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# A Social Informatics Perspective On Socio-Technical Networks

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## Abstract

Network-centric perspectives have gained increasing salience, as interconnected information and communication technologies (ICTs) become more ubiquitous in our daily lives. In this paper, we provide an overview of socio-technical network studies, which we then use to help situate the development and use of ICTs within social and organizational domains. We briefly review traditional conceptualizations of socio-technical systems, and then introduce some contemporary theoretical extensions and sociological re-conceptualizations. This discussion emphasizes the capability of social informatics perspectives to guide our current and future examinations of ICT use in socio-technical networks.

## New Socio-Technical Studies

The pervasiveness of computing in social life and organizational work underscores the nuanced and interwoven arrangements that arise between people, what they do, and the information and communication technologies (ICTs) they use. This increasing interconnection between the social and the technical aspects of our worlds highlights the potential value of conceptualizing such arrangements as socio-technical networks.

For us, socio-technical networks refer to the interactions between people, organizations, institutions, and a range of technologies in rather intricate heterogeneous arrangements in which what is "social" and what is "technical" cannot be readily isolated in practice. This approach differs in some significant ways from the focus of traditional socio-technical studies, particularly in our explicit attention to ICTs and information systems. In our view, socio-technical networks are fundamental to socio-technical studies, and ICTs are necessary (but not sufficient) components of networked forms of social organization.

## Traditional Conceptualizations of Socio-Technical Systems

Several research traditions emphasize some kind of socio-technical perspective. The two best-known approaches are the Social Shaping of Technology (SST) tradition, based on social studies of science and

technology (cf. Williams and Edge, 1995), and the Tavistock Institute's Socio-Technical Systems (STS) tradition, based on the analysis of work organization (cf. Mumford, 1997; 2000). The SST perspective focuses on large-scale socio-technical ensembles, which we call socio-technical networks. SST researchers examine the ways in which social arrangements shape emergent technologies. Bijker (1995), for example, uses a socio-technical framework to discuss the development of a wide range of dissimilar technologies, such as bicycles, the origin of plastic (bakelite), and other innovations. The STS approach to socio-technical systems emphasizes workplace interactions with various technologies. STS researchers have focused on developing socially sensitive, ethical, and humane methods for technology design. In doing so, STS scholars have developed concepts and evaluations for use in the analysis of organizational structures and in the diagnosis of workplace discontinuities (Moldaschl and Weber, 1988; Land, 2000).

Neither approach explicitly pertains to ICT development and use. However, in the sense that ICTs are a special case of "technology," both approaches have been helpful to IS researchers trying to understand the use of ICTs and the emergence of socio-technical networking arrangements. Quintas (1994) has used the SST approach expressly to inform his analysis of software engineering innovations. Orlikowski and Gash (1994) have also used SST concepts to interpret the development of organizational information systems. Their study merges Bijker's concepts with organizational change theory as they examine complex artifacts and complex "users"--which differ greatly from the turn-of-the-century products and individual consumers in Bijker's histories. Their analysis exposes the recursive nature of changes in technological frames and technological artifacts as complexity increases, and begins to point out the need for a more robust and well-integrated socio-technical network approach.

STS perspectives have also been applied to ICT use contexts, beginning with the work of Bostrom and Heinin (1978a, 1978b), but the association between STS concepts and IS research is often not explicitly articulated as such in contemporary literature (Mumford, 1997; Newman and Sabherwal, 1996). Some of this disconnect may stem from the dynamics of networked ICTs, when considered in conjunction with current trends toward globalization. This emergent global context differs substantially from the localized settings of early SST and STS studies.

Social Informatics (SI) researchers such as Kling and Iacono (1989), Ruhleder and Star (1996), and Bowker et al. (1997) have made basic connections between early STS concepts and new IS technologies. However, their studies make the need for fresh conceptualizations of socio-technical arrangements increasingly apparent.

More recently, a revived interest in socio-technical phenomena has been accompanied by critical examination of existing theories and an incorporation of new network-centric theorizing from sociologists like Latour (1987) and Castells (1996.) Their theories provide a basis for refocusing ICT-related research, and seem particularly apt for understanding the development and use of digital communication applications, such as email, the Internet, intranets, electronic journals, and other collaborative arrangements. Motivated in part by empirical study, some SI researchers have begun to build on these theoretical concepts, and to put forward new and additional interpretations of socio-technical interaction (Walsham and Sahay, 1999; Lamb, 1999.)

## A Social Informatics Perspective

Contemporary research of socio-technical networks is newly reforming around a solid research foundation of SI research, built in part on STS and SST concepts, and extended by new conceptualizations of socio-technical arrangements -- with explicit theorizing about the role of ICTs.

The social informatics foundation provides a multi-disciplinary perspective. It is the interdisciplinary study of the design, uses and consequences of information technologies that takes into account their interaction with institutional and cultural contexts. SI research focuses on the social consequences of the design, implementation, and use of ICTs over a wide range of social and organizational settings. Of particular interest are the roles of ICTs in social and organizational change. SI researchers have studied various social aspects of computerization for over 25 years, including the "social analysis of computing," the "social impacts of computing," "information policy," "organizational informatics," "computers and society," and, more recently, "computer-mediated communication" (Kling, 1999; Bishop and Star, 1996).

Social informatics is a problem-driven research domain that begins with an assumption that ICTs and the social and organizational settings in which they are embedded are in a relationship of mutual shaping (Bijker, 1993; Kling, 1996; Orlikowski and Baroudi, 1991). Researchers in fields as varied as computer science, information science, communications, sociology, anthropology, information systems, management science, education, and library science (to name a few) have been investigating the ways in which ICTs and the people who design, manage, and use them shape and influence each other in different social contexts. Approaching their

questions from multiple theoretical and methodological perspectives, social informatics researchers attempt to understand the complex issues surrounding ICTs and their uses. Their analyses frequently challenge commonly held assumptions about information technologies, and often attempt to improve the lives of the people who work and play with ICTs. SI work is also empirically focused. That is, SI research tries to make sense of the vexing issues people face when they work and live with systems in which advanced ICTs are one important and increasingly pervasive component.

Social informatics research involves *normative*, *analytical*, and *critical* orientations, which may be combined in any specific study. The *normative* orientation refers to research that aims to recommend alternatives for professionals who design, implement, use, or develop policy about ICTs. This type of research has an explicit goal of influencing practice by providing empirical evidence illustrating the varied outcomes that occur as people work with ICTs in a wide range of organizational and social contexts. For example, much of the work in participatory design focuses on identifying the nuance in ways that users come to understand and adapt how they work through complex socio-technical relationships (e.g., Sachs, 1995; Wynn, 1979).

The *analytical* orientation refers to studies that develop theories about ICTs in institutional and cultural contexts or to empirical studies that are organized to contribute to such theorizing. This type of research seeks to contribute to a deeper understanding of how the evolution of ICT use in a particular setting can be generalized to other ICTs and other settings. One example is Kling's (1980) depiction of various perspectives on ICT use in organizations.

The *critical* orientation refers to examining ICTs from perspectives that do not automatically (uncritically) adopt the goals and beliefs of the groups that commission, design, or implement specific ICTs. The critical orientation is possibly the most novel (Agre and Schuler, 1997). It encourages information professionals and researchers to examine ICTs from multiple perspectives (such as the various people who use them in different contexts, as well as people who design, implement or maintain them) and to examine possible "failure modes" and service losses, as well as idealized expectations of routine use.

## Reconceptualizing Socio-Technical Systems as Socio-Technical Networks

This discussion of social informatics helps to emphasize a key idea: ICTs do not exist in social or technological isolation. The cultural and institutional contexts in which they are embedded influence the ways in which they are developed, the kinds of workable configurations that are proposed, how they are

implemented and used, and the range of consequences they have for organizations and other social groupings. In this sense, our focus of study can most usefully be conceptualized as “socio-technical networks” of an interrelated and interdependent milieu of people, their social and work practices, the norms of use, hardware and software, the support systems that aid users, and the maintenance systems that keep their ICTs operating.

Social informatics perspectives provide a rich set of conceptual insights to guide current and future examinations of ICT use in socio-technical networks. However, the growing ubiquity of ICTs and the globalization of network phenomena challenge existing socio-technical interpretations. Other considerations include the resurgence of social-structural perspectives on innovations and social organization (Burt, 2000; Swedberg, 1994), the configurational nature of new ICTs (Kling, Crawford, Rosenbaum, Sawyer and Weisband, forthcoming) and the limitations of direct-effects models of ICT use (Orlikowski, 1992).

Some interesting challenges can be found in network-centric theories that build on social network analysis (SNA). For example, the work of Wellman et al. (1996) builds directly on social network concepts, but infuses this approach with intensive qualitative study that blends the best analyses of SI and SNA researchers. Gitell’s work (2000a, 2000b) also highlights the role of social networks and the use of various enabling technologies (including ICTs) to support forms of relational coordination.

Another new research thrust also draws on sociological theory to develop a better understanding of networks and ICTs. Latour’s (1987) actor-network theory (ANT) combines the broad-scale thinking of the SST tradition with new conceptualizations that raise technologies (such as computers and networks) to an equal status with human actors. This perspective explores the intricate interrelationships that develop between people and the technologies they employ to interact with other individuals, organizations and institutions within complex, interconnected networks (Walsham, 1997).

A third and promising new approach has also begun to be articulated by SI scholars. Drawing on prior research about “web models” of computing (Kling and Scacchi, 1982), Kling et al. (forthcoming) have developed the concept of socio-technical interaction networks (STIN) to guide current studies of scientific laboratories. Working from Castells’ network society theory (1996, 1997), Lamb and Kling (forthcoming) have also begun to develop a set of concepts to guide SI researchers in more broadly scoped studies of socio-technical networks and interorganizational ICT-based interactions.

## Opportunities for Socio-Technical Network Study

In this brief review, we have developed a view of contemporary research in socio-technical networks that is anchored in the confluence of three research streams: (1) traditional STS and SST concepts, (2) contemporary theory relative to social networks and the network society, and (3) the expansive literature of social informatics.

The new theoretical explorations that we have highlighted here provide a basis for examining issues that have come to the forefront in today’s increasingly network-oriented society. These theories and concepts are being used to reframe studies of ICTs that have co-evolved with network society dynamics, such as ERP systems and email implementations, as well as new ICT configurations, like intranets, knowledge management systems and other collaborative work arrangements.

The three areas of active reconceptualization that we have focused on showcase the intense interest that researchers are giving to network-centric socio-technical concepts. In doing so, they also highlight the variety of interpretations that these concepts engender. Taken altogether these theories and concepts provide a rich resource and a firm research foundation for extending the traditions of socio-technical research into the ICT-enabled and networked societies of our future.

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