Preface

When a baby is born it is tender and fragile: when it grows and dies it becomes hard and stiff… Therefore the stiff and unyielding belong to the realm of death while the tender and sympathetic belong to the realm of life.

—Laotze, Tao Te Ching, Verse 76

INTRODUCTION

This handbook addresses current issues of research into socio-technical systems (STSs)—which are computer technologies that enable social interactions of any type. Examples include conversations (e-mail), group discussions (chat), group writing (Wiki), online trade (e-bay), online learning (WebCT), social networking (Facebook), and so forth. The Internet has evolved from hosting information to hosting social interactions. Yet as technology becomes part of social life, surely social life should be part of technical design? Without this, a "social-technical gap" emerges—a deficit between what society wants and what technology does. This book aims to reduce that gap, by suggesting how social knowledge can synergize with technical knowledge.

Socio-technical systems arise when social systems emerge from technical ones, so their success requires social as well as technical performance. The new multi-disciplinary field of socio-technical development cuts across traditional disciplines like engineering, psychology, computing, health, sociology, education, and business. This is a field that no specialist academic discipline can or should encompass. It "belongs" to all disciplines, as connecting social and technical involves not one specialty but many specialties. Any research organization working in this field needs not just cross-disciplinary teams but cross-disciplinary people, to cross discipline borders to make useful connections, as many chapters of this book illustrate.

The socio-technical concept generalizes and includes human-computer interaction (HCI), standing as it were upon the shoulders of HCI. Equally at a higher level "human-centered" computing contains both STS and HCI components. This book asks not how to make technology more efficient, nor how technology harms or helps society, but how to successfully combine society and technology in socio-technical systems. The premise is that technology is not a "given", but something people create for their use, so technology should work for us, not vice-versa. Ultimately, global humanity must control, direct, and define the computer technology that is currently changing humanity, and perhaps we need to change what is changing us, to survive. If society is the context of technology, not the other way around, it is incumbent upon us to define requirements, designs and measures for technology to follow. Since it would be unwise to try to do this blindly, this book sheds light on many of the issues involved.

VISION

Throughout the world today people are using computers to socialize in ways previously thought impossible—by e-mail, chat, instant messages, online worlds, e-markets, blogs, Wikis, social networks, social bookmarks, and many other ways and forms. Each of these is a socio-technical system (STS)—a social system that emerges somehow from a technical one. This book asks how such systems work and what makes them succeed. While connecting people electronically is complex, connecting them socially is even more so, as an STS must "perform" in both social and technical terms. Spam illustrates what happens when technical but not social problems are addressed, as ISP and user inboxes fill with messages nobody reads, wasting time, money, and resources. What use is a technically efficient network if 99% of its transmissions are unwanted spam, which creates neither social value nor meaning? Similarly, online issues of security, education, health, trade, and education now depend as much on social factors as on technical ones. Yet the real issue is neither social nor technical but how they connect.

As humanity enters a new millennium, one cannot help but feel that we have, over thousands of years, and sometimes with bitter struggle, made social progress. Villages formed into towns, then cities, then city states, then nations, then "nations of nations", such as the United States, the European Union, or China. We have indeed evolved from tribal social units to social systems with hundreds of millions of people. This gives us hope that the next step, an online global society with us all "citizens of the world", is possible, by the power of global communications technology. If so, understanding social history and principles is important in creating that technology. Social "inventions" like accountability, group identity, friendship, fairness, and public good have been as important to human progress as technology inventions. While computer technology enables new and previously impossible social forms, these forms may still need to follow principles inherent in all social situations, whether virtual or physical. Given several thousand years of physical social history, often written in blood and tears, it would be arrogant for technology to discount the social as irrelevant to the technical. And as online social generations come and go it is becoming clear, in areas like e-commerce, that technology alone does not have all the answers.

As technology problems are increasingly solved, now is a good time to start to address the critical socio-technical questions. A technology-savvy society is affected by the technology it runs upon, but equally it can "socialize" the technology which it creates. Conversely, technology designs are embedded within a social context, and need to engage that context to flourish. Without a social direction technology will not grow as it should, and equally without technology society will not grow as it should. The social and the technical are partners of vastly different natures, yet together they synergize the future. Some themes of this book are that:

1. The socio-technical evolution is only just beginning.
2. Technical systems that ignore social requirements will tend to fail.
3. Social systems that ignore technical support will tend to fail.
4. The future lies in harmonizing social and technical systems in innovative ways.

THE HANDBOOK

The exploration of social-technical issues requires the "coming together" of social and technical knowledge. To produce this book we invited new perspectives from top researchers and practitioners around the world. We asked them how social ideas can enlighten technical developments, and how technical

developments can inspire new forms of social interaction. The contributors to this handbook are from many countries and disciplines, and practitioners as well as academics. We hope that an understanding of social computing today and tomorrow can be found in their many points of view. This state of the art summary of research in socio-technical design and social networking provides:

1. *Social concepts and theories,* to enlighten and inspire the analysis, design, implementation, evaluation and operation of socio-technical systems.
2. *Methods of system development,* to manage the complexity of socio-technical interactions.
3. *Examples of developed systems*, with application lessons learned.
4. *Socio-technical cases,* as fields or laboratories for social or technical research.
5. *Suggestions and future trends*, based on current developments and directions.
6. *Discussion of critical ethical and social issues*, involving technology and society.

The "*Handbook of Research on Socio-Technical Design and Social Networking Systems*" is distinctive in its variety of contributors, depth and breadth of scholarship, clarity and readability, structure and layout organization, combination of practice and theory, and positive vision of the future. The quotes provided by authors throughout the book epitomize their insights. This book will be useful not only to technical designers, where understanding of social principles can decide system success or failure, but also to those working in social fields, as it shows how social concepts and goals can manifest in technical practice. It will also help those teaching the social use of technical systems in any field, as the chapters provide excellent learning cases, and the number of chapters permits selection to fit almost any focus.

Socio-technical systems are essentially "hybrids", which are an uneasy mix of high level socio-cognitive structures with equally complex hardware and software architectures. Developing systems that balance human and social aspirations with the constraints of a technology base is a difficult endeavor. We should not expect to get it right the first time. More important than success is to remember hard-won lessons, as ultimately progress is based on knowing more. This book is not the "right way" of socio-technical systems, but merely a report on initiatives, efforts and experiences from workers in the field with the aim to increase knowledge in the field. STS theory and practice is still in its infancy. It has few established paradigms, and given its inherent complexity may continue for some time as it is today—a bubbling flux of new ideas. Yet that we do not know everything does not mean that we know nothing. We do know a great deal about merging the social and the technical, as this book testifies. It provides many signposts pointing to fruitful socio-technical destinations. We invite readers to form their own STS "gestalt" based on the fascinating collection of ideas and experiences presented here, and join the journey.

CONTENTS

The book is organized by sections, representing how a socio-technical system might evolve, from concept to implementation and evaluation. Of course such linear paths are never smooth. Just as agile methods skip or cycle phases, most chapters in this book cut across multiple sections. The grouping is by primary concern, recognizing that chapters are rarely "pure", as ideas on analysis, say, may have implications for design. The structure is simply a convenient way to structure a complex field by the problems it faces: to conceive, analyze, design, implement and evaluate useful and practical socio-technical systems as catalysts for human social progress.

Section Summaries

The section details are as follows:

Section I introduces the core socio-technical concepts underlying socio-technical systems development and traces their historical roots, as one must know the past to understand the present (Chapter I). As the term implies, socio-technical research is like two different and distant worlds colliding (Chapter II), where the impact is not just technical upon social (Chapter III), but also social upon technical (Ch 4). This collision of research worlds has implications for online work systems (Chapter V), for online communities (Chapter VI), and for software development in general (Chapter VI).

Section II presents some socio-technical perspectives for socio-technical development. Privacy is the information equivalent of physical freedom, that is freedom to control not just one's physical self but also information about that self. This social principle can apply both to the governance of physical world data (Chapter VIII), and to the governance of virtual world data (Chapter IX). Another critical social factor is leadership (Chapter X), which in turn affects the critical online choice to participate or not, that is to use the technology tools provided (Chapter XI). Social revolutionaries like Martin Luther-King and Mahatma Ghandi tapped this ultimate human choice: to act or not. Similarly, on the Internet today people also choose to participate or not, with reasons from practical needs to simple entertainment (Chapter XII). Modern social democracies produce more by letting every race, creed, and color participate, and engage productivity by fairly sharing social gains both by need (socialism) and performance (capitalism). In contrast anti-social acts like stealing deny all forms of fairness. Two complementary response strategies in cyberspace are: (1) to lessen individuals use of technology to form flow "bubbles" that isolate them from society (Chapter XIII), and (2) to strengthen social values in technology to better allow society to protect Internet citizens from anti-social others (Chapter XIV). Finally, to advance, a society must support and not repress the human innovation that bubbles up from within it, with online service provision an excellent example of how technology can help do this (Chapter XV).

Section III suggests a range of approaches to socio-technical analysis, as one must capture socio-technical requirements before developing improvements. Doing this for socio-technical systems is not as simple as just asking people what they want, as people in groups follow norms instinctively despite declared statements (Chapter XVI). With this warning, socio-instrumental pragmatism (SIP) is a useful analytic approach (Chapter XVI), and business analytics is a useful source of information, although the analysis itself is a socio-technical process (Chapter XVIII). Another useful information source is users themselves, suggesting the concept of "co-design" (Chapter XVI). Conceptual graphs can also be used to formally analyze workflows and social norms in development (Chapter XX). In any socio-technical analysis expectations are raised or lowered, as interacting with people also affects them, so socio-technical success may depend on managing those expectations (Chapter XXI). Finally, if the goal of analysis is to find out "what users want", one way to do this is to give them technology "stubs" and let them report needs and expected usage at different times (Chapter XXII).

Section IV considers socio-technical design—the actual putting together of software components to create a social effect, that is, methods for turning social requirements into technical solutions. The socio-technical walkthrough is a useful way to test a design that involves people before it is implemented (Chapter XXIII). As creating software designs parallels the creative design of furniture, the translational design approach can help STS designers (Chapter XXIV). In socio-technical systems, the human-computer divide is not absolute, so computer agents in organizational environment must model social goals, responsibilities and dependencies (Chapter XXV). Equally critical for human participation is trust, as

without trust people will not risk social interactions with others (Chapter XXVI). One way to remember socio-technical success is with "patterns"; Alexander's architectural design concept carried over into software design (Chapter XXVII). Group interaction involves not only complex individuals, but also their interactions, making designing systems to support group interaction a challenge of the first order (Chapter XXVIII). Equally complex are systems that connect people in an organization to the resources they need (Chapter XXIX). If one works from social needs to technology design, rich media communication technologies need to meet those social needs not mimic face-to-face interactions (Chapter XXX). Social interaction is complex not only by quantity and quality, but also by recursion, for example me seeing you changes my behavior, but that you see that I see you also changes your behavior, which in turn changes mine, and so on. Such ripples of recursive social reflexion, where each act changes all acts, make social interactions match those of fluid mechanics for complexity, and for the same reason—the causality is circular not linear. Yet social principles can manage this complexity, for example *translucence* (that people can see clearly what others do and act accordingly) is one principle behind the success of eBay that can apply to other socio-technical systems (Chapter XXXI). Finally, for computer agents to succeed in social environments they must respect social rules, that is etiquette (Chapter XXXII).

Section V looks at socio-technical implementations, to explore some of the practical lessons learned. For example, in today's virtual worlds people can adopt a persona to live out a "second" life. While such worlds pale beside Star Trek's "Holo-deck" for realism, their capacity to support social interaction is far greater. To understand how millions of people can interact within virtual worlds a socio-technical perspective is essential (Chapter XXXIII). And while Star Trek's Captain Kirk often stressed that computers cannot comprehend human emotions, today's computer tutoring systems aim to do precisely that (Chapter XXXIV). Eye gaze is another usually human cue that is now amenable to computer analysis and used in computer interfaces (Chapter XXXV). Yet not all the conditions for human sociability seem fulfilled by current social networking systems, as while people frequently *maintain* social relations by computers they less frequently *create* them that way (Chapter XXXVI). The missing factor(s) may be not physical realism but emotional realism, that is genuineness (that you mean what you say) supported by properties like spontaneity and immediacy, effort (not copied) and non-modifiability (not faked). This trend to represent emotional and social complexity is evident in knowledge representation systems (Chapter XXXVII), online teaching systems (Chapter XXXVIII) and even academic research, as for researchers to share expensive technical resources requires collaboration (Chapter XXXIX).

Section VI looks at socio-technical evaluation, as evaluating systems gives the feedback necessary for continuous improvement. Evaluations are based on criteria, which in turn depend on one's perspective and concerns. For example, Bandura's collective efficacy concept has led to a useful measure of online communities (Chapter XL). Likewise that social capital has cognitive, relational and structural dimensions suggests dimensions for evaluating social network sites (Chapter XLI), as does the concept of situational awareness for online team collaboration systems (Chapter XLII). Online learning communities in contrast suggest a scale of affective satisfaction, as emotion is important to learning (Chapter XLIII). One can not only measure the current *state* of an online community but also its current *rate* of advancement or decline; as "social health" implies that social systems can grow or decline as individuals do (Chapter XLIV). Critical to the evolution (or devolution) of a social system is how it engenders/fosters innovation to reinvent itself for each new generation (Chapter XLV). Finally, one must measure the social context of technical systems, as a value clash at the cultural level can cause unused or unwanted systems (Chapter XLVI).

Section VII considers the future of the budding field of socio-technical development. We must learn from the past, where computing has previously over-estimated its capacity in areas like artificial intel-

ligence, e-commerce, pattern recognition, and spatial processing. We may need to recognize that if the world is not ultimately "computable", despite computing power, the role of the computer in social computing may need to change from "solver" to "supporter" (Chapter XLVII). Equally if the role of computing as a power sharer in e-commerce is overstated, perhaps the real online commerce revolution is still to come (Chapter XLVIII). While teaching socio-technical concepts at graduate and undergraduate levels is likely to increase, it may need a change from content to process focused delivery (Chapter XLIX). While some see socio-technical progress as inevitable, one can equally argue that online communities will become more formal and rigid as they "age" (Chapter L). Yet every problem can also be seen as an opportunity, as a view on houses of the future illustrates (Chapter LI). And while technology progress may "atomize" online experiences, it also suggests systems that enhance trust in society as a whole (Chapter LII). Finally, the ultimate question facing humanity may be the old choice between good and evil, so socio-technical developers need to rise to the challenge of designing for good not ill (Chapter LIII).

FINAL WORDS

While the physical reality of technology is "hard", social realities by comparison seem "soft". That the soft should direct the hard seems counter-intuitive, but we believe this is the way computing will evolve, as it is the spirit of life. The quote beginning this preface illustrates the principle. To let technology define our future is to let something blind to human benefit lead humanity forward. Who knows where that will lead? It is better that people lead the technology forward, based on human and social concepts. While people are flawed they are not blind, as technology is, and so-called human "flaws" like variability may be virtues in an evolutionary context. Our very human reasons, emotions and social instincts have guided us well enough this far. Let us not now defect in our obligation to determine our technological future. What the human mind can conceive it can achieve, so if it can conceive technology it can conceive how to harmonize that technology not only with the social systems of humanity, but also with the natural systems of "Mother Earth" that ultimately sustain our global society.

We send our good will to all those who work to these good ends.

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