Chapter I
The Social Requirements of Technical Systems

Brian Whitworth
Massey University–Auckland, New Zealand

ABSTRACT

A socio-technical system (STS) is a social system built upon a technical base. An STS adds social requirements to human-computer interaction (HCI) requirements, which already add to technical (hardware and software) requirements. Socio-technical systems use technology to connect people socially, for example through e-mail, electronic markets, social network systems, knowledge exchange systems, blogs, chat rooms, and so forth. Yet while the technology is often new, the social principles of people interacting with people may not be. The requirements of successful social communities, whether mediated by computers or the physical world, may be similar. If so, socio-technical systems must close the gap between social needs and technical performance, between what communities want and what the technology does. If online society is essentially a social system, of people interacting with people, social principles rather than the mediating technology should drive its design. Societies create value through social synergy, which is lost for example when people steal from others, whether time (spam), money (scams), credibility (lying), reputation (libel) or anything else of value. The success of today's global information society depends upon designing the architecture of online interaction to support social goals. This chapter briefly reviews some of the emerging requirements of STS design.

Man is a social animal

—Seneca

INTRODUCTION

A *socio-technical system* (STS) is a social system sitting upon a technical base, with email a simple example of social communication by technology means. Whether a community is electronically or physically mediated a socio-technical system is people communicating with people through tech-

nology rather than the physical world (which is a "socio-physical system"). The term *socio-technical* was introduced in the 1950's by the Tavistock Institute as the manufacturing needs of industry confronted the social needs of local communities, e.g. longwall mining in English coalmines (see http://www.strategosinc.com/socio-technical.htm). It opposed Taylorism which broke down assembly line jobs into "most efficient units", suggesting that technical systems needed to respect social needs, e.g. a nuclear plant near a village had to balance its technical needs against social needs. The socio-technical view later developed into a call for more ethical computing by supporters such as Mumford (Porra & Hirscheim, 2007).

General Systems Theory

In general systems theory (Bertalanffy, 1968) systems form when autonomous (self-directing) parts *mutually interact to create equally autonomous wholes*. Such systems do not reduce entirely to their parts as their creation involves not just those parts *but also complex feed-back and feed-forward interactions*. Just as a person is a system of autonomous cells, so a society is a "system" of autonomous citizens. Such holistic systems, whether simple cells or complex people, can *self-organize* and *self-maintain* (Maturana & Varela, 1998).

The socio-technical system (STS) is not just social and technical systems side-by-side but the whole unit. For example, a pilot flying a plane is two side by side systems with different needs, one mechanical (the plane) and one human (the pilot). In human computer interaction (HCI) these systems must work together–pilots must understand the plane's controls, which must be understandable by its crew. The STS is the plane plus crew as a *single system* with human and mechanical levels. On the mechanical level the human body is just as physical as the plane, with weight, volume etc. However the "crew + plane" system can now strategize and predict, say in an aerial dogfight. The perspective change seems minor, but has major ramifications. If a human system sits *next to* a technical one it is usually secondary, as ethics is an afterthought in engineering, but if social systems *include* technical ones, as physical societies have architectures, then the social *contextualizes* the technical even as it is created by it. Hence STS research is not just applying sociological principles to technical effects (Coiera, 2007), but how social and technical aspects integrate into a higher level system with emergent properties.

Socio-Technical Levels

Are physical systems the only possible systems? The term "information system" suggests not, and philosophers propose idea systems in logical worlds, sociologists propose social systems, psychologists propose cognitive systems, economists have economic systems, programmers have software systems, and engineers have hardware systems. Which of these approaches is "real"? Paradoxically, none are… and all are. None are, because they are all just ways of conceptualizing systems, like views in a database, not the system itself. All are, because one can without contradiction describe a system from many perspectives, namely from that of the engineer, computer scientist, psychologist and sociologist.

As system complexity increases higher system views seem to apply. For example, in the 1950s/60s computing was primarily about hardware, while in the 1970's it became about business information processing, and in the 1980s about "personal computing". With the 1990s and email computers became a social medium, and in this decade social computing has flourished with chat rooms, bulletin boards, e-markets, social networks, wikis and blogs. Computing "reinvented itself" each decade or so, from hardware to software, from software to HCI, and now from HCI to social computing. To explain this, Grudin suggested three IT "levels" (hardware, software and cognitive) (Grudin, 1990) and Kuutti later added an organizational level (Kuutti, 1996). These *physical, informational, personal* and *communal* levels suggest hardware, software, HCI and STS systems (Figure 1):