and indirect measures, see e.g., Coltman et al. (2015)).

In the upcoming demonstration of the measurement approach, the methods and metrics are applied on a data extract of the implemented ESN in a company (step 4, see section 5), before conducting an interview with a board member of the company to evaluate the results both from a theoretical and a practical perspective (step five, see section 5). The results are presented in this paper (step 6).

4 Design and development: Methods and Metrics to measure the IT capability Social Capital

To operationalize the benefits of the IT capability Social Capital, we refer to the categorization as presented by Wehner et al. (2017a): personnel development (PD), merging of business and private life (MBPL), trust-based community (TbC), disclosure of hidden aspects (DhA) and common identity (CI). For each of these categories, the benefits are presented and methods and metrics for their measurement are described. An overview of the measurement model is shown in Table 1.

4.1 Category: Personnel Development

The category personnel development (see **PD** in Table 1) contains benefits that focus on the development of individual employees: (i) *empowering employees*, (ii) *supports employees gaining influence in the corporate community*, (iii) *increases reputation*, (iv) *increases feeling of belonging*, (v) *helps gaining a level of confidence*, and (vi) *motivates employees*.

(i) ESN are platforms, where employees are able to perform several actions (Richter et al., 2013), e.g., post content and send messages (Chin et al., 2015b). Thus, all registered users obtain a voice in the corporate community, as their actions can be seen throughout the company (*empowering employees*) (Chin et al., 2015a, Silic et al., 2015). To measure this benefit, we identify those employees who actively and publicly interact on the platform. Those active users are often referred to as “posters” who have a high word-of-mouth capability (Wallace et al., 2014). Metrics describing this benefit represent the percentage of active users (Richter et al., 2013) as well as the share of employees who made at least one post in the ESN. (ii) Regarding the benefit *supports employees gaining influence in the corporate community*, Yang and Leskovec (2010) state that the global influence of a node can be measured by the rate of information diffusion through the underlying social network. This influence can be measured based on the indegree centrality (Cha et al., 2010). In directed networks, the indegree centrality is a metric measuring the number of in-coming links of a node, which can be seen as an independent measure of the size of an individual’s advice network (Brass and Burkhardt, 1993). Users with a high indegree value have greater access to and control over information and can be identified as influential users (Sasidharan et al., 2012). Further, the Linear Influence Model (LIM) is an indicator modeling the global influence of a node on the rate of information diffusion through the underlying network (Yang and Leskovec, 2010).

ESN affect the social behavior and the personal perception of the employees in four ways. (iii) First, in an ESN, the activities of employees are visible to others and employees are recognized by the community giving them the opportunity to earn reputation (*increases reputation*) (Chin et al., 2015b) (Silic et al., 2015). The construct of reputation is assessed by Kügler et al. (2015) by means of a questionnaire including statements such as “Using the system will improve my image within the organization”. (iv) Second, the sense of being “in the same team” with colleagues, which can be described as an *increased feeling of “belonging”*, is identified as an effect of ESN (Han et al., 2015). Belongingness in general can be assessed by means of seven questions as presented by Gambone and Arbretton (1997). We transferred these questions onto an organizational context leading to seven statements, e.g., “I feel like I belong to my organization”, “I feel like my ideas count”. (v) Third, the ESN helps *gaining a level of confidence*. This benefit is strongly related to self-efficacy, which comprises learning the tasks of a new job and gaining confidence in a particular role (Gonzalez et al., 2015), which can be seen as the degree to which employees feel capable of completing their job tasks successfully. Ten statements are identified by Schwarzer and Jerusalem (2010) named the general self-efficacy scale (GSE). These statements can be used to assess whether the ESN enables a shift towards a more self-confident

	Benefit	Methods and Metrics (References)	*
PD	<i>Empowering employees</i>	- Share of active users - Share of users who made at least one post (Revelle et al., 2016, Richter et al., 2013, Wallace et al., 2014)	d
	<i>Supports employees gaining influence in the corporate community</i>	- Indegree centrality - Linear Influence Model (Cha et al., 2010, Sasidharan et al., 2012, Yang and Leskovec, 2010)	d
	<i>Increases reputation</i>	- Three statements as defined by Kügler et al. (2015)	i
	<i>Increases feeling of “belonging”</i>	- Seven statements as defined by Gambone and Arbretton (1997)	i
	<i>Helps gaining a level of confidence</i>	- Ten questions as defined by Schwarzer and Jerusalem (2010)	i
	<i>Motivates employees</i>	- 26 questions as defined by Mak and Sockel (2001)	i
MBPL	<i>Helps to develop interpersonal relationships in the workplace</i>	- Evolution of the friendship or interaction network using social network analysis (Kurka et al., 2015)	d
	<i>Increases flexibility of working hours</i>	- Temporal distribution of the employees’ interactions - Share of interactions outside of regular working hours (Weiss et al., 2015)	d
	<i>Helps to find employees with similar interests</i>	- Visited profile pages per time period - Number of subscriptions of an employee to groups (Chin et al., 2015b, Zhang et al., 2010)	d
TbC	<i>Supports on-boarding newly hired employees</i>	- Number of interactions when on-boarding - Assignments to groups when on-boarding - Number of asked and answered questions when on-boarding (Brandall, 2016, Liu et al., 2013, Richter et al., 2013)	d
	<i>Creates or strengthens trust among employees</i>	- Trust value based on recommender system analysis (Kurka et al., 2015)	d
	<i>Strengthens social connections</i>	- Number of interaction between two neighbors - Average number of characters between two neighbors - Qualitative analysis of exchanged messages between two neighbors (Granovetter, 1978, Jansen, 2006)	d
	<i>Creates and sustains a user community</i>	- Communities based on groups including the number of members - Interest groups based on topic analysis including the number of members - Communities based on the number of mutual friends (Correa et al., 2012, Dey et al., 2017, Moosavi et al., 2017, Newman, 2006)	d
	<i>Builds a networked organization</i>	- Density - Diameter (Burns and Friedman, 2012, Yang and Leskovec, 2015)	d
DhA	<i>Identifies key contributors in the corporate network</i>	- (Weighted) Degree, betweenness, eigenvector centrality - Number of reactions held by a node (Berger et al., 2014b, Freeman, 1978, Kane et al., 2014)	d
	<i>Higher recognition of high performing employees</i>	- Number of likes and bookmarks held by a node (Leonardi, 2014)	d
	<i>Improves meta-knowledge on “who-knows-whom”</i>	- Specific questions as conducted by Leonardi (2014)	i
CI	<i>Creates greater overall business understanding</i>	- Explanatory information diffusion models on business relevant posts (e.g., status-updates) (Guille, 2013, Han et al., 2015, Newman, 2006)	d
	<i>Creates better understanding of own employees</i>	- Interest groups based on topic analysis including the number of members (Dey et al., 2017, O’Leary, 2016)	d
	<i>Better understanding of the organizational culture</i>	- 16 questions as defined by Grau and Moormann (2014)	i

Table 1. Overview of the measurement approach (* d=direct measure, i=indirect measure)

employee-base, e.g., “I can always manage to solve difficult problems, if I try hard enough”. (vi) Finally, researchers identified employees to be more motivated in their everyday work (*motivates employees*), when they are informed about organizational aspects and have a chance to contribute to organizational success (Gibbs et al., 2014). Both aspects are well covered in ESN (e.g., being up-to-date due to status updates of colleagues or contributing to innovation threads (Chin et al., 2015b)). To assess employee motivation, various methods are provided in literature depending on the context, e.g., Mak and Sockel (2001) assess employee motivation by a set of 26 questions as for instance “All in all, I am satisfied with my job” or “I would encourage a friend to work for my company”.

4.2 Category: Merging of Business and Private Life

The second category focuses on the interaction of employees with colleagues both privately and in a business context (**MBPL**). It contains the benefits (i) *helps to develop interpersonal relationships in the workplace*, (ii) *increases flexibility of working hours*, and (iii) *helps to find employees with similar interests*.

(i) In several case studies, employees state that the implemented ESN *helps to develop interpersonal relationships in the workplace* (e.g., (Chin et al., 2015c, Gonzalez et al., 2015)). Friendship relationships are described in social network theory as the direct symmetric connection of two users (“be-friend with each other”) (Smith et al., 2009). Further, the number of exchanged interactions indicates the “strength” of a relationship, i.e., many exchanged messages indicate a strong tie (Kurka et al., 2015, Leonardi, 2014). Looking at ESN in particular, the evolution (comparing two time periods) of the network that is implicitly created by the employees’ interaction (interaction network) (Kurka et al., 2015) is analyzed to measure this benefit. (ii) The ESN allows employees to interact more easily at more diverse hours (*increases flexibility of working hours*) (Weiss et al., 2015). To measure if employees actually make use of this opportunity, we analyze the point in time the actions of the employees take place on the platform and assess the share of the employees’ actions outside their regular working hours. (iii) The benefit *helps to find employees with similar interests* is strongly associated with social browsing (Wu et al., 2010), as personal information of employees – including interests – become visible on their private pages (Zhang et al., 2010). We count the number of visits on the profile pages as an indicator. Further, employees are able to actively subscribe to groups of interest, which contain “like-minded individuals” (Chin et al., 2015b). To measure these aspects, group assignments are analyzed.

4.3 Category: Trust-based Community

Due to the interaction of employees in ESN, the category trust-based community (**TbC**) was formed, containing the benefits: (i) *supports on-boarding newly hired employees*, (ii) *creates or strengthens trust among employees*, (iii) *strengthens social connections*, (iv) *creates and sustains a user community* and (v) *builds a networked organization*.

(i) For the *support of on-boarding newly hired employees*, various ways of how to best integrate newly hired employees are established in companies and several checklists can be found containing what should be done during their first week (e.g., explain long-term expectations) and during their first month (e.g., encourage them to socially interact with the team) (Brandall, 2016). Social integration plays a crucial role in this process and the ESN are used to support this process (Liu et al., 2013). This benefit can be measured analyzing the ESN interaction with colleagues after becoming a member of the company. In particular, we focus on the number of interactions or the assignment to groups during on-boarding. Further, as new employees often ask questions regarding corporate belongings, the questions asked by new employees and the answers of colleagues are analyzed.

(ii) The more interactions employees perform among each other, the more familiar they become with each other and trust is built (*creates or strengthens trust among employees*) (Richter and Riemer, 2009). Trust networks are generally described as groups of related users that are considered to have a valuable opinion on specific matters. The truthfulness is further related to a user’s proximity to a reference user (Kurka et al., 2015). For example, Walter et al. (2008) propose a recommender system,

which defines trust relationships based on a trust value between two neighbors (linked nodes) in a social network. We calculate this trust value, which is also closely related to the benefit *strengthens social connections*. (iii) The strength of a social tie is described using the intensity, i.e., frequency, between two neighbors in the network, the importance for the users or the extent of transferred resources, e.g., the number of characters of a message (Jansen, 2006). The frequency and the extent of transferred resources can be identified analyzing the interaction between two neighbors and the importance for the employee can be deduced by a qualitative analysis of the interaction (e.g., messages).

(iv) The more people interact on common interests, the more *communities are created and sustained*. Moosavi et al. (2017) define communities as “groups, clusters, subgroups or moduli in various areas, and discovering a community in a social network means recognizing a set of nodes communicating with each other more than other nodes in the network” (p. 2). Dey et al. (2017) state that communities are identified by individuals subscribing to existing interest groups (explicitly belonging to a community) or by a set of individuals knowing each other or having a large number of mutual friends (implicit community). Further, communities are formed by links inferred from user-generated topics or content (Correa et al., 2012). Detecting communities, particularly in online social networks, are performed in various ways, e.g., by modularity-based, structural (e.g., indicated by high density values of sub-networks) or functional community detection (Newman, 2006, Yang and Leskovec, 2015). (v) The more people are connected, the more a *networked organization is built*. “Networked organization” can be identified by the degree of cross-linking in the network. In this regard, various metrics are defined that characterize the network, e.g., network density, which enable to compare different social networks (Burns and Friedman, 2012, Smith et al., 2009). For example, the density of a network is calculated with the number of existing ties divided by the number of possible ties (Kane et al., 2014).

4.4 Category: Disclosure of hidden Aspects

The ESN further enables to disclose hidden aspects (**DhA**) covered by the benefits: (i) *identifies key contributors in the corporate network*, (ii) *higher recognition of high performing employees* and (iii) *improves meta-knowledge on “who-knows-whom”*.

(i) The benefit *identifies key contributors in the corporate network* is related to the position of an employee in the corporate network, which is based on the employee’s activity and measured by centrality metrics (Kane et al., 2014). For example, the betweenness centrality measures the number of the shortest paths passing through a node in the network (Freeman, 1978). In the context of ESN, key contributors are seen as value-adding users, who contribute and communicate their knowledge, which is afterwards liked or bookmarked by colleagues (Berger et al., 2014b). Thus, the number of reactions held by a node can be seen as an indicator of key contributors. (ii) This benefit is closely related to the benefit *higher recognition of high performing employees*, as the reactions to a post are seen by the entire company. (iii) This effect also *improves the meta-knowledge on “who-knows-whom”*, which is created by reading the conversations of employees that are publicly visible in an ESN. Readers remember, for example, who is in contact with someone else in another department (Leonardi, 2014). Leonardi (2014) gathers this data by conducting semi-structured interviews in a company with questions additionally aligned to the specific company. A generic questionnaire could not be identified. To measure this benefit, a set of questions has to be defined.

4.5 Category: Common Identity

This category comprises benefits leading to a better alignment of corporate values and the common identity (**CI**) in the company: (i) *creates greater overall business understanding*, (ii) *better understanding of the organizational culture* and (iii) *creates better understanding of own employees*.

(i) The ESN is a means to spread business-relevant information all across the company, which *creates a greater overall business understanding* by connecting business areas across geographical regions (Han et al., 2015). Information diffusion across an online social network can directly be extracted from the log data using several models, e.g., explanatory models, which aim at retracing the implicit path taken by a piece of information (Guille, 2013). Applying these algorithms to an ESN, especially on

business-relevant information such as status-updates, will provide insights into the business understanding based on the particular information flow.

(ii) Culture is a diffuse concept depending on its context (Kroeber and Kluckhohn, 1952). Gonzalez et al. (2015) identify employees to obtain a *better understanding of the organizational culture* using the ESN. Various questionnaires to assess organizational culture are elaborated, using e.g., the dimensions “strategic orientation” and “cooperation and teamwork” (Grau and Moormann, 2014). The questions in each dimension can be posed to the employees to find out how – in their opinion – the ESN contributes to a better understanding of the organizational culture and the cultural values.

(iii) Finally, Richter et al. (2016) provide insights into ESN from a manager’s perspective. As in ESN, employees communicate and discuss about various topics, managers can learn about the needs of their employees (*create better understanding of own employees*) (O’Leary, 2016). As previously described, the topic-based community detection (Dey et al., 2017) is applied to provide managers not only with the topics of interest, but also with the employees who form the community. Table 1 gives an overview of the benefits and metrics that can be applied on log-data.

5 Demonstration of the Approach

5.1 Case and Data Collection

The demonstration of our measurement approach takes place in a professional services company in the following referred to as SerCom. SerCom, founded in 2010, has 130 internal and external (e.g., freelancers) employees and strives for a leading position in custom consulting services and solutions in the field of Data Warehousing and Business Intelligence. The company’s employees are based in five different European subsidiaries. As the employees are additionally based at customer sites across the globe during projects, e.g., in the US, it has become increasingly difficult for the company’s employees to stay connected and keep current on organizational information. In 2015, management decided to introduce an ESN to provide a platform for the employees to connect to each other and to make the employees’ voice heard at a management level. In mid-2015, the employees were informed about the tool Yammer and 93% of all employees registered within the first three months. By October 2017, 120 registered users performed all kinds of interactions. As the goals of introducing Yammer foremost focus on – but are not limited to – social aspects (e.g., networking and integrating employees across subsidiaries), SerCom is a suitable candidate to demonstrate our approach.

The dataset we are analyzing is a full data excerpt of the tool Yammer from March 2016 through September 2017, stored in several csv-files. For each employee, we have additionally been provided with their subsidiary, department, job role, hierarchy level, and date of registration (and deletion, if the employee left the company in the meantime). The data excerpt contains, amongst others, conversations between employees, group conversations, public postings, posts in groups, attachments, tagging of users, and the timestamp of each interaction. Even though the data was anonymized before the analysis, the data can be linked to the additional employee information (e.g., department) using a unique user id. In total, the data excerpt comprises 670 posts and messages of the given timeframe.

5.2 Applying the Methods and Metrics to the Case

In this section, the direct metrics, which are based on log-data (see Table 1), are applied, and interesting results of this analysis are presented. In addition to a statistical analysis, the structural analysis of the network is performed and visualized in the tool Gephi. The results are structured according to the categories as presented in section 4. Further, as the dataset was anonymized beforehand, random names are assigned to the nodes in the network to better describe the data and to make the results understandable. Applying the indirect metrics at SerCom is part of our future research agenda.

From a general network perspective, 120 nodes, i.e., employees, exist in the network. Looking at the interaction network (see Figure 2), it becomes obvious that even if most of the employees registered in the ESN, only a limited number of employees perform interactions in the ESN. Employees without

any interaction are shown in the outer area of the network in Figure 2, left side. A statistical analysis of the overall network shows therefore very low values in regard to average degree values, for example. In the following, we will refer to the relevant sub-networks (see for example Figure 2, right side).

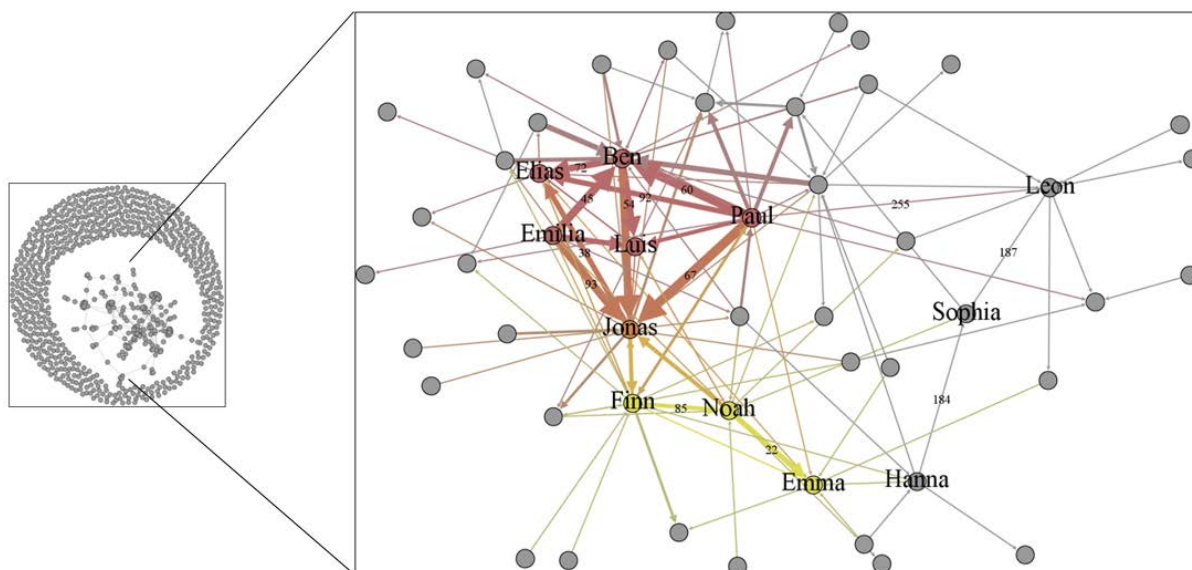


Figure 2. Interaction Network of SerCom (sub-network)

Looking at the category **Personnel Development (PD)**, the share of active users at SerCom is 18% (22 employees) and 75% of all posts (500 out of 670) are allocated to these users. Additionally, 47% of the employees (56) made at least one post (*empowering employees*). From a temporal point of view, the posting behavior after the registration in Yammer is analyzed. All active users started interacting on the platform right after registration and continued to interact throughout the given timeframe. For all employees, no case could be identified where active users stopped being active and passive users started being active. Regarding this benefit, we clearly see that some employees use the ESN as a voice in the corporate community. The *influence in the corporate community* is analyzed modelling the directed interaction network (Smith et al., 2009) and calculating the weighted indegree centrality. Out of the 120 employees in the network, we identify seven employees with much higher values than the rest. Figure 2 shows the directed interaction (sub-)network with the thickness indicating the frequency of the interactions and the values on the ties indicating the average number of characters of the messages of two neighbors. On the basis of the weighted indegree values, the top three nodes with the highest influence are (in descending order): Ben (weighted indegree value: 35), Jonas (34), and Elias (16). In conclusion, on the one hand, looking at the single resulting values, it is difficult to rate them. For example, is a share of 18% of active users a sufficiently high value? This value has to be further interpreted by decision makers or they have to be continuously monitored over time to see its trend. On the other hand, influential users are directly identified, which is a valuable information as these employees are often involved in the formation of opinions, for example.

In the category **Merging of Business and Private Life (MBPL)** the evolution of the interaction network is analyzed (*helps to develop interpersonal relationships at the workplace*). We split the provided timeframe in two periods with ten and nine months and 370 and 300 interactions, respectively. Table 3 shows the undirected interaction networks in both time periods for the previously mentioned employees as an example. When comparing the two networks, little difference regarding the individual network size is identified with 26 nodes in period 1 and 24 nodes in period 2 and an increased interaction between the nodes (thicker edged). This shows that hardly any new relationships were built between the given periods even though the employee base increased by about 40%. In regard to the benefit *increases flexibility of working hours*, we analyze the timestamps in the dataset. The distribution is a bell-shaped curve with a small peak from 7 – 8 a.m. and the main peak from 12 – 1 p.m. Further,

83% of all interactions on the platform took place between 7 a.m. and 6 p.m., which is in line with the regular working hours at SerCom. Even though the ESN enables to interact outside of the regular working hours, employees at SerCom make only sparse use of this possibility. To analyze the benefit *helps to find employees with similar interests*, the group assignments of the employees are evaluated. There are ten groups in total, which focus on both business and private matters. The business-related groups are deduced from the organizational structure, e.g., groups such as “Product Development”, “Professional Services” and “ICT”, while private groups have widespread topics and participants throughout the company, e.g., in the group “Radio”, employees discuss music, while in the group “Friends of CCO” widespread topics are discussed. In total, 45 employees are assigned to at least one group and 25% of all interactions take place in groups. In conclusion, we see that groups play an important role at SerCom’s ESN and employees team up in groups based on both similar interests and deduced from the organization structure. This is in line with the strategic goal of SerCom to connect the employees across organizational boundaries (interest groups). Very few new relationships have been built in the ESN, especially between subsidiaries. This is an interesting finding as regards the planning of actions to better connect the subsidiaries.

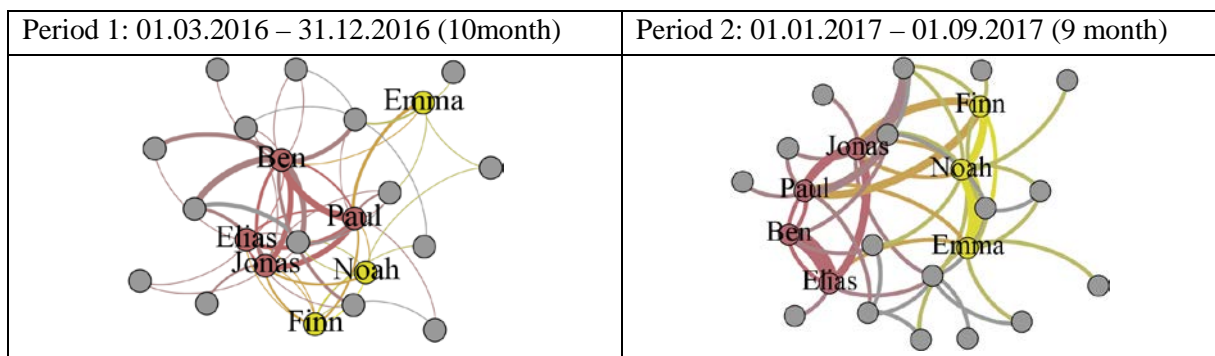


Table 2. Comparison of the undirected interaction networks in both time periods

Looking at the benefit *supports on-boarding newly hired employees* in the category **Trust-based Community (TbC)**, the three defined metrics (number of interaction, assignment to groups and asked/answered questions when on-boarding) show marginally low values. Still, we identified the group “Professional Services Trainee Program”, which is supposed to bring trainees and mentors together. However, this group is also sparsely used and, thus, there is no evidence that the ESN helps with the on-boarding processes. In regard to *strengthened social connections*, we analyze the number of interactions between two neighbors (thickness of the edges, see Figure 2) and the average number of characters between two neighbors (numbers on the edges). On average, messages and posts in SerCom’s Yammer have 190 characters. When correlating the frequency with the average number of characters, we see that frequent interactions among two neighbors have a smaller number of characters (e.g., Ben and Luis with 54 characters on average), while neighbors with few interactions have a higher number of characters (e.g., Paul and Leon with 255 characters on average). Analyzing the messages in detail, neighbors interacting frequently often leave out opening and farewell set phrases, indicating a stronger relationship. Comparing the two different periods (see Table 2), an increasing number of interactions with a smaller average number of characters indicate that the connections became stronger. The *created and sustained communities* are identified in several ways. The communities based on groups are explained beforehand (e.g., “Product Development”). In addition, a structural and topic based analysis is performed. In terms of the structural analysis, the density of the sub-network is calculated and compared. As a result, we see two structural communities, which are marked in red and yellow in Figure 2. In addition, a qualitative analysis of the messages on the platform is performed and the identified topics are used to cluster distinguishable topic-based groups. The topics are very widespread, both regarding business and private topics. However, two topics have a higher occurrence than the rest: technical solutions and fun posts. Technical solutions are mostly discussed in the group “Product Development”, which also shows a large overlap in the structural analysis (red community in

Figure 2), while the fun posts are widespread across the employees. Regarding the overall network structure (*builds a networked organization*), the network density is very low (0.113; possible values range from 0 to 1), with a high number of components (portions of the network disconnected from each other) and a diameter value of 5 (possible values range from 1 to 49 looking at the largest coherent subnetwork). In conclusion, we see that the employees are networked very sparsely, even if there are several communities e.g., based on technical aspects with an expert user group and based on private matters with a heterogeneous user group. This gives managers insights into the topics that are important to their employees and how they work together, which may help to form project teams socially familiar leading to better project results.

In the category **Disclosure of hidden Aspects (DhA)**, we *identify the key contributors* applying the betweenness, degree and eigenvector centrality. As a result, Jonas, Ben and Finn are identified as the key contributors with high values regarding all metrics. These employees also have high response rates to their mutual comments and are *highly recognized employees* in the company. Those employees can be seen as possible trust persons to be asked about relevant topics. In the category **Common Identity (CI)**, we apply an explanatory model (Guille, 2013) and analyze the messages to identify how information spreads, which is supposed to *create a greater business understanding*. In particular, we focus on business relevant information such as status updates on negotiations with customers and news from customers and the respective industry. Those messages cover 10%, however, their impact on the general understanding of the business can hardly be estimated as the dataset does not provide information on the reading behavior of the employees.

6 Evaluation and Discussion

After presenting the application of the metrics on the dataset, we now revert to its evaluation. For this purpose, we conducted a semi-structured interview with a board member (BM) of SerCom in October 2017. The interview lasted two hours and was structured as follows: first, the measurement model including the categories, benefits and (direct) metrics was presented and afterwards evaluated by the BM. Second, since at the time the interview took place we had already applied the metrics, we were able to present and discuss the resulting values. Further, we discussed the usefulness of the methods and metrics and as to which extent the measurement approach can be used to better manage the implemented ESN (evaluation of the added value). The complete interview was conducted by two researchers, recorded, transcribed and finally reduced to the most important statements for the evaluation. Finally, in this section, we discuss our contribution to ESN success measurement in general.

(1) The BM of SerCom holds a PhD and has published in the field of IS, in particular data management and data analytics, since 2000. Due to his research background and his practical experience as a board member for several years, he is a suitable candidate to evaluate our approach. After presenting each benefit and the corresponding methods and metrics, the BM was asked to rate the validity of the approach – in particular the benefits completeness and usefulness for the intended purpose, which are both common criteria to evaluate DS artifacts (Hevner et al., 2004, March and Smith, 1995). Completeness refers to the extent to which the proposed methods and metrics cover all aspects of a particular benefit (Eval1) whereas usefulness describes how good the core characteristics of a benefit are reflected by the methods and metrics (Eval2). Both criteria are rated for each individual benefit using a Likert-scale ranging from 1 (low) to 5 (high). Eval1 shows an arithmetic mean of 4.25 and a standard deviation of 0.72; Eval2 4.35 and 0.98, respectively. Both criteria indicate a good quality of our model. Only one outlier was identified: the benefit *higher recognition of high performing employees* is measured by the number of reactions held by a node. In the course of the interview, the BM explained that in the current metric, we do not address the fact that *high performing* employees are recognized. As an example, he showed us a fun post with many likes included in the current metric. In future research, we will address this issue referring to business-relevant posts only.

(2) Afterwards, we presented the resulting values to him and discussed how they could be used to better manage the ESN. For example, in regard to the measured benefit *empowering employees* and the strategic goal of SerCom “to make the employees’ voices heard at a management level” (see section

5.1), the approach can be used in three ways: first, it enables to assess if the strategic goals using the ESN are achieved. During the interview, we identified large gaps between the resulting values and the values expected by the BM, e.g., in the case of active users, a discrepancy was detected. We presented a rate of only 22% of active users, while he had been expecting a rate of about 50%. Second, the benefits and metrics are a basis to define adequate actions to be taken, e.g., actions to increase the number of active users. As a consequence, the BM thought about changing the internal communication strategy – in particular to promote Yammer more intensively and documents that all employees are required to have will be made available in Yammer. Third, the metrics can be used as part of an ongoing success measurement to see if the implemented actions are effective over time.

(3) In comparison to existing ESN success measurement approaches (e.g., Richter et al. (2013)), the approach is a meaningful complement, which analyzes ESN success from an additional perspective, i.e., Social Capital, which has only recently been identified (see Wehner et al. (2017a)). Social integration at the workplace is becoming more and more important for employees, especially when looking at the so-called Generation Y (Aksoy et al., 2013). With our approach, we provide a means to make social effects of ESN assessable and manageable. Its applicability is demonstrated and evaluated for the direct metrics (see Table 1), the demonstration and evaluation of the indirect metrics, are on our future research agenda. Even though the methods and metrics have been applied in a single case study only, they are applicable in any company analyzing ESN log-data, which include employees, their interactions, messages and group affiliations.

7 Conclusion

The aim of this paper is to operationalize the IT capability Social Capital in ESN on the basis of individual benefits to assess and better manage the social effects resulting from ESN usage (see Wehner et al. (2017a)). Therefore, we applied the Design Science approach (Peppers et al., 2007). Each benefit was presented and methods and metrics were identified. To demonstrate the applicability of the measurement model, we analyzed a dataset provided by our cooperating partner. In addition, we performed a semi-structured interview with a board member of the partner company to evaluate the measurement approach and its applicability.

Our research contributes to both theory and practice. As a contribution to theory, we first developed a measurement approach to measure the IT capability Social Capital as identified by Wehner et al. (2017a). Second, we identified methods and metrics to be used in future research to perform a multi-dimensional analysis of ESN data combining social and business-related aspects. Third, we identified several fields for further research, e.g., we see a strong need to develop a success measurement tool, which enables to monitor ESN success continuously. Fourth, from a practical perspective the measurement approach can be applied in all companies that use an ESN. Fifth, we show the applicability of the measurement approach drawing on a dataset of a company. Finally, as presented on the basis of the interview, the approach enables making decisions, e.g., to adapt the strategy regarding internal communication structures.

Our research is not without limitations. As we applied the measurement items in one company only, our results are not generalizable. Further, we only assessed the values that can be calculated using the dataset (direct metrics). Seven benefits could not be assessed, as they are based on indirect metrics. The evaluation shows that, for at least one benefit, new metrics have to be defined. In the course of our research, we came upon objects of further research. First, the mentioned limitations present a basis for further research, e.g., we will apply established scale development procedures to conduct the survey at SerCom to gather data measuring the indirect measures. Second, we will assess the dataset provided from a multidimensional perspective. Third, we will collect requirements and develop a tool, to automatize the calculation of the metrics. Fourth, as the measures are currently based on existing literature, we are planning workshops with experts to further evaluate our model with additional evaluation criteria and, if necessary, define additional measures to better cover the ESN benefits and increase the quality of the approach.

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