Sociotechnical approaches to the study of Information Systems

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Abstract

Through this chapter we provide an overview of the sociotechnical premise: the mutual constitution of people and technologies. The sociotechnical premise and its various approaches, including the seminal work of the Tavistock scholars, the Nordic and Scandic approaches, and their evolution, are developed as the historical basis of this work. In the chapter we also cover the role of sociological thinking, the contributions of science and technology studies and social construction/social shaping of technology, actor network theories, and contemporary approaches. The chapter concludes with a cursory review of current debates around economic sociology, multidimensional networks and advancing our current conceptualization of the digital artifact.

Outline

1. The sociotechnical premise

Through this chapter we introduce and explain the sociotechnical premise relative to the study of information systems (IS). The sociotechnical premise can be articulated as: (1) the mutual constitution of people and technologies (and, specifically, digital technologies[1]); (2) the contextual embeddedness of this mutuality; and, (3) the importance of collective action. Some readers will value this chapter for its breadth of coverage. Established sociotechnical scholars will likely thirst for more advanced discussions than what we provide here. Some readers will value the material in this chapter for identifying particular debates, current themes or emerging approaches. We see this as a special opportunity and focus on these topics at the chapter's end.

We begin by noting beyond the widespread ethos within the IS research community that it is sociotechnical by definition. As Allen Lee notes:

> *Research in the information systems field examines more than just the technological system, or just the social system, or even the two side by side; in addition, it investigates the phenomena that emerge when the two interact. This embodies both a research perspective and a subject matter that differentiate the academic field of information systems from other disciplines. In this regard, our fields so called reference disciplines are actually poor models for our own field. They focus on the behavioral or the technological, but not on the emergent sociotechnical phenomena that set our field apart. For this reason, I no longer refer to them as reference disciplines, but as contributing disciplines at best* (Lee 2001, , p. iii).

Our goal in writing this chapter is to encourage scholars to move beyond this rhetorically pleasant articulation of sociotechnical thinking towards more deliberate conceptual development, increased empirical activity, and greater methodological capacity.

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[1] For this chapter we use technology to mean digital technologies, information and communication technologies (ICT), information technologies, and computer technologies. So, technology here is more narrowly circumscribed (than all kinds of technologies) but inclusive (of digital) conceptual shorthand.

1.1. Mutual constitution

Sociotechnical research is premised on the interdependent and inextricably linked relationships among the features of any technological object or system and the social norms, rules of use and participation by a broad range of human stakeholders. This mutual constitution of social and technological is the basis of the term sociotechnical. Mutual constitution directs scholars to consider a phenomena without making *a priori* judgments regarding the relative importance or significance of social or technological aspects (e.g., Latour 1999; Bijker 1987, 1995).

Mutual constitution differs from social determinism as social determinists see ICT as being caused by or created for the organizational needs and peoples' decisions about how to meet those needs (albeit, imperfectly at times). In particular, socially deterministic researchers contend there cannot be any specific "effects of technology" attributable to the material qualities of technology. That is, the "cause" and the nature of "particular effects" are always social interpretations (Grint and Woolgar 1997).

Mutual constitution stands apart from technological determinism, which regards the technology as the main cause of organizational change. Technological determinists characterize ICT as an independent (and often *the* primary) variable. The essence of this cause-and-effect relationship is conveyed by the word "impact". Technology is seen as an exogenous, independent and material force which determines certain behavior of individual and organizations, producing predictable changes in organizational traits such as structure, size, decision making, work routines and performance (e.g., Pfeffer and Leblebici 1977; Leavitt and Whisler 1958).

Mutual constitution implies (1) that both humans and technologies may have some sort of agency – some ability to act – in a given situation and (2) these actions are not deterministic – actions are not independent of surrounding events. The underlying premise of mutual constitution is co-evolution among that which is technological and that which is social. The focus on interdependency among technology and human organization is done by attending to material triggers, actions of social groups, pressures from contextual influences, and the complex processes of development, adoption, adaptation, and use of new (digital) technologies in people's social worlds (Jones and Orlikowski 2007). Directionality is a property of the situation, not inherent to a relation.

Why is this important? Barley (1988) argues that a singular focus on the material aspects of technology leads researchers into inappropriate materialism. On the other hand, a focus on technology as a solely social production has led to an overreliance on social orders as primary

drivers, potentially leading to social determinism. In contrast, the sociotechnical perspective, and in particular the principle of mutual constitution, speaks directly to the complex and dynamic interactions among technological capacities, social histories, situated context, human choices and action rather than looking for simplified causal agency.

1.2. The view of context

The sociotechnical premise is that all technologies are socially situated. Any IS or ICT is embedded into a social context which both adapts to, and helps to reshape, social worlds through the course of their design, development, deployment and uses (e.g., Kling 1980; Avgerou 2001; Land and Hirschheim 1983; Walsham 1993; Orlikowski 1992). This situated and mutually adaptive conceptualization stands in contrast to much of the current IS research (and pursuit of a standard model) that is "…de-problematized <of> time, space and the uses of ICT" (Lee and Sawyer 2009, , p. 3) which is self-limiting in its failure to recognize the depth of social engagement. The desire for such an a-contextual perspective on IS (and ICT) continues to fascinate scholars (e.g., Brynjolfsson and Hitt 1996). However, this discourse, through its own framing, fails to account for social changes within which technological innovations unfold (e.g., Fleck 1994).

Adherents to the standard model of IS pay too little attention to the environment of the organization and temporal dimension of technological innovation. For example, the literature focused on investigating the strategic implications of IS has sought to provide guidance for how to best harness strategic potential of new ICT/IS as a source of competitive advantage (e.g, Porter and Millar 1999; Earl 1989; Morton 1991; Hammer and Champy 1993). However, their depiction of an organization's environment does not typically delve into the complicated social processes which embed technological innovation within organizational or social contexts. In addition, these appraoches tend to ignore the temporal dimension of ICT. More than 20 years ago, Orlikowski and Baroudi (1991) found nearly 90% of IS research represents a single-snapshot data collection method which does not include observations and data collection over time. The problem continues today (e.g., Avital 2000; Pollock and Williams 2009).

In contrast to a-contextualized and de-temporalized approaches, the sociotechnical perspective is premised on the embedding of the ICT/IS into the more complex world of situated action: a world that is tightly tied to the characteristics of where the actions occur. In their analysis, sociotechnical scholars focus on situating work and seek to examine all contextual factors. This type of enquiry leads to a holistic view of context: one which does not diminish or remove contextual elements, even those with limited influence. In this situated view, context is not taken as fixed or delineable,

but is defined dynamically. Sociotechnical approaches focus on building situational and temporal conditions directly into their theories, relating these to conceptualizations of ICT/IS (e.g., Dourish 2004).

1.3 Collective action

The third element of the sociotechnical premise is collective action: the pursuit of goal(s) by more two or more interested parties (Merton 1968). Collective action undergirds the concept of organization (and all sociality) without implying positive or negative outcomes: there are shared pursuits. So (and typically), multiple parties pursue different goals, creating conflict. The underlying premise is that the joint pursuit of one or more shared goals by two or more parties, focusing on the design, development, deployment and uses of a particular ICT or IS is both shaped by, and shapes, the nature of collective action.

The premise of collective action is that joint interests and multiple goals are intertwined with both the context and the technological elements. And, contemporary sociotechnical research focuses less on individual workers and simplified social situations – such as worker/manager differences -- to attend more complex problematizations of social settings and tensions of multiple parties such as distributed online organizing (Kling 2007; Sawyer and Eschenfelder 2002).

1.4 The sociotechnical premise in contemporary IS research

Sociotechnical approaches differ in three ways from what Kling and Lamb (2000) call "the standard model" of an IS. First, standard models of IS focus on the technological aspects and pay far less attention to social roles and structures.[2] Second, standard models of IS decontextualize the work in search of generalities and best practices. Third, standard models of IS emphasize the cognitive and behavioral aspects of people's involvement with technologies.

The sociotechnical approach eschews simplifying rationales that seek a single or dominant cause of change. Instead, sociotechnical approaches foreground both the complexity and the uncertainty involved in the process of technologically-involved change. In contrast to the socially or

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[2] There exists an insightful body of IS literature focusing on social analyses of IS and ICT (Avgerou, Ciborra, and Land 2004). These social analyses of IS and ICT emphasizes the social and behavioral activities which frame and underpin the development, deployment and uses of any ICT or IS. Social analysts take a strong social constructivist view on the sociotechnical relationships. Many social analyses draw on sociotechnical theories. But, they take a "weak constructionist" view of the ICT. That is, the technological elements are seen primarily as an outcome of social practices and social forces, with the technology having little or no agency or impact. Our articulation of the sociotechnical premise differs primarily in the elevation of the importance of the ICT's and IS's roles – we assign some agency or the potential for direct effects to be of the ICT's doing. In all other ways the sociotechnical perspective is very similar to the social analytic perspective.

technologically deterministic views, sociotechnical approaches require a detailed understanding of dynamic organizational processes, and the occurrence of events over time in addition to knowledge about the intention of actors (situated rationality) and the features of technologies. As a result, studies in this stream of work construct neither independent nor dependent variables, but instead adopt process logic to investigate the reciprocity and co-evolution of the contextual interactions and outcomes (Barrett, Grant, and Wailes 2006).

Sociotechnical researchers focus attention to the heterogeneous networks of institutions, people and technological artifacts that, together play roles in the design, development, deployment, take-up and uses of any particular IS (Kling, McKim, and King 2003). So, as Michel Callon and John Law put it, any distinction between ICT (or IS) and society as context is an over simplification which obscures the complex processes where human and technologies jointly construct sociotechnical entities (Callon and Law 1989).

2. Historical roots and conceptual developments

In this section we outline the historical roots of sociotechnical research.

2.1. The Tavistock tradition

The term "sociotechnical" was coined by researchers at the Tavistock Institute of Human Relations in England (Mumford 2000). The Tavistock Institute was founded in London in 1946 under the auspices of the Rockefeller Foundation. Its initial mission was to weave together social and psychological sciences in order to benefit a society damaged by the effects of the Second World War. Tavistock researchers, including therapists and a wide variety of consultants, strove to formulate techniques that could help to rehabilitate war-damaged soldiers (Jones 2004). Some Tavistock scholars came to believe that the same techniques could be employed in support of a more humane (or human-centered) organization of work in industry. These scholars suspected that the techniques would be applicable to the work of lower rank employees who spent most of their time on routine and simple tasks without any clear prospect for job satisfaction or personal development (Mumford 2000).

This extension of Tavistock agenda to the workplace showcased two attributes of sociotechnical scholarship that unfolded in quite different ways over time. The first, and most prominent, attribute is the close association between the technological and the social (sub-) systems of organizations. The technological elements, perceived as machines and associated work practices by Tavistock's researchers, was not meant to be the sole controlling factor when a new technological

system was implemented.   Tavistock scholars advocated equal attention should be paid to providing a satisfactory work environment for employees. In this regard, the main innovation of the Tavistock research was the design of technology-supported work arrangements that could enrich work practices using multi-skilled jobs with workers organized into teams. The sociotechnical approach was, in this way a rebellion against the evolution of work-design practices of the time that had become an instrumental view of work and the workforce.

The second attribute of the Tavistock approach was the importance of worker involvement. At its core, Tavistock's sociotechnical approach was interventionist and activist. As we note below, this orientation to worker's interests and activism underlies the action-research orientation of Enid Mumford's ETHICS and Peter Checkland's Soft-Systems Method (SSM) (Checkland 1995; Mumford and Weir 1979), the participatory design principles that characterize the Scandinavian and Nordic scholarship , and perhaps some of the more contemporary design-centric approaches to IS.

The Tavistock researcher's fundamental goal was to humanize jobs through redesigning work practices and workplace technologies, while propagating democracy at work.   This led to the formulation of theories that entailed concepts like "quality of working life" (Kling and Lamb 2000). These theories postulated that employees who were involved in the new system should be given a voice in the design process to determine how the new system could improve the quality of their work. In addition, the practical side of the sociotechnical approach sought to give equal weight to both technical and social aspects in the design process.

2.1.1. Early developments of sociotechnical approaches in IS

The Tavistock approach to sociotechnical design inspired a number of researchers in the nascent field of IS. Enid Mumford, greatly influenced by her association with the Tavistock Institute, is considered to be the most influential researcher to initiate sociotechnical research within IS (Davenport 2008). She, along with her peers such as Frank Land and students (Land 2000), voiced concerns that the bulk of IS research and professional know-how were limited to engineering approaches which centered on the effective construction of reliable technical artifacts.

Mumford's work placed the social context and human activities/needs at the center of IS design. The essence of the early sociotechnical discourse in IS is found in the proceedings of the "Human Choice and Computers" conference (Mumford and Sackman (1975). The overall tone of was critical of the perceived computer's impact on key social institutions like the social order of industrial democracy in the workplace.

Findings from projects across the 1960 and 1970s were consolidated by Mumford and her colleagues and students and gave rise to a system development methodology, called Effective Technical & Human Implementation of Computer-based Systems (ETHICS) (Mumford and Weir 1979). This methodology drew upon sociotechnical principles and involved a double-design effort: the design of IT-based systems/IS and the design of work processes. Initially, the two design efforts were conducted separately. The design of IS followed the technical system analysis method whereas the design of work processes was aimed at the elicitation of "job satisfaction" requirements of workers. The latter analysis involved the application of work quality principles such as multi-skilled jobs. The two streams of design were brought together to achieve a "sociotechnical optimization" (Mumford 2006).

In ETHICS the starting point was work design, rather than system design, and the methodology placed emphasis on the interaction of technologies and people[3]. The main objective of the method was to develop information systems that are both technically viable, and entail social qualities that would lead to high worker satisfactions (Mumford and Weir 1979). To this end, an IS designed to solely meet technical requirements, is "likely to have unpredictable human consequences" (Mumford and Weir 1979, p. 13). Therefore, ETHICS uncompromisingly elevated humanistic approaches to system design and called attention to scoring the quality of working life in terms of fit between personal achievement and organizational goals[4].

2.1.2. Industrial engineering/human factors

Scholars from other intellectual communities began drawing from the Tavistock work, translating the sociotechnical principles into new intellectual communities and, in turn, impacting practice. One of the most successful of these translators was Albert Cherns (1987; 1976). Cherns was an associate of the Tavistock Institute and published his summation of sociotechnical design principles in *Human Relations* (see Table1). The design principles Cherns laid out quickly gained prominence in the intellectual communities concerned with ergonomics, human factors and large-scale systems design and usability.

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[3] More recently, Alter's work systems (Alter 2006) approach has rekindled interest in this approach, though his conceptual roots are less directly rooted in Tavistock or sociotechnical thinking

[4] At about the same time, Peter Checkland advanced Soft Systems Methods (SSM) as an IS design approach. Similar to ETHICS in its attention to human and technological sub-systems, the conceptual framing builds from systems theory. See Checkland (1998, 1995).

In IS, Cherns' sociotechnical principles were translated and introduced through two articles of Bostrom and Heinen (1977, a; 1977, b)[5]. This translation emphasized the computer-based information systems as the focal technological subsystem and centered attention on its design rather than on the Tavistock principles of quality of working life. Bostrom and Heinen further problematized, and constrained, the social subsystem in two ways. First, they characterized the social aspects of an IS as emphasizing the tension between worker's interests and manager's interests. Second, Bostrom and Heinen defined workers (but not managers!) as users.

Table1: Chern's Principles of Sociotechnical Systems	
Compatibility	The design process should be compatible with its objectives. If the design is intended to foster democracy in work situations, the design processes themselves must be democratic.
Minimal Critical Specification	No more should be specified than is absolutely essential. However, the designers should ascertain what is essential.
The Sociotechnical Criterion	Variances, as deviations from expected standards, must be kept as close to their point of origin as possible. In other words, solution to problems should be devised by the groups that directly experience them, not by supervisory groups.
Multifunctionality Principle	In order for groups to respond to the changing work environment, they need a variety of skills. These include skills that go beyond what day-to-day production activities require.
Boundary location	Boundaries exist where work activities pass from one group to another and where a new set of skills is required. However, boundaries should facilitate knowledge sharing. All groups should be able to learn from one another despite the existence of the boundaries.
Information	Information must reside where it is principally needed for action. A sociotechnical design gives the control authority to the groups whose efficiency is being monitored.
Support Congruence	A social support system must be in place to enjoin the desired social behaviors.
Design and Human Values	High quality work involves: a. jobs to be reasonably demanding;

[5] See also the more recent work of Clegg, C.W., (2000), Sociotechnical Principles for Systems Design, *Applied Ergonomics*, (31), 463-477.

	b. opportunity to learn;
	c. an area of decision-making;
	d. social support;
	e. the opportunity to relate work to social life; and
	f. a job that leads to a desirable future.
Incompletion	Practitioners must recognize the fact that the design is an iterative process. It never stops. The new changes in environment require continual revisions of objectives and structures.

Bostrom and Heinen's problematization of the social system as workers v. managers, and their definition of workers as users, likely reflects contemporary management thinking of the 1970s in the U. S. Since then it seems to have become an accepted stance in much of the IS literature. Contemporary scholars, such as Avgerou and colleagues (Avgerou, Ciborra, and Land 2004), who have built from and extended the Tavistock approaches to sociotechnical scholarship, are consistently critical of the conceptual limitations of this managerialist reframing and the diminished emphasis on humane design. And, while the Bostrom and Heinen papers are cited, their work has had a lesser impact on methods and concepts in IS than might be expected given the rhetorical enthusiasm for sociotechnical claims of IS.

2.1.3. Participatory design and worker involvement

The importance of worker participation, fundamental to the Tavistock approach, was widely adopted in practice (Land, Mumford, and Hawgood 1979; Land and Hirschheim 1983). In its original sense, user participation encouraged all intended users to be involved in all IS development tasks and stages. However, across the latter part of the 20th century, user involvement was implemented in a much more limited way: users were typically consulted primarily to learn about the tasks and the technical systems that support them, then not involved in the rest of the design process (Land, Mumford, and Hawgood 1979).

However, the sociotechnical ideals of the Tavistock Institute found fertile ground in Scandinavian countries. In the late 1960s, "the Norwegian Industrial Democracy Projects" introduced the principle that technology innovation should improve work practices along with productivity measures (Thorsrud 1970). This was meant to empower employees to organize their own jobs. In the 1970s, figures like Kristen Nygaard–and more recently Bo Dahlbom, Pelle Ehn, Erik Stolterman and their students –pioneered the Scandinavian approaches to the social analyses of computing.

This approach reflects a strong orientation towards worker-involvement in designing IS and attends to both the quality of working life and potentially humanizing power of ICTs.

Perhaps the Tavistock approach garnered attention in Scandinavia because it resonated with the socio-political context grounded in deep appreciation for workers' right (Sawyer and Tapia 2007). This tendency was also reflected in the principles of participatory design (PD) and more recently activity theory-centric approaches (Kuutti 1996)[6]. In addition, the information system development methodology suggested by Mumford in the UK has been tried in Denmark and Sweden (Bjorn-Andersen and Eason 1980; Hedberg 1980). To this day, PD and social-theoretically inspired analyses of computing underpin much of information system research in the Scandic and Nordic countries (Iivari and Lyytinen 1998).

Despite its promising principles, sociotechnical design in IS failed to proliferate outside of the UK, Scandinavia and the Nordic countries. During the 1990s, economic, business, and technological arenas witnessed dramatic changes; the consequences turned out to be frustrating for advocates of sociotechnical design. In the harsh competitive environment, corporations were forced to embark on methods like lean production and business process reengineering that took little consideration of employees' needs or their quality of working life (Kling and Lamb 2000). As Carr (2008) notes, pointedly, the focus in corporate IT over the past 15 years has been to routinize, automate, and outsource. And, despite its progress in places like Scandinavia and the Nordic countries, few contemporary organizations were interested adopting PD and sociotechnical design approaches.

Workplace trends across the 1990s had companies creating flatter hierarchies and encouraged people to see innovative companies as requiring highly skilled groups to work together as members of high performance teams. While these trends expanded their member's responsibility and autonomy, this also created a more divided workplace as only high-status groups gained these benefits. Lower status positions (service, support and administration) were often outsourced or transferred to temporary employment and given far less voice or status in the contemporary firm. This segmentation of the workforce further undermined sociotechnical approach, which targeted broad groups of organizational members (Mumford 2006).

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[6] An entire intellectual community, centered on participatory design, has grown up and meets every other year (see http://pdc2012.org/about.html) at to advance sociotechnical design principles. Many of the leading scholars are known to the IS community, but are more likely to publish in computer-human interaction (CHI) or computer-supported cooperative work (CSCW) venues.

2.2. The sociological perspective on sociotechnical systems

Independent (at first) of the Tavistock efforts, in the late 1960s some scholars in sociology began a stream of theorizing on the roles of ICT (e.g., Joerges 1990). These scholars typically focused on ICT relative to human social structures such as groups, communities, organizations, social stratifications/societies and changes in power and equity (e.g., Latham and Sassen 2005). The focal interest of sociologists, however, has led them to foregrounding macro-sociological interests relative to the roles of ICT in and of society. So, computing continues to be a tertiary topic for contemporary sociologists[7].

The sociological perspective on sociotechnical systems unfolds in discourses which Kling (1980) sought to capture and articulate as belonging to either the rhetoric of "systems rationalists" or "segmented institutionalists" (Kling 1980). Systems rationalists focused on the positive, intended and often technologically-inspired opportunities from computing and automation of the workplace. Segmented institutionalists focused on the importance of social power, conflict and pursuit of non-commensurate goals as the undergirding of any computerization activity.

And, as we turn to below, Kling and his colleagues thundered against the naïve simplifications of systems rationalists.   In doing so, Kling and colleagues advanced – through empirical, methodological and analytical efforts – a range of segmented institutionalist approaches to the sociological analysis of computing (Wellman and Hiltz 2004). This approach was not pursued by many computer scientists or IS scholars and even fewer sociologists (as Kling (2003) himself rued in a posthumously published reflection on his work). Sociologists continue to grapple with the roles of ICT in social life, albeit with little attention to the work of Tavistock scholars, the IS community in Scandinavia, the Nordic countries, the UK; or the Kling-inspired colleagues in North America.

In the 1990s, new research interests in the social dimensions of IS emerged. These were directed to the relationships among IS development, uses, and resultant social and organizational changes. The new stream of research has offered fresh insights into the emerging role of ICT within differing organizational contexts (e.g., Walsham 1993; Hirschheim, Klein, and Lyytinen 1996; Kling and Scacchi 1982; Orlikowski 1992). Drawing directly on sociological theories of institutions, this wave of sociotechnical research has informed, if not directly shaped IS scholarship (Avgerou 2002). The

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[7] This noted, there is a thriving community of sociologists interested in online communities and the nature of social networks. See Wellman et al (2001) among others.

sociological theories leveraged by the new stream of sociotechnical research had flourished in parallel with the early sociotechnical approaches while they similarly dispensed with technological determinism. Even though not explicitly using the term "sociotechnical", these sociological theories offered a solid basis upon which emerging sociotechnical research built. In the following section, we discuss institutional theories, structuration theory, social network perspective and social philosophy that proved to be instrumental in the creation of this scholarly space.

2.2.1 Institutional theories

Institutional theories in organization studies emerged as a counterpoint to organizational theories which saw people as rational actors. In contrast, institutional theories focused on cultural and normative explanations for organizational phenomena (DiMaggio and Powell 1991). Barley and Tolbert (1997, p. 93) note: "…organizations, and the individuals who populate them, are suspended in a web of values, norms, rules, beliefs, and taken-for-granted assumptions, that are at least partially of their own making." The institutional perspective is premised on the concept of "institution" which denotes the importance of authoritative, established, and rule-like procedures that provide order in society.

A key aspect of institutions is their interest in continuing to exist. As institutions become taken for granted, people are likely to believe that there is a functional rationale for their existence, and therefore their validity is not questioned by social actors. By employing the concept of "institution", new intuitional theorists build a conceptual basis for delineating contextual influences and the broader influences of organizations' social environments.

From an institutional perspective, ICT is not merely viewed as a set of material features functioning according to the functional rules that are inscribed into their physical components, but as a product of embeddedness into social institutions (Avgerou 2002). In this way ICT can be considered as an institution in its own right, one which interacts with other institutions in modern society. As an institution, ICT can be characterize as emergent, embedded, evolving, fragmented and connected to an ephemeral social presence that is shaped as much by other institutional and contextual forces as by technical and economic rationales (Orlikowski and Barley 2001). Examining the interactions of ICT with other intuitions, Swanson and Ramiller (1997) concludes that institutional forces are significant in shaping the perception about the organizational potentials of ICT. Avgerou (2000), building from the institutional perspective, captures the process of IT-enabled organizational change with both the ICT innovation and organizational practices considered to be institutions:

each having its own mechanisms and legitimating elements. In this way, the interaction between these two types of institutions is theorized as the dual processes of institutionalization of IT and de-institutionalization of established organizational structures and practices.

While institutional theory provides a powerful framework for understanding the context of organizational change, its pillars rest upon the assumptions of stability, persistence, and the limited scope for change. By overstressing stability and the robustness of institutions, they could underestimate the role of human agency and ignore their potentials in transforming the institutional patterns (Barley and Tolbert 1997; Dacin, Goodstein, and Scott 2002). By the same token, ICT artifacts also retreat to a secondary position in institutional analyses. In fact, the institutional perspective does not inquire into the nature of technological artifact, and does not address whether IT itself can represent any material influences independent of institutional forces.

2.2.2 Structuration

Many scholars have theorized about the mutual constitutions of individuals and society (e.g., Urry 1982; Bourdieu 1977; Bhaskar 1998); however, it was the work of Anthony Giddens that introduced the concept of structuration to a wide range of social sciences, making him one of the world's most cited sociologists (Bryant, Jary, and Hutton 2001, , p. 43). Through the concept of structuration, Giddens (1986) rejects traditional characterizations of social phenomena as determined by either objective social structures or totally autonomous human agents. In his view, social phenomena are neither structure nor agency, but are continuously constituted in their duality. Giddens adopts an unconventional definition of structure as "rules and resources, organized as properties of social systems" that exists only as structural properties (Giddens 1989, , p. 258). Human agents draw on social structures in their actions, and at the same time, these actions produce or reproduce social structures. In this sense, action and structures are in a recursive relationship, and this is the meaning imparted by the term "structuration".

Structuration's dynamic conception of structure, as being recurrently produced and reproduced through situated interactions of people facilitates studying technological change (Orlikowski 2000). The fundamental duality of actions and structures as featured in the theory helped IS researchers to break away from both technological or social determinism (Markus and Robey 1988). Early champions of structuration theory in IS research employed the theory to link the context and process of change, examining the ways ICT contributes to the structuring of organizations. (Orlikowski 1992; Orlikowski and Robey 1991; Walsham and Han 1991). DeSanctis and Poole

(1994) developed an IS specific version of the theory, called Adaptive Structuration Theory (AST). AST focuses on (a) structures that are embedded in the technologies and (b) structures that emerge as human actors interact with those technologies. Scholars have noted the inconsistency of AST: Giddens theorized that structure cannot be inscribed or embedded in technology since they don't exist separately from the practices of social actors (Jones 1999).

Rejecting the hypothesis of structure as embedded in technology, subsequent interpretations of structuration theory in IS gave more weight to agency, focusing attention on improvisation, enactment, and the emergent nature of ICT-enabled organizational practices (Orlikowski 1996; Orlikowski and Hoffman 1997; Weick 1998). The shift from technology as an embedded structure toward agency of humans reached its apex with the practice lens of Orlikowski ((Orlikowski 2000; Schultze and Orlikowski 2004). She proposes the notion of technology-in-practice, which refers to the structure of technology use enacted by social actors while they interact recurrently with a particular technology artifact. Seen this way, technology-in-practice is emergent and enacted, not embodied or appropriated.

Despite its potential for explaining the social processes through which ICT and organizations interconnect, structuration theory has limitations for empirical IS research. For instance, Giddens makes almost no references to IS or ICT in his writings (Jones and Karsten 2008). In structurational analyses, technologies can have a material influence on human actions, but the effects are contingent upon how social actors engage with them through their practices. Thus, "…as they do things in relation to machines and so forth, these are the stuff out of which structural properties are constructed" (Giddens and Pierson 1998, , p. 83). What this "relation to machines" might be, and how it affects social actors' practices, however, is not elaborated in structuration theory and analysis of these properties remains largely underdeveloped (Jones and Orlikowski 2007). Moreover, structuration theory deals with social phenomena at a high level of abstraction. This leads to it being seen as a "meta-theory:" a way of thinking about the world, rather than an empirically testable explanation of organizational practices.

2.2.3 Social network/structure
The social network perspective first blossomed in the 1920s at Harvard University's Department of Sociology. Since then this approach has been taken up and advanced by scholars in sociology, anthropology, psychology, and organization science, to name a few (Scott 2000). In organization studies, scholars have explored different elements of social networks relative to embeddedness of organizational routines, informal information sharing, holes and bridges in knowledge flow, and the

transfer of social norms and tacit knowledge (e.g. Granovetter 1973; Burt 1992; Merton 1957; Wellman and Berkowitz 1988). In IS social networks concepts have been used to study the behaviors of teams, organizations, industries and ICT-enabled communities (Barabasi 2003; Christakis et al. 2009; Monge and Contractor 2003; Nohria and Eccles 2000).

The social network perspective is useful for studying some of the emerging forms of social or organizational arrangements and the roles of ICT (and more recently, social media) in those arrangements. A social network is a social structure made up of individuals called "nodes" who are "connected" by an interdependency like friendship, kinship, common interest, financial exchange, and knowledge or prestige. Networks of relations are enacted by sharing of information or resources among nodes (people) via ties between them (their interdependency). These simple concepts continue to offer scholars " …a surprisingly fruitful way to analyze how social formations organize, change, and grow." (Oinas-Kukkonen, Lyytinen, and Yoo 2010, , p. 62).

Concepts of network analysis such social capital (as resources derived from networks of relationships) provides a vehicle for examining digitally enabled social networks. For example, Robert et al (2008) use social capital as the lens to study the differences between lean digital networks and face-to-face interactions. In addition, via emerging computational capabilities, researchers are also enabled to conduct complex network analysis such as ICTs (such as social media) can enhance interactions across social networks (Agarwal, Gupta, and Kraut 2008). In this regard, building from the theory and methods of social network analysis, Kane and Alavi (2008) studied how multiple users interact with multiple ICTs within healthcare groups.

2.2.4 Social philosophy

Scholars in IS have drawn on social philosophers to gain conceptual insight into contemporary and complicated dimensions of information systems design, management and theory. These dimensions include but are not limited to politics, power, cognition and rationality of information systems (Fitzgerald 1997). The philosophy-oriented conceptual thinking came about in part as a challenge to the conventions of system rationalism that pervaded much of the early approaches to studying IS. This work also provided a more conceptually nuanced view of the world, shifting attentions from systems and technology to the interplay of people and their complex universe.

Most notably, IS researchers have levered philosophical approaches with a significant input from critical Social theorists to address IS sociotechnical problems. Arguably, critical social theory in these studies is mostly rooted in the work of Jurgen Habermas and Michel Foucault. These critical

social theorists posit that social structures are not independent of people: they are produced and reproduced by them. And, people's ability to transform their social and economic circumstances is constrained by multiple cultural, social and political forces. To this end, critical research seeks to outline the restrictive dimensions of the status quo and carry forward an emancipatory agenda by focusing on conflicts and contradictions in contemporary society (Myers 1997).

Other IS researchers have drawn on critical social theories to study freedom, social control, and power with regard to the development, use, and role of IT in organizations and society at large. Critical social theory has allowed these researchers to account for ethical and moral aspects of information systems, by focusing on emancipatory approaches and the betterment of people lives (Ngwenyama and Lee 1997). Critical approaches critique taken- for-granted assumptions; directing our attention to the potentials of people in changing their social and material circumstances. Germane to this view is the thesis that people who interact with information systems need not be constrained by their social circumstances (Orlikowski and Baroudi 1991). As an example, Hirschheim and Klein (1994) applied critical social theory to study IS development. Their critical approach discards over-simplistic notion of users and the dynamics of context by pay attention to how different user groups are affected by system development and may react to it. It also explicates how the system may fit into organizational context, and how other organizational dynamics such as power and politics come into play

While sharing some of the same philosophical roots, recent sociotechnical scholarship has shifted focus from rebelling against prescriptive IS development methodologies towards a broader view on the roles of ICT in contemporary organizations. In particular, the new sociotechnical approach that emerged in the 1990s is strongly inspired by the broader stock of social science theory (i.e. theories from science and technology studies) in order to address the multiple substantive issues that are associated with ICT (Dunlop and Kling 1991). These theoretical insights are critical in contrast to the classic sociotechnical approaches that had some distinctive "blind spots" in dealing with rapidly changing contingencies of workplaces and malleable technologies that lend themselves to user improvisation (Malone, Lai, and Fry 1995; Ciborra and Lanzarra 1999).

2.3. Science and technology studies (STS)

Scholars in the intellectual community known as science and technology studies (STS)[8] are concerned with the reciprocal relationships among social, political and cultural structures, science/scientific research and technological innovation. Scholars of STS bring a broad range of

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[8] For more about the STS community, see Hackett et al (2008) and http://www.4sonline.org.

perspectives to focus on the relationships among technology and society. So, historians, communications, sociology, computer science, political science/policy studies and information studies scholars are found in central roles in STS.

Given the variety of models, conceptual frameworks and domains of study, there is no agreed upon definition of what constitutes or qualifies as studies of technology within STS (Van House 2003). This intellectual ambiguity serves STS well as it makes the community open to exploring new technologies. And, by the 1980s, technology studies began to proliferate in STS. Two seminal works on social shaping of technology (MacKenzie and Wajcman 1985) and the social construction of technological systems (Pinch and Bijker 1987) signaled what Steve Woolgar was to call the "turn to technology" (Woolgar 1991).

Despite its ontological and epistemological heterogeneity, STS scholars pursue common themes. Virtually all STS researchers are united in their aim to dispense with the predominance of technological determinism. They believe that the simplicity offered by such a perspective fails to recognize the dynamic and complex process through which technologies interact with society (Bijker 1995; Latour 2005). STS researchers also unanimously argue that the "black box of technology" should be opened up for sociological analysis (Law and Bijker 2000). To do so, researchers must pay due attention to the process and content of technology itself. Shifting away from "the impact" of technology, this body of research tends to highlight how technology is constructed during research, development and innovation phases, and how structural and political circumstances of its development are reflected in technology. Over time, STS scholars have embraced several theoretical approaches. Three of the most prominent are: the social construction of technology (SCOT), focusing on constructs like interpretive flexibility and relevant actors; the social shaping of technology (SST) drawing on concepts like configuration and trajectories; and, actor-network theory (ANT) which introduces networks, enrollment, translation and irreversibility.

2.3.1 Social construction of technology (SCOT) and social shaping of technology (SST)

As the name implies, the social construction of technology (SCOT) conceptualizes technology as not determining human action: humans socially construct technology (Bijker 1997). Social constructionists, the advocates of SCOT, deny any self-evident explanations of effects stemming from the material attributes of a technology: constraining and enabling effects of technologies are matters of interpretative practices of people in the social context. The process through which technology is constructed is described through a number of stages. The first stage involves the

concept of interpretive flexibility to explain how a technology is socially constructed. The second stage explains how technology reaches stabilization, a state where the "relevant social groups" have their problems resolved and desires manifested in the artifact. In the final stage, the technological content of the artifact is linked to the social, through considering the meanings that are assigned to the artifact by the relevant social groups: it comes to 'closure.'

The conceptual pillars of SCOT are found in a number of IS studies. One example is Orlikowski and Gash's (1994) study of people's interpretation of Lotus Notes. Building on Bijker's (1987) conception of "technological frames," their study stressed the specific uses to which the technology is put in a given setting, and how the context of use influences the users' interaction with the IS. The lack of uniformity among the technological frames of disparate social groups is also attributed to the fact that "technologies are social artifacts, their material form and function will embody their sponsors' and developers' objectives, values and interests, and knowledge of that technology" (Orlikowski and Gash 1994).

Some scholars see SCOT's notion of closure as privileging design over use as this diminishes the recurrent reinterpretations of technological artifacts by different groups of users (Wajcman 2000). In response, STS scholars advanced the social shaping of technology perspective (SST). The SST perspective shares many commonalties with SCOT but avoids the problems which lead SCOT theorists to implicitly assume that technological structures will become something external to human actions during use (Orlikowski 2000). Still, and like SCOT, early SST work was rebutted for giving undue attentions to technology developers and technology design (Russell 1986).

Through a number of revisions, SST researchers (notably: Russell and Williams 2002) fine-tuned their theorization to open up the concept of design and development, portraying technology development as an open and indeterminate activity, through concepts like "innofusion" and "configuration." Innofusion is the process through which innovation extends to implementation, consumption and use (Fleck 1988). The technological artifact emerges and remerges "through a complex process of action and interaction between heterogeneous players" – what Fleck calls "learning by trying" (Fleck 1994). Along the same line, "configuration" advances the notion of open design and implementation, by appealing to technology in cases where a constellation of heterogeneous components are locally incorporated into some kind of working orders. In this sense, technology developers only preconfigure their products, which later become subject to various reconfigurations in the local site of use (Williams 2000).

The "strong constructivism" that underpins both SCOT and SST has been called into question. The focus on social constructivism, however, can lead analysts to discount any trace of, or role for, technological agency. Hutchby (2001, , p.450) argues strong constructivist approaches showcase "…humans are capable of interpreting the capacities of technologies [such as a bridge or an airplane] in varying ways." But, strong constructivists do not address the central question of "…does the aeroplane lend itself to the same set of possible interpretations as the bridge; and if not, why not?" (Hutchby 2001, , p.447).

2.3.2 Actor network theory

In contesting technological determinism, both SCOT and SST have been accused of falling into a form of social determinism: over-stressing social choice at the expense of technological considerations. By contrast, actor-network theory (ANT) seeks to avoid determinism. While ANT shares with social constructivists the central premise that social structures and practices cannot be realized solely through an account of the material properties of technologies, ANT distances itself from social determinism by making no analytical distinction between the social and technical (Latour 1987, 1999). Rooted in a "…ruthless application of semiotics" (Latour 1999, , p. 3), ANT's first premise is that entities have no inherent qualities: they acquire their form and functionality only through their relations with other entities[9].

The second premise of ANT is "symmetry" among humans and technological artifacts, arguing against any *a-priori* distinction between what is technical and what is not (Bloomfield and Vurdubakis 1997). As Latour (1991, , p. 129) maintains: "… rather than assuming that we are dealing with two separate, but related, ontological domains—technology and organizations—we propose to regard them as but phases of the same essential action". Building from the concept of symmetry, both technological and social entities are explained as "actants" (Akrich 1992).

An actor-network is constructed through the enrolment of actants (both human and non-human actants) into a network of relations by means of negotiations. This process is explicated by the "sociology of translation" which aims to describe, rather than explain, the transitions and negations that take place as the network is configured or 'translated' (Callon 1986). The translation process is

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[9] One implication of this relational premise is that concepts of context cannot be distinct from an actor-network – what one might characterize as 'context' or 'aspects of the situation' matter in ANT only if there is a relationship developed among entities of interest. That is, ANT is neither contextual nor a-contextual: the actor-network is both local and distant and the relationships between entities of interest, action and location are the focus.

political in nature, and begins with a certain "problematization" when one actor identities a problem that is shared by others and starts to convince other actors that the problem is significant enough to dedicate resources for its solutions.

Actor-networks reach stability when they become irreversible. Irreversibility is when it would be either too costly to reverse the relationships or doing so becomes improbable. Reaching network stability requires: (1) successfully negotiating the enrollment of participants, followed by the (2) translation of an (3) obligatory passage point (when the sets of relations and those enrolled become (4) irreversible) (Latour 1987). Mobilization of network members ensues as a result of irreversibility and stability where social investment in the network reaches a point at which withdrawal would be unthinkable. The durability of a network is matter of the robustness of the translation. Networks collapse or undergo changes if the translation processes which brought the networks to their current state can revert or if the networks cannot resist alternative translations.

To date, ANT's conceptual vocabulary and methodological demands have been used eclectically in IS research (Walsham 1997; e.g., Pouloudi and Whitley 2000). Numerous case studies inspired by ANT serve as a means to improve the understanding of IS researchers of the design and use of ICT, which is of significance for IS (Hanseth, Aanestad, and Berg 2004). And, there exists a prominent and meticulous adoption of ANT in the literature on information infrastructure. The size and complexity of infrastructural technologies such as groupware, and the characteristic that they generally build upon existing technologies, make researchers direct their focus from ICT or isolated technological artifacts to a more complex notion of IT infrastructure (Hanseth, Monteiro, and Hatling 1996). Several researchers have drawn upon ANT to account for the sociotechnical nature of the information infrastructure which not only includes artifact but also human habits, norms, and roles, that may prove its most intractable elements (Jackson et al. 2007). For example, building on ANT's conceptual vocabulary, Hanseth and Monteiro (1996) investigate how any given elements of information infrastructure constrain others, and how these elements inscribe certain patterns of use. To do so, they identify explicit anticipations of use by various actors during use, and the way these anticipations are translated and inscribed into standards.

3. Contemporary sociotechnical theories

There has been, over the past 15 years, substantial sociotechnical theorizing. Many of these contemporary approaches to sociotechnical theorizing draw together concepts from several of

these sociotechnical sources and combine both empirical and theoretical work to advance sociotechnical thinking, as we outline below.

3.1 Genres

The concept of "genre of organizational communication" was introduced to examine organizational communication with a particular focus on the mediating role of communicative technologies. Rooted in ancient Greek word, *genos*, genre denotes race, kinds and classes (Zimmerman 1994). The academic use perhaps dates back to the 1950s and these early formulations were mostly taxonomy-oriented, seeking to classify the form and content of written and spoken communicative actions. Contemporary efforts have shifted towards classification of communicative or rhetorical practices (Østerlund 2007).

Yates and Orlikowski (1992), building on Miller's (1984), define a genre as ". . . a typified communicative action invoked in response to a recurrent situation."(p. 301). The recurrent situation encompasses the history and nature of established practices, social relations, and communication media within organizations. In this view, genres are meaningless without the daily practices they are situated in. Furthermore, central to this theorization of genres is a focus on community. That is, the communicative purpose of a genre has to be shared within a community (i.e., organization) by more than one person.

The structural features, communicative technologies, and symbol systems of a genre are all made sense of within the community (Yates and Orlikowski 1992). For example, an e-mail is not an instance of communicative genres while a memo or a meeting agenda, which may be mediated by the use of email, are (Päivärinta 2001). With this distinction, genre theory dispenses with information richness theory, which defines a medium rich or lean due to its intrinsic characteristics. Based on genre theory, the same communicative medium can convey messages using different genres, just as the same genre can ensue using different communicative media. For instance, email can carry messages in the form of business letter or informal personal notes which are essentially considered disparate forms of genres (Lee 1994). Genres are dynamic: introducing and using a new medium may transform daily practices and changing communication practices. For example, Davison (2000) examined how computerized clinical order system changed interactions among multiple groups of organizational actors (e.g., physicians, nurses and pharmacists).

3.2 Boundary objects

A boundary object is something that is simultaneous 'rigid' enough to be commonly understood among different social worlds and 'plastic' enough to be understood within each social world (Star and Griesemer 1989; Star 1989). Some scholars have focused on how ICT serve as boundary objects among different groups (Fleischmann 2006, 2006; Gal, Lyytinen, and Yoo 2008). Others have focused on the negotiations that occur around boundary objects (Lee 2007; Lutters and Ackerman 2007; Rajao and Hayes 2012). Still others have focused on how ICT, acting as boundary objects, facilitate the flow of information in collaborative work (Osterlund and Boland 2009; Tyworth et al. 2012). Still others have focused on how to design ICT to function as effective boundary objects (Akoumianakis et al. 2011).

3.3 Biographies of artifacts

The biographies of artifacts (BoA) approach has emerged from the work of a small group of scholars in and around Edinburgh University (Pollock, Williams, and Procter 2003). Building on the series of deep studies of various broad-scale commercial technologies, the BoA conceptualization is that an ICT or IS often exists at one or more places (installed in more than one location) and varies by both the version (temporal) and location (spatial). To understand and study such diverse, distributed and popular (or common) IS requires one to pursue a biographical approach to analysis, one that focuses on the evolution of the particular artifact over time, its changes and evolution based on uses and events at various sites, and the players in these various arenas (Pollock, Williams, and Procter 2003). Building, as it does, from the SST tradition and from cultural studies (where the BoA concept first emerged), BoA provides a framework to approach large scale technological analysis. Its emphasis on trajectories and social shaping, and the demands of maintaining a dual focus -- on both common events and unique events, as both can shape the direction of the artifact's evolution – make it a demanding approach at present (e.g., Pollock and Williams 2009).

3.4. Domestication

Domestication of ICTs is premised on the processes of consumption and focuses on the ways in which a new artifact, concept or object of interest is brought into an existing social world (Berker, Hartmann, and Punie 2006). Consumption is more than use as it encompasses the mutual adaptations of social structures, processes and meanings as people bring the object of interest into their world and learn to live with it (or not). Much of the original domestication scholarship focused on the take-up and uses of the media and digital technologies in the home (Silverstone and Haddon,

1996). Domestication scholars broadened their focus of inquiry and the conceptual approach soon could be found in IS (e.g., Frissen 2000).

Domestication focuses attention to the ongoing and mutually adaptive processes of bringing ICTs into existing social worlds (often the home or people's lives). Domestication scholars see ICTs as arriving with pre-formed meanings constructed by advertising, design features and both informal discourse (e.g., word-of-mouth and personal networks) and formal media messages. One acquired, households and individuals invest them with their own significance, create and adapt strategies to manage, use and value these, and deal with the changes their presence, uses and meanings entail (e.g., Stewart 2003; Haddon 2006) makes clear domestication focus on consumption, rather than use, highlights processes of negotiation in bringing ICT into the social world. This process of making something (like a commodity technology or a particular artifact) personal is a 'taming' or training that take place over time. This may not lead to success (or a desired outcome) and domestication scholarship often highlights the churning or seemingly cyclical patterns of non-progress towards full acceptance/belonging. In studying this process, domestication emphasizes the relationships among the object, individuals and the larger social milieu in which this process unfolds (and often grants agency to the media messages and opinion leaders for framing the roles, uses and expectations of ICT).

3.4 Computerization movements

The computerization movements approach extends concepts of social movements in two ways. A social movement, broadly defined, is coordinated collective action that relies on informal social units to pursue institution building towards shared goals. These goals can be either aimed at a specific and narrow policy or be more broadly aimed at cultural change. Often this institution building creates conflict with existing institutions. Institution building requires leaders, visions, resources, followers and events. Adapting this broad area of sociological inquiry, Kling and Iacono (1988) articulated a computerization movement as a specific form of social movement, one focused on institutionalizing a particular ICT or IS. Moreover, a computerization movement emphasizes the public discourses around a new ICT, the ways in which various adherents and opponents frame the computerization efforts, and the practices through which these frames and discourses unfold. Elliott and Kraemer (2008) compiled a volume of computerization studies as a tribute to the late Rob Kling. Hara and Rosenbaum (2008) have extended computerization movements, developing a typology based on an empirical analysis of published work in this area.

3.5 Sociomateriality

Derived in part from the sociology of science, sociomateriality posits social practices as intrinsically conjoined with material things – and for our interests, this tends to focus on the material aspects of ICT and IS (Orlikowski and Scott 2008). Sociomateriality does not assign agency to people or technology but views the social and technological to be ontologically inseparable (Suchman 2007). It hence provides a means for understanding how social meanings and technological actions are inextricably related and, together, shape social practices.

The sociomaterial perspective considers knowledge to be enacted—every day and over time— in and through people's practices. Practices are "...recurrent, materially bounded and situated action engaged in by members of a community."(Orlikowski 2002, , p. 256). Sociomaterial scholars treat knowledge and practice as mutually constitutive: knowing is inseparable from knowledge practices and is constituted through those actions. Central to this view is the thesis that technological affordances are achieved in practice and can only be understood by focusing on their material performance which is always enacted by humans. In this way, the performativity of ICT and IS are not given *a priori*; they are temporally emergent and enacted (Orlikowski and Scott 2008).

3.6 Social informatics, social actors and sociotechnical interaction networks

Inspired by constructivist approaches to studying technology found in STS and sociology, social informatics (SI) is particularly concerned with computerization movements: the transformation of human social arrangements and activities that follows from the implementation, use and adoption of computers in different types of organizations and social systems (Horton, Davenport, and Wood-Harper 2005). Social informatics is a perspective, a way of framing, the particular dynamics of IS and ICT in social and organizational worlds. Social informatics scholars seek to theorize ICT and IS as evolving crystallizations of interests, activities, structures and artifacts that are constructed over time in response to local and institutional conditions (Davenport 2008).

Social informatics scholarship arose in response to the research in computer science's failure to adequately explain or even examine the changes in social structures and organizational processes that arise as new ICT and IS are taken-up and used. (Kling 2007) notes that social informatics is "... a body of research that examines the social aspects of computerization. A more formal definition is 'the interdisciplinary study of the design(s), uses, and consequences of information technology that takes into account their interaction with institutional and cultural contexts."

Kling is recognized as the foremost proponent of social informatics during his lifetime (Day 2007) and hailed as the man who "brought computing and sociology together" (Wellman and Hiltz 2004). Kling, as a prominent member of a research group at the University of California, Irvine, began to explore information systems in local government across the US in the early 1970s. Soon, Kling and Scacchi (1982) developed an explanatory framework, "the web of computing," in which they asserted that organizational computing must be viewed as an ensemble of equipment, applications and techniques with identifiable information processing capabilities. This ensemble or web stands as an alternative to 'engineering models' which focused on the technological equipment and their information processing capabilities.

As part of the perspective, social informatics scholars have advanced a set of findings: insights drawn from many studies that, together, can be taken as common or expected outcomes from any computerization effort (See Kling 1996; Kling, Rosenbaum, and Sawyer 2005). First, the uses of any ICT lead to multiple and sometimes paradoxical effects. Second, the uses of ICT shape thought and action in ways that benefit some groups more than others. The design, development and uses of ICT will reshape access in unequal and often ill-considered ways. Third, the differential effects of the design, implementation and uses of ICT often have moral and ethical consequences. This finding is so often (re)discovered in studies across the entire spectrum of ICT, and across various levels of analysis, that ignorance of this point borders on professional naiveté. Fourth, the design, implementation, and uses of ICT have reciprocal relationships with the larger social context: It is not possible to isolate an ICT or its effects. Finally, effects of ICT will vary by the level of analysis, making it appear as if there are different phenomena at work across these levels.

Two characteristics of social informatics distinguish it from the broader sociotechnical research literature. First, SI provides an intellectual framework that can guide methodological practices of IS researchers, one focusing specifically on ICT (and not more generically on 'technology'). In the 'web of computing' paper (Kling and Scacchi 1982) and later work (Kling 1987) presented IS researchers with a methodological guide for studying institutional uses of ICTs with a focus on the institutional level. A second differentiating characteristic of SI is the greater level of agency provided to the ICT and IS. This stands in contrast to the more common strong constructivism found in SST and SCOT where technical capacities are not fixed but essentially indeterminate and open to interpretive flexibility (For an overview of this debate, see (Grint and Woolgar 1992; Kling 1992, 1992)).

The social aspects of the web of computing were advanced by Lamb and Kling (2003). They emphasized that the focus on workers and others as users diminished their larger and more complex roles as 'social actors' and that only a portion (and often a remarkably small portion) of one's work is as a user. The social actor model further articulated several important social relations relative to the ways in which ICT and IS are taken up and brought into the social worlds of these actors (e.g., Rowlands 2009).

Several SI scholars have also extended the web of computing model, advancing Sociotechnical Interaction Networks (STIN) as a more fully developed version (Kling, McKim, and King 2003). Inspired by the symmetrical treatment of humans and non-humans in actor-network theory, Kling defines STIN as a network that "includes people (also organizations), equipment, data, diverse resources (money, skill, and status), documents and messages, legal arrangements and enforcement mechanisms, and resource flows" (Kling, McKim, and King 2003, , p. 48). STIN distinguishes itself from ANT's conceptual and abstract vocabulary by providing a methodological heuristic for identifying the network's members and boundaries (e.g., Meyer 2006).

4. Emerging scholarly spaces

Beyond the substantial intellectual activity surrounding the development and conceptual advances in contemporary sociotechnical theorizing as described in section three, we provide an overview of two emerging scholarly spaces – multidimensional networks and economic sociology – that are grappling with characterizing the roles of technology and are reaching out to sociotechnical scholars for guidance. The first space reflects a sub-community of social network scholars who are grappling with the empirical and conceptual issues of various ICTs being involved in or interacting with people's social networks. The second space is a distinct intellectual sub-community that is generating attention in both economics and sociology.

4.1. Multidimensional networks

Many scholars are drawing on concepts from social networks to study the roles and effects of ICTs in social and organizational life. Relative to this, two major views coexist. In the first view, ICT is considered an exogenous variable that can shape social networks. For example, the work of scholars like Barry Wellman and colleagues have investigated how ICTs can substitute for communication networks and how it can reconfigure these human-centric relationships (i.e., Wellman 2001; Wellman and Gulia 1999; Wellman and Haythornthwaite 2002).

Recently, a second view on the role of ICTs in social networks is emerging. This view rejects any separation between ICT and the network, treating ICT as an endogenous variable (e.g., Monge and Contractor 2003). These scholars advance the concept of a multidimensional network to help researchers capture the entangled and multi-faceted relationships between individuals and technologies. By definition, multidimensional network are both multimodal and multiplex. Multimodal networks contain nodes of different types, and multiplex networks are comprised of multiple types of relationships among nodes (Contractor, Monge, and Leonardi 2011)[10]. These simple concepts help sociotechnical researchers focus on the structure and dynamics of networks involving different types of players (people and technology) and different types of relations among multiple people and technologies.

4.2.   Economic sociology

Economic sociology has emerged in the past 20 years as an intellectual community that focuses attention to the socially-embedded nature of economic activity (see Swedberg (1994). Social-embeddedness is at the core of economics sociology and has three characteristics. First, an economic transaction is done by and for people. As such this transaction reflects sociality in the ways it is conducted, in the sets of assumptions regarding the behaviors of the participants (and the behaviors of the non-participants), and the roles that these transactions play in the larger social world (their structuring potential). A second characteristic is that the motives of the participants are influenced by their social relations, norms and structures: participants are social agents (e.g., Swedberg and Granovetter 2001). In this rejection of "*homo-economicus*," economic sociologists go beyond Simon's concepts of satisficing and reflect the fundamentals of bias, anchoring and attention to social activity that Tversky and Kahneman (1974) theorized on in their Nobel-winning prospect theory. The third characteristic of economic sociology is the importance of institutions and their construction as sets of shared interests and social relations that are so important to the structuring of society that these interests and relations are often encoded as laws and regulating social norms (e.g., Rauch and Casella 2001).

The empirical and conceptual premise of economic sociology is being advanced by economists, sociologists and political scientists. However, they have, collectively, done little to conceptualize

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[10] This discourse has similarities with the sociomateriality discussion (section 3.5). The most distinctive difference between the two is the explicit embedding of a technological artifact into a network of social relationships that multimodal networks demand. Concepts of networks and embedding may also harken ANT. But, the multimodal conceptualizations are not premised on the conceptual foundations of symmetry, enrolment, negotiation, translation and irreversibility on which ANT relies

the roles or effects of ICT. That is, the roles of ICT as both a participant in economic life and social life, and the potential effects of the presence and uses of ICT on social relations and social structure, remains an anomalous. This noted, there has been some recent work to advance the role of technology (more broadly) in economic life by building on the flexible conceptualizations of technological materiality (e.g., Pinch and Swedberg 2008).

5. Conceptualizing the ICT artifact

We began this chapter by noting that IS scholarship focuses on the relationships among ICT and organizational actions, processes, structures and changes (Markus and Robey 1988; Leavitt and Whisler 1958; Benbasat and Zmud 2003); (Sidorova et al. 2008). As these scholars and others have noted, conceptualizing the ICT artifact, IS more broadly, and their effects remains both a core mission and a difficult task for IS scholars (Orlikowski and Iacono, 2001; King, 2011). As we have outlined here, the sociotechnical perspective and its underlying premises provide IS scholars with a range of conceptual tools to advance our empirical bases, theoretical understanding, and design interventions relative to IS in organizations and society.

At the core of the sociotechnical perspective are (1) the characterization of ICT and IS and (2) the conceptual focus on technological agency. Relative to the characterization of ICT and IS, sociotechnical approaches provide a range of conceptualizations: the strong social-constructionism of SCOT, the more limited social-constructionism of SST, the conceptual symmetry of ANT, and the weaker constructionism of STIN and sociomateriality. Relative to technological agency, sociotechnical approaches from this is mutually interdependent with social and organizational aspects of the situated phenomena. This provides a useful alternative to both the standard models of IS and other emerging approaches seen in IS.

Over the past decade, scholars have begun advancing design science and design theory as another approach to IS research (e.g., Gregor 2007; Pries-Heje and Baskerville 2008). Given the design focus and interventionist orientation of the Tavistock traditions of sociotechnical research, it may be that design research is one vehicle for sociotechnical scholars to pursue (e.g., Markus, Majchrzak, and Gasser 2002; Baskerville and Pries-Heje 2010). More generally, given the broad scope of IS scholar's research interests and the equally broad range of conceptual approaches taken, the sociotechnical perspective provides a set of conceptual tools and empirical insights to advance the state of IS research (Sawyer and Winter 2011; King 2011). That is, sociotechnical approaches to studying ICT and IS provide useful intellectual guidance to advance our theorizing on technological

artifacts, and how people's work practices and organizational arrangements are afforded by technological resources and inhibited by technological constraints.

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