Public Involvement in Technology Policy: Focus on the Pervasive Computing Environment

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Abstract

This paper examines the role of the general public in informing technology policy, observing that public involvement often occurs only through the electoral process or via feedback after plans have been implemented. Planners and policymakers are not necessarily in touch with the feelings and desires of the public who will be affected by their decisions. For this reason, it is important to seek a clearer understanding of the views of citizens who are not typically involved in the planning or design process in order to guide the evolution of technology, as well as to highlight areas where there may be some discrepancy between planners and the needs of everyday users. To broaden the inputs into discussion of emerging problems related to pervasive computing in the State of Hawaii, both information and communication technology specialists (including government policy makers) and members of the general population were invited to participate in a multi-phase study. Differences in perception between specialists and the general public were identified in all phases of research. Specialists were identified as being more focused on near-term issues related to barriers affecting the growth of high-technology industries within the State. Non-specialists showed greater concern for "human" issues, including issues related to the control of technology. Importantly, both groups independently described a need for increased public participation in the process of technological development. Analysis also revealed that both groups found the problem statements generated by non-specialists to be valuable contributions, arguing for their inclusion in the process of problem identification and further supporting the use of participatory planning methods.

Introduction

Numerous advances in information technology point to the emergence of a new communications infrastructure in which computational intelligence becomes a part of everyday life. In Mark Weiser's seminal vision of ubiquitous computing, first presented in a 1991 *Scientific American* article, "The Computer for the Twenty-First Century," the future will be populated with a multitude of computers, communicating autonomously over distributed networks, and seamlessly integrated into the environment [1]. This vision of a world where computers are omnipresent, perhaps outnumbering humans by hundreds or thousands to one, is decidedly human-centric. Ubiquitous computing strongly emphasizes the

recession of computers into the periphery of consciousness, invisible and designed to "enhance our peripheral reach" without being obtrusive [2]. As subsequent researchers have noted, "this technology will fundamentally change the nature of computing, allowing most objects we encounter in daily life to be 'aware,' interacting with users in both the physical and virtual worlds [3]." For over a decade, a variety of efforts towards this ubiquitous or pervasive computing environment have been underway at numerous academic, corporate and government institutions. Existing examples of this strongly emerging trend are personal digital assistants, cellular phones that access Internet resources via wireless application protocol (WAP), and the many microprocessors embedded in modern cars. New technologies such "Smart Dust" networks of autonomous, mobile nodes, containing sensors, computational power, and wireless communication [4] are ready to be used in a multitude of applications pending specific engineering solutions [5].

Pervasive computing is not merely a 'technical' issue, however, as its development and use is guided by numerous social, political, or economic interactions that have the potential to radically transform virtually every aspect of human life. While these advancements hold great promise, the emergence of pervasive computing environments is likely to raise many challenges as well as opportunities. Because we are still in the earliest stages of the pervasive computing era, emerging policy issues are largely off the radar. We have little information about the potential impacts of these technologies and how they will affect different constituencies. Overall, the components of this infrastructure are viewed in isolation (e.g., wearable computers, implants, or intelligent agents), and there is no holistic view to guide discussion. As technological innovation typically outpaces economic, socio-cultural, or legal change, there is a strong need for foresight into this emerging future as a guide for policy decision making and to ensure that the needs of diverse stakeholders are considered.

Role of the Public in Technology Policy

It is commonly assumed that decision-making in a technologically advanced society requires a level of expertise that exceeds that of most citizens. Traditional models of policy formation emphasize the public's exertion of power only through the electoral process or via feedback after plans have been implemented. Yet planners and policymakers are not necessarily in touch with the feelings and desires of the public who will be affected by their decisions. Technology policies are often framed by representatives of three

groups: businesses, the military, and universities. It is members of these groups who are "invited to testify at congressional hearings, serve on government advisory panels, and prepare influential policy studies [6]." While the public at large is deeply impacted by these developments, and may have alternate opinions or concerns, these viewpoints are not directly included. This process implies that a select group of experts "know better," presenting them as modern Platonic guardians, who alone are enlightened and able to understand and guide the complexities of science and technology. Members of the general population are assumed to lack the necessary understanding of scientific or management principles to substantially contribute to decisions about the development and control of technologies or it is perceived as too difficult to effectively harness their perceptions.

Discrepancy between the visions of designers and planners and the rest of the populace can lead to public policy disasters, policies that cannot adapt to the constantly changing reality of technological progress and an increasingly disenfranchised populace. This lack of involvement may foster a belief that technology dramatically affects the human realm, but that we have very little say in the creation or rejection of technologies. This may be one reason why "people seem to distance themselves from a critical evaluation of the technologies of their lives, as if these technologies were inevitable forces of nature rather than things we design and choose [7]."

The general population may have less direct involvement in the development of technologies and technology policy, yet they are important stakeholders who will be profoundly affected by the outcomes of this process. While the level of detail and expertise required in implementing plans is far more complex than can be handled as a public process, inclusion of the public can set criteria for planning that can be used as guidelines by decision makers [8]. For this reason, it is important to seek a clearer understanding of the views of citizens who are not typically involved in the planning or design process in order to guide the evolution of technology, as well as to highlight areas where there may be some discrepancy between planners and the needs of everyday users. Increased recognition of the need to widen input into the policy and planning process has led to development of participatory methods that include members of the general public. One of the more successful efforts is the "Consensus Conference" used in discussion of technology policy in Denmark. This technique involves selecting a panel of everyday citizens to interact with technology experts on a given subject. The experts provide information to the citizen panel, who

then assess the technology and consider its consequences, both positive and negative. The citizen panel drafts a final report that is made public and submitted to Parliament for consideration. The Danish Board of Technology has successfully used this technique since 1987 to address social impacts of technologies such as electronic surveillance and genetic testing. "Consensus Conferences in Denmark have resulted in public debate on technology, and politicians have thus been made aware of the attitudes, hopes and concerns of the public. On several occasions the Consensus Conferences have caused political debate and initiation of new regulation [9]." The Consensus Conference technique has also been applied to policy issues in others countries, including Britain, Japan, Austria, and New Zealand [10].

When considering pervasive computing, we must acknowledge that it is an emerging environment and its investigation requires futures forecasting methodologies. In forecasting studies, participatory methods may range from polling the general population of a region or nation to the organization of highly interactive futures workshops [11]. Dator has argued that "foresight that is undertaken as only a technical, scientific, and professional matter is incomplete. Foresight must also and necessarily be a political, ethical, esthetic and very broadly participatory project… It is absolutely essential that all people who have a stake in the future be involved in determining it [12]." Public-oriented methods tend to have a normative focus, emphasizing desired rather than 'actual' futures, in order to explore a range of potential issues related to technological impacts and provide fresh insight into possibilities. For example, involving non-decision makers early on (i.e., framing perceived problems) allows a broader range of concerns to be voiced. Further, it may contribute to an increased acceptance and public involvement in the overall planning process. Finally, it serves to educate the public on emerging issues and makes them part of an ongoing planning process. This will enhance decision making and ensure that planning decisions are in closer alignment with the true public interest. It is also an opportunity for new, unexpected views to be proposed and discussed and may help to elucidate alternate forecasting or policy pathways that would not otherwise be considered. Participatory efforts should be viewed as *part* of a process where members of the general public share their concerns and desires about the future, which are then considered by forecasters, policymakers, or system designers in the formation of foci and priorities and plans for implementation.

Public Input into Emerging Problems Related to Pervasive Computing in Hawaii

Current economic development plans have promoted Hawaii's potential as an information and communication technology center for the Pacific region. Recognizing the positive economic benefits of attracting high technology industry, the State has implemented tax initiatives and other incentives. As we move towards this complex socio-technical future, it is important that we ask ourselves if we are promoting an outcome where pervasive computing will enhance our lives, as in Weiser's vision, or impose unnecessary burden. Foresight into the potential problems of pervasive computing environments is important in guiding this initiative, as it identifies potential obstacles to human-centered development, as well as provides a method for negotiation among various stakeholders. Diverse participation also ensures that no single domain (e.g., economic development) dominates the process.

To investigate potential emerging problems related to pervasive computing developments in the State of Hawaii over a twenty-year time frame, Winter sought to include a greater breadth of controlled participation in the process of problem identification [13]. This research harnessed the perceptions of 165 individuals from six islands throughout Hawaii, both information technology specialists and members of the general population (non-specialists). The specialists group (n_S=81) represented those traditionally involved in planning or information and communication technologies development activities, including representatives from state and local government. The non-specialists group (n_N =84) was selected to reflect the diverse demographics of Hawaii residents. In addition to broadening input into the process of problem identification and assessment, the

inclusion of both groups provided an opportunity to explore whether there were differences in problem perception.

In one phase of this multi-method study separate groups of specialists and non-specialists (n_S=19, n_N=19) participated in electronic focus groups and were asked to reflect on a scenario for the year 2022 of a fully immersive pervasive computing environment. To elicit a broad range of responses, each participant was asked to generate descriptions of potential problems that they felt may emerge in each of six domains: Social, Political, Economic, Technical, Educational, and Psychological. Content analysis was applied to the transcripts of each group, and statements were combined for redundancy, yielding 80 unique problem statements across the six domains.

In a subsequent phase, 123 new individuals (n_S=58, n_N=65) evaluated the overall importance of 80 problem statements by evaluating the overall importance (criticality) of the problems derived from the electronic focus groups by rating each on a five-point scale. This process was intended quantify perceptions of both the specialists and non-specialists in order to narrow the complete list of problems so that a manageable subset could be analyzed in greater detail as well as to add another dimension to the exploration of differences in opinion between groups.

Results

Non-specialists participating in the problem identification focus groups expressed distinct and different concerns than specialists. A notable trend was that problems in the pervasive computing environment as framed by non-specialists often focused on "human issues," the complexity of emerging technologies, and *how and why* they were being created and implemented. Participants' reactions to a scenario of pervasive computing in Hawaii 2022 differed greatly: a general trend was that specialists assumed that the vision presented was a natural, and even desirable, progression of technology:

> **First Specialist***:* Your scenario describes a world in which I'd be very comfortable most of the time.
>
> **Second Specialist**: By 2022 people will represent mobile data sets. With vast quantities of data available about all aspects of our lives, this information will become totally mundane and people will no longer be concerned with keeping private facts on our medical condition, income, taxes, credit history, criminal record, etc. All of this information will be freely available and of relatively little interest. A psychological shift will have gradually taken place so that we are concerned less with the data points, but with more important things like viewing and smelling our garden of virtual roses growing off of our 120th floor lanai.

In contrast, a number of non-specialists expressed shock or horror:

> **First Non-Specialist**: Rather than being about communication the scenario that I am in is one of my worst nightmares… This scenario seems to put barriers between all of the things that make us sure that we are human.

> **Second Non-Specialist:** In the past century humans put more stress on our planet than ever in the entire history of mankind. We have polluted our air, contaminated our water, filled the area we call "space" with junk, filled innumerable landfills with material which was designed to be obsolete. Why is there so much emphasis on making more and more devices which will be instantly be obsolete? Why can't technology be used to undo the damage? Why can't it be used to learn how to leave the earth as we found it rather than making more and more machines for the junk pile in hopes of what?

In these representative examples, the specialist authors anticipate and appear comfortable with dramatic change posed by pervasive computing. The non-specialist authors view the potential pervasive computing environment with greater concern and anxiety. Many problems presented or assessed highly by specialists were focused on present and future changes required to arrive at a world similar to the scenario. Specialists tended to focus on how to address current and near-term obstacles to the growth of alternative, high technology industries within the state (and thus economic growth overall). This may be characterized as a frame that seeks to determine *how* to achieve the pervasive computing environment, while assuming that the overall vision (with some changes) is desirable.

In contrast, statements generated by many non-specialists were more critical about the pervasive computing environment itself, questioning the rationale for its development. While both groups perceived economic concerns as a prerequisite for social well-being, non-specialists expressed greater concern over longer-term emerging human issues, particularly those related to control of the process of technological development. This was evident in all domains, with the most substantial differences noted in the Psychological, where non-specialists contributed seventy-seven percent of the total statements. Non-specialist statements tended to deal with more philosophical issues, such as challenges to human identity in the face of autonomous intelligent systems, erosion of social and community life, and conflicts with local Hawaiian cultural values.

Who Controls Technological Development in the Pervasive Computing Era?

One interesting and unexpected discovery from this research is the degree to which the content (problem statements and assessments) reflects the need for participatory methods. While many of the perceived problems identified dealt with tangible issues such as the need to find reliable power sources or dealing with material waste generated by a multitude of pervasive devices, a distinct class of problems emerged

that dealt with concerns about "control of technology". One subset of these control problems, generated in the electronic focus groups by both specialists and non-specialists, expressed concern about the increasing complexity of modern life and a growing lack of public involvement in the decision-making process.

Several statements generated by specialists addressed the overall complexity and potential negative effects of rapid technological development. For example, there was concern about the possibility that pervasive computing technologies *will continue to increase in complexity and will often be too complex for average users to use to their full potential.* As one participant observed, "the information gap will certainly widen the cultural gap between Hawaiians and other groups in Hawaii. It will widen the economic gap as well. As general society's dependence on computers and information grows, the people that reject and avoid (or can't afford) the technology, become increasingly disadvantaged." This concern further extends to the idea that *technologies will become too complex for average users to understand and make informed decisions about.* Thus, this growing gap in knowledge is also expected to limit individuals' abilities to be active in civic culture.

Both the specialist and non-specialist focus groups expressed concern that *public involvement and local solutions to problems will decline as increased data collection and computer processing power result in decision-making becoming more concentrated in the hands of a few planners and politicians*. As one participant commented, "[f]or us to advance in the future, we need to determine a better way to govern ourselves. One way is to increase citizen oversight of the political process. Another is to give more power to the people in the political process. Whatever the solution, the government by the few, of the few and for the few will not promote a better society at large for the rest of us."

This unease also extended to the process of technological development, where both groups felt that *there will be a lack of adequate guidelines and checks and balances to ensure new technologies reflect broad community values*. One participant noted that "[w]e would be wise to make sure that the features programmed into each new device support broad community values and not bottom-line objectives. But - will new voices that [sic] come forward with enough credibility to make sure that happens?" The non-specialist group also suggested that *we will not have adequate time to assess potential negative impacts*

before technologies are implemented. These concerns indicate that the pervasive computing environment is anticipated to accelerate technological change and, at the same time, exclude members of the general population from active participation in guiding technological development and ensuring that new technologies meet community approval.

An example of these concerns about the lack of public participation arose during discussion of future electronic surveillance. At the time of the focus group meetings, there were a number of prominent news stories about "Van Cams", part of a traffic enforcement program initiated by the Hawaii Department of Transportation in early 2002. Automated cameras were stationed in vehicles alongside roads to help enforce traffic laws by photographing license plates of vehicles whose drivers exceeded the speed limit or ran red lights. Widespread public outcry about invasions of privacy led to eventual termination of the program. Several specialist participants noted that many future technological developments, such as electronic surveillance by ubiquitous networked computers, would be difficult to implement given the reaction of the public to this program and their success in ensuring its termination. However, another participant suggested that

> ubiquitous computers and remote monitoring… may actually come about by default, slowly and with limited public debate. This is primarily because technology issues are extremely complex and frustrating to understand and public participation in voting and government is declining.

This is an important observation, as the public was not actively involved in the decision to implement the Van Cams and only became involved after implementation and enforcement occurred. While in this case the public was able to stop the Van Cam program, this was a rare, and perhaps temporary, victory. Considering the economic and human resources expended and the intensity of feeling on the part of the citizens of Hawaii, it is clear early feedback about this would have allowed an alternative, less costly and distressing solution to be negotiated. Although both groups contributed problem statements and discussion and exhibited concern for the lack of public involvement, investigation of between-group differences during the problem assessment phase revealed that all of the items relating to imbalances in the political and technological development process that would exclude non-specialists from full participation in the decision-making process were rated significantly higher by non-specialists (Mann-

Whitney U, two-tailed, $p<.05$, $n_S= 58$, $n_N =65$).[1]

Table 1. Mann-Whitney U: Selected Problems Statements Related to Public Policy Process

Problem Statement	M_S	M_N	U	Z	2-tailed Sig. (p<.05)
Technologies will become too complex for average users to understand and make informed decisions about (POL01)	**1.79**	**2.25**	**1504.000**	**-1.993**	**.046***
Public involvement and local solutions to problems will decline as increased data collection and computer processing power result in decision-making becoming more concentrated in the hands of a few planners and politicians (POL03)	**1.79**	**2.60**	**1238.000**	**-3.362**	**.001***
There will be a lack of adequate guidelines and checks and balances to ensure new technologies reflect broad community values (POL04)	**2.00**	**2.57**	**1379.500**	**-2.631**	**.009***
Technical systems will continue to increase in complexity and will often be too complex for average users to use to their full potential (T01)	**1.86**	**2.42**	**1376.000**	**-2.694**	**.007***
Technological development will progress so rapidly that we will not have adequate time to assess potential negative impacts before technologies are implemented (T02)	**2.17**	**2.80**	**1303.000**	**-3.037**	**.002***

This subset of control problems was part of a larger group present in each domain that addressed concerns about human autonomy in the face of intelligent automated systems, social impacts, and reliability of technologies [14]. Non-specialists consistently assessed these as being more critical problems than did their specialist counterparts.

Assessment of Non-specialist Input

Another consideration of this research was the degree to which the problem statements generated by non-specialists were perceived as important by both groups. During the problem assessment phase neither group was aware of the origin of problem statements (or that two separate groups had generated them). To test whether the non-specialists' inputs were perceived as useful inputs, ranked lists of mean scores weighted by all participants were produced and examined to see the relationship between

[1] Test performed on each pair of responses (specialist, non-specialist).

origination of problem statements (i.e., non-specialists, specialists, or both groups) and their ranking. As *Table 2* illustrates, one non-specialist-generated problem was ranked in the top 10, as compared with two from specialists (the remainder were addressed by both groups). Of the top 20 items, exactly one half of the problem statements were generated by both groups, with an additional 25% contributed by each individual group. However, by the end of the second quartile, the number of non-specialist comments rose to 32.5% (cumulative) with only 22.5% (cumulative) of

comments generated by specialists, indicating the non-specialist comments were perceived as valuable contributions by both groups.

Table 2. Origin and Number of Problem Statements in Each Quartile*

Items	S	S cumulative/ cumulative %	N	N cumulative/ cumulative %	B	B cumulative/ cumulative %
1-10	**2**	**2**	**1**	**1**	**7**	**7**
11-20	**3**	**5 (25%)**	**4**	**5 (25%)**	**3**	**10 (50%)**
21-30	**1**	**6**	**3**	**8**	**6**	**16**
31-40	**3**	**9 (22.5%)**	**5**	**13 (32.5%)**	**2**	**18 (45%)**
41-50	**4**	**13**	**3**	**16**	**3**	**21**
51-60	**6**	**19 (32%)**	**3**	**19 (32%)**	**1**	**22 (36%)**
61-70	**1**	**20**	**7**	**26**	**2**	**24**
71-80	**6**	**26 (33%)**	**3**	**29 (36%)**	**1**	**25 (31%)**

* Column totals indicate the cumulative number of items and horizontal totals indicate the cumulative percentage of items in each quartile. S=Specialists, N=Non-Specialists, B=Both

Because the specialists were not aware that non-specialists had contributed statements and vice-versa, this argues that there was no bias for or against any particular statement based on the perception of who generated it. These results indicate that non-specialist comments were perceived by both groups as

important contributions and add support for the inclusion of non-specialists in the process of problem identification in the policymaking and system design process.

Conclusions

The results of this study suggest that, in addition to ethical concerns about the exclusion of non-specialist insights from the decisions about technology policy, non-specialist input provides different and useful inputs into the process. These findings are in accordance with definition of problems as socially-defined phenomena [15], as well as theories of the policy-making process that suggest that the views of specialists and the general public may differ [16, 17]. Many non-specialist concerns were related to human issues, rather than explicit technological or macro-economic ones. Considering these alternative perspectives is important because issues that are *perceived* as problems will *be* problems to at least one segment of society. Although more abstract, these problems have external implications. For example, social movements or violence may occur due to concerns about pervasive computing-related developments, or people may simply choose not to adopt certain technologies that are at odds with their values. While it is common to perceive non-expert concerns as being trivial or unenlightened, these contribute substantially to public policy issues. Further, emerging problems often provide early warning signs years or even decades in advance of their appearance and their impacts may be substantially mitigated if action to address them occurs early in their development [18].

One interesting finding was that issues related to the policy process itself were identified as problems that will be exacerbated by pervasive computing environments in coming decades, and that non-specialists assessed these concerns as being more important than their specialist peers. Risk Society theorists argue that modern society is characterized by risk, the method of handling the various changes and threats introduced by humans in the process of technological innovation [19]. Risk is embedded in institutional and technocratic processes that place little value on public opinion or concern. The general public's alienation from decisions about which risks are acceptable may lead to anxiety, and a sense of loss of control in the face of complex dangers related to pervasive computing. Rapidly accelerating technological innovations must be constantly assessed and monitored, but no effective means exists for most people to feel actively involved. The "control of technology" issues identified in this study may be viewed in the context of modernity and globalization as conceived by Giddens. Globalization extends beyond economic

implications to focus on the way that advanced information and communication technologies interconnect both the local and the global worlds across time and space. Giddens argues that we are moving into a period of "radical modernity", as abstract mechanisms such as global monetary systems or expert knowledge disembed social relations from their local contexts and reconstruct them in a global time and space. Society becomes much more reflexive and aware that it is founded upon knowledge that is continually revised. Expert knowledge and authority are questioned. To minimize the high-consequence risk brought about by this "juggernaut" or "runaway world" will require the transformation of political systems. Here, Giddens advocates harnessing the positive aspects of modernity, particularly "envision[ing] alternative futures whose very propagation might help them be realized [20]."

What can be done today to address these concerns? The inclusion of a broader segment of the public in the process of technology policy is one step in this direction. From Giddens' perspective, we must view power as *more than involvement in a formal planning and decision-making process*. Technological systems arise out of institutional processes: they are the product of complex interactions and negotiations among many social actors over time. Our day-to-day lives are imbued with actions that will affect the development of pervasive computing. However, individual social actors may not feel empowered to make changes that would bring the rapidly unfolding future into closer alignment with their values and desires.

Nardi & O'Day suggest that individuals must become "critical friends" of technology, as this opens the door for the critique and subsequent change of technologies. Distancing ourselves from the "rhetoric of inevitability" enables us to take a more active role in the development of technology, be it more formal attempts to influence government technology policy or through our daily actions at work, home, or other local levels. "We all have personal relationships with some of these institutions. We can influence them without having to change broad governmental policy, though that might happen in some cases [21]." Ultimately, a more "democratic politics of technology" will require both the inclusion of non-specialists in public discourse and decision making about technology *and* an invigoration of "informal politics." Informal politics refers to the daily activities of people and institutions. Here, Sclove notes that "people have diminished access to local mediating institutions or to public spaces that could support democratic empowerment within the broader society [22]."

"Control of technology" problems may appear broad or ill-defined, and they are difficult to address even when their potential significance is acknowledged. This class of problems is unlikely to be substantially reduced via a direct approach (i.e., attempting to reduce the problem *as it appears*). Because of their elusive form, they may resist attempts to reduce them, and any resources allocated to their solution may be consumed with no noticeable results. These issues may only have a solution in increasing the role of the public in dialogue and decision making about technology. That is, the solution of some of these larger and less tractable issues requires a change in the process through which decisions about technology are made.

One of the final recommendations of this study is the initiation of a long-term planning process involving participatory futures studies methodologies. The complexity of the policy-making environment requires that this be an *iterative* planning process, including the development and implementation of multiple plans (e.g., 2-, 5-, and 20-years). While providing specific guidance in the present these should also be flexible enough to adapt to new and varied inputs. Including as broad a population as possible in this planning process is essential, as this will ensure that technological development more closely reflects broad community values and goals, and it will increase public support for policy initiatives that are implemented. Creating and testing of a variety of "visions about the future" will aid in the reduction of uncertainty and enhance the social negotiation of multiple perspectives to guide technological development within Hawaii. Further, understanding the opinions of diverse stakeholders and identifying differences between them may be an effective means of identifying emerging problems long before they become costly or affect the quality of life. Examination of these differences is important because it initiates futures-oriented social negotiation involving multiple perspectives, leading to a more human-centered implementation of technology, as in Weiser's guiding vision. In addition to reducing the separation of the planning process and the public, including members of the general populace adds legitimacy to future planning efforts.

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