Human Values and the Future of Technology:
A Declaration of Responsibility

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Abstract

"We must learn to balance the material wonders of technology with the spiritual demands of our human nature." –John Naisbitt (1982).

We can make a difference in shaping the future by ensuring that computers "serve human needs (Mumford, 1934)." By making explicit the enduring values that we hold dear we can guide computer system designers and developers for the next decade, century, and thereafter. After setting our high-level goals we can pursue the components and seek the process for fulfilling them. High-level goals might include peace, excellent health care, adequate nutrition, accessible education, communication, freedom of expression, support for creative exploration, safety, and socially constructive entertainment. Computer technology can help attain these high-level goals if we clearly state measurable objectives, obtain participation of professionals, and design effective human-computer interfaces. Design considerations include adequate attention to individual differences among users, support of social and organizational structures, design for reliability and safety, provision of access by the elderly, handicapped, or illiterate, and appropriate user controlled adaptation. With suitable theories and empirical research we can achieve ease of learning, rapid performance, low error rates, and good retention over time, while preserving high subjective satisfaction. To raise the consciousness of designers and achieve these goals, we must generate an international debate, stimulate discussions within organizations, and interact with other intellectual communities. This paper calls for a focus on the "you" and "I" in developing improved user interface (UI) research and systems, offers a Declaration of Responsibility, and proposes a Social Impact Statement for major computing projects.

1. Introduction

"The machine itself makes no demands and holds out no promises: it is the human spirit that makes demands and keeps promises. In order to reconquer the machine and subdue it to human purposes, one must first understand it and assimilate it. So far we have embraced the machine without fully understanding it." Mumford (1934) p.6

Those who believe that they can change the future will change the future. This optimistic view is an extreme statement, but it does contain an important, useful, and action-oriented message. If commentators give up cursing the darkness of fatalism and light a candle of hope, they can guide us to a positive image of the future. However, even with a positive attitude, inventing the future is not easy. As scientists and technologists we must begin with a belief that we can influence the future of technology (Florman, 1976). This seems a realistic goal since each day corporations and government agencies choose which technologies to support and thereby shape the future. The lively debates about space exploration, the strategic defense initiative ("star wars plan"), heart transplants, high-definition television, recombinant DNA, birth control, etc. are powerful testimony that social forces are at work to shape the future of technology. In fact the philosophical drift is towards still more profound changes in perceptions of our powers. The editors of *Scientific American* dared to call their September 1989 Special Issue "Managing Planet Earth," suggesting that we have the power and responsibility to shape our ecological future. At the same time John McPhee dealt with these issues in his book "The Control of Nature" while Brian McKibben wrote on "The End of Nature." These sources emphasize that decision makers must grapple with the issue of responsibility for the ecological future of our planet. Similarly, I argue that decision makers in government, corporations, universities, etc. can and must take responsibility for our technological future. Specifically, I focus on shaping the future for people who use

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computers. My concern is on how users are empowered by new technologies, how they apply their growing power, and the choices that researchers and developers can make to influence user interfaces. I believe that we can choose to build a future in which computer users experience competence, clarity, control, and comfort and feelings of mastery and accomplishment. At the end of the day these users can take pride in a job done well, and appreciate the designers who created the technology.

2. Philosophical foundation and goals.

"I firmly believe that any organization, in order to survive and achieve success, must have a sound set of beliefs on which it premises all its policies and actions...the basic philosophy, spirit, and drive of an organization have far more to do with its relative achievements than do technological or economic resources..." Tom Watson, Jr. (1962), cited by Jin (1990). A sound philosophical foundation will help us to deal with specific issues. The challenge is to produce a set of goals that would be widely accepted, yet still specific enough to be useful. A starting point would be fundamental concerns such as:

- world peace
- medical and psychological health care
- adequate nutrition and housing
- safe transportation
- protection of the environment
- effective education
- access to communication and information resources
- freedom of expression
- support for creative exploration
- privacy protection
- socially constructive entertainment and sports

Presumably these societal concerns could be translated into personal experiences of freedom, challenge, engagement, pleasure, accomplishment, and self-actualization. Responding to these grand concerns and enduring values may seem to be beyond the scope of computing researchers and designers, but I believe that we can define them by specific and measurable goals such as 10% (or more) changes to: - reduce nuclear and conventional forces

- increase life expectancy
- slow population growth
- reduce homelessness
- reduce automobile accident deaths
- increase air quality in major cities
- reduce illiteracy worldwide
- reduce the cost of communication and travel

In some cases, it is clear that information and computer technology can make an impact, e.g. by educational applications in literacy training or by computer control of automobile engines to reduce pollution. In other situations, the linkage with improved human-computer interaction may be less clear initially. In fact, some goals may be more difficult to attain by only redesigning computer technology, but the example of our profession taking up the cause may prove to be an inspiration to others. Therefore, even though we may not know the path, a clear statement of the destination will benefit us and inspire participation as we ask others for assistance. Earlier in this century physicists recognized their responsibility in dealing with atomic energy and vigorously debated the issues. I believe that we in the computing professions must also recognize our responsibilities and set an example of moral leadership by inspiring discussion and influencing colleagues in other fields of science or in engineering, social sciences, medicine, law, etc. I believe that computer technology is pivotal in shaping the future since it influences daily life in every office, store, farm, school, factory, and home (Zuboff, 1988). We have a unique responsibility to consider the impact of our technology and to guide it to produce the maximum benefits with the minimum harm. Therefore, I propose a **Declaration of Responsibility**:

1) We, the researchers, designers, managers, implementers, testers, and trainers of user interfaces and information systems, recognize the powerful influence of our science and technology. Therefore we commit ourselves to studying ways to enable users to accomplish their personal and organizational goals while pursuing higher societal goals and serving human needs.

2) We agree to preparing a Social Impact Statement (patterned on the Environmental Impact Statement) at the start of every human-computer interaction project. The Social Impact Statement will identify user communities, establish training requirements, specify potential negative side-effects (health, safety, privacy, financial, etc.), and indicate monitoring procedures for the project's lifetime.

3) We recommend that professional societies prepare an agenda of vital, specific, and realizable goals for the next decade (with some thought to the next century and thereafter). These goals should be ambitious and inspirational for our profession and for others. Philosophers and ethicists can help refine the higher level goals, while the entrepreneurs and marketeers can inform us of the practical realities. Project managers and experienced government regulators can help shape the Social Impact Statement so that it helps designers meet their goals while reducing costs, saving time, and increasing quality. For those directly involved in creating the scientific theories and designing working systems, the following sections are a starting point for new ways of thinking.

3. Rethinking human-computer interaction

"Unlike machines, human minds can create ideas. We need ideas to guide us to progress, as well as tools to implement them... Computers don't contain 'brains' any more than stereos contain musical instruments...Machines only manipulate numbers; people connect them to meaning." Penzias (1989)

A key technology for the next phase of computing will be human-computer interaction design. The emergence of visually-oriented and graphic user interfaces that use direct manipulation has helped bring about a revolution in accessibility, ease of learning, low error rates, rapid performance, high retention over time, and high subjective user satisfaction. This revolution will continue to expand the possible applications of computers and engage ever larger fractions of the world's population. Like photography, computing will spread till it is nearly universal during the next century. However, computing technology is still perceived as threatening, anxiety-producing, cold, or alien by a large proportion of the population who would be terrified by the vision of universal use of computers. I believe that the goals mentioned earlier will only be attainable if as we recosider the applications we also properly redesign the user interfaces to computers so that usage will be satisfying. I have long advocated a scientific approach to studying user interfaces (Shneiderman, 1980; 1987) by controlled psychologically-oriented experiments, data collection from actual usage, and more informal process-oriented or ecological observations. For designers I have promoted usability testing, user interface management software, guidelines documents, and participatory design involving typical users. I believe that there is a golden opportunity to conduct pioneering and productive research on topics such as:

- interaction styles (commands, menus, form-fill-in, direct manipulation)
- screen layouts, graphic design, and window strategies
- input devices and strategies
- display design to increase legibility, readability, and comprehensibility
- color, animation, graphics, sound, video, tactile feedback
- workstation physical design and ergonomics
- response time impact

In addition, user interface researchers and designers can benefit from improved theories that refine psychological theories in this new field (Norman, 1988). However, while we adhere to the rigorous, reductionist scientific method, we must retain the holistic, intuitive, subjective, contextual, and experiential perspectives. Fortunately, I believe that the balance has been attained in our emerging multi-disciplinary field as the diverse influences of computer scientists, psychologists, graphic designers, human factors specialists, technical writers, etc. have been often effectively combined. The emergence of five scientific journals (*International Journal of Man-Machine Studies*, *Behavior and Information Technology*, *Human-Computer Interaction*, *Interacting with Computers*, and the *International Journal of Human-Computer Interaction*), a review journal (*Abstracts in Human-Computer Interaction*), multiple conferences, and numerous books testifies to the successful growth. As for specific directions, some daring researchers and designers have broadened their concerns from the current list of perceptual, cognitive, and motor issues to pay more attention to additional factors (Winograd and Flores, 1986; Kling, 1980). I think that these directions will lead to very exciting results and systems in the coming decades:

- Individual differences. Identify design principles for: – experts and novices – personality and cognitive styles – gender – handicaps (physical and mental) – elderly.
- Social context, collaboration, teamwork, and communities. Develop groupware for improving communication and collaboration among remote groups and for facilitating discussion in meeting or classrooms.
- Affective impact. Design to accommodate playfulness, romance, sadness, etc.
- Cultural differences. Understand the impact of diverse languages, customs, religion.
- Explore application of computing to a wider variety of tasks

This list of broadened issues will keep several generations of researchers and designers gainfully occupied (Shneiderman, 1986). I believe that the inclusion of the philosophical foundations and attention to the fundamental concerns described in Section 2, can lead to novel and useful scientific discoveries and exciting technology. In short, expanding our philosophical horizon can lead to better science. Lessons from research on elderly or handicapped use of computers will undoubtedly improve access for all. Recognition of the value of participatory design and computer-supported collaborations will open the door to novel technologies that counter the negative effects of competitiveness and support a more cooperative spirit (Eisler, 1987). Not all commentators are as optimistic. Many critics are concerned that computing can be "de-skilling," in that users may lose their skills and abilities as computers take on more components of their jobs. However, few tears are shed for the loss of skills such as carrying water or stoking coal furnaces. I believe that we can make technology that, more often than not, empowers users and gives them a greater sense of control and competence. I claim inadequate design theories accompanied by inappropriate philosophies are the cause of the de-skilling phenomenon and that improvement is possible. Effective designs should empower users and create a greater sense of control, mastery, predictability, and clarity. One of the misleading philosophies has been artificial intelligence. While designers may be attracted to the goal of making impressive and autonomous machines that perform tasks as well as humans do, this is not what most users want. I believe that users want the sense of their own accomplishment rather than to admire a magically smart, intelligent, or expert system. Users want to be empowered by technology to be able to apply their knowledge and experience to make judgments that lead to improved job performance and greater personal satisfaction. Sometimes pre-defined objective criteria can be applied to a task, but often human values must be applied and flexibility in decision-making is a necessity

(Weizenbaum, 1976). With increased automation it is often beneficial to reconsider the balance between high-tech and high-touch (Naisbitt, 1982). Some examples may help to clarify this issue. Doctors do not want machines that do medical diagnosis, but rather a machine that enables them to do a more accurate, reliable diagnosis, to obtain relevant references to scientific papers or clinical trials, to gather consultative support more rapidly, and record it more accurately. Similarly air-traffic or manufacturing controllers do not want a machine that automatically does their job, but one that increases their productivity, reduces their error rates, and enables them to handle special cases or emergencies effectively. I believe that an increase in personal responsibility will result in improved service. Therefore, I chose to emphasize the User Interface (UI) in place of Artificial Intelligence (AI) as the guiding image. UI puts the emphasis on the user, not the machine, and is a not so subtle pun on having "you" and "I" as the focus of attention.

4. Questions for designers

"The real question before us lies here: do these instruments further life and enhance its values, or not?" Mumford (1934) p. 318. In an earlier work (1987), I described "Ten Plagues of the Information Age" and cautioned designers. However, each one of these potential plagues is also a challenge to be overcome; can contemporary designers build a better world by preventing these plagues?

1) Anxiety: Can we build improved user interfaces and systems that will reduce or eliminate the current high level of anxiety experienced by many users? In fact, can we not set our goal to make use of computers appealing, engaging, relaxing, and satisfying?

2) Alienation: Can we build user interfaces that encourage constructive human social interaction?

3) Information-poor minority: Can we build systems that empower low-skilled workers to perform at the level of experts? Can we arrange training and education for every able member of society?

4) Impotence of the individual: While large complex systems may overwhelm individual initiative, it seems clear that computers have the potential of dramatically empowering individuals. How best to ensure that this happens?

5) Bewildering complexity and counterproductive speed: This is a serious challenge to designers because the normal social and economic pressure is for more power, complexity, and speed. Stern adherence to basic values may be the only path to a safer, saner, simpler, and slower world where human concerns predominate.

6) Organizational fragility: The complexity of technological systems sometimes leads to their breakdown, but disaster can be avoided by effective design, proper training, and wise management. Can developers anticipate the dangers and produce robust designs?

7) Invasion of privacy: Can managers seek policies and systems that increase rather than reduce the protection of privacy?

8) Unemployment and displacement: Improved systems should lead to economic expansion but individual job displacement is a serious issue. Can employers develop labor policies that ensure retraining and guarantee jobs?

9) Lack of professional responsibility: Complex and confusing systems enable users and designers to blame the machine, but with improved designs responsibility and credit will be properly given and accepted by the users and designers.

10) Deteriorating image of ourselves: Rather than be impressed by smart machines, accept the misguided pursuit of the Turing test, or focus on computational skills in people, I believe that designs that empower users will increase their appreciation of the richness and diversity of unique human abilities.

These ten challenges are a useful checklist for designers, but I find that there are four fundamental questions that can act as useful guides: Have I considered individual differences among users in the design of my system? Have I considered the social context of users? Have I arranged for adequate participation of users in the design process? Have I considered how my design empowers users? I'm sure that there are other important questions, philosophies, guidelines, rules, or maxims that can aid designers. I look forward to lively debates about how best to build the happier, wiser, and safer world of the future.

5. Kindling the fires

"Before large-scale action can be taken, however, there must be public awareness, public debate, and a decision to take action as a society. We are not naive enough to think that this can take place overnight, but we do know that major transformations have already come about rapidly." Ornstein and Ehrlich (1989)

Hard-core computing professionals often have little patience with grand social visions. To capture their hearts and minds requires practical and realizable steps. This expectation is legitimate and even helpful. I think the excitement of creating new products and theories will be sufficiently engaging for many people, but courageous leaders must encourage the shift in attention. First steps would be to produce discussions within professional societies, corporations, government agencies, and international organizations. Professional societies, such as the Association for Computing Machinery (ACM), Computer Professionals for Social Responsibility (CPSR), or IEEE Computer Society, can respond to the Declaration of Responsibility by educating their members, issuing public position papers, stimulating discussions in their journals and conferences, and guiding corporations and governments. They can begin by refining the proposal for the Social Impact Statement. Corporations stand to gain

the most and are likely to carry the vision forward if their officers can understand how profits can be increased, stockholders pleased, and employees satisfied. Any vision of expanded use of computers is likely to lead to increased production of hardware and software, with attendant increases in service, training, maintenance, etc. Although proof is hard to come by and there are certainly negative side-effects, I believe that expanded use of computers increases productivity, improves quality, and stimulates economic growth. In short, corporations are likely to support a suitable plan. Directors of research and corporate officers might be invited to national and international planning sessions to coordinate activity (Jin, 1990). Government officials and agencies in the United States and other countries can often become leaders in these novel directions. For example, the U. S. Office of Technology Assessment convenes working groups addressing novel technologies which might recommend ways to apply the Declaration of Responsibility. Financial support from the National Science Foundation can steer research directions and initiatives from the National Institute for Standards and Technology are often influential. A set of principles espoused by the Office of Personnel Management or the Government Accounting Office can direct developments within other government agencies. I hope the members of Congress and other government officials will recognize the opportunities before they are challenged for their abdication of responsibility. Similar agencies exist in governments in many countries. International scientific organizations can also play a role by raising these concerns at conferences such as the triennial IFIP World Conference on Computers. United Nations agencies or the International Commission on Human Aspects of Computing can disseminate the ideas and reach key parties in corporations, governments, and scholarly institutions around the world. There is an opportunity for professional, academic, corporate, and governmental leaders to take the initiative in shaping the future before the ozone hole of irresponsibility grows too large. Positive visions are important, but practical plans and innovative theories are also necessary. Then, as steps are taken, there is a need for a feedback and evaluation process to make mid-course corrections.

While inspiring leadership is essential, ultimately every step is taken by an individual designer who makes one decision at a time. Each decision may be an opportunity to make the world a better place by enabling a doctor to make a more effective treatment plan, a teacher to be more successful in helping a student learn, an airline reservationist to find a shorter and cheaper routing, or an arms-control negotiator to more easily revise a treaty. Ultimately, quality, cooperation, and compassion emerge from solitary decisions made by committed and concerned individuals. ◆

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