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There are potential limitations to the current trajectory of social network research in the IS field. The availability of large volumes of computer-readable data, inexpensive processing power, easy-to-use analysis and visualization tools (Trier, 2008; Zhang & Watts, 2010) and seemingly straightforward network measures and concepts, could lead to a narrow and limiting type of social network research gaining prominence within the IS community. Our target audience is the new generation of IS social network researcher who may pursue sophisticated mathematical analyses of ever increasing large electronic datasets, without considering the 'how' and 'why' questions qualitative methods are designed to tackle. Our purpose is to accentuate potential intellectual traps and articulate an alternative direction based on the combination of trace data with qualitative approaches. We acknowledge social network researchers have long argued for richer network analyses grounded in their social context. Thus, our vision for IS social network research is not essentially new when contrasted with thinking from the broader field of social networks. We echo the view of Kane at al. (2014) that the interaction between social media and social networks represents a new frontier for IS research. Yet, there is a danger IS scholars will develop an unintentional bias and assume quantitative analysis of large datasets computationally derived from trace data as the only way to study social networks.

Recognizing the distinctiveness and position of digitally enabled social networks vis-à-vis individuals and other social structures is central to understanding both the opportunities and the challenges presented by the evolving social network revolution. Social network concepts, methods, and theories are valuable because they enable us to move beyond isolated individuals by characterizing abstract social structures such as relationships, groups, organizations, and institutions in a form that is computationally manageable, and to consider the implications of these broader social structures. Thus, social networks provide a basis for theorizing and studying individuals in context in seemingly precise, quantifiable ways, and it is precisely because social networks can be distinguished from isolated individuals and abstract social structures that the social network approach is so appealing.

Yet, this appeal comes with limitations. Social network data, while invaluable for characterizing the ties between for example individuals, have little or nothing to say about how social networks are experienced or about how they are embedded within social, spatial, or temporal contexts. As Emirbayer and Goodwin (1994: 1446-7) note, *"Network analysis gains its purchase on social structure only at the considerable cost of losing its conceptual grasp upon culture, agency and process. It provides a useful set of tools for investigating the*

patterned relationship between historical actors. These tools, however, by themselves fail ultimately to make sense of the mechanisms through which these relationships are reproduced or reconfigured over time". Dealing with such issues has from the beginning been a matter of research design for traditional social network datasets. However, as the focus of social network analysis (SNA) research has become increasingly quantitative due to rapid advances in mathematical techniques and software development over the past decades, focus on such issues has waned.

Similar to researchers in a broad range of other fields such as sociology, anthropology, economics, politics, and psychology (Edwards, 2010), we call for a rejuvenation of qualitative SNA approaches and even for the combination of qualitative and quantitative approaches at both the data collection and analysis levels (Crossley, 2010). While we acknowledge the tremendous opportunity afforded by accessible network data, our purpose in this commentary paper is to explore the potential dangers inherent in the trace data driven approach. First we highlight how the social network perspective has contributed to our understanding of IS phenomena. Next we review mixed methods research in IS social network research. Following this we present an agenda for future IS social network research, building upon the work of Kane et al. (2014), and suggest how qualitative approaches can best complement trace data in addressing focal social network questions. We then conclude by discussing some of the challenges for IS researchers in conducting qualitative studies of digitally enabled social networks.

2. Social Network Concepts in IS research

Social network analysis and theory has its origins in sociology and anthropology. Early network scholars distinguished themselves from other social scientists by focusing not on individuals as entities, or abstract collections of individuals, but by exploring how particular social structures constrain or promote human behavior (Rogers, 1987). The social structure of interest manifests itself in the pattern of relationships between network actors, patterns that may not even be apparent to participants. As such, *"Network analysts search for deep structure - regular network patterns beneath the often complex surface of social systems"* (Wellman, 1983: 157). Ronald Burt's work on structural holes (Burt, 1992) is an exemplar of the social network tradition. Burt argues that gaps in a social network, or structural holes, create brokerage opportunities where competitive advantages accrue to the individual whose relationships span structural holes. In this way, Burt and other social network researchers

seek to explain larger social phenomena such as status differences and variable access to resources. The objective is not simply to identify social network structures but also to use the network measures and constructs to address fundamental questions about the nature and functioning of larger social systems.

IS researchers have been attracted to social network theory for its potential relevance to a variety of IS research problems, such as knowledge transfer, collaboration, and performance. It is important to note that network trace data in IS research is not essentially new. For example, over 20 years ago, Rice (1994) examined how network position influences performance in R&D settings through the analysis of computer monitored email usage patterns. What is new, and what has the potential to impair the value of network research, is the sheer volume and ease of access to social media driven datasets. Below we highlight the influential IS social network research and group them based on the two main ways they influence IS research. While our classification is certainly not exhaustive, it serves our purpose of revealing the central contributions of IS social network research.

IS-relevant structures in "traditional" organizational settings

Studies in this vein consider how IS shapes, and is in turn shaped by, social networking activities within and between organizations. Within formal organizational settings, scholars have revealed the nuanced ways through which the introduction of IT alters the flow of information within networks and, hence, enable people to adapt formal organizational structures, decision making, and power relationships (Burkhardt and Brass, 1990; Barley, 1990; Whelan and Teigland 2013; Wu, 2013). For example, in a study of the electronic communications of 8,037 employees over 2 years, Wu (2013) concludes that information-rich networks enabled through the use of social media can drive both work performance and job security, but that there is a tradeoff between engaging in friendship communication and gathering diverse information. Other researchers have conceptualized the user-system relationship as a multimodal network with multiple users interacting with multiple systems (Kane & Alavi, 2008; Contractor et al., 2011). Empirical evidence produced by these studies demonstrate that the movement of an information system to a more centralized position within a social network enhances both efficiency and quality outcomes (Kane and Alavi, 2008) while also altering the position of human actors in ‗what' and ‗why' advice seeking networks (Contractor et al., 2011). Expand…

Structures and behavior in IS enabled forms of organizing

Due to the advances in IT, we now have the ability to collaborate and interact with participants in our social network without ever resorting to face-to-face contact. Such virtual forms of organization afford users many capabilities not possible in offline networks, such as network visualization, participant and content search, larger networks, reputation promotion, and quicker information access (Kane et al, 2014). The performance implications emanating from these new capabilities have intrigued IS researchers. Studies have brought the social network lens to bear on the pattern of ties in virtual groups (Ahauj, Galetta, and Carley, 2003), e-mail networks (Aral and Van Alstyne 2011; Rice 1994), social media platforms (Gray et al. 2011; Wu, 2013), and open source projects (Hahn et al., 2008). Research has also drawn from social network methods to shed light on how the ̱fabric of organization‘ (Zammuto, et al 2007) in online communities is woven. For example, Moser et al. (2013) find that communicative genres fulfill the role of intangible organizing structures in online communities. Likewise, Crowston and Howison (2005) find that the social structure of open source software projects is not all that different to other organizational forms. Expand

In sum, social network theory and methods have been adopted, and extended in a variety of ways, by IS research. But as alluded to in table 1, the current trajectory IS social network is very much in the realm of sophisticated data mining and mathematical techniques, coupled with analyses of massive digital datasets. There is certainly merit in such approaches but also dangers which the new generation of social network researcher may not consider. We now elaborate on the contribution of interpretivist research approaches to the study of social networks.

3. Tracing the Use of Interpretivist Approaches in SNA Research

The first SNA studies were ethnographic explorations conducted by anthropologists interested in the structures of kinship and interpersonal relations (Barnes 1954; Bott 1957; Mitchell 1969). Ever since, a long tradition of using interpretivist approaches to investigating face-to-face social networks and organizational dynamics has developed (e.g., Barnes 1954, Roethlisberger & Dickson 1939; Uzzi; 1997). Uncovering and understanding meaning is of central interest to interpretivist researchers. Beyond the diversity of their methods, interpretivist approaches share two tenets: 1) meaning cannot be separated from its context, i.e., a specific frame of reference, and 2) the researcher should be open to the subject matter with any previous understandings being considered preliminary (Hollstein, 2011). Thus, interpretivist network studies focus on examining issues such as how networks

are influenced by culture, narrative, content, and context (e.g., Edwards, 2010; Emirbayer and Goodwin 1994), and they provide a unique basis for studying questions that cut across individual-network and network-organization/group boundaries.

Similar to all research approaches, interpretivist research has its own weaknesses when applied to social networks. Interviews, archival analysis, and participant observations are unable to map and measure certain aspects of social relations in a systematic and precise fashion. Likewise, collecting network data through qualitative means can be extremely time consuming often resulting in a small number of participants. But it is precisely those limitations where quantitative SNA approaches excel, particularly those employing digital trace data. Today researchers within numerous fields are promoting qualitative approaches as a complement to quantitative ones. As noted by Crossley (2010:21), *"Network structure is not the whole story...and for that reason we need to supplement methods of formal network analysis with qualitative observations about what is "going on" within a network".* In other words, quantitative approaches helps to grasp the structure of relations – the outsider view of the network. It can complement qualitative research which explores the insider view of the network (Jack, 2010). Mixing methods in IS research also seems to be relevant as some of the most promising findings about digitally enabled social networks arise from multi-method approaches, as advocated in Urquhart & Vaast (2012), and illustrated in O'Mahony & Ferraro (2007), Gibson (2005), Moser, et al. (2013), Whelan and Teigland (2013), and Parise et al. (2015).

In addition to helping address the quantitative limitations, interpretivist approaches also lead to significant new insights and theory generation. A review of the literature from other relevant fields reveals three areas where interpretivist approaches have recently led to theory development: 1) network dynamics, 2) network multidimensionality, and 3) the role of embeddedness and trust in networks. First, network dynamics are attracting increasing interest from both qualitative and quantitative researchers alike as evidenced by a 2012 special issue of *Organization Science* focusing on network dynamics (Ahuja et al. 2012). The emerging work on *network dynamics*, which has been primarily conducted at the team and organizational levels, has been categorized into three research questions: 1) how does the life cycle of ties (young versus old ties, imprinting ties, or those acquired later) impact performance outcomes, 2) how do tie formation and dissolution influence network change and development, the most common approach to date, and 3) how do entire network structures evolve (Bensaou et al., 2014). Research to date suggests that human agency has a

significant role in network genesis and development and as a result that social networks are more flexible and plastic than cross-sectional studies may assume (Ahuja et al., 2012; Bensaou et al., 2014). In a fascinating longitudinal study combining content analysis of electronic communications with a massive repository of trace data, Wu (2013) concludes social media can induce a change in network structure over time. Future IS social network studies could learn much from Wu's innovative combination of qualitative and quantitative approaches.

Studies of social capital have also employed interpretivist approaches to address the limitations of agency and endogeneity inherent in quantitative approaches (Bensaou et al., 2014). Agency is the notion that actors purposively enact their social structures, also generally known as agency behavior (Emirbayer and Mische 1998; Burt 2005), by choosing or not choosing to establish connections with certain other actors in their networks, by forming or dissolving network links, or by strengthening or weakening relationships (Ahuja et al., 2012). With reference to endogeneity, network research tends to be static, often failing to take into account that networks are dynamic - configurations of people as opposed to collectivities with definite boundaries (Crow, 2004:8), and have even been conceptualized as a support convoy that alters in shape and texture over time as new people join the convoy and others exit (Antonnuci, 1985; Heath et al., 2009). In a longitudinal study based on interviews of 53 service professionals, Bensaou et al. (2014) developed the key insight that through creative interpretation and choice that leverages cultural attributes, agency is an important force in individual networking and network genesis. Their findings further demonstrate how individuals employ distinct schemas, beliefs, and values in their personal networking strategies. While certain strategies are natural to some individuals, these same strategies make others cringe‖. This longitudinal research thus also answered important questions related to endogeneity by clearly pointing out that individual networking strategies cannot be simply explained by prior network positions (e.g., dense versus sparse structures) and that these discovered networking strategies subsequently influenced the network structure and networking activities of these actors.

IS network scholars would be well advised to ground themselves in the variety of interpretivist studies revealing the significant role that different types of ties or *multidimensional network structures* have on organizational outcomes. For example, one study focusing on the role of multiplex relationships in innovation dynamics, conducted an analysis of 25 interviews of CEOs and second-tier managers to reveal that not only is the

diffusion of innovation enabled by personal (as opposed to professional) relationships, but that the contexts, i.e., communication channels, locations, and social environments, in which strategic activities occur differ from those in which operational and innovation activities occur. In other words, the locus of strategy is not the locus of innovation as the multidimensional network is characterized by each dimension playing a different role in supporting specific activities (Ceci & Iubatti, 2012). A second study employing a grounded theory approach collected social network data through semi-structured interviews within supply chain management (Gligor & Autry, 2012). Twenty-six managers from nine different companies yielding 16 dyads were interviewed and results indicated that personal relationships facilitated communication between buyers and sellers of logistics services and that this enhanced communication process led to superior business performance.

One study looking at both network dynamics and multidimensional network structures in the context of new product development was based on a longitudinal case study of a semi-conductor multinational (Simon & Teller, 2011). Analysis of 67 interviews combined with social network data collected through a survey and secondary sources revealed that actors' behaviors and motives affect the evolution of their social network and the idea development process. Four phases of idea development were identified with actors' motives to exchange information differing across the phases, and similar to the previous study by Ceci & Iubatti (2012), individuals used different networks for different activities in each of the phases.

The third primary strand of interpretivist research deals with the role of *embeddedness in social networks*. One study investigated inter-firm learning by analyzing data collected through 26 interviews and observations from 11 banks in Chicago (Uzzi & Lancaster, 2003). Findings revealed that when arm's length ties connect firms, they tend to transfer public knowledge and stimulate exploitative learning while when embedded ties connect firms, they tend to transfer private knowledge and engage in exploratory learning. A second study of an R&D alliance in the US using interview, observation, and network survey data from seven organizations revealed a three-way interaction among trust, motives, and relationship governance, a dynamic previously missing in the alliance literature (Stephens et al., 2009). Findings indicated that the potential benefits to be gained from allying with another firm were found to be more important in driving the creation of the alliance relationship than the need for a trusted partner or strong governance.

Having considered the efficacy of combining interpretivist approaches with trace data to enhance network insights, we now provide a case illustration focusing specifically on social media research. Deeper, richer insights will almost certainly emerge if the network researcher takes the time and effort to combine trace data studies with qualitative techniques. It is to the enrichment of SNA with qualitative approaches we now turn.

4. Illustration: Qualitative Methods in Social Media Network Research

In an analysis of intersection between traditional social network research and social media technologies, Kane et al. (2014) develop a precise set of research questions, which if addressed, can lay the groundwork for a robust social media agenda potentially spanning multiple disciplines. In the remainder of this article, we build upon the valuable work of Kane et al. (2014). Specifically, as detailed in table 2, we take a set of the questions posed and posit how they can be best addressed through a combination of trace data and qualitative approaches.

Table 2 – Addressing social media research questions through the combination of trace data and qualitative approaches

Research question (taken from Kane et al. 2014)	Pertinent data sources and methods	Possible execution
1.		
1. How do different types of ties (e.g., proximities, relations, interactions, flows), individually and in combination, affect users' networking behavior and shape the formation and characteristics of social media networks?	Quantitative • Analysis of online photo tags and subgroup membership as detailed on sites such as Facebook. See Lewis et al. (2008). • Sophisticated content analysis such Dirichlet Latent Allocation. See Wu (2014). Qualitative • Participant observations. See Martinez et al. (2003) • In-depth interviews. See Whelan and Teigland (2013).	A future study could combine trace data, content analysis, and interviews. Trace data can be extracted from a platform such as Facebook to determine how a network evolves over time. Content analysis can be conducted to divide the multiplex network into component and overlapping networks of interest e.g. friendship network, work network. Follow up interviews with specifically identified participants to focus on understanding how different types of ties influence networking decisions.

2. How do the features of relational ties (e.g., symmetry, allowable number) affect users' networking behavior and shape the formation and characteristics of social media networks?	Quantitative • Large-scale longitudinal social media trace data. See Aral and Walker (2014). • Longitudinal analysis of messaging behavior through use of trace data. See Rice (1982). Qualitative • Focus groups of social network participants. See Fox and Moreland (2015)	A future study could use a combination of trace data and focus groups. A large-scale experiment can be conducted on a social media platform whereby relational tie features are tweaked for certain groups (e.g. differing network size limits). Please note, the ethical issues of experimenting with social media users to illicit certain reactions needs to be fully considered (the Facebook newsfeed experiment to influence emotions generated much controversy). Follow up focus groups with users can focus on understanding why relational tie features influence the observed network formation.
3. What tie features are missing from social media platforms (e.g., strength, affect)? How might these features affect users' networking behavior and shape the formation and characteristics of social media networks?	Quantitative • A large-scale social network experiment with randomized trials. See Aral and Walker (2011) and Centola (2010). Qualitative • Qualitative content analysis of online interaction. See Ellison et al. (2006).	Future studies could conduct randomized experiments on a social media platform to compare how the presence and exclusion of certain tie features impacts user behavior and formation. Qualitative approaches, such as content analysis, can then be conducted to analyze social media exchanges to determine the strength and affect (whether positive, neutral, or negative) of each relationship.
4. How do the features of the user profile (e.g., content type, digital trace, third-party contributions) affect users' behavior and influence the way content spreads across a social media network?	Quantitative • Analysis of interaction and engagement as detailed on sites such as Facebook. See Lewis et al. (2008). Qualitative • Netnography (conducting ethnography on the	Future studies could access trace data to uncover, for example, the role of social media ‚lurkers'. Combined with netnography could reveal a deeper insight into what they contribute and take from social media, and how they influence the spread of content.

	internet). See Kozinets (2010).	
5. How do people use information about the network structure provided by social media platforms to develop structural capital, and how does this use result in performance variation between users?	Quantitative • Exponential random graph models (ERGMs) and simulations to examine online relationships. See Chesney (2014). • Sophisticated content analysis techniques such as Latent Dirichlet Allocation. See Wu (2014) Qualitative • In-depth interviews with egos and alters. See and Teigland (2013).	For example, to determine how the network visualization capabilities afforded by social media systems influence networking behaviors, in-depth interviews with system users could first be conducted. The insights from the qualitative approach can then be used to a build a more accurate simulation of user responses to network visualization capabilities.
6. How and why do people use (or not use) computer-aided networking recommendations to develop structural capital, and how does this use result in performance variation between users?	Quantitative • Trace data of who interacts with whom and what content through social media platforms. See Parise et al. (2015) • Sophisticated content analysis techniques such as Latent Dirichlet Allocation to determine content diversity inherent in one's network. See Wu (2014). Qualitative • Interviews and focus groups with system users • User network communication diaries. See Baym et al. (2004).	For example, to determine if social media algorithms lead to filter bubbles, standard SNA measures such as density and transitivity can be used to measure the diversity of information inherent in peoples' online networks. These measures can then be compared with performance data (e.g. billable hours, idea quality ratings etc.) To gain a deeper insight into impact of recommendation systems, communication diaries of a small number of participations can be analyzed for evidence of impact.

Research question 1 – Different types of ties

Understanding what a particular relationship between entities actually means requires a interpretivist study of it. For example, despite the name, it would be foolish to act as if two

Facebook friends are necessarily friends in any traditional sense. The question then arises, what exactly is the social meaning of that particular association? How does the data that link two people (or user accounts in this case) map onto the features that, in the past, have been associated with social ties? While it might be the case that researchers general intuitions are sufficient to determine this, conducting in-depth qualitative studies of these ties is important if we are to be able to use the trace data in rigorous, generalizable ways.

At the same time, we should not assume that prior concepts for characterizing social ties are either complete or sufficient. Qualitative studies of the social ties and networks in and around social media platforms should be conducted with an eye toward developing novel and better ways of conceptualizing social ties. For example co-presence ties are based on a particular model of place/space. However, in social media systems the design space for interaction and place is significantly different than in physically-based social systems. As a result, we should be open to the idea that our existing ways of describing the mechanics and the semantics of social ties may be either insufficient, or at least poorly suited for this brave new world. Asking how else we might describe the semantics of social ties - what other features might matter or types might exist - is one way that qualitative network studies have the potential to significantly contribute to not just social media studies, but to studies of social activity and context more generally.

Early methodological studies of individual responses to social network instruments demonstrated that subjects could not reliably recall specific interactions or events. Instead they provided generalized responses that indicated network ties and what - typically occurred (Bernard et al. 1982; 1984). Trace data do potentially enable a more reliable basis for a network tie; however, several issues with this were raised above. For example, while Facebook data might be used to construct more nuanced measures, tie strength is socially constructed, which calls for the use of qualitative approaches to decipher the meaning actors attach to their connections. Thus, rather than focusing exclusively upon trace data, IS researchers can use trace data as one of several means to define ties and to develop an understanding of the social context they are considering (e.g., Moser, et al., 2013). For example, in investigating tie intensity in online environments, the traditional social anthropological methods of observation and in-depth interviewing in person, the phone or electronically, will most likely be more fruitful (see Vaast & Walsham 2009 as an example). Indeed, we would advise researchers interested in addressing these and similar questions to

consider adopting the innovative approach to content analysis for conceptualizing social networks developed by Ceci and Lubatti (2012).

Research Question 2, 3 and 4 - Features of relational ties

Social ties can be thought of as either objective phenomena (something that has defined specific features) or subjective (something that has features only to the degree that they are accepted/understood/constructed by the participants). Simply asking what social ties are present or what their features are is not likely to be sufficient to answer questions about how social ties affect user behavior and the resulting networks. Rather it will also be necessary to ask and answer questions about how individuals' experience different relational ties, and how those experiential differences affect behavior and larger network dynamics.

For example, it has been noted in past research that high status individuals experience relational ties differently than low status individuals. An intern having a hallway conversation with a Prime Minister is likely to see the encounter as highly significant, remember it, and be significantly affected by it. On the other hand, it is less likely that the Prime Minister is even likely to realize that a relational tie has occurred. The same relational tie may have fundamentally different effect on individuals. Qualitative studies of individuals' experience of social media ties and networks are important for uncovering these experiential differences, which can than be developed further with appropriate trace data studies. Understanding the relationship between characteristics of social media platforms and social ties will necessarily require close readings of the interfaces, data structure, and systems themselves. As noted in Wanda Orlikowski's recent OCIS keynote address at Academy of Management 2015 Annual Meeting - the platforms, systems, and technologies that we are discussing are no longer simple devices. They are complex, highly distributed, contingent systems that change on an almost continuous basis. Qualitative studies of the platforms themselves are necessary to develop more complete and nuanced ways of describing the platforms and what it means for a tie feature to be present or absent from the system.

A long-standing management and sociology question has been "Do networks make institutions sustainable or do organizations and institutions make networks sustainable?" This is an instance of the more general issue of understanding how social interactions and relationships affect, and are affected by the larger socio-technical systems in which they are

embedded. With the advent of social computing systems, it now becomes a critical IS question, and one for which qualitative research can offer significant insights. Such ubiquitous computing systems make it far more difficult to separate peoples' interactions with other people from peoples' interactions with technologies. Networks based solely on trace data, while offering interesting insights, necessarily oversimplify these complex interactions. Consequently, it may make more sense to treat technologies and interaction with them as endogenous to social networks, rather than as exogenous to them (Contractor *et al.,* 2011). As noted by Contractor *et al.* (2011), instead of asking how digital technologies might alter social networks, a more appropriate question is "What happens when a new technology becomes a part of a social network?" Trace data combined with deep interpretive studies, and particularly those characterized by ethnographic data, are necessary to address the influence of relational tie features and truly capture the complex socio-technical dynamics inherent in these important organizational forms. An exemplar in this vein is the Park and Kluver (2009) study of the blogs of Korea's National Assembly members where a hyperlink network analysis was followed with interviews of blog authors designed to help explain changes in online network behavior over time.

In the initial rush to capitalize on the data gold mine presented by social media sites, researchers have often overlooked a critical issue. While all social network data by definition share a common structure (dyadic relations between nodes), are manipulated with common techniques (matrix algebra), and can be characterized in terms of common measures (centrality, degree, density, etc.), the reality is that in most cases each type of network data represents a different phenomenon and is embedded in different socio-technical contexts. Facebook friend links are semi-publically announced, unilaterally initiated, bilaterally accepted indications of association that provide the parties with access to information spaces containing items provided by the involved individuals. In contrast, the response network for an online discussion forum, which is just as much a network structure, is the representation of a unilaterally initiated, communication event between two or more individuals that is visible to all participants in the forum. While these two social media networks are structurally identical, they are conceptually completely different. Although the methods used to capture and analyze them may be similar, there is little or no basis for considering them to be theoretically comparable or related.

The availability of many new types of network data forces us back to basic questions about

what the data are measuring and how those constructs and phenomena relate to other constructs and phenomena of interest. Does having a behavioral trace that is seen by others facilitate or hinder the formation of advice seeking and advice giving ties? How do public network declarations affect formation and maintenance of social relationships? When does a public declaration of a friendship strengthen it and when does it weaken it?

Research Question 5 and 6 - Information about the network structure

While data collection methods employed prior to the advent of trace data presented methodological challenges for social network researchers, studies using these data uncovered basic facts about how individuals know their context. Such insights have been carried forward and expanded by work on socio-cognitive structures that consider the individual's knowledge and perception of his/her position and surrounding networks (Carley & Krackhardt, 1996; Krackhardt, 1987; Mehra et al., 2001). These studies have repeatedly found that some individuals have more extensive and more accurate knowledge of the networks in which they are embedded, while others are simply confused by these structures. This knowledge varies with individual dispositions such as self-monitoring (Mehra, et al., 2001) and network position and status (Krackhardt, 1990).

With the advent of social media platforms, new questions emerge about how these systems and the interactions that take place within them affect individuals' perception and knowledge of their social networks. Does the embedding or recording of social ties in a social networking system, such as Facebook, change individuals' perceptions of their positions and the networks around them? Are individuals more or less able to discern the patterns of social behavior in online environments? The ability to retrieve, visualize, and manipulate data about social behaviors and networks might facilitate the formation of more accurate and more extensive knowledge of an individual's social position and the networks around them. For example, Facebook, LinkedIn, and Google+ make some aspects of social networks concrete and immediately visible, and visualization tools such as InMaps, TouchGraph, NodeXL and Microsoft's Academic Search provide graphic representations of networks easily and inexpensively while Klout provides a relative measure of an individual's influence within social networking sites. What is the impact of these platforms and tools on an individual's network knowledge and behavior? Do users of these systems know their networks better? Can they see the structures around them and around other people? In this technology saturated world, what affects the accuracy and extent of an individual's

knowledge about his/her social context? What are the consequences of strong (or weak) knowledge of social networks for individuals and the networks within which they are embedded? Questions of this nature are best addressed with an interpretivist toolkit.

No matter what the knowledge outcomes of online social networks are, they lead to a second set of questions regarding the implications for individual behavior and experience of the social setting. Do prior findings that individuals with more accurate and more comprehensive knowledge of the social networks around them are better able to leverage those networks still hold in technology-enabled environments? Is delegated knowing sufficient for these outcomes? What happens to the social systems if all participants have significantly improved knowledge of the social network? Such questions can only be answered though a multi-method approach combining trace data with interpretive insights.

Another critical question is whether an increased knowledge of social networks, either individually or collectively, is necessarily desirable. Social overload studies suggest that individuals faced with an overwhelming complex set of relationships will feel real stress and anxiety and may opt to cut back on interactions, or even abandon a social setting as a result (Baum et al. 1982). If online social environments make forgetting ties less feasible, does this alter the nature of ties and potentially change the behavior of those involved? How do individuals, who otherwise would not develop and maintain knowledge of their social network, respond when faced with technologies that capture that information and forcefully present it back to them? Whether positive or negative, desirable or not, digital technologies are changing how individuals know their social networks and with that how they experience the social worlds in which they live. Further research is needed to better understand how individuals experience and respond to these fundamental changes in their social environments. Our belief is that such questions are best address with a mixed method approach. And it is to the challenges of mixed methods in IS network research, with our suggestions to overcome them, we now turn to.

6. Challenges to Conducting Mixed Method Studies of Digitally Enabled Social Networks

Mixed method researchers examining digitally enabled social networks face several challenges. First, interpretivist research requires that researchers remain open during data collection to ensure that relevant data are not excluded beforehand and to allow the

contextualized meaning to unfold as fully and deeply as possible. One clear challenge to the first requirement in evolving digital contexts is how to define the network boundary, i.e., which individuals are included in a network and which are not? How is membership to be defined and what degree of participation in a network and over what time period signals that an individual is a member or not? While it is common to refer to some technology platforms, such as Facebook or Twitter, as social networking sites, it is problematic to assume that the interactions, relationships, and contacts recorded in these sites are comprehensively representative of a larger or more influential social structure without substantive evidence to support this claim. This problem is not unique to network studies using digital trace data. Studies of inter-locking boards, co-authorship, citation, and co-attendance networks have presented similar challenges to the network researcher. Without careful studies examining how the measured networks relate to social groups, organizations, and communities across which they span or within which they are embedded, our ability to understand the implications of network studies of digitally enabled networks will be limited.

Although it might seem the comprehensive nature of online records make boundaries a non-issue, in fact the opposite is the case. In face-to-face networks, it is neither feasible nor possible to continually expand network boundaries because the effort required necessarily introduces constraints. In contrast, in digitally enabled networks the availability of logged contacts, trace data, and even relatively easy access to interview participants creates the temptation to expand data collection, regardless of whether or not it contributes to the theoretical objectives of the study. Yet boundary issues significantly affect the questions that can be asked and the interpretations that are likely to arise and thus should be considered during the design phase of the research. As with all types of social network studies, if the researcher has secured full access to a network, then restricting investigations to only those who have participated above a pre-decided threshold level will lead to a different set of findings than investigations in which all members, regardless of their level of activity, are included. The phenomena and processes a researcher seeks to investigate and which types of theoretical contribution he or she intends to build must inform the selection of network boundaries, even if the availability of data does not constrain them.

In the IS literature, there is a general consensus that digitally enabled networks are social networks. With the widespread availability of trace data to quantify a social network, our fear is that IS scholars could assume data linking two actors reflects a meaningful social tie. In other words, the correspondence between connected records and social relationships

might not be rigorously questioned. Tie definition and strength is a central feature of social network research and if it is not given due consideration by IS researchers, the findings they report will be subject to validity concerns. Some of the original studies of online networks assessed tie intensity by asking questions such as - How close do you feel to this person? and —How often do you get favors or advice from this person? (Cummings et al., 2002). Trace data offer many advantages to the network scholar, but in their basic form they cannot distinguish links based on psycho-social measures. That is not to say trace data from platforms such as Facebook cannot be leveraged to confirm the existence or strength of a network connection. For example, one person can take a photo of another, then upload and tag it (i.e. identifying those who appear) on Facebook. The public act of posting a photo of another suggests one person wishes their relationship with the other to be publically recognized. This approach was employed by Lewis *et al.* (2008) in their innovative study of subgroup interactions among college students. Likewise, geo-location data from platforms such as Foursquare can be extracted to determine if, and how often, people interact.

A second challenge that is more specific to digitally enabled social networks involves the nature of the data to be collected. Grounded researchers usually design their studies to develop an in-depth understanding of their research object, and therefore often rely on participant observation. In traditional face-to-face network research, qualitative data collected through participant observation or even interviews include any act of expression such as a verbal utterance or physical gesture that allows inference about the context (Hollstein 2011). However, in researching digitally enabled social networks, much of the data collection occurs online, through avatar or participant observation, text chats, or audio interviews (e.g., Teigland 2010). Thus, qualitative researchers interested in digitally enabled networks must explore and make sense of new forms of data, including emoticons, avatar scripts such as waving, and video/audio conferencing. Many studies make use of opinion mining or machine learning techniques to make inferences. Gaspar et al. (2016) argue there are however limitations to this type of sentiment analysis of massive datasets due to the a priori assumptions behind this approach, namely that: 1) sentiment is a one-dimensional concept characterised by valence (positive, negative, neutral, ambivalent), 2) circumscribed to a small set of emotions (e.g. fear, anger, surprise) and 3) expressed with no visible/explicit goal or function, or even "irrationally". In their study of social media reactions to 2011 EHEC food contamination incident in Germany, Gaspar et al. (2016) conducted both quantitative and qualitative sentiment analysis of Twitter discussions. Affective expressions

in the Twitter dataset varied not only in terms of positive or negative valence but also in terms of the form in which it was expressed and the function it may have served. Consider the following tweet: *My government is staying on top of things and informing me the latest on the E. coli outbreak here in Germany. #thanks.* Taken in its full context, a human can infer the tweet is written in a sarcastic tone to express distrust. Computer based approaches which extract keywords would more likely categorise the same tweet as a positive affirmation. Thus, questions regarding how sentiment pervades throughout social networks, particularly in response to unexpected events, can only be addressed through a combination of computer and machine-based approaches.

Third, researchers need to be especially attuned to ongoing transformations and to adjust their methodological perspectives and toolboxes to unearth the emergence of meaning and the changing trajectories of digitally enabled social networks (e.g., Urquhart and Vaast 2012). Whenever adopting a qualitative stance, the researcher takes on the roles of explorer and cartographer of a new terrain (Kozinets, 2010: 179). In the case of digitally enabled social networks, this terrain is continuously being shaped and reshaped as networks emerge, form, mutate, and recede to be replaced by new ones. Technological developments, such as the ability to participate ubiquitously through one's smartphone or immersively through an avatar (e.g. Schultze & Orlikowski 2010; Wasko et al., 2011), contribute to the dynamism of social networks. So too do changes in language, expressions, social behaviors, and coordinating practices of network members who interact both with one another and with the technology to evolve in an intertwined way (e.g., Hanseth et al., 2004). For example, a recent study of an online community investigating how the system's features interacted with the members' technology capabilities and differing agendas to shape member participation, illustrates such reflexive engagement with the methodological opportunities and challenges of studying digital social networks (Germonprez and Hovorka, 2013). Additionally, research questions directed at understanding why certain views prevail in large online networks, are best addressed using a multi method approach. Using tweets mentioning the Republican party, Shneiderman et al. (2011) famously showed in one SNA visual how massively polarized the online world can be, with the majority of people only connecting with information confirming their existing beliefs. While certainly an innovative way to make use of social media data, the Shneiderman study (and the many others in a similar vein) does not explain why certain deep-seated opinions prevail, even when rival and critical opinions are only a click away. We advise researchers interested in discovering 'why' to adopt a

multi-method approach. The combination of network trace data with netnography could yield powerful insights. Netnography is the branch of ethnography that analyses the free behaviour of individuals on the Internet (Kozinets, 2010). In a netnographic approach, the researcher becomes emersed in the natural online network to observe the textual discourse. When combined with SNA measures of the evolving network structure, netnography can provide deeper perceptions of the underlying network sentiment and how it became so.

Fourth, there are also critical questions about privacy, anonymity and identity (Wasko et al., 2011; Kane et al. 2014). Individual participants in traditional social network studies tend not to be anonymous since the nature of the method generally requires the identification of each individual. In digitally enabled social networks, issues of identity and anonymity arise and take on new shapes. While the researcher may have an email address or avatar name for the individual participant, the real world identity of the individual may be disguised. For example, a participant may have a young, blonde, male avatar with a male voice, yet the real life person behind may be using voice distortion software and may be of a different age, race, and even gender. In a closely related way, the study of digitally enabled social networks raises considerable ethical challenges for researchers and in particular for grounded theorists. Researchers may have access to all previous and ongoing communications within a network as well as other information about the individual network members from their profiles on social networking sites, e.g., LinkedIn, twitter. This wide access to online interactions blurs the perception of what is private and what is public information (Buchanan & Ess 2009) and even transforms the nature of the relationship between field researchers and field participants (Schultze & Mason 2011). Finally, researchers of these contexts also need to be very aware of often highly specific and changing terms of service that dictate what data may or may not be collected and used for publication. Qualitative approaches to social network investigation, in part because they are considered less intrusive, are usually less frowned upon than automatic algorithm-led data collection (Allen et al., 2006). However, concerns do exist and change over time, and terms of services can have ethical and legal ramifications regarding what researchers can and cannot do with their data.

Whether and how the various issues presented above impact researchers studying digitally enabled networks remains an open question and should be decided according to the specifics of each research project. We, however, urge all researchers of digitally enabled social networks to consider these issues explicitly during the research process as well as in public forums such as in academic conferences and publications. A mixed-method approach

enables researchers to both map and measure network properties and to explore issues relating to the construction, reproduction, variability and dynamics of network ties, and crucially in most cases, the meaning that ties have for those involved.

7. Conclusion

The availability of extensive sources of social network data create rich opportunities for IS research. It can provide invaluable insights and allow us to develop sophisticated methods. It also creates the impetus and basis for engaging fundamental questions about how technology affects the way individuals experience the social worlds in which they live and how IT shapes, and reshapes, the larger social world around us. However, to truly exploit these opportunities IS research needs to broaden its horizons. We need to fully leverage foundational studies from sociology and anthropology and have clear conceptualizations how meaning can be extrapolated from the study of online network structures. We see a potential danger facing the field. In a race to analyze the biggest dataset of nodes and edges with the most sophisticated quantitative techniques, IS researchers may fail to fully appreciate the theoretical richness and conceptual depth of the social network tradition, and disregard the value of qualitative research approaches. The challenges we identify are certainly not insurmountable for the network researcher intending to extract insight from large sets of digital trace data. Interpretative research approaches are well suited to providing the rich and deep insights needed to describe and analyze the organizational impacts of technology mediated social networks, and the technical, economic and behavioral challenges they face. In this paper, we have articulated the enormous potential for interpretive research, particularly when combined with digital trace data, and identified the challenges that IS researchers need to address when contemplating such studies. Our hope is that doing so will help stimulate a greater appreciation for the social network tradition and how the combination of trace data and interpretive approaches can advance our understanding of social networks constructed on technology platforms.

References

Ahuja, M. K., Galletta, D. F., & Carley, K. M. (2003), Individual Centrality and Performance in Virtual R&D Groups, *Management Science*, 49, 21-38.

Allen, G. N., Burk, D. L., & Davis, G. (2006) Academic data collection in electronic environments: defining acceptable use of internet resources. *MIS Quarterly*, 30, 500-510.

Antonucci, T. (1985) Personal Characteristics, Social Support, and Social Behaviour', in R. Bistock and E. Shanas (eds) *Handbook of Aging and the Social Sciences*. NewYork: Van Nostrand Rheinhold and Company.

Aral, S. & Van Alstyne, M. (2011) The Diversity-Bandwidth Tradeoff. *American Journal of Sociology*, 117, 90-171.

Aral, S. and D. Walker (2011). Creating social contagion through viral product design: A randomized trial of peer influence in networks. *Management Science* 57(9): 1623-1639. (2011)

Aral, S. and Walker D. (2014) Tie Strength, Embeddedness & Social Influence: A Large-Scale Networked Experiment. *Management Science*, 60(6): 1352 - 1370. (2014)

Barley, S. (1990). The alignment of technology and structure through roles and ritual. *Administrative Science Quarterly*, 35, 61-103.

Barnes, J A. (1954). Class and committees in a Norwegian island parish, *Human Relations*, 7, 39-58.

Baum, A., Calesnick, L. E., Davis, G. E. & Gatchel, R. J. (1982) Assessing the political landscape: Structure, cognition, and power in organizations. *Journal of Personality and Social Psychology*, 43, 821-830.

Baym, N., Zhang, Y. B., & Lin, M.-C. (2004). Social interactions across media: Interpersonal communication on the Internet, telephone and face-to-face. New Media & Society, 6, 41- 60.

Bensaou, B.M, Galunic, C., and Jonczyk-Sédès, C. (2014) Players and Purists: Networking Strategies and Agency of Service Professionals. *Organization Science* 25(1):29-56.

Bernard, H.R., Killworth, P.D., & Sailer, L. (1982) Informant accuracy in social-network data: An experimental attempt to predict actual communication from recall data. *Social Science Research*, 11, 30-66.

Bernard, H.R., Killworth, P.D., Kronenfeld D. & Sailer L. (1984) The problem of informant accuracy: The validity of retrospective data. *Annual Review of Anthropology*, 13, 495-517.

Borgatti, S.P. & Molina, J.L. 2005. Toward ethical guidelines for network research in organizations. *Social Networks*, 27, 107-117

Bryman, A. (2006) Integrating quantitative and qualitative research: how is it done, *Qualitative Research*, 6, 97–113. Buchanan, E.A, and Ess, C.M. (2009) Internet research ethics and the institutional review board: current practices and issues, *ACM SIGCAS Computers and Society*, 39, 43-44.

Burkhardt, M.E. and Brass, D.J (1990) Changing Patterns or Patterns of Change: The Effects of a Change in Technology on Social Network Structure and Power, *Administrative Science Quarterly*, 35, 104-127.

Burt, R. S. (1992) *Structural Holes: The Social Structure of Competition*. Harvard University Press, Cambridge, MA. Burt, R. S. (2010) Structural holes in virtual worlds. Working Paper: University of Chicago Booth School of Business. http://faculty.chicagobooth.edu/ronald.burt/research/index.html

Carley, K. M. & Krackhardt, D. (1996) Cognitive inconsistencies and non-symmetric friendship. *Social Networks*, 18, 1-27.

Cecia, F. and Iubattib, D. (2012) Personal relationships and innovation diffusion in SME networks: A content analysis approach, Research Policy, 41, 565-579.

Centola, D. (2010). The spread of behavior in an online social network experiment. *Science*, 329, 1194.

Chesney, T.(2014)., "Networked Individuals predict a community wide outcome from their local information", *Decision Support Systems*, Vol.57, pp. 11-21.

Christakis, N. A & Fowler, J.H. (2007) The Spread of obesity in a large social network Over 32 Years, *New England Journal of Medicine,* 357, 370-379.

Computers in Human Behavior 45 (2015) 168–176

Contractor, N. S, Monge, P. R, & Leonardi, P. (2011). Multidimensional networks and the dynamics of sociomateriality: bringing technology inside the network, *International Journal of Communication,* 5, 682–720.

Crossley, N. (2010). The Social World of the Network. Combining Qualitative and Quantitative Elements in Social Network Analysis, *Sociologica*, 1.

Crow, G. (2004) Social Networks and Social Exclusion: An Overview of the Debate', in C. Phillipson., G. Allan and D. Morgan (eds) *Social Networks and Social Exclusion: Sociological and Policy Perspectives*.

Aldershot: Ashgate. Crowston, K. and Howison, J. (2005) The social structure of free and open software development. *First Monday,* 10(2)

Cummings, J., Butler, B. S., & Kraut, R. E. (2002) The quality of social ties online. *Communications of the ACM*, 45, 103-109.

Edwards, G. (2010) *Mixed-method approaches to social network analysis.* Discussion Paper. NCRM.

Ellison, N., Heino, R. and Gibbs, J. (2006) Managing impressions online: Self-presentation processes in the online dating environment, *Journal of Computer-Mediated Communication,* 11 (2), 415-441 Emirbayer, M. & Goodwin, J., 1994. Network analysis, culture, and the problem of agency.

American Journal of Sociology, 99(6), pp.1411-54. Facebook.com (2011) Autonomy of facebook http://www.facebook.com/note.php?note_id=10150388519243859, date accessed 5

October 2012. Fang, X., Hu, P.J., Li, Z. and Tsai, W. (2013) Predicting adoption probabilities in social networks. *Information Systems Research,* 24 128-145.

Fischbach, K., Gloor, P., Putzke, J., & Schroder, D. (2010) The evolution of cooperation networks in massively multiplayer online games. *Journal of the Association for Information Systems*, 11. Available at: http://aisel.aisnet.org/jais/vol11/iss2/2

Fox, J. and Moreland, J. J (2015) The dark side of social networking sites: An exploration of the relational and psychological stressors associated with Facebook use and affordances.

Germonprez, M, & Hovorka, D. S. (2013) Member engagement within digitally enabled social network communities: New methodological considerations. *Information Systems Journal*, 23, 525-549.

Gibson, D.R. (2005). Taking turns and talking ties: Networks and conversational interaction. *American Journal of Sociology*, 110, 1561–1597. Gligor, D.M. and Autry, C. W (2012) The role of personal relationships in facilitating supply

chain communications: A relational view. Journal of Supply Chain Management, 48 (1), 24-43.

Gray, P. H., Parise, S., and Iyer, B. (2011) Innovation Impacts of Using Social Bookmarking

Systems, *MIS Quarterly*, 35, 629-643. Hahn, J., Moon, J.Y., and Zhang, C. (2008) Emergence of new project teams from open source software developer networks: Impact of prior collaboration ties. *Information Systems*

Research 19, 369-391. Hanseth, O., Aanestad, M, & Berg, M. (2004) Actor-network theory and information systems. What's so special?" *Information Technology & People*, 17, 116 – 123. Heath, S, Fuller, A. and Johnston, B. (2009) Chasing shadows: defining network boundaries in qualitative social network analysis. *Qualitative Research* 9: 645-661.

Hollstein, B. (2011) Qualitative approaches.In: *Sage Handbook of Social Network Analysis*. Scott, J. & Carrington, P.J. (Eds.), pp. 404-416, London/New Delhi: Sage.

Howison, J., Wiggins, A. & Crowston, K. (2011) Validity issues in the use of social network analysis for the study of online communities. *Journal of the Association of Information Systems*, 12, article 2. Jack, S. L. (2010) Approaches to studying networks: Implications and outcomes. *Journal of Business Venturing*, 25: 120-137.

Kane, G. Alavi, M. Labianca, J. and Borgatti, S.P (2014) What's different about social media networks? A framework and research agenda, *MIS Quarterly*, 38, 275-304.

Kane, G.C. & Alavi, M. (2008) Casting the net: a multimodal perspective on user–system interactions. *Information Systems Research*, 19, 253–272.

Karahanna, E., Straub, D.W., Chervany, N.L (1999) Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs, *MIS Quarterly*, 23, 183-213.

Khan, Z. & Jarvenpaa, S.L. (2010) Exploring temporal coordination of events with Facebook.com. *Journal of Information Technology,* 25, 137-151.

Kleinnijenhuis, J. Van Den Hooff, B., Utz, S., Vermeulen, I. & Huysman, M. (2010) Social influence in networks of practice: an analysis of organizational communication content. *Communications Research*, 38, 587-612.

Kozinets, R. (2010) *Netnography: Doing Ethnographic Research Online*. Sage Publications, London.

Krackhardt, D. (1987). Cognitive social structures. *Social Networks*, 9, 109-134. Krackhardt, D. (1990). Individual differences in coping with crowding: Stimulus screening and

social overload. *Administrative Science Quarterly,* 35, 342-369. Lewis, K., Kaufman, J., Gonzalez, M., Wimmer, A. & Christakis, N. (2008) Tastes, ties, and

time: A new social network dataset using Facebook.com, *Social Networks*, 30, 330-342. Lo, L.Y. & Lin, S. W. (2010) The effects of price presentation, sales promotion, sales restrictions, and social networks on consumer EWOM activities: Two-phase validation.

ICIS 2010 Proceedings. Paper 49, St. Louis, MI, USA. Martinez, A., Dimitriadis, Y., Rubia, B., Gomez, E. and de la Fuente, P. (2003) Combining

qualitative evaluation and social network analysis for the study of classroom social

interactions. *Computers and Education* 41:353-368. Martinez, A., Dimitriadis, Y., Rubia, B., Gomez, E. and de la Fuente, P. (2003) Combining

qualitative evaluation and social network analysis for the study of classroom social

interactions'. *Computers and Education* 41:353-368. Mehra, A., Kilduff, M. & Brass, D. J. (2001) The social networks of high and low self-monitors:

Implications for workplace performance. *Administrative Science Quarterly*, 46, 121-146.

Moser, C., Ganley, D., and Groenewegen, P. (2013) Communicative genres as organizing structures in online communities – of team players and story tellers. *Information Systems Journal*, 23, 551-567.

O'Mahony, S., & Ferraro, F. (2007) The emergence of governance in an open source community. *Academy of Management Journal*, 50, 1079-1106.

Orlikowski, W. J., and Baroudi, J. J. (1991) Studying IT in Organizations: Research Approaches and Assumptions, *Information Systems Research*, 2,1, pp. 1-28.

Parise, S., Whelan, E. and Todd, S. (2015). ―Twitter users generate better ideas‖ *MIT Sloan Management Review*, 56(4), 21-25.

Park, H. W. and Kluver, R. (2009) Trends in online networking among South Korean politicians – A mixed-method approach, *Government Information Quarterly* 26: 505-515.

Reingen, P. H., & Kernan, J. B. (1986) Analysis of referral networks in marketing: methods and illustration. *Journal of Marketing Research*, 23, 370-378.

Rice, R. E. (1982). Communication networking in computer-conferencing systems: A longitudinal study of group roles and system structure. In M. Burgoon (Ed.), Communication yearbook, 6 (pp. 925-944). Beverly Hills, CA: Sage.

Rice, R. E. (1994). Relating electronic mail use and network structure to R&D work networks and performance. *Journal of Management Information Systems*, 11(1), 9-20.

Rice, R.E. & Aydin, C. (1991). Attitudes towards new organizational technology: Network proximity as a mechanism for social information processing. *Administrative Science Quarterly*, 36, 219-244.

Roethlisberger, F. J. & Dickson, W. J. (1939) *Management and the Worker*. Cambridge, MA: Harvard University Press.

Rogers, E.M. (1987). Progress, problems and prospects for network research: Investigating relationships in the age of electronic communication technologies. *Social Networks*, 9, 285-310.

Rui, H., Liu, Y., & Whinston, A. B., (2010) Chatter matter: How twitter can open the black box of online word of mouth. *ICIS 2010 Proceedings,* Paper 204, St. Louis, MI, USA.

Sasidharan, S., Santhanam, R., Brass, D.J. and Sambamurthy, V. (2012) The effects of social network structure on enterprise systems success: a longitudinal multilevel analysis. *Information Systems Research* 23, 658-678.

Schultze, U. & Orlikowski, W. J. (2010) Research commentary - Virtual worlds: A performative perspective on globally distributed, immersive work. I*nformation Systems Research*, 21, 810-821.

Schultze, U., & Mason, R. O. (2011) Ethics of online research: Inquiry in a fishbowl, *Academy of Management Conference*. San Antonio, Aug 12-16.

Simon, F., and Tellier, A. (2011) How do actors shape social networks during the process of new product development?. *European Management Journal* 29, 414-430.

Singh, P.V. and Phelps, C. (2012) Networks, Social Influence, and the Choice Among Competing Innovations: Insights from Open Source Software Licenses. *Information Systems Research* 24, 539-560.

Sundararajan, A, Provost, F. Oestreicher-Singer, G. and Aral, S. (2013) Research Commentary- Information in Digital, Economic, and Social Networks. *Information Systems Research* 24, 883-905.

Sykes, T.A,Venkatesh, V. and Gosain, S (2009) Model of Acceptance with Peer Support: A Social Network Perspective to Understand Employees' System Use, *MIS Quarterly*, 33, 371-394.

Teigland, R. (2010) Born virtuals and avapreneurship: A case study of achieving successful outcomes in peace train – a Second Life organization. *Journal of Virtual Worlds Research*, 2.

Trier, M. (2008) Research note-Towards dynamic visualization for understanding evolution of digital communication networks. *Information Systems Research* 19, 335-350.

Urquhart, C., & Vaast, E (2012) Building social media theory from case studies: A new frontier for IS research. *ICIS 2010 Proceedings,* Orlando, FL, USA.

Uzzi, B. (1997) Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, 42, 35-67.

Uzzi, B. and Lancaster, R. (2003). Relational embeddedness and learning: The case of bank loan managers and their clients. *Management Science* 49(4), 383-399.

Vaast E. & Walsham, G. (2009) Trans-situated learning: Supporting a network of practice with an information infrastructure. *Information Systems Research*, 20, 547-564.

Vaast, E. (2007) What goes online comes offline: Knowledge Management System use in a soft bureaucracy. *Organization Studies*, 28, 283-306.

Vaast, E., & Walsham, G. (2013) Grounded theorizing for electronically-mediated social contexts. *European Journal of Information Systems*, 22, 9-25.

Venturini, T. and Latour, B. (2010). ‖The Social Fabric: Digital Traces and Quali-Quantitative Methods‖. In *Proceedings of Future En Seine 2009: The Digital Future of the City*, C. Digital (ed.), Paris, France, pp. 30-15.

Wasko, M. & Faraj, S. (2005) Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quarterly*, 29, 35-57.

Wasko, M., Faraj, S., & Teigland, R. (2004) Collective action and knowledge contribution in electronic networks of practice. *Journal of the Association for Information System*s, 5, 493-513.

Wasko, M., Teigland, R., & Jarvenpaa, S. L. (2011) Stepping into the Internet: New ventures in virtual worlds. *MIS Quarterly*, 35, 645-652.

Wasserman, S. and Faust, K. (1994). *Social Network Analysis: Methods and Applications*. New York, Cambridge University Press.

Watts, D.J., (2007) A twenty-first century science. *Nature*, 445, 489. Wellman, B. (1983) Network analysis: some basic principles. In: *Sociological Theory*, R.

Collins (ed.). San Francisco: Jossey-Bass. Whelan, E. and Teigland, R. (2013) 'Transactive memory systems as a collective filter for mitigating information overload in digitally enabled organizational groups'. *Information and Organization*, 23, 177-197. Wu, L. (2013) Social network effects on productivity and job security: Evidence from the

adoption of a social networking tool. *Information Systems Research* 24, 30-51. Zammuto, R.F, Griffith, T.L, Majchrzak, A., Dougherty, D.J., and Faraj, S. (2007) Information

Technology and the Changing Fabric of Organization, *Organization Science,* 18, 749–762

Zhang, W. & Watts, S.A (2008) Capitalizing on content: Information adoption in two online communities. *Journal of the Association for Information Systems*, 9, 73-94.

Gaspar, R, Claudia, P. Panagiotopoulos, P. and B. Seibt (2016) Beyond positive or negative: Qualitative sentiment analysis of social media reactions to unexpected stressful events, Computers in Human Behavior, 56, 179-191.