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ABSTRACT

Throughout the social sciences, theorists have grappled with the problem of interdependence; what is the connection between the social world of individuals, groups and their interactions, and that of complex organizations, institutions, and social structures? This problem is still being investigated in sociology, where is it called by some the "micro-macro" problem and by others problem of the relationship between agency and structure. What ever it is called, the problem of interdependence is a serious theoretical challenge. This paper argues that as an unintended consequence of the social turn in information systems research, the problem can be expected to arise and without useful conceptual tools, much intellectual capital will be spent thinking it through. It offers a concept from social informatics Kling et al.'s (2003) "sociotechnical interaction network" (STIN), as a way to resolve the problem by offering a link between the micro order of information and communication technology use and the larger macro order of organizations and institutions. Extended by incorporating insights from Dourish's (2004) interactional view of context and Scheff's (2005) interpretation of Goffman's concept of frames, STIN is useful for providing a connection between the macro and micro orders.

Keywords (Required)

Social informatics, information systems research, macro-micro, sociotechnical interaction network.

INTRODUCTION: THE PROBLEM OF INTERDEPENDENCE IN INFORMATION SYSTEMS RESEARCH

The micro-macro problem, also called the problem of interdependence (Ellis, 2000; 31), involves understanding and accounting theoretically for "the connections between the small world of individuals and immediate interactions, and the larger worlds of social structure." Interdependence is shorthand for a number of conceptual dichotomies bound up in the problem and include the micro-macro distinction, agency and structure, and the individual and society. This problem has been prevalent in many social sciences for many years and has preoccupied the minds of some of the most influential social theorists of the last half of the 20th century. It is thought to be fundamental, worth resolving, and at first glance seems simple. It is clear that individuals exist and that they are constantly engaged in social interactions with each other. It is also clear that social institutions exist that can interact with each other and that individuals routinely interact with them as well. How can the connections or linkages between structure and agency, between the individual and society, between the micro and macro order, be worked through theoretically and grounded empirically?

Beginning with the micro order, the challenge is to explain how complex structural phenomena can be generated through the actions and interactions of individuals. Sawyer (2003; 332) refers to this as the problem of "emergence" and explains, "this is a fundamental intellectual problem" that many researchers (sociologists, in this case) have inadequately theorized (Hedstrom, 2006). From the macro order, there is a similar challenge, which is to explain how individual actions and interactions are shaped by changes in large scale social structures and institutions. This is the problem of order (Ellis, 2000; 335) that has dominated much of social science discourse during the last century and, according to Alexander (1992), "one cannot think of any major contemporary theorist who is not preoccupied with the micro/macro problem." It seems clear that there are complex and thorny difficulties creating a clear logical narrative that begins either at the micro order or the macro order and moves smoothly to the other. For example, the emphasis on the determining role of structure undermines conceptions of individual agency while explanations that begin with individuals and their interactions cannot easily account for the existence

of institutional structures that transcend the boundaries of micro-interactions. Assuming that much of what unfolds at the micro level involves people talking with each other, mostly face-to-face, Scheff (2005; 369) asks metaphorically

> How is it that conduct and subjective experience both reflect and generate the society in which they are embedded? How can we represent the reciprocal relationship between words and gestures in interaction and the vast social structure/process of which they are a part? If discourse is the basement of a skyscraper, and social institutions the top floors, can one construct an elevator that goes up and down without having to get off at every floor?

Is it time for people in information systems research (ISR) to begin work on the elevator? One important reason why is it apposite to open a discussion of the problem of interdependence in ISR is that the discipline seems to have taken a social turn over the last decade. Now many researchers routinely analyze information and communication technologies (ICT) in social and organizational settings by incorporating and adopting concepts, methodologies and theoretical approaches drawn from anthropology, sociology, and other social sciences. Importing conceptual frameworks from other disciplines is a good way to spark innovation in theory and method in information systems research. There is interesting work that is being conducted at societal, group, and individual levels of analysis that is taking advantage of what these reference disciplines have to offer. However, there is potentially a cost to such bricolage because problems and concerns from other disciplines may work their way into ISR discourse. This paper seeks to reflect on and open discussion about one such possibility. It argues that the problem of interdependence will soon appear as IS scholars reflect on the findings and implications of research on information systems that are embedded in social and organizational settings. It suggests that a concept from social informatics, the sociotechnical interaction network (Kling, McKim, Fortuna, and King, 2000; Kling, McKim, and King, 2003), may provide an interesting path to follow that will allow researchers and theorists to sidestep the problem.

CAN SOCIAL INFORMATICS ADDRESS THIS PROBLEM IN A USEFUL WAY?

A number of researchers have been instrumental in opening information systems research to social concerns (Barley, 1986; Orlikowski and Robey, 1991, Clement and Halolen, 1998; Rose, 1999; Baskerville, Stage, and Degross, 2000). One of the earliest voices belonged to Kling who realized in the late 1970s that to understand the relationships among ICT, the people who use them, and the work that is done with them, it is necessary to adopt a social science perspective (Kling, 1977, 1980; Kling and Iacono, 1995). Over time the social study of computing, as it was labeled in the late 1980s and early 1990's has become known as social informatics, which is the study of ICT and their interactions with the social and organizational contexts in which they are embedded and used (Kling, Rosenbaum, and Sawyer, 2005). By explicitly focusing on the contexts of ICT design, management and use, SI researchers focus on sociotechnical phenomena related to ICTs at different levels of analysis. For example, at a macro level, Kling and Iacono describe computerization movements, broad social movements that emerge around particular ICT such as personal computers and cell phones. In their work, they explicitly draw upon sociological theories of social movements. At a 2005 workshop honoring the legacy of Rob Kling, a group of scholars presented papers exploring this concept in some depth (see, for example, Hara and Rosenbaum (2005)). At micro levels, Clement and Halonen (1998), Barley (1986), and Orlikowski (1996) and others have studied individuals and groups and their uses of ICT in specific and constrained settings.

As social informatics theorizing and research progresses, there seem to be steady streams of work investigating ICT and people along a continuum, the ends of which can be called the micro and the macro orders. Over time, this results in more complex and empirically grounded theorizing and research findings about the ways in which the mutual shaping occurs as we design, implement and use ICT in social and organizational settings. Some fundamental problems are now receiving sustained attention, such as Lamb and Kling's (2003) analysis of the "social actor," which, they argue, is a more viable and useful concept that that of the "user" because it captures the embeddedness of individuals using ICT in social and organizational worlds. In their view (2003; 218):

> A social actor is an organizational entity whose interactions are simultaneously enabled and constrained by the socio-technical affiliations and environments of the firm, its members, and its industry. In short, social actors are not primarily users of ICTs

They argue that studying "users" produces socially thin results because the individual is removed from the rich social world in which he or she lives and works. This is important work, however, there is an untended consequence of this type of activity, which it to recreate what was described above as the "micro-macro problem" or the "problem of interdependence" (Ellis, 2000; Alexander and Geisen, 1987). At the core of this problem is the question of the link between the macro and

micro orders; now that ICT are also embedded in social and organizational contexts, are they part of the micro order or the macro order? Are they somewhere in between?

This paper proposes that the debate can be headed off in ISR by exploring a concept that has received scant systematic treatment but which may provide a missing link between the micro and macro orders. We argue that the context of sociotechnical interaction networks is a bridge between the micro order of individuals interacting with ICT and each other in constrained organizational and social settings and the macro order of organizations, institutions and societies. We will introduce and explore the concept of the STIN and provide a sketch of the way in which the concept provides a bridge connecting individual, group, and institutional levels of social reality.

WHAT IS A SOCIOTECHNICAL INTERACTION NETWORK?

A socio-technical interaction network is a concept intended for use in research and theorizing focused on complex networks of heterogeneous elements including people, ICT, organizations, and their structured interrelationships. Kling, McKim and King (2003; 40) define a STIN as

> A network that includes people (including organizations), equipment, data, diverse resources (money, skill, status), documents and messages, legal arrangements and enforcement mechanisms, and resource flows. The elements of a STIN are heterogeneous. The network relationships between these elements include: social, economic, and political interactions.

It is "an emerging conceptual framework for identifying, organizing, and comparatively analyzing patterns of social interaction, system development, and the configuration of components that constitute an information system" (Scaachi, 2005:2). The STIN has its roots in actor network theory (Holmström, and Robey; 2005) and the social construction of technology approaches (Meyer, 2005) and provides an analytic means by which to study the roles of ICT in social change in sociotechnical systems. It allows a mapping of networks with ICT centrally located and the other actors, groups, and organizations arrayed in relationships to the ICT and each other. In this sense, it is an updated version of Kling and Scaachi's (1988) "web of computing," a concept intended to capture the individuals, groups and organizations that are involved in implementing, maintaining and overseeing ICT. It assumes that for a given setting in which ICT are being used, social and technological concerns are inseparable and even though the focus is on the technologies, the social actors are "embedded in multiple, overlapping, and non-technologically mediated social relationships, and therefore may have multiple, often conflicting, commitments" (Kling, McKim and King, 2003; 57).

The STIN is useful for the "fine-grained analysis of the complex relationships among the various components of the socio-technical networks within which ICTs are designed, implemented, and used" (Rosenbaum and Joung, 2004; 128). It "highlights how social relationships are inscribed into ICTs and how social practices and social forms interact with ICTs" (Eschenfelder and Chase, 2002). These social relationships go beyond the people who have their hands on the ICT on a daily basis to include, for example, the decision makers involved in procurement of the technologies, people who set IT policy for the organization, and people who provide support for the ICT. The breadth of a STIN is summarized by Barab et al. (2001; 73)

> We use the term sociotechnical interaction network to capture the complex sociotechnical arrangements involved in a technology-intensive project, emphasizing the reciprocal character of the interaction among people, among people and equipment, and even among sets of technical structures and political climates.

The STIN model has been used to study collaboratories (Kling, McKim, Fortuna, and King, 2000), educational communities (Barab et al. (2001), web information systems (Eschenfelder and Chase, 2002), scholarly communication (Kling, McKim and King, 2003), digital libraries (Rosenbaum and Joung, 2004), and digital photography (Meyer, 2005).

THE BOUNDARIES AND CONTEXT OF A STIN

One interesting question is how to delineate the boundaries of a STIN. Where does a STIN end? Kling, McKim and King argue that it is possible to determine empirically the boundaries of a STIN (2003; 54, 57) by following a set of heuristics; the researcher should:

Identify a relevant population of system interactors.

Identify core interactor groups

Identify incentives

Identify excluded actors and undesired interactions

Identify existing communication forums

Identify resource flows

Identify system architectural choice points

Map architectural choice points to socio-technical characteristics

These guidelines lead to a set of empirical constraints on a given STIN because they require the researcher to focus on two primary types of social interactions called "resource dependencies" and "account taking" (Kling, McKim, and King, 2003). The former includes interactions and the resulting relationships that connect social actors who routinely provide inputs into the network or receive outputs from the network; these are producers, suppliers, and consumers – all are included within the STIN. Kling, McKim and King's (2003; 54) study of a STIN in online scholarly communication finds that the resource dependencies include "networks of funders and grantees, employers and employees, and journal publishers and authors." Account taking includes a range of interactions that develop over time as social actors in the network use other social entities as reference groups to imitate, distinguish themselves from, or avoid (Rosenbaum and Joung, 2004). With the heuristics and the focus on particular types of interactions, the boundaries of a STIN can be mapped (see Figure 1: A STIN map for an electronic journal.)

STIN as context

Given the empirical and theoretical value of the concept, it is now appropriate to return to the main argument of this paper, which is that the STIN has a role to play in sidestepping the problem of interdependence in information systems research. By extending the concept, and more fully developing its interactional and boundary elements, the STIN can become a setting within which micro interactions take place among people and between people and ICTs and the macro order emerges. In order to play this role, a STIN should be conceptualized as an instantiation of the context of ICT. A key element of the definition of social informatics is the social and organizational context of ICT design, implementation and use. There is a broad consensus among social informatics scholars that "context matters," but in many ways, the concept remains a trope, vague and amorphous (Scheff, 2005) There have been attempts to clarify the concept within social informatics (Rosenbaum, 1999), but more has to be done.

 Borrowing from the work of Dourish (2004; 22), as a context of ICT, a STIN is an "interactional problem … in which the central concern with context is with the questions 'how and why, in the course of their interactions, do people achieve and maintain a mutual understanding of the context for their actions?" It is a practical accomplishment of the social actors (peopleand ICT) whose actions and interactions generate and maintain the STIN. This implies that the STIN is a "relational property" that has situational relevance that can change over time. Some elements of a STIN will change quickly over time and others will be less dynamic. The boundaries of a STIN, then, are somewhat fluid, expanding and contracting as the exigencies of the situation change. People and technologies can be added to and removed from a STIN over time, meaning that the "scope of contextual features is defined dynamically." STINs arise from the actions and interactions of the social actors that move within it; "context isn't just there, but is actively produced, maintained, and enacted in the course of the activity at hand" (Dourish, 2004; 22).
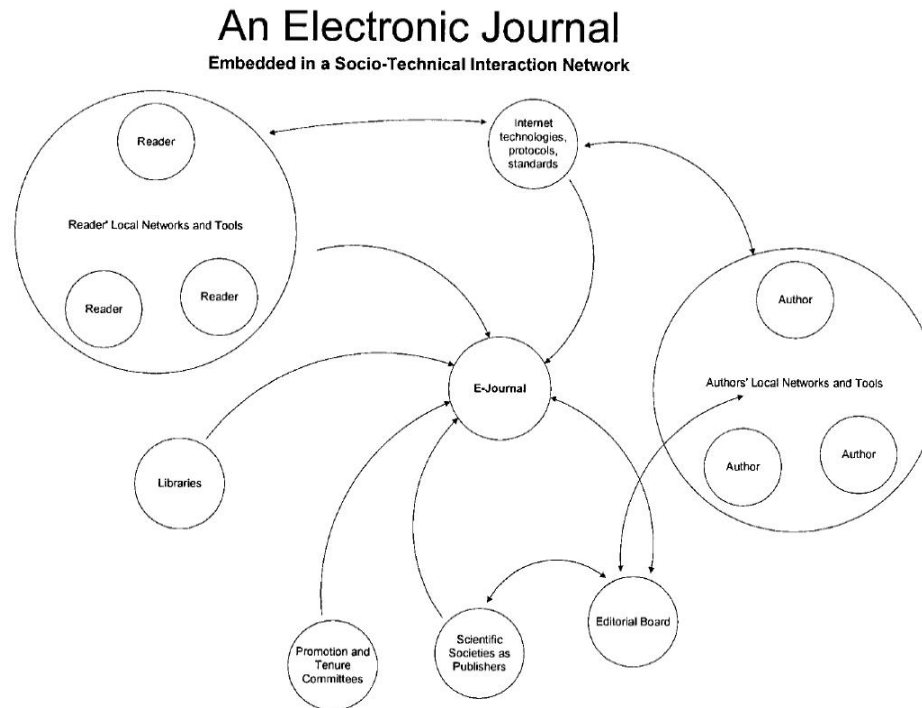
Figure 1: A STIN map for an electronic journal (from Kling, McKim, and King, 2003; 53)

As a context, a STIN is ordinary, in the ethnomethodological sense of the term, and, for many participants, taken for granted. It is managed and maintained by social actors as they routinely carry out the tasks and activities of their days and as they interact with each other. As they make use of the ICT that is at the center of the STIN, they are negotiating and developing social and work practices within the STIN that are shaping it as they are being shaped by this context. This is what Dourish (2004; 28) calls "embodied interaction," which seeks to account for the way in which "the meaningfulness of artefacts arises out of their use within systems of practice."

Despite being ordinary and a practical accomplishment of embodied interaction, the STIN as a context is a key concept linking the micro and macro levels of social reality that is a possible resolution to the core problem of interdependence. Scheff (2005; 369) argues that Goffman's concept of frames can be used to account for the contextual product of what Dourish calls embodied interaction. In his view, a frame is a principle of organization that governs events in the social world. It is part of the definition of the situation which itself is part of a social actor's subjective response to social life. When people are interacting, they are engaging in mutual framing that Scheff (2005; 376) calls a "recursive model of mutual awareness" that leaves each person with the understanding that his or her "experience with others has given them external grounds for believing that their" frames are correct. This, he argues, is a source of the ability of frames to constrain action and interaction.

A decade earlier, Orlikowski and Gash (1994) made a similar point, arguing that the concept of frames could be used to understand how the meanings of ICTs are constructed and explain the origins of conflicts over the development and uses of, and changes in technologies are enacted in organizations. Scheff, however, pushes the concept further. Using the metaphor of a "fractal," he explains that there are the frames that emerge from our interactions with particular contexts that are recurrences of larger frames all of which serve to help participants understand the interactions in which they are engaged. An instructor can be talking with a student about class work and there is a frame related to the understanding of the work that is linked to a larger frame that defines the institutional positions and relative power of each participant. This can be enclosed in a still larger frame representing both participants' understandings of the University. Scheff (2005; 381) call this "an assembly of frames, one fitting within, or merely added to the other" that combine into the "organization of experience" where the micro and macro orders co-exist.

CONCLUSION

This paper has argued that the problem of interdependence is lurking in the shadows of information systems research; if it emerges as it has in other disciplines, notably sociology, it will consume a staggering amount of intellectual resources as people work through it. Because of its heavy use of social science theories and concepts, social informatics is well positioned to address the problem. The sociotechnical interaction network, taken from Kling and colleagues (2000, 2003) framework for studying computerization movements, is a concept that may be useful for addressing the problem of interdependence. Extended by incorporating insights from Dourish's (2004) interactional view of context and Sheff's (2005) interpretation of Goffman's frames, STIN is useful for providing a connection between the macro and micro orders.

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