Foreword

The brilliant innovators, who described socio-technical systems, wisely anticipated the complex problems that challenge modern designers. They understood that Moore's Law and other principles of technology advancement would need to be supplemented by social design breakthroughs that accommodate the realities of human relationships. While mega-bytes and giga-hertz remain adequate measures of technology advances, we still await the definition of equivalent "mega-contribs" or "giga-collabs" to represent the progress in human contributions and collaborations brought by the rapidly growing socio-technical and networking systems. Still greater challenges remain as designers, managers, and researchers struggle to measure and improve socio-technical and networking systems so as to increase trust, empathy, responsibility, and privacy.

While some narrowly focused technologists find the social aspects of systems a troubling distraction, visionary policy makers, industrial leaders, and academic researchers share a growing recognition that socio-technical and social networking systems offer compelling opportunities. They have seen beyond the playful, discretionary Web-based applications that promote personal identity exploration, fantasy game-playing and entertainment-oriented social media. These will flourish as entrepreneurial successes, but other applications are beginning to support major national priorities such as healthcare delivery, workforce competitiveness, disaster response, and political participation. Still broader applications will promote international development, sustainable energy solutions, environmental protection, and homeland security. Existing applications such as e-commerce or education will also benefit from the new possibilities brought by social media and user-generated content.

This remarkable collection of articles captures some of the excitement and possibilities for system developers and researchers. The chapters, which come from an international community representing academia and industry, provide valuable guidance for the difficult road ahead. Blending Internet technology and social goals is a challenge but the payoffs are potentially enormous. However, the turbulence of change can be unsettling, so socio-technical designers can only succeed by considering costs and benefits for all stakeholders. Since unintended consequences of these new socio-technologies may be disruptive, experience from previous systems and mechanisms for continuous improvement, such as this book provides, will help to smooth the way. For instance, for large government-directed projects, independent oversight to review designs for proposed socio-technical systems could play a positive role in ensuring successful outcomes. In addition, independent oversight panels can play a helpful role in continuously monitoring impacts and through annual retrospective reviews that update procedures and set future priorities.

The power of the Internet to lower the costs of collaboration reshapes the possibilities for socio-technical designers. Centralized, rigid, and hierarchical solutions were needed in the past when communication was difficult, dialog was a time-consuming distraction, and broad participation in discourse was a costly luxury. However these demands no longer dominate design. Shedding 19th and 20th Century

top-down solutions in favor of bottom-up egalitarianism is a step in the right direction; exchanging the top-down way of thinking for a bottom-up way of thinking is somewhat harder. When every user can be an initiator and every community can quickly organize its members, technology designers and social planners need new ways of thinking. Initial attempts at alternative metaphors to capture this new concept of rapid action are not yet satisfying: viral marketing has a disease-like connotation, while explosive and forest-fire analogies are disturbingly destructive. Fresh metaphors could help designers and users appreciate the potential for thriving communities, catalytic collaboratories, and Wiki-wisdom. Visual imagery linked to defined social requirements might also more clearly give users the reassurance they demand in areas like swift trust, privacy shields, and lockbox security.

The challenges of socio-technical design and social networking systems go well beyond getting great screen designs with compelling graphics. A socio-technical infrastructure must support huge, yet reliable databases, sprawling yet easily navigable network connections, and powerful yet rapid services. The starting point for interface design is a clear presentation of choices so users can make selections with confidence, learn shortcuts for their most frequent actions, and explore safely when trying something new.

When problems arise, as they inevitably do, user support not only provides users a safety net and a supportive resource, it provides the managers with data for the continuous improvement of basic designs. However, like all social interactions customer relations go both ways. Even further, the social network allows users to help users, and this has already been an unanticipated but remarkable success story. Discussion groups have already reshaped online customer service, enabled sharing of medical experiences, and generated extensive reviews of products and services from movies to medical care.

Reliable infrastructure and excellent customer service are easy to describe but hard to deliver, due to the massive scale of modern socio-technical applications. Huge server farms with readily available backups are a good start, but keeping millions of routers and cell phone towers operating when natural disasters or peak usage periods hit is critical goal for infrastructure operators. The aspiration for customer service providers is equally complex, as it may involve millions of people across dozens of countries. Successful strategies include offering novices comprehensible navigation paths while allowing frequent users shortcuts, and enabling users of diverse languages to easily apply translation tools. The enormous variety of people means that there is a long "tail" to user needs, which includes support for older adults, for children, for users with motor, visual, or auditory disabilities, and for users with special needs such as dyslexia, aphasia, memory problems, and other cognitive limitations.

Attaining universal usability is a stronger requirement than merely achieving accessibility. It has created challenges and work for designers and programmers, but there are two pieces of good news. First, designing for diverse users has usually led to better designs for all users. For example, keeping to the clarity needed for challenged users makes for more rapid learning by novices, more speedy activity by frequent users, and better error prevention. Second, developer toolkits increasingly provide support for diversity, so that third-party tools such as screen readers, screen magnifiers, language translators, and so forth, are easy for designers to integrate. Attaining universal usability will make clear the need to also pursue "universal sociability", that is, technology that supports social principles common to all communities, like civil liberties, privacy, or fairness—in some ways that is the vision of this book.

The broad valleys joining infrastructure and customer service are filled with a rich variety of challenges, such as providing excellent service despite small displays, slow networks, and old platforms. The large displays on desktop systems are a luxury environment for designers, who must also cope with the small displays that are the norm on cell phones, digital cameras, music players, medical devices, Global Positioning Systems, and hundreds of other mobile consumer electronic products. Slow networks and even intermittent access complicates the designers' job in providing a great user experience when on-the-go users have to choose between using old data or waiting unpredictable lengths of time to get fresh data for their decision making.

The easy systems implementation problems have been addressed, so the next generation of computer managers, designers, and researchers will have to be especially creative and work intensely to come up with successful applications. Pure technical expertise is no longer enough. However, if managers require multiple evaluations, rehearsing initial designs from multiple social and technical perspectives, they have a chance of getting favorable reviews on opening night. But for all the complexity of initial roll-outs of new technologies, the real test is to ensure a successful process of continuous improvement over many years of growing usage. Socio-technical systems have to be built for easy revision, upgrade, extension, and integration with other services. Successful social systems will have long lifetimes, even as the surrounding culture evolves over decades or even hundreds of years. Similarly, socio-technical designers need to support data collection and decision making that ensures effective modifiability. Experienced designers also account for the termination of such systems, with procedures for adequate preservation or destruction of sensitive and personal data, gathered perhaps over decades of operation.

Unfortunately, the world is not always a safe place for socio-technical system designers. Hardening applications to prevent penetration and providing backup systems for recovery are known protective strategies. While building in security and repair mechanisms can double the cost of system development and service provision, they can prevent system collapse or failure. Beyond natural disasters, peak usage problems and various breakdowns, providers must also deal with incorrect data, fraudulent usage, and malicious attacks.

The socio-technical equivalent of a physical disaster is a social disaster, where anti-social behavior destroys trust and participation. Maintaining users' trust in the face of such problems is the goal, but new measures will have to be developed to assess the many flavors of trust and the fragility of users' goodwill when breakdowns occur. Examples include transparent systems where user actions are visible to all, accountable systems that make users responsible for their impacts on others, and reputation systems where users act to maintain the goodwill and trust they have worked hard to achieve.

This long list of concerns may frighten some developers, but more and more designers and their organizations are stepping forward to these challenges while advertising their skills and successes. Meanwhile researchers have stepped forward to develop new research methods and fresh theoretical foundations. The methods social and natural sciences, business, education, health, engineering, and computer science can be applied to study socio-technical systems. Marketing analysis, ethnographic observation, user surveys, focus groups, case studies, and critical incidents will join traditional experimental approaches in this emerging field.

Carefully reported case studies, long accepted in medical literature and business education, and could become central to a science of socio-technical systems when controlled experiments are difficult or impossible to do. The reductionist approach, of breaking a system down into its component parts, so valuable during four centuries of natural sciences, may have limited applicability to the study of socio-technical systems, which by definition "emerge" from their components as new system types. Indeed the integrated nature of socio-technical systems may explain the plurality of methods and disciplines involved in it. In other writing (*Science 319* (March 7, 2008), 1349-1350), I have suggested the name *Science 2.0* for the evolution of science to include new forms, such as those that deal with the human-made world of socio-technical systems. The logic is that science needs to develop new methods and measures to cope with the difficult issues of trust, empathy, responsibility, and privacy raised by Internet-based human collaboration. Eventually researchers will clarify these terms enough so that designers can know how much of an improvement in privacy is necessary to generate a desired level of trust, or whether there is sufficient responsibility to ensure fairness, or intimacy to create empathy.

The massive scale of human collaboration and contributions made possible by the Internet and related technologies has the potential for enormous benefits in demanding applications such as healthcare

delivery, disaster response, international development, or sustainable energy programs. It also raises equivalent risks, like the spread of terrorist ideologies, the denial of civil liberties, and the oppression by harsh rulers. Technology can magnify both good and bad, but open discourse, participatory design, and free flow of information can raise the awareness that defeats discrimination and oppression.

This volume contributes greatly in raising awareness about socio-technical design and social networking systems. It also presents a great deal of knowledge that users, designers and managers can use to build a better world in these complex times. Brian Whitworth and Aldo de Moor have gathered valuable material from an international panel of experts who guide readers through the analysis, design and implementation of socio-technical systems. It will be widely useful in defining issues in engineering, computing, management, organization, government policy, and ethics. The practical guidance and fresh theories can inspire a new generation of designers and researchers to catalyze even more potent forms of human collaboration.

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