How "Sociotechnical" is our IS Research? An Assessment and Possible Ways Forward[1]

Completed Research Paper

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Abstract

This paper seeks to offer an assessment regarding the extent to which we, as IS academics, have been faithful to sociotechnical paradigm, often considered as a fundamental guiding frame for the discipline. As a first step, the paper identifies eight ways in which the technical and the social are featured in the IS literature. Having done so, the paper provides a critical commentary on whether, and in what sense, we have been true to the sociotechnical framework. Finally, the paper offers some ideas for the IS community to reflect on regarding how to move forward with respect to sociotechnical framing of IS research.

Keywords: IS Research, IS Discipline, sociotechnical, assessment, recommendation

[1] The first two authors contributed equally to this paper. This paper is partially based on the material presented in a SIGPHIL panel, Shanghai, 2011.

Introduction and Motivation

Sociotechnicality and the Identity and Legitimacy of the IS field

Our research community has, for long, been concerned about the status of the Information Systems (IS) discipline, with much scholarly discourse centered on legitimacy and identity issues. As part of this conversation, it has been argued that a potentially promising path to enhancing the status of IS research (and by association, the status of the discipline) is the development of *native* IS theories, offering a somewhat unique perspective to IS-related phenomena compared to one those offered by traditional social science theories (Leonardi 2013; Straub 2012; Gregor 2006), that are widely adopted or discussed within (and, if possible, outside) the discipline.

Many scholars (e.g. Kautz and Jensen 2013; Beath et al., 2013; Mutch 2013) observe that such native IS theories stem from the *sociotechnical* perspective, which "underlies much of IS research systems where the human and the technical must each be considered in relation to any IT - enabled change…" (Beath et al. 2013, p. iii) and which is *foundational* to IS research and scholarship (ibid). Indeed, this sociotechnical perspective allowed the IS discipline to be "decades ahead of computer science and software engineering in their attention to the context of systems" (ibid, p. iii), thereby showing the relevance of this perspective to shaping the *identity and legitimacy* of the IS discipline.

It may thus be argued that the sociotechnical paradigm has been a guiding light for the IS discipline, for both research and practice (Bostrom et al. 2009)[2], and a key contributor to the legitimacy of the discipline. Because IS includes technological artifacts as well as the people who develop/use those artifacts within a given social context, its nature inherently is sociotechnical (Briggs et al. 2010). Indeed, "much IS research has grown up around *sociotechnical* topics [emphasis added]…" (Chiasson and Davidson 2005, p. 399). These include multiple and diverse areas such as IS development (e.g. Luna-Reyes et al. 2005), IS-induced organizational change (Lyytinen and Newman 2008), IS problems/failures (Bostrom and Heinen 1977), IS innovation (Avgerou and McGrath 2007), knowledge management (Pan and Scarbrough 1998), human-computer interaction (e.g. Alter 2010), and finally, group processes and interactions (Jensen et al. 2010).

Why is the sociotechnical paradigm popular?

It is not hard to envisage the reasons underlying the popularity of the sociotechnical paradigm, two of them being particularly salient. *First*, it has enabled researchers to *create a common ground within the IS discipline*, given that IS by definition, is sociotechnical (Briggs et al. 2010). For example, Hirschheim and Klein (2012) note that the IS discipline "formed from the nexus of computer science, management and organization theory, operations research, and accounting (Davis and Olson, 1985, pp.13-14)." They thereby inherently acknowledge that the sociotechnical paradigm incorporating both technology (computer science) and social (e.g., organizational) aspects, is one of the *key unifying strands* in the development and the evolution of the IS field. *Second*, beyond creating a common ground, arguably, the sociotechnical paradigm captures the essence of what Benbasat and Zmud (2003) articulate as the core *identity* of the IS discipline. As an example, they argue IS research should focus on (p. 186):

"The managerial, methodological, and operational practices for directing and facilitating IT artifact usage and evolution" [e.g., social/organizational practices in the use of technological artifacts]

One can therefore contend that the sociotechnical paradigm has possibly helped the IS community to develop a *shared identity, by contributing to the definition of the discipline's core properties*. More

[2] It is notable that many different kinds of IS have been studied from a sociotechnical perspective. For example, Kwahk and Ahn (2010) and Lyytinen et al. (2009) use a sociotechnical perspective to understand ERP use/implementation. Others, such as Lim (2012) have suggested that the sociotechnical lens is appropriate for studying social media use. Further, the evolution of mobile applications has been understood from a sociotechnical viewpoint (e.g. Allen 2003). Finally, Grabski et al (2011) discuss the value of the sociotechnical approach while developing a research agenda for accounting information systems. This view is reiterated by Robey et al. (2013) who note that accounting may be understood from a sociotechnical perspective where accounting technologies can be thought of as being embedded within the social aspects of accounting practice.

specifically, it has contributed to cumulative knowledge generation associated with the IS discipline because knowledge generation within the IS discipline "is…recognized and questioned as a product of…*socio-technical practices* [emphasis added]" (Constantinides et al. 2012, p. 15).

The sociotechnical paradigm acknowledges the inherently interdisciplinary nature of IS research (Constantinides et al. 2012; Baskerville and Myers 2002; Lee 2001) and has helped us differentiate ourselves from the purely technological fields (e.g., computer science) or the purely social and/or management disciplines (e.g., sociology and management). Often the call to embrace the sociotechnical approach has served as its disciplinary slogan, with scholars conceptualizing "organizations…as socio-technical systems" (Lyytinen and King 2004, p. 229) and trying to theorize new ways of "seeing into and intervening in *socio-technical* [emphasis added] problems" (ibid, p. 232).

While the sociotechnical paradigm has been much appreciated and idolized in IS research, it has not been without its shortcomings and criticisms. For example, the global move toward capitalism implied less influence of trade unions and thus diminished focus on sociotechnical practices (Kyng 1998; Mumford 1999; 2000; McGrath 2005). Other challenges of the sociotechnical approach included its inherent idealism, and an inability to influence IS innovations during design as well as use and implementation (McGrath 2005; Avgerou 2002). In addition, sociotechnical practices lead to "untenable courses of professional action because it neglects power dynamics"[3] (Avgerou and McGrath 2007, p. 312) and have "limited meaning outside an industry context" (Chiasson and Davidson 2005, p. 399).[4] In addition, as the sociotechnical approach is essentially a planned approach (we discuss this later in the paper), it falls short of legitimizing and sustaining spontaneous innovations (Avgerou and McGrath 2007).

Notwithstanding such criticisms, it is also notable that in the last few years, the sociotechnical movement has gained *further momentum* in terms of what has referred to as the *sociomaterial* movement in the IS discipline.[5] Building upon the sociotechnical perspective, many scholars have recently argued that social and the material (i.e., technological) are intrinsically linked (e.g., Leonardi 2011; Leonardi and Barley 2008, 2010; Orlikowski and Scott 2008; Orlikowski 2007) and that "everyday organizing is inextricably bound up with materiality [i.e. with the technology]" (Orlikowski 2007, p. 1435). Therefore, we can conclude that despite the alleged limitations, the sociotechnical paradigm historically has been, and continues to be, an important perspective guiding IS scholarship and practice and strongly contributes to the identity and legitimacy of the IS discipline.

Focus/Motivation of this paper

Given that the debate on the nature, identity, and legitimacy of the IS field has been ongoing (Agarwal and Lucas 2005; Klein and Hirschheim 2008; Lyytinen and King 2006; Weber 2006; Hirscheim and Klein 2012), and the relevance of the sociotechnical paradigm to this discourse, we feel the time is ripe to assess the sociotechnical perspective. This assessment would arguably contribute to discussions around the identity of the IS discipline. Specifically, it is valuable to return to the sociotechnical approaches (Robey et al. 2013; Mutch 2013), and "revisiting and refreshing the insights from the socio-technical tradition, with its emphasis on a non-conflationary approach, in which the social and the material are held apart for the purpose of exploring their interplay" (Mutch 2013, p. 29).

In this context, it is useful to note that many scholars believe that the sociotechnical perspective can improve the stature of IS as a reference discipline (King 2013), in particular, because it has been at the core of the IS discipline (Yoo 2013). Therefore, understanding the nature of sociotechnical research in IS is an important endeavor toward furthering the identity and legitimacy of the IS discipline. Indeed, in the

[3] Sociotechnical conceptions may possibly ignore power relations because they often preclude the context and thereby ignore the regimes of truths and biases that surround IS development, use, and implementation (Avgerou and McGrath 2007).

[4] This is because of the need to contextualize assumptions regarding the technological artifacts within an institutional and industrial environment (Chiasson and Davidson 2005).

[5] According to Leonardi (2013, p. 60), the sociomaterial perspective has now become "one of the most popular, most cited, most debated, and most critiqued topics in the fields of information systems and management." However, it is notable that scholars argue that the core conceptions of sociomateriality have previously been present in the IS discipline in *sociotechnical* systems thinking (Kautz and Jensen 2013), which formed the core of the IS discipline especially during the formative years (Yoo 2013). One can observe that the sociotechnical paradigm subsumes the recent trends in sociomateriality (Leonardi 2013a).

face of fears that the IS discipline may not exist (King 2011) or that IT does not matter (Carr 2003), it is perhaps in the best interest of IS scholars to focus on issues related to the core identity of the IS discipline and be attentive to concerns regarding its legitimacy. In other words, there is a need to re-assess the usefulness and relevance of the sociotechnical paradigm so as to better understand and further the legitimacy of the IS field.

In this paper, we strive to address this issue and assess the *actual usefulness* of the sociotechnical paradigm to IS research. Specifically, this aim guides the *research questions* motivating this paper:

- How faithful have we been to our conception of the sociotechnical approach, which, arguably lies at the core of the IS discipline? Have we truly followed this paradigm, or has it just been nothing more than a disciplinary slogan for the IS community?
- In what different ways have we conceived of and implemented this paradigm?
- Finally, do we need to revise our conception of the sociotechnical approach so as to move the IS field forward?

At the very least, therefore, this paper seeks to offer a *state-of-the-art review of sociotechnical thinking* implicit in IS literature, identifying *key strands* of sociotechnical research, delineating possible *issues* in how the sociotechnical concept has been implemented in studies, and providing *future considerations* for the IS community. With this motive, we proceed as follows. Next, we provide an overview of the typical sociotechnical perspective originally espoused in IS research, and delineate its core characteristics. Then, we evaluate how well we have been faithful to this sociotechnical conception by investigating the different types of instantiations that we find in IS research. This also allows us to provide a state-of-the-art evaluation of the sociotechnical paradigm in IS research. We conclude with recommendations on how to forward the sociotechnical paradigm so as to guide and benefit future IS research.

Traditional conception of the Sociotechnical Paradigm in IS research

As a foundation for our arguments, it is important that we first summarize our understanding of how the sociotechnical paradigm has been traditionally viewed in IS research. The origin of sociotechnical thinking can be traced to the multiple post World War II field studies undertaken in the British coal-mining industry by the Tavistock Institute (Trist 1981). It emerged as a new paradigm, which challenged the prevailing worldview that understood technologies as being external antecedents to organizational (i.e. social) structure and behavior (Beath et al. 2013). According to sociotechnical thought, neither technology nor organizations should be singularly privileged over the other; one should focus on their interplay (ibid). Figure 1 captures this perspective, which has since been articulated in many of the well-known/influential studies published within, or even outside the IS discipline (e.g., Bostrom and Heinen 1977; Land 2000; Trist 1981; Cherns 1976; Bjorn-Andersen et al. 1986; Bansler 1989; Pasmore, 1985; Lee 1999; Ropohl 1999'; Lamb and King 2003).

Essentially, the sociotechnical approach conceptualizes two mutually interacting subsystems, the technical subsystem (TS) and the social subsystem (SS) (Alter 2013). The TS comprises of the hardware, the software, and the databases, as well as the techniques (Nolan and Wetherbe 1980; Ryan et al. 2002) while the SS includes employees, their social capital, their knowledge bases, skills, and abilities (Ryan et al. 2002). The sociotechnical approach essentially focusses on the fit between the TS and SS (Pava 1983; Trist 1981; Wallace et al. 2004) and explicitly acknowledges the interdependency between the TS and the SS (Bostrom et al. 2009; Ryan et al. 2002; Alter 2013). Furthermore, this fit/harmony should result in not only increased instrumental objectives (e.g., productivity), but also better humanistic objectives (e.g., better worker enjoyment) (Wallace et al. 2004; Bostrom et al. 2009).

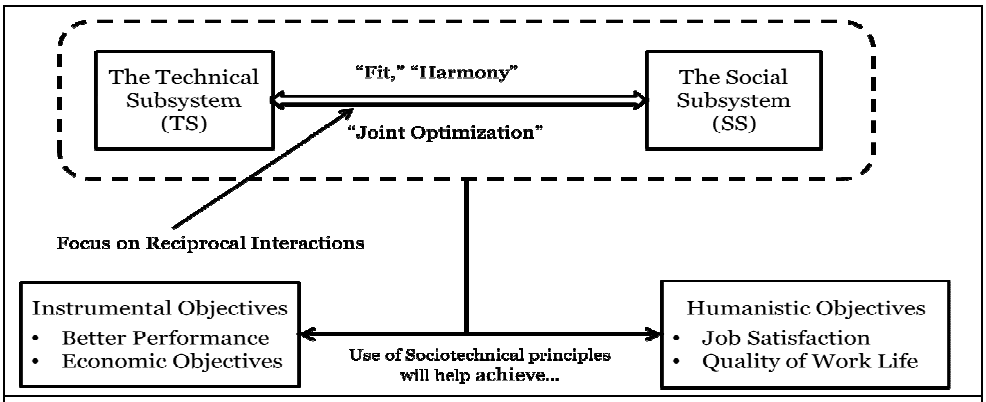

Figure 1. The Sociotechnical Approach

One can observe from Figure 1 that the traditional conception of the sociotechnical has been usually applied at a specific level of analysis, that of the "work system" (Alter 2013). Alter (2006) notes that work systems consist of "work practices, participants, information, and technology" (p. 368) as well as its outputs (products/services) and the external environments such as customers and other stakeholders. Jasperson et al. (2005) provide a similar view, when they observe that the work system provides the context for employees to work and includes both technology and social structures. It is immediately evident, therefore that work systems are fundamentally conceived in sociotechnical terms as they "are sociotechnical systems by default" (Alter 2013, p. 82).

To what extent have we been faithful to the above conception

While sociotechnical thinking is an espoused ideal, it does not necessarily mean it is a practiced ideal, as there can often be differences between what we idealize and what we practice (Lee 2010). Therefore, we contend that we need to actually assess our faithfulness to this paradigm. Formally, following our research questions, we look back and evaluate the following aspects of the sociotechnical tradition in IS research:

- Have we conceived of our phenomena of interest as consisting of a *social* and a *technical component* (with *an even-handed emphasis*)?
- Have we focused on the *reciprocal interactions* between the two components, a key consideration in the sociotechnical approach?
- Have we focused on *fit*, *harmony*, and/or *joint optimization between the TS and SS*?
- Have we focused on how the *dual objectives* (economic and humanistic) are being or can be met?

To answer these questions, we try to categorize[6][7] the different types of sociotechnical approaches observed in prior IS literature in the following sections. We also note here that this paper is not intended to be a criticism of any particular strand(s) of sociotechnical research, but rather to proffer an honest opinion that, we believe, can help move the IS community forward in terms of sociotechnical thinking.

[6] We see very different appropriations of the sociotechnical perspective, both in our review and in the observations by prior academics (e.g. Griffith and Dougherty 2002). Consequently, there is a need to systematically investigate and unearth the varied sociotechnical approaches in terms of the various types presented here.

[7] We developed this classification based on a review of papers, most of them published in the MISQ and ISR over the last several years. The process of deriving the types involved induction as well as abduction. We first summarized the patterns we discerned in these papers and then interpreted them using our knowledge of the literature and discipline.

Type I. Technology as the (hidden?) context for the social

The first category (Figure 2) of sociotechnical IS research that we encounter can be characterized as the "absent presence" of technology (Gergen 2002, cited in Orlikowski 2010). This perspective does not account for technology, which therefore remains unacknowledged and imparts ontological priority to human/social actors and structures (Orlikowski 2010); consequently, "technological artifacts…tend to disappear into the background and become taken for granted" (ibid, p. 128). Orlikowski (2010) further observes that in general, such research has treated IT as "either absent, black-boxed, abstracted from social life, or reduced to surrogate measures" (Orlikowski and Iacono 2001, p. 130).

According to Orlikowski, this deficiency is long-standing, a view supported by the quite telling observation by Pinch and Bijker (1984) long back that "in the economic analysis of technological innovation everything is included that might be expected to influence innovation, except *any discussion of the technology itself* [emphasis added]" (p. 404). Part of this reason may be that while technologies enable absent presence, they are not the only enablers of such absent presence- other media (e.g., books, newspapers) can also foster it (Campbell and Kwak 2011).

Due to the "implied presence" of technologies, such research is typically characterized by application/extension/testing of traditional social theories in technology-mediated contexts. This is because many researchers believe that virtual and collocated phenomena are comparable and theorize about them in similar terms (Orlikowski and Iacono 2001). Such research has therefore mostly been engaged in the social analysis of technology-related phenomena, focusing on social factors leading to ERP implementation success (Sarker and Lee 2003), the process of user-analyst interaction (Newman and Robey 1992), or the group features/characteristics and outcomes in technology-mediated teams (e.g., Alnuaimi et al. 2010).

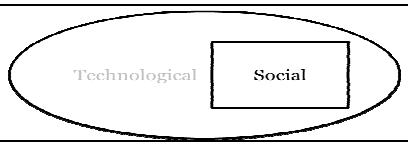

Figure 2. Technology as the hidden context for the social

Figure 3. The Technical Influences the Social

Type II: The Technical Influences the Social

The second type of sociotechnical research (Figure 3) is where the studies show how the technological artifacts influence the social. This influence is often conceived as a form of technological determinism, which views that technologies influence and or constrain changes in the social world (Heilbroner, 1967; Leonardi and Jackson 2004; Markus and Robey 1988; Perrow 1967). As Orlikowski and Scott (2008) observe:

"Many of the studies…posit technology as an independent variable…having a range of effects—at different levels of analysis (individual, group, enterprise, and inter-organizational)—on multiple organizational outcomes (the dependent variables)." (p. 439).

In this perspective, IT is seen to cause structural, communicative, and decision-making changes in organizations (Pinsonneault and Kraemer 2002). While such technological determinism has often been empirically refuted, this stills remains "powerful and pervasive" and views that technology influences social progress (Leonardi and Jackson 2004, p. 618). Essentially therefore, this conception perceives that organizational/social change is often a product of technological developments (Leonardi and Jackson 2004; O'Mahony and Barley 1999; Edwards 1979; Edwards 1995). This view is often positivist and rationalistic, and thereby understands technology as tools to reduce process losses and increase human and organizational efficiency (DeSanctis and Poole 1994; Rice 1984).

This perspective focuses on numerous impact and/or evaluation studies, as recounted by scholars (e.g. Leonardi and Bailey 2008). A couple of examples showcase this assertion. First, let us consider the well-known Electronic Market Hypotheses or EMH (Malone et al. 1987) and the studies it inspired. EMH posited that advances in IT will reduce coordination costs, which in turn will influence a move toward a

market structure or, alternately, a move away from a hierarchical coordination structure. In addition, IT itself will influence such market mechanisms, and will drive out the intermediary (middleman), leading to shorter value chains (Giaglis et al. 2002). This is called the disintermediation hypotheses, also proposed in the same Malone et al. paper. Another recent example of this type of sociotechnical research is Mithas et al. (2011) where they investigate (among others) the impact of IT on revenue growth and firm profitability. Following the resource based view of the firm (RBV) (e.g. Barney 1991), they view IT as a key resource which increases firm revenues and profitability.

Type III. The Social influences/shapes the Technical

The third kind of sociotechnical IS research (Figure 4) is where the social shapes the technological. In this perspective, technology is designed by humans to cater to organizational needs for information processing and is therefore the dependent variable (Markus and Robey 1988). Technology here is a product of human choice and action (DeSanctis and Poole 1994). This perspective is also called as the "organizational imperative" where human actors largely influence technology and its consequences (Markus and Robey 1988). One can argue that this conception of the relationship between the social and the technical is also similar to the *institutional* view of organizational change (DeSanctis and Poole 1994). As DeSanctis and Poole observe, institutionalists focus on social structures instead of technological structures. This perspective is in direct contrast to the previous technocentric perspective (Type II).

In this conception, human agency is given priority (Orlikowski 2010; Galliers 2003). An example of research following this stream of thought can be found in Cooper et al. (2000) who use a case study to illustrate how organizational characteristics can affect creative IT requirements and logical design. Another example is Wallace et al. (2004) who theorize (among others) that "social subsystem risk" influences "technical subsystem risk," and also find empirical support for this relationship.

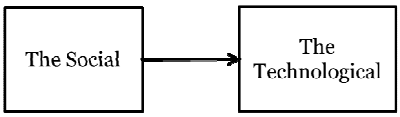

Figure 4. The Social influences the Technical

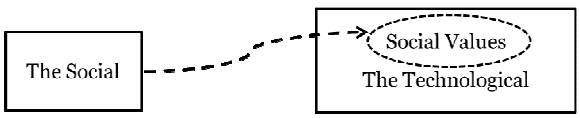

Figure 5. The Social Inscribed within the Technical

Type IV. The Social Inscribed within the Technical

The fourth type of sociotechnical research (Figure 5) is where the social considerations are inscribed within the technological artifact. This type is exemplified by design science research, where the focus is on creation and evaluations of IT artifacts (Hevner et al. 2004).

IS research has seen multiple instances of such design science research – for example, Walls et al. (1992), who design an executive information system and Poltrock and Handel (2010) who use models of collaboration as a foundation for building collaborating technologies. In the design science approach, IT/design artifacts (as also design processes) are based upon theories of natural and/or social sciences, which inform a set of design goals for the design artifact (Walls et al. 1992). In other words, a major focus of the design science research field is on how to include or inscribe *social values* into IT artifacts. In this perspective, social considerations form the justificatory knowledge that informs the design of technological artifacts (Gregor and Jones 2007; Gregor 2006). A typical focus of research in this area has been the notion of value sensitive design, which designs technology by accounting for human values (Friedman et al. 2006). Prior research has argued that such human (i.e. social) values can be inscribed while designing IT artifacts (Friedman, 1996; Chae et al. 2005).

As an example of this perspective, Chatterjee et al. (2009a) proposed a design of groupware by incorporating human ethical values drawing upon the philosophical works of Immanuel Kant (1804) and John Rawls (1971). As another illustration, Siponen and Iivari (2006) discuss the applicability of various ethical theories in designing IS security policies. As one example, they discuss how virtue ethics (Aristotle 1985) and corresponding virtues can be incorporated into IS security policies and guidelines.

Type V. The Social and (also) Technical Factors Explaining Individual/Collective Outcomes

The fifth type of sociotechnical research (Figure 6) we see is where the social and technological factors explain individual/collective outcomes. This is a frequently occurring type, as authors are under pressure to demonstrate that their work has technical and social components and satisfy the review panel's demands for the "errors of exclusion" (Benbasat and Zmud 2003). Such works typically include some technical variables to a primarily social explanation. The difference between this and type I is that this perspective explicitly recognizes a role of technology (though disproportionately small) in their theorization, while the latter does not.

As an example of this type, Wixom and Watson (2001) investigated the factors affecting data warehousing success. The major factors deemed relevant were organizational resources, user participation, and the skill of the employees, which influence whether the data warehousing project will be successful (i.e. be on time and budget). However, technological factors this study considers include unstandardized source systems and poor technology development.

Notably, this perspective while different from Type III, still *apportions dominance to social factors*. Thus, technology, though an independent variable in this type, still performs a *secondary role*. Therefore, even this type does not investigate the social and the technical with a comparable emphasis.

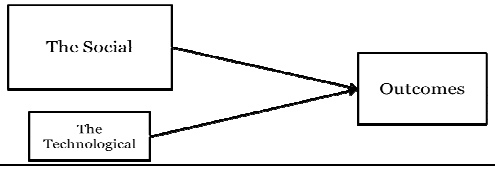

Figure 6. The Social and (also) the Technical Explaining Individual and Collective Outcomes

Figure 7. Reciprocal Interaction Between the Social and the Technical

Type VI. Reciprocal Interaction between the Social and the Technical

Yet another type of sociotechnical research – and arguably one that stays closest to the original conception of the sociotechnical paradigm - has been to understand the reciprocal interaction between the social and the technical (Figure 7). In such a conceptualization, technology is both influenced by human action, as well as an influencer of human action (Orlikowski 1992). Notable within this genre of sociotechnical research is the stream influenced by Orlikowski's (1992) work on the structurational model of technology (Jones and Karsten 2008). In this conception, technology is part of complex organizational processes and engages in dynamic interactions with social elements (Orlikowski and Scott 2008). These interactions are embedded, emergent, mutually dependent, and temporally co-evolve (ibid).

The general view of these studies is that IT and social structures mutually appropriate each other (Orlikowski 1992). Appropriation refers to choosing and adapting technologies within specific work contexts (DeSanctis and Poole 1994; Kang et al. 2012). In this perspective, technology is seen as "interpretively flexible" (Jones and Karsten 2008) and "reinforces and transforms the institutional properties of organizations" (ibid, p. 142). DeSanctis and Poole (1994) provide an interesting example of such mutual appropriation between IT and social structures in their formulation of Adaptive Structuration Theory (AST) (DeSanctis and Poole 1994). In AST, appropriation of IT through a process of structuration (Kang et al. 2012; DeSanctis and Poole 1994) gives rise to new social and/or technological structures which are produced/reproduced over time to result in further new sociotechnical structures that ultimately become accepted within an organization (DeSanctis and Poole 1994).

Type VII. Fit between the Social and the Technical leading to Desirable Outcomes

This type (Figure 8) investigates an interaction effect between social and technological factors leading to desirable outcomes. Thus, in this conception, the sociotechnical is understood as an *interaction*. This understanding of the sociotechnical approach has been acknowledged by Orlikowski and Scott (2008)

who note that "studies in this stream [view] technology…as a moderating variable that variously influences the relationship between organizational variables…and certain outcomes…" (p. 439).

Examples of this conception abound in current literature. For example, Morris and Venkatesh (2010) investigate the influence of job characteristics such as task significance, task identity etc., on job satisfaction (a humanistic outcome), moderated by the IT artifact, i.e., pre- and post- ERP implementation. Similarly, Strong and Volkoff (2010) identify different domains of organization-enterprise system misfit, and discuss the problems experienced by users because of the misfit. A third recent example of such research is Sarker and Valacich (2010) who argue that groups' communication media interact with individual members' a-priori attitude toward the technology and group majority opinion to influence group valence toward technology. This valence influences humanistic outcomes like satisfaction and instrumental outcomes such as performance. Finally, variation of this form is research on task-technology fit (Goodhue and Thompson 1995; Goodhue 1998), where technology characteristics and task characteristics interact to produce desirable instrumental outcomes such as performance (Goodhue and Thompson 1995) and humanistic outcomes such as satisfaction (Straus and McGrath 1994).

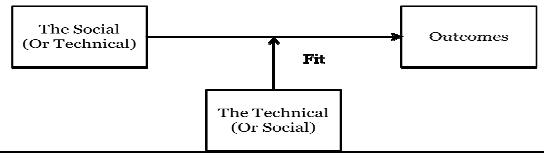

Figure 8. Fit between the Social and the Technological leading to Desirable Outcomes

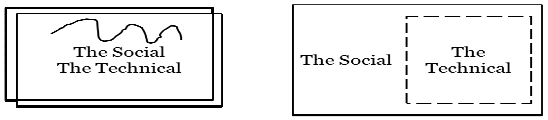

Figure 9. The Social and the Technical Entangled in Practice

Type VIII. The Social and the Technical Entangled-in-practice

The final type of IS sociotechnical research (Figure 9) that we identified through our review holds that the social and the technical are ontologically inseparable (Orlikowski 2010) and challenges the social-technical dualism in early views of sociotechnical. This "relational ontology" "privileges neither humans nor technologies" (Orlikowski 2010, p. 134). Notably, this *new* sociotechnical movement seems to be taking hold in the discipline (e.g. MISQ Special Issue call). The essence of this perspective is noted below:

"Thus the social cannot, in any simple sense, be seen as lying behind and directing the technological. Neither, of course, can the technological be seen as lying behind and directing the social. Rather, it has to be asserted that the sociotechnical influences the sociotechnical" (Law 1987, p. 418).

Specifically, this stream of research focuses on "the entwining of the social and the technical system" (Leonardi and Barley 2008, p. 162) using a metaphor of imbrication (Leonardi 2011) which captures how the human and the material [i.e. technological] components are intertwined (ibid). In this conception, human and technological agencies are different, but effectively produce outcomes only when conjoined synergistically (Leonardi 2011). Such imbrications affect future imbrications, though not in any deterministic manner (ibid) – often with consequences that are unanticipated or even contradictory (Introna and Hayes 2011). In sum, this perspective understands that humans and technologies are both contexts for each other in forms of "constitutive entanglements…of humans and technologies" (Orlikowski 2010, p. 135) which is related to the organization's capacity for action (Introna and Hayes 2011). A good example of sociomateriality is Actor-Network theory (Orlikowski 2010), which subscribes to a relational ontology that recognizes human and nonhuman actors taking actions within networks as being symmetrical and equivalent (Callon 1986).

Recent IS literature has seen a proliferation of articles following the sociomaterial paradigm. For example, Wagner et al. (2010), using a sociomaterial perspective, provide an investigation of how an enterprise systems project survived challenges to become a working system. Again, Leonardi (2011) shows how sociomaterial imbrications of human beings and technologies result in new routines and infrastructures. With the special issue call in MISQ, we expect that such research will continue to grow.[8]

[8] Of course, there are some variations in how different authors such as Orlikowski and Leonardi approach the relationship between the social and the technical. While the former conceptualizes social and technical as inseparable, we sense that Leonardi is less insistent on the inseparability of the social and the technical.

Discussion: Assessing the "the sociotechnical approach" of existing IS research[9]

Assessment 1. Ontological separateness between the social and the technical

From the above review, it seems that while the sociotechnical paradigm has been a cornerstone of IS research, ironically, the dominant views in IS literature have imparted *a disconnect between the social and the technical*. Specifically, this disconnect has stemmed from the "*ontology of separateness"* (Orlikowski 2010, p. 125) aligned with the *realist* and *reductionist* character of information systems popularized in research (Kallinikos 2009), and IS implementation as a "managed change" by the implementer/designer from outside the system, characterized by a subject/object dualism (Orlikowski and Scott 2008).

The "ontology of separateness" (Orlikowski 2010, p. 125), implies "an ontology of separate things that need to be joined together" (Suchman, 2007, p. 257). According to the ontology of separateness, either human beings or information technology artifacts can be agents of action and/or change in organizational/social contexts (Orlikowski 2010; Introna 2007). In other words, the TS and the SS are separate, representing a Cartesian dichotomy where the TS symbolizes and automates entities in the real world belonging to the SS (e.g. people and processes), and is therefore separate from the SS (Yoo 2010).

The ontology of separateness is evident from the fact that, apart from Type I, all other types explicitly feature social and technological elements. These elements are either conceptualized as discrete from each other (this is most common), or they are conceptualized as an assemblage (the socio-material conception, which seems to be a growing trend). We see that the focus of IS research has been "on technology as causing or occasioning some organizational effect or change (e.g., development, diffusion, adoption, adaptation, improvement, etc.)" (Orlikowski and Scott 2008, p. 454).

As a consequence of such a focus, according to Orlikowski and Scott (2008), most of the research (other than types VI and VIII) has either focused on technological determinism – "the view that technology's effects on social life are determining and inevitable" – or on social determinism – "a focus on technology as a social production" (Orlikowski and Scott 2008, p. 451). Indeed, this is possibly why Avgerou and McGrath (2007) noted that the (so-called and practiced) sociotechnical research has not been any less deterministic and rational in nature; furthermore, the social and the technical have not emphasized equally with studies privileging either or the other at a time. This is in contrast to the spirit to the original conception of the sociotechnical approach.[10]

Assessment 2. Precluding a study of mutual interactions: Instrumentalism, realism, and reductionism exemplifying the subject-object dualism

Barring type VI, mutual interaction between SS and TS is also not much in evidence in IS research. This follows from the commonly held conception that IT automates what is believed to be the fundamental reality capturing the embeddedness of TS in the SS (Kallinikos 2009). The existing sociotechnical view in IS research has been realist and reductionist in character (Markus and Silver 2008; Kallinikos 2009), perhaps a legacy of the modernist paradigm capturing much of scientific, as well as, IS research (Chatterjee et al. 2009b). As Chatterjee et al. (2009b) note, much of the progress in the IS discipline has followed this modernist paradigm which has a mathematical positivistic and Galilean worldview characterized by mechanistically reducing/decomposing complex problems into simpler ones (von Bertalanffy 1972).

[9] These assessments roughly correspond to the research questions posed earlier.

[10] We should emphasize that we are not against the ontology of separateness; however, one of its unintended consequence of this ontology has been that researchers have tended to assign dominance of one over the other. In other words, the ontology of separateness is not so much of a problem but it is the misappropriation of the ontology of separateness that is problematic.. Therefore, later in the paper, we prescribed moving to duality to cure IS research of this rather unwanted and unplanned fallout of the separation of the social and the technical. Note that in duality, the social and the technical are not separable, therefore, there is no way to assign dominance to either, even if one wanted to.

This decomposition is usually carried out from a realist perspective (Markus and Silver 2008), such that a reductionism is believed to provide "finer grained analyses" and "more accurate or realistic depictions of the environment" (ibid, p. 619). It is notable that "analytic reduction has always been key to technology, and instrumental reason and action" (Kallinikos 2009, p. 190) because "computation entails the relentless analytic reduction of the composite character and complexion of the world" (ibid, p. 183) and "represents the technological embodiment of analytic reductionism (ibid, p. 191). It can be argued that this separation between the social and the technical has often resulted from an instrumental view of IS, precluding the study of mutual interactions between the TS and the SS. In such a conception, IT is often an instrumental object that can be managed by the human/social element (Schultze and Stabell 2004) for achieving organizational/human objectives and outcomes (Persson et al. 2011; Oshri et al. 2008; Kallinikos 2005; 2006; Elmes et al. 2005; Kirsch et al., 2010; Soh et al. 2011). For example, such a conception understands IT "as a necessary tool to establish control" (Silva and Fulk 2012, p. 231) in order to achieve such desired outcomes.

Further contributing to this separation between the social and the technical, development and implementation of technological artifacts has been routinely viewed as a process of organizational change managed by the social, i.e., the human elements (Chatterjee et al. 2009b). This inherently precludes a mutually interactive perspective, because here the SS (or at least some part of it) manages the TS. As Chatterjee et al. note, there is strong support in the IS literature of this perspective – whether in terms of conceptualizing IS as networks of people (Lamb and Kling 2003), or understanding IS development in terms of complex social activities within an organizational context (Goulielmos 2004), or conceptualizing the systems analysts as key in maintaining the sanctity and potency of the IS development and implementation processes (Hirschheim and Klein 1989; Hirschheim et al. 1995).

A direct result of this conception has been the subject-object dualism where "humans/organizations and technology are assumed to be discrete, independent entities with inherent characteristics" (Orlikowski and Scott 2008, p. 438). Dualism can be understood as "*either/or* thinking (Orlikowski and Robey 1991) and a construction of the world in terms of binaries or mutually exclusive opposites (Kondo 1990)" (Schultze and Stabell 2004, p. 553) and "privileges the object-like framing of phenomena as independent objects and the creation of mutually exclusive categories" (p. 557). Due to this subject-object dualism, where TS and SS are understood as being mutually exclusive, and often one in control of the other, studies of mutual interactions have not been very common. This is, in spite of the fact that the core idea of the sociotechnical paradigm is to "view any organizational work system as consisting of social and technical subsystems, interacting with and influencing each other" (Bostrom et al. 2009, p. 18).

Essentially, as articulated above, the SS views TS as a set of instrumental tools which are "*standard, compatible, and reliable* [emphasis added]" (Anantatmula and Thomas 2010) and are used to achieve certain goals (Kallinikos 2005; 2006). But ironically, if IT is just an instrumental tool in the hands of SS, then obviously, a study of mutual interactions is rendered moot. It seems like, somewhere along the line, one essential spirit of the sociotechnical approach - the careful consideration of the mutual interaction between the engineering detail of TS and the social dynamics of SS (Ciborra 2002) - has been lost.

Assessment 3. Non-Simultaneous study of Instrumental and Human Goals

Another important observation is that in most instances (across the various types we see), humanistic and instrumental goals are not simultaneously sought or studied. The focus has been mostly on instrumental goals such as efficiency, productivity etc. (Bryant et al. 2009). This is not surprising perhaps, given that "many IS scholars may sympathize with Milton Friedman's (1970) dictum that it is the social responsibility of business to increase its profits" (Stahl 2012, p. 649). In fact, the Sarker and Valacich (2010) study is one of the few instances of IS research where both instrumental (i.e. economic) and humanistic outcomes are *simultaneously* investigated.

This observation is not surprising, because the IS field has been mostly focused on instrumental and economic outcomes, and humanistic focuses (for example, ethical concerns) have lagged behind such economic focuses (Bryant et al. 2009). Indeed, traditionally the IS research (much like other business disciplines) saw economic success (instrumental outcomes) as opposed to humanistic outcomes. As Mumford (2006) notes, much of the focus during the past decade (especially in practice) was to choose "methods such as lean production and 'business process reengineering' that took little account of

employee needs and did not produce good human results" (p. 332). In other words, humanistic outcomes were neglected in favor of economic outcomes.

However, in recent times, increasingly IS researchers are gearing up to the possibility of a connection between humanistic and instrumental outcomes. For example, Culnan and Williams argue that "ethics is good business" (p. 682) - implying that being ethical can lead to business success. In recent years, works such as Stahl (2012) have argued the necessity of human goals such as ethics to innovation and prosperity of organizations. Therefore, perhaps the apparent distance between instrumental and human goals may be closing in IS research. Indeed, humanistic goals may be seen as key to achieve instrumental goals- a view that the IS community has been hesitant to embrace, but may be warming up to.

Assessment 4. Lack of joint optimization/fit/harmony[11]

On a related note to the above, a fourth observation is that interactions are explicitly studied in Types VI (mutual interaction), and in VII (fit), and perhaps VIII (entanglement). However, *no type features joint optimization where "the social components of an organization are combined with the technical components in an attempt to create a balanced and synergistic relationship"* (Griffith et al. 1998, p. 21), even though it is a key underpinning of sociotechnical philosophy. It is notable that according to the sociotechnical paradigm, "desired results can only be achieved if the *interdependency* [emphasis added] of these subsystems is explicitly recognized and addressed" (Bostrom et al. 2009, p. 18).

Our assessment is supported by various scholars. For example, Griffith and Doherty (2002) note "that joint optimization has largely been left out of critical STS presentations" (p. 210). This is perhaps due to the inability of STS to surface concerns of the social as well as address the negotiation between the social and the technical (Avgerou and McGrath 2007). As Damanpour et al. (1989) argued some years ago about something that holds true even today:

"Even in the sociotechnical systems design, where the joint optimization of the social and the technical system is advocated, in practice, 'relatively few sociotechnical experiments actually involved technological changes; instead, most concentrate on rearranging the social system around an existing technology in order to approximate joint optimization' [emphasis added] *(Passmore et al.1982, p. 1182)" (p. 589).*

This observation is not surprising since IS research, as mentioned earlier, knowingly or unknowingly bestowed ontological superiority either to technology (technological determinism) or to humans (social determinism) – rarely has it conceptualized both as having equal/comparable status. This may be due to the fact that sociotechnical systems are composed "of two distinct systems which, although correlative, are governed by different laws" (Trist and Murray, 1993, p. 588). In other words, joint optimization has not been achieved because of the apparent dissimilarities between the social and the technical subsystems. Other challenges have been the unavailability of improved methods to analyze such phenomena of joint optimization between social and technical subsystems (Griffith and Doherty 2002). In addition, sociotechnical practices were seen as being risky or expensive (Mumford 2000), and thereby not economically viable. Even in studies which acknowledged the importance of joint optimization, it was not directly tested (Patnayakuni and Ruppel 2010), perhaps due to this reason.

Finally, *even investigations of harmony between the technical and social subsystems are not really much in evidence in extant IS research*. For example, the discussion in the previous section tells us that mostly either the social, or the technical have dominated published research work in IS, but not both simultaneously (i.e. in one study). The problem could be traced back to arguments in the previous section,

[11] The idea of joint optimization need not to be interpreted literally. In the words of Mumford (2006), this basically suggests that "Human needs must not be forgotten when technical systems are introduced. The social and the technical should, whenever possible, be given equal weight" (p. 321). Essentially, this implies "that democratic and participative communication and decision-making must be available to give these people a voice" (ibid, p. 321). In other words, the goal of joint optimization according to Mumford at least, is not in mathematically optimizing both the technical and the social. It can be interpreted as the attempt to provide the humans with a voice to be heard when a new technology is implemented.
Leonardi (2013a) recounts a nice example based on the works of Rice (1953; 1958; 1963), who focused on the jointly optimizing the social and the technical systems in the weaving sheds in Ahmedabad, India. He describes how the technology warranted interdependent work, while the social structure set up by the workers favored them working independently. Rice solved this problem by creating self-governing teams based on roles which were interdependent. Thus, both the demands of the technical and the social system were met, and this can be termed as a form of joint optimization.

summarized by Leonardi and Barley (2008) who note that "most papers on the creation, perpetuation or change of technologies and organizations eventually favor one or the other [i.e. organizations or technologies]" (p. 160). This is perhaps a consequence of the long-standing perception that as one emphasizes harmony in such sociotechnical systems, "it may tend to shift emphasis away from overall competitiveness" (Quinn and Rohrbaugh 1983, p. 370). This is partly similar to another observation on why joint optimization has not been studied - the fact that the technical and social subsystems "speak different languages, and use different currencies (measures)" (Mohamed et al. 2006, p. 112).

Considerations for the future

From our review, it is apparent that, even though for many scholars, "sociotechnical" has been a disciplinary slogan, research in the IS discipline overall has not been particularly faithful to the original formulation. Some of the reasons for this are documented above, but the larger question that needs to be answered is: How do we, as IS researchers, move forward in terms of sociotechnical thinking? To that end, we present some possible considerations, which future research needs to ponder about, and also suggest possible challenges/issues as a result of those considerations. We do not claim to provide definitive answers in this paper because this will require significant deliberation (and debate) amongst the IS academic community; our aim here is to present these considerations to start the deliberation process. We hope that, the "solutions" would emerge as an outcome of this contemplation in the IS community.

Discard or encourage the sociotechnical paradigm?

The first question that we need to ask is - given that IS research has not been particularly faithful to the "spirit" of sociotechnical research – *how useful is the sociotechnical label*? We could answer this question in two ways. One reaction could be - since researchers do not follow it anyway, may be it is time to discard it. One may argue, along these lines, that the sociotechnical concept, as classically espoused, may have outlived its relevance to the IS discipline. The other perspective is that we can encourage future researchers to be more *true* to the sociotechnical paradigm. If such an approach is favored, there will probably be a need to re-formulate and re-articulate a sociotechnical paradigm (given that existing research appears to have mostly paid lip service to it) to guide the discipline, and to re-educate members of the community. If we subscribe to this latter notion, and assume that we want sociotechnical research to be alive and well within the IS discipline, the next consideration is: in the spirit of controlled diversity (Benbasat and Weber 1996), are there any "types" of sociotechnical research that we need to encourage as a discipline? We discuss our response in the context of the debate around the "IT artifact" (Benbasat and Zmud 2003) within the IS discipline.

In their influential paper, Benbasat and Zmud (2003, p. 186) called for the IS discipline to consider its identity by investigating phenomena closely related to the "IT artifact" (as mentioned earlier in our paper). We see that Benbasat and Zmud's (2003) prescriptions regarding how IT needs to be featured in IS studies undoubtedly have a sociotechnical flavor, with IT given an explicit and prominent role, to ensure that the IS retains a unique identity. If one privileges this view, Type I and Type VIII would probably not qualify as legitimate sociotechnical research within the IS discipline. However, some prominent scholars have criticized this view. For example, DeSanctis (2003) argued that some of the ways to further the IS discipline is "via boundary enhancement rather than constraint" and "greater attention to research questions of current interest, even if they are peripheral to the artifact…" (p. 360). In other words, DeSanctis (2003) may be interpreted to imply that we should look beyond the sociotechnical paradigm and into other research questions that may not necessarily fit the sociotechnical frame. Robey (1996; 2003) follows a similar line of thinking and argues that diversity is important and that we should resist having a dominant paradigm – in other words, we should at least consider the possibility of going beyond a dominant sociotechnical paradigm. This perspective of diversity seems to be further supported by Ives et al. (2004) who advocate "*fresh perspectives, discipline newcomers, boundary spanners, and topical outliers as the likely source of the field's creativity, vitality, and long-term survival" (p. 108).*

In sum, the views purported by the above mentioned scholars in response to Benbasat and Zmud (2003) can be interpreted to be the following: if the classic view of the sociotechnical approach, as a dominant, static paradigm stands in the way of diversity in the IS discipline, then it would be detrimental to follow this paradigm. Therefore, the choice in front of the IS discipline is to embrace the sociotechnical approach

and perhaps put diversity at risk OR to discard the classical notion of the sociotechnical approach and embrace diversity. If we want to embrace diversity, a possible way out could be to leverage on general systems theory (Boulding 1956). Notably, even though systems theory has been interpreted to be rational, mechanistic, and instrumental (von Bertalanffy 1972), it has its advantages from a diversity perspective. Indeed, according to Boulding (1956, p. 1999), a major goal of systems theory is to:

"develop…generalized ears, and by developing a framework of general theory to enable one specialist to catch relevant communications from others…a specialist…will be more sensitive to the contributions of other fields if he is aware of the many similarities…in widely different empirical fields."

Going by this perception, a general systems perspective on how the technological and the social work together, one which also captures the mutability of the sociotechnical paradigm, and its adaptability to changing conceptions and practices, might be a fruitful consideration. This leads us to our next point.

Reformulation of the sociotechnical paradigm: advantages and potential pitfalls

One conclusion that can be drawn from the discussion above is that the notion of the sociotechnical, if we choose to retain our guiding paradigm, should probably not be rigid, but flexible enough to adapt to changing needs and perspectives of the IS academic community. Therefore, we see that there is value in revisiting/reformulating the sociotechnical paradigm.

One possible reformulation is in terms of the entanglement ontology which the recent socio-material movement in IS has espoused (e.g., Leonardi 2011; Leonardi and Barley 2008; Wagner et al. 2010; Orlikowski 2007; 2010; Orlikowski and Scott 2008). This perspective is captured by Orlikowski (2007) who notes that "the social and the material are *constitutively entangled* in everyday life. A position of constitutive entanglement does not privilege either humans or technology… instead, the social and the material are inextricably related—there is no social that is not also material, and no material that is not also social" (p. 1437). This is an intriguing perspective, and as noted earlier, has gained momentum in current IS research (e.g., the *MIS Quarterly* Special Issue call on Sociomateriality), perhaps as a reaction to the ontology of separateness embodying much of IS research (see our earlier analysis following the review). This is because the social and the technical are increasingly being regarded as equivalent, essentially being two different forms of "task bearers" (Österle et al. 2010).

Indeed, there are many positives in promoting this new brand of sociotechnical research. The primary of them is the *greater legitimacy of technological considerations in research outside IS*. After all, if there is no difference between the social and the technical, and they are always entangled in action, organizational/managerial and IS phenomena are essentially equivalent. What this means is that pursuing this research paradigm would result in increasing the impact of IS across other disciplines, and move it closer to a reference discipline – thoughts often harbored by IS scholars (e.g., Grover et al. 2006) who note that IS "is taking up a more *socio-technical* [emphasis added] persona, building upon its own knowledge base, and *repaying its debts* [emphasis added] by contributing to other disciplines" (p. 271).

For example, recent researchers have argued that the relation between IT and organizational phenomena can be understood in terms of affordances (Zammuto et al. 2007), consistent with the sociomaterial perspective (Leonardi 2011). IT affordances are conceptualized as how the materiality of IT "favors, shapes, or invites, and at the same time constrains, a set of specific uses" within an organizational context (Zammuto et al., 2007, p. 752). Thus, "affordances for organizing depend not only on the functionality characterizing the information technology, but also on the expertise, organizational processes and procedures, controls, boundary-spanning approaches, and other social capacities present in the organization" (ibid, p. 752)- implying their essentially sociomaterial nature. A focus on affordances of IT might therefore be a way to push forward the reformulated sociotechnical paradigm. Nonetheless, while the sociomaterial paradigm has the potential to increase the visibility of the IS discipline and its impact across other disciplines, there are potential pitfalls too. For example, is this perspective good for the IS discipline in terms of its distinct identity, prosperity, and survivability? *If there is no difference between the social and the technical, then one can question as to whether the IS field is any different from organizational/management research*. From a diversity perspective, there are scholars who would probably not have an issue with this (e.g., Ives et al. 2004; Galliers 2003; Robey 2003), however, others (Benbasat and Zmud 2003) would probably argue that this would erode away the core of the IS discipline.

In other words, *an aggressive pursuit of the sociomaterial paradigm may increase the legitimacy, visibility, and impact of the IS discipline while also compromising that very legitimacy!* This is a paradox that the IS community probably needs to seriously consider. A possible metaphor explains this issue further. Let us think of the IS community, focusing on the IT artifact, as a specialist physician (e.g. a cardiologist). We can say that the IT artifact and the social artifacts cannot (and should not) be distinguished (because they are entangled), just as the human body cannot be separated from the heart and its functions. So, what we basically mean is that a generalist (e.g. an organizational scientist) would be all that one would need to analyze, design, and implement a sociotechnical system. This claim probably may seem contentious to many! Also, if the social and the technical always entangled, then in case of a project failure, how does the organizational management identify the root problem? In most cases, the causes need to be identified/ fixed in the technology, and/or in the social practices. In an entangled conception of the social and the technical, it would be difficult for managers to identify where the problems lie – the social or the technical – potentially making it more difficult to address such problems.

Studying interactions between the social and the technical

Another important consideration is what kind of interactions and fit (between the social and the technical) we need to encourage. In the classical sociotechnical perspective, fit was mainly conceptualized as "joint optimization" or "harmony" between the two subsystems (Bostrom et al. 2009). However, as our review of sociotechnical IS research suggests, this fit has been more implemented as moderation, with either the social or the technical subsystems acting as a moderator (type VII). So, should we change the conception of fit to interaction rather than joint optimization or harmony?

A possible renewed understanding of fit could be in terms of focusing on the "I" of IS and a more granular elaboration on information and people (e.g., people, activities, and knowledge). For example, Galliers (2003) argued that the central artifact of the IS community is "people/ information." In our obsession with the "systems" focus – especially while espousing its instrumentalism - we may have mostly neglected this perspective. Therefore it would probably be beneficial to shift the locus of analysis as an interaction between the "information" and the "system." In other words, instead of looking at fit between technical and social subsystems, we could begin to look at the fit between information and system. This would be a way of moving forward, especially as this would entail a focus on "information" which, ironically, has often been "poorly defined" in IS research (McKinney and Yoos 2010, p. 329).

Therefore, we argue that a fruitful consideration for future research could be in studying the interactive space created by "information theory" and "systems theory". This is appropriate, given that Galliers (2003) contends that these are two important roots of IS. Examples of studies drawing upon both these aspects also appear in the IS field. For example, well-known studies of media richness exist (e.g., Carlson and Zmud 1999; Dennis et al. 2008). These studies inherently exist within this interactive space between information and system, because they actually showcase how perceptions of media (TS) characteristics change depending upon the experience or the information processing needs of the users. Perhaps the development of similar theories can be encouraged.

Leveraging on the interactive space between "information theory" and "systems theory" has its advantages. First, even though information theory originated in the field of electrical communications, it has been applied profitably to analyze business and social problems as well (e.g. Theil 1969; Boulding 1956). Again, while systems theory has often been criticized for being overtly mathematical, reductionist, instrumental, and devaluing social factors von Bertalanffy (1972), there have been *humanistic trends* in systems theory (ibid) that may be leveraged by IS researchers to further the sociotechnical paradigm in IS research. For example, von Bertalanffy (1972) argues that an object (i.e. in IS parlance, an IT or social artifact) can be defined only in terms of its cohesion to other artifacts. Put in a different way, the concept of "fit," "joint optimization" or "harmony" in the sociotechnical paradigm can be interpreted to capture the *cohesiveness* (a systems theory concept) between the social and the technical.

Therefore, focusing on certain aspects of information and systems theory may draw us closer to the sociotechnical paradigm. We should also remember that while systems theory has often been viewed in instrumental terms, it is "also a way of seeing things which were previously overlooked or bypassed, and in this sense is a methodological maxim" (von Bertalanffy 1972, p. 424). Maybe, therefore, we can use the maxim of systems theory to redefine and rethink sociotechnical phenomena. Such flexibility is allowed by

systems theory which enables recognition of work systems depending upon the observer (Alter 2013; Skyttner 2005). Therefore, it encourages mutable conceptions of work systems – which are sociotechnical - based on different "observers" (i.e. academics/practitioners).

Move from dualism to duality

Another consideration is: should we move from the subject-object dualism pervading much of sociotechnical IS research to a perspective that embraces greater duality between the subjects (e.g., social collectives) and objects (e.g., technology)? One can note that traditionally, the sociotechnical paradigm (and mainstream IS) has embraced dualism as it considers differences between the social and the technical (which nonetheless, influence each other). In the words of Schultze and Stabell (2004, p. 553), dualism implies "*either/or* thinking (Orlikowski and Robey 1991) and a construction of the world in terms of binaries or mutually exclusive opposites (Kondo 1990) – such as "subjective-objective, macro-micro, and self-other binaries (Bourdieu 1977)."

As argued before, a major problem with this subject-object dualism is that it creates the ontology of separateness and assigns predominance to either the social or the technical, creating a dysfunctional situation where one is controlled by the other (Avgerou and McGrath 2007; Ciborra et al. 2000). This issue may be potentially addressed by a shift to duality which "applies *both/and* thinking, which implies a dialectic yet integrative strategy (Baxter and Montgomery 1996)" (Schultze and Stabell 2004, p. 553). This is the essence of the sociomaterial perspective (Doolin and McLeod 2012). Therefore, if we were to encourage this perspective in IS research, it would probably entail subscribing to the sociomaterial perspective. Indeed, sociomateriality replaces "traditional *dualism*…by a mutually constitutive *duality* [emphases in italics] between what we call the social and the material [i.e. technical]" (Doolin and McLeod 2012, p. 571). In other words, if we have to understand duality as an important cornerstone of sociotechnical research, one possible way would be to go the sociomaterial route. However, given the discussion above about the potential pitfalls associated with the sociomaterial paradigm, we might want to pursue this route with caution.

There is yet another perspective which might help remove the ontological separateness between the social and the technical, and thus help us focus on the duality of IT and social structures. This is a recent direction, espoused by Kallinikos et al. (2013), who argue that we need to focus on digital artifacts which are inherently more dynamic (being embedded in dynamic ecosystems) and "ontologically ambivalent" (p. 367) than the comparatively stable ontological conceptions of the IT artifact. Tilson et al. (2010) support this and call for research on digital infrastructures, which are examples of such dynamic digital artifacts.

Studying planned change vs. improvisation

Another important consideration relates to whether the phenomenon being studied falls under planned change or improvisation. The sociotechnical paradigm has been traditionally aligned to a conception of planned change (Bostrom and Heinen 1977; Lyytinen and Newman 2008). Given this view, how does improvisation relate to the sociotechnical approach? Can improvisation/innovation be understood in sociotechnical terms? As Elbanna (2006) notes, prominent scholars within the IS discipline have argued that planned and controlled change [i.e. an important component in the very spirit of the sociotechnical approach] is an anachronism which should be substituted by improvisation, given that the world is dynamic, including its interactions with technology (e.g. Ciborra 1991; 1994; 2002; Ciborra and Hanseth, 1998). Further, in contrast to the view of the sociotechnical approach as a planned change, others have equated it to phenomena that are interactive and emergent (Law and Callon 1988), which often require improvisation. As Elbanna (2006) notes, improvisation often creates a "convergence point" for the key entities in a sociotechnical process- this includes technological entities. All of this suggests that we need to reflect on whether the sociotechnical approach is more relevant to understanding planned change or to understanding improvisations, or whether (and how) it can capture the messy reality where everything is partly planned and partly improvised (Bygstad et al. 2010).

Contribution and Future Implications

To conclude, this paper offers three distinct contributions *First*, by providing a review of the sociotechnical concept, it sensitizes the IS community on what has been historically an important perspective underlying much of behavioral and design-oriented IS research. Our paper revisits the traditional sociotechnical concept to open it up for further review/evaluation. *Second*, by identifying key types of sociotechnical research, it provides an opportunity for researchers to understand in what sense their work is (or is not) true to the (original) sociotechnical ideals. While the key types of sociotechnical research may serve as references for 'legitimizing' certain types of IS research, they also provide opportunities for challenging the legitimacy of other types, as well as their utility to the IS discipline and beyond. *Finally*, by providing future considerations for IS academics, the paper highlights possibilities and dilemmas on how to move the field forward, and also alerts us to possible issues related to the path(s) we choose.

As an immediate future implication of this paper, we hope that the IS academic community will engage in this debate regarding the ideas presented here. Specifically, we invite colleagues to support, modify, or even challenge and invalidate our arguments. This is especially important given that "socio-technical principles and practices have not had the impact that their proponents might wish" (Clegg 2000; Doherty and King 2005, p. 2). In fact, modest progress can be observed in developing sociotechnical principles, methods, and practices (Doherty and King 2005) and indeed, organizations are not particularly enthusiastic to spread the appreciation and practice of sociotechnical principles across different units and levels (Mumford 1997; Doherty and King 2005). This may need to change, and hopefully our paper will energize the IS community to think more deeply about this important topic.

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