Socio-Technical Design

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Introduction

Socio-technical design is concerned with advocacy of the direct participation of end-users in the information system design process. The system includes the network of users, developers, information technology at hand, and the environments in which the system will be used and supported. The process includes the design of the human-computer interface and patterns of human-computer interaction. It stands in opposition to traditional system or software engineering design methods that focus attention exclusively or primarily to activities of system engineers who design the computational functions and features of a new system, and who use computer-aided design tools and notations to capture and formalize the results of such a design process.

This article first provides a brief review of the history of socio-technical design approaches in order to establish a context for discussing contemporary issues in socio-technical design of information systems, and for identifying a sample of research directions that embody or build from recent approaches, results, and concepts for modern socio-technical systems (STS) design practices.

The Legacy of Socio-Technical Design

The Tavistock Institute for Human Relations in London is widely credited with originating the concept and practice of STS design, beginning in the 1940's, though the Institute is still active today. The Institute's focus was directed at the design of work systems in factories and offices, and initially focused on traditional non-computing manufacturing systems (Emery and Trist 1960). STS design, together with social psychology and social ecology, were the three major foci of the Institute's concern with fostering and improving relations between people that were otherwise seen as "dehumanized" by modern industrial society. Viewers of the cinema classics *Metropolis* (1927) by Fritz Lang, or Charlie Chaplin's *Modern Times* (1936), have seen how dehumanization and conflicts between labor and management in the industrial age have

been visualized and dramatized but with melancholy resolutions, instead of the ongoing strife and restricted assembly line working conditions that gave impetus to the STS design movement. By the 1970's, the Institute had begun to focus attention to the design and introduction of computing systems as STS for use in organizational settings.

During the 1960's through 1980's, a number of Scandinavian projects emerged following a similar tradition that recognized the introduction and design of computing systems as STS for use in manufacturing organizations and office work. However, these Scandinavian projects broadened the focus of STS to include not only user participation in system design, but also recognize the need to address the politics of labor conditions and labor-management conflicts through improved workplace democratization (Bjerknes and Bratteteig 1995).

The results from the Tavistock Institute, Scandinavian projects, and others that followed (e.g., Ehn and Kyng 1987, Greenbaum and Kyng 1991, Kling 1978, Schuler and Namioka 1993) addressing the design and introduction of computing systems in new settings and situations became associated with the following recommended practice for how best to design computer-based information systems: information systems development and adoption efforts should involve the participation of end-users in the design, introduction, and integration of system features and workflow so as to make system-based work more satisfying and rewarding. Key terms used to denote this proposition include *user involvement*, *participatory design*, *user satisfaction*, *human relations*, and for the political dimension, *workplace democracy* (Kling and Scacchi 1980).

Contemporary Socio-Technical Design Issues

While the STS design movement has been a source of inspiration for many students and designers of contemporary information systems that embody human-computer interaction, the concepts and practices for socio-technical design have evolved. Much of the legacy of STS design was prescriptive, but contemporary scholars of human-computer interaction prefer empirically grounded studies with descriptive results or proactive "action research"

agenda, and thus work towards development of an STS design practice that builds on such grounds. The classic prescription for user involvement in participatory design says little about which users, user representatives, or customers are chosen in practice to participate in a system design effort. Similarly, unless users are trained or already skilled in the design of information systems, then their participation may yield little in working towards a system design that increases their satisfaction with their system-based work, or enables them to expand their work or occupational skills and career options. Instead, their naïve participation may enable their unwitting revelation of social relations, communication, or discourse patterns that make their system-based work/usage more easily monitored, or the boundaries of their privacy more easily traversed by system designers who are tasked to design system usage and navigational monitoring mechanisms. Finally, the whole notion of what is and is not part of an information "system" is being called into question as problematic, based on empirical studies. Instead, alternative metaphors suggesting ways of viewing an information system embedded in an organizational workplace as a "web of computing" or "socio-technical interaction network" are being used in their place [Kling and Scacchi 1982, Kling, Kim, and King 2003]. Thus this points to a reframing, from user participatory STS design, to participatory analysis and mapping of the STINs that provide one or more views into the embedding context of information system and system-based work design [Beyer and Holtzblatt 1997, Kling and Scacchi 1980, Scacchi 2001, Scacchi 2002, Viller and Sommerville 2001].

IS development shaped by emergent requirements and contextualized design, rather than something that you get right the first time and then are done with [Beyer Holtzblatt 1997, Truex, Baskerville, Klein 1999]. Historically, STS design seemed predicated on the percept that an IS can somehow be designed to be correct, consistent, and complete prior to its implementation, deployment and use. Instead, it has become evermore clear from a variety of studies and sources that IS development is incremental, iterative, and ongoing when situated within a complex organizational setting. Even so-called packaged software that can be bought off the shelf cannot often be installed out of the box without configuration or customization, adaptation, training, and the need to temporarily support

parallel (both legacy and new) system versions. Thus, the requirements and design of an organizationally embedded information system are never finished or final [Truex, Baskerville, Klein 1999], but instead are routinely recapitulated, reviewed, and revised in response to how the system is adapted to present circumstances of usage, and to the external market, government, and enterprise conditions that impinge on system usage or functionality. Unfortunately, the classic STS design approach does not provide the critical insights, tools, or guidelines beyond "user participation" for how to best stay abreast, engage and empower both users, developers, and maintainers of an IS in managing IS evolution.

Similarly, the prescription for design of an STS via user participation or involvement by itself will not lead to or induce radical changes in the way a given information system is intended to support its users, their workflow, or their workplace. Such participation is necessary but not sufficient to affect changes that address the political order of an organization or its institutional surrounds. Instead, reinvention and transformation of existing organizational information systems and work practices is central to achieving radical change [Scacchi 2001]. Reinvention seeks to discover new ways of doing established work practices, while transformation seeks to rearrange workflow, staffing, and related resource configurations. Both reinvention and transformation are most effective when participatory throughout their trajectories, and most likely to fail when simply assigned or delegated by others that are not part of existing work practices.

With these observations of current issues for STS design in mind, attention can now be directed to identifying some directions for further research and study.

Research Directions

The future of research in the area of the design of STS seems likely to focus attention to the following topics.

First, the focus of STS design research is evolving towards attention to STINs [Kling, Kim, King 2003] of people, resources, organizational policies, and institutional rules that

embed and surround an information system, as well as how the interact and interface with one another. This may be due in part to the growing recognition that a traditional focus on system design being either system-centric or human/user-centric leaves the boundary for what is or is not part of the system ambiguous. Such ambiguity means that prescriptive policies toward user participation leaves open who is a user of what, thus confounding where user participation or involvement is best encouraged and practiced. In contrast, a focus on STINs draws attention to the web of socio-technical relations that interlink people in particular settings to a situated configuration of IT and organizational resources that must collectively be mobilized or brought into alignment in order for a useful information system to be continuously (re)designed to meet evolving user needs.

Second, the focus of attention will likely expand to address both the socio-technical requirements and designs of information systems. The traditional attention to system design assumes that system users have clear or well-defined needs that can be addressed through a proper design discipline and participation strategy. In contrast, growing recognition that a large set of information systems in complex organizational settings generally have user requirements that are situated in space (organizational, resource configuration, markets, and social worlds) and time (immediate, near-term, and long-term), meaning that user requirements are continuously evolving, rather than fixed [Truex, Baskerville, and Klein 1999]. Given the continuous evolution of information system requirements, then techniques for continuously engaging system users are needed to determine which of their existing requirements have changed, what new requirements are at hand, and which former requirements are no longer relevant.

Third, it is often unclear given the first research direction above, what an STS or STIN looks like, how to communicate their form or dynamics to others, and how to systematically reason about them. This situation points to the need for how to visualize, represent, or depict (via text, graphics, or multi-media) an STS or STIN. Existing approaches to data or information visualization focus attention to techniques for displaying primarily quantitative data, rather than qualitative relationships. In contrast, techniques for mapping an STS or STIN like rich pictures [Monk and Howard 1998],

social network diagrams (sometimes called sociograms), discourse patterns or social interaction protocols, interactive graphic simulations, or even the virtual worlds of computer games may inspire new ways and modalities for communicating the structural conditions and process dynamics that help outline what can be visually represented about an STS or STIN.

Fourth, the practice of the design of STS will evolve away from prescriptive remedies to embodied and collective work practices that can be easily adopted and put into effect. Perhaps the best example of this can be found in the world of free/open source software development projects or communities. In this socio-technical world, the boundary between software system developers and users is blurred, highly permeable, or non-existent. Participation in system design, assertion of system requirements, or design decision-making is determined by effort, willingness, and prior public experience in similar situations, rather than by assignment by management or some other administrative authority. Similarly, the openness of the "source code" of a software system encourages and enables many forms of transparency, access, and ability to customize/localize a system's design to best address user/developer needs in a particular site or installation. Furthermore, as people who participate in the design and evolution of free/open source systems often do on a voluntary or self-selected basis, then these people quickly recognize the need to find ways to cooperate and collaborate in order to minimize individual effort while maximizing collective accomplishment. This is most easily observed in the online (or Web-based) communications, shared source code files and directories, application invocation or system configuration scripts, Web pages and embedded hyperlinks, and other textual artifacts that people in free/open source software project communities employ as the media, content, and (hyperlinked) context of system design and evolution [Scacchi 2002].

Last, the four preceding research directions collectively begin to draw attention to matters beyond the design of user-system interaction or human-computer interfaces. Instead, future STS or STIN research will increasingly employ Web analyses [Kling and Scacchi 1980, 1982], ethnographic methods [e.g., Viller and Sommerville 2000] and

contextualized design techniques [Beyer and Holtzblatt 1997] to study of how people accomplish their work in an organizational setting using the information technology, people, resources, and circumstances at hand. Understanding the information system or interaction network will need to include understanding the workplace, inter-organizational networks, social worlds and cultural milieu that embed and situate how people interact with and through the information systems at hand in the course of their work and workflows. Similarly, there is a basic need to discover new ways and means that enable information system developers to understand or become users, and for users to understand and become developers so as to empower and sustain each group in their collective effort to continuously design and redesign the information systems for their work.

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