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The Relevance of
Social Issues
in Ubiquitous Computing Environments

New forms of social interaction and organization require modifying existing models.

SOCIAL ISSUES INCLUDE INDIVIDUAL, GROUP, AND *organizational behaviors that are affected by ubiquitous computing. Our discussion of these issues is prompted by the following questions. What if technology was literally untethered by any physical connection to a network, to a workspace, or to an organization? What new ways to communicate, collaborate, coordinate, organize, and manage would we see? Answers to these questions invite fresh approaches to studying the social consequences of technologies. Ubiquitous computing technologies not only enable new ways of acting and interacting, but also stimulate fundamental reassessments of the meaning of human action and interaction. In some cases, social actions will occur in entirely new ways, and in other cases completely new social actions will appear.*

Each issue that follows is illustrated by an anecdote demonstrating not only the social possibilities afforded by ubiquitous computing, but also the residue of past and present notions of appropriate behavior. As a result of the interplay between what is possible and what people already understand, each social issue described here is framed as a somewhat contradictory outcome.[1]

Individual Behavior
The Pied Piper of Concourse C. Given the fixed positions of computers, furniture, and personnel at the check-in counters in most airports, people have developed expectations and closely follow norms of checking in to get their boarding passes. They get in the back of the line and slowly make their way up to the person at the counter with the computer. In a European

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[1]An analysis of contradictory organizational outcomes of information technologies can be found in [8].

airport that had recently converted to wireless computers, airline personnel roamed freely throughout the concourse, checking in passengers with mobile computing devices. This posed a problem for passengers who did not understand how to behave. In an attempt to get checked in, people lined up behind the roving employee. The scene quickly took on the appearance of the Pied Piper as the employee with wireless computer walked around the concourse with a growing, snaking line of travelers desperately trying to follow the only norm they knew for that context, forming a line behind her.

This example illustrates that ubiquitous computing challenges individuals to rethink their behavior. However, it also illustrates that old habits are often difficult to break. Thus, the handheld computers introduced to remove queues at the airport resulted in mobile queues snaking through Concourse C.[2]

More serious issues are raised when we try to rethink how employees in organizations should be supervised. Should not ubiquitous computing simplify and enhance supervisory activity by steering it toward an evaluation of work output rather than behaviors and appearance? Clearly, a mobile and distributed work force that is enabled by portable technologies cannot be watched physically as office managers once watched workers through glass office walls. However, a manager (or robotic assistant) may more easily monitor the digital traces of mobile workers' activities in a ubiquitous computing environment. Performance evaluation might be based on mountains of more detailed information, perhaps converted into performance indexes that measure not only end results but also intermediate activities. How long were you connected? How many messages did you send and receive? What was your total document production? In such a scenario, roaming employees may be less empowered than co-located office workers, and the value of their contributions might be obscured in the digital representation of their performance.

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[2]We are indebted to Anna Sidorova for this anecdote.

Although some managers may exercise such compulsive monitoring in at attempt to replicate their previous supervisory activities in a ubiquitous computing environment, others may abandon attempts to supervise. As a result, roaming employees may receive little guidance or development. Left on their own, without supervision, employees may not learn necessary skills or develop organizational commitment.

The search for new ways to supervise individuals is comparable to the search for new ways to handle passenger check-in. Because the new possibilities enabled by ubiquitous computing do not carry their own prescriptions, people must discover new behaviors on their own. In some cases, those behaviors simply replicate with wireless connections what was done previously with wires. In other cases, people abandon existing practices without finding viable substitutes. Airline passengers, for example, may become so confused by the moving check-in counter that they lose their way, miss flights, bypass security, and disrupt passenger boarding in other ways.

Team Behavior
It Is Rocket Science! In a recent study of virtual teamwork, Ann Majchrzak and her colleagues described a team of rocket designers from different companies using a dedicated "Notebook" technology to coordinate their work [5]. In a few cases, team members were able to meet face-to-face, but the team insisted all voice communications be logged into the discussion databases in the portable notebooks. Unfortunately, the requirement to write everything into textual databases placed too much pressure on team members. Not only was data entry laborious, but members also were unable to express the complex rationales underlying design recommendations. Eventually, the team introduced regularly scheduled telephone conferences to add verbal communication to the electronic text. This adjustment helped the team succeed in its design task.

This example suggests virtual teams may need to employ older technologies, such as telephones, or even face-to-face meetings, to complement their dependence on ubiq-

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uitous computing technologies. Several recent studies support the notion that teams are more effective when they intersperse face-to-face meetings with remote communication [6, 9]. Although ubiquitous computing allows teams to form as needed, vary their composition as tasks change, and operate independently of time and space, we know little about how effective virtual teams interact. How do they vary their work rhythms, distribute workloads, and pace themselves? Does each team develop "local" norms for group practice? Are some coordinating technologies better than others? Despite the ability of technology to accommodate any number of members, are there limits on group size? As with the study of individual behavior, team behaviors in ubiquitous computing environments are likely to reveal contradictory mixtures of old and new practices.

Behavior of Organizations

Virtual Organizations, Virtually Nonexistent. Ubiquitous computing has enabled organizational forms that are ephemeral at best and illegal at worst. For example, the "paper" corporations alleged to have been formed at Enron Corporation were supposedly created simply to move, hold, hide, and/or create the appearance of corporate assets [2]. This kind of corporate shell game is easier to accomplish with ubiquitous technologies that so easily enable virtual corporations without any material basis.

Similarly, ubiquitous computing technologies have made it possible to operate legitimate virtual companies that merely coordinate the activities of other firms. For example, products may be designed by engineers in California, manufactured by contract employees in Mexico and Malaysia, distributed by an international third-party logistics carrier, and marketed by independent e-commerce companies and retailers. The accounting and information systems functions could be outsourced to companies in India, and independent contractors working from a call center in Nevada could handle customer service. In such a "hollow" corporation, no core competency is needed other than the strategic imagination required to build and coordinate the partners in the virtual alliance [3].

A related organizational issue concerns the creation and maintenance of social boundaries between work and non-work. Prior to the fourth technological wave, social boundaries specified locations where work was designed to take place, and locations such as the home

lay outside of those spatial boundaries. Temporal boundaries also specified when a person should work. The 40-hour, five-day workweek and the practice of moving oneself physically from the home to the workplace each day became institutionalized. With the advent of ubiquitous computing, people can work outside of traditional spatial and temporal boundaries.

Level of Social Analysis	Research Issues
Individual	What prevailing social norms are challenged by the advent of ubiquitous computing?
	How can employees be supervised in technology-rich, mobile working environments?
	How are definitions of action and work redefined by ubiquitous computing?
Team	How do work teams adopt and adapt ubiquitous computing technologies?
	How can virtual teams be most effective?
	How are social interactions redefined by ubiquitous computing?
Organization	What new organizational forms and business models can be realized with ubiquitous computing?
	How can reasonable and effective social boundaries be created and maintained in technology-rich environments?
	How are organizations redefined by ubiquitous computing?

Social research issues in ubiquitous computing.

Many households have become primary workplaces [1]. Thus, work can be performed anytime, anywhere as long as workers can maintain contact with other employees, customers, and share data via ubiquitous computing technologies. The main issue with working anytime, anywhere is having work become *all the time, everywhere*. As individuals and organizations interact more frequently with portable computing devices, they will need to establish their own boundaries between work and non-work.

Conclusion

The table appearing here offers a sample of specific research issues at each of the levels of social analysis. We conclude with the following challenges to social scientists. First, ubiquitous computing enables innovative forms of social action, novel organizational forms, and new business models. We can rely only partially upon what we know about people and organizations in order to better understand how ubiquitous computing is used and managed. The challenge is to exploit and modify existing social theory to explain, for example,

the behavior of the confused airline ticket holders or the obsessive supervisors described prevoiusly.

Second, we should not underestimate the resourcefulness of groups to adapt to the demands of remote work and the ensembles of collaborative tools available to them. Simply defining teams as virtual does not eliminate their opportunities to meet face-to-face. Research on virtual teams that focuses solely on the capabilities of ubiquitous computing technologies may neglect team choices to work around technology to meet their needs. The challenge is to study teams as they actually behave, not as they are designed to function.

Third, theories of organization should be revised with the thought that organizations are not tied to particular places or times. Theories of organization need to acknowledge that work is performed in both material space and cyberspace, and that coordination between those spaces poses special new requirements [4]. Theories also need to take into account the role of human agency in enacting new technologies [7]. It is only when the promise of ubiquitous computing is engaged by social actors that its actual consequences will be realized. The challenge is to make theory relevant to organizations as they exist now and in the future, not as they existed 50 years ago. ▣

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