The Social Impact of Pervasive Technologies

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Abstract

Large scale deployment of communications technologies has produced major changes in the way we communicate for social and business purposes. Most of these deployments were technology led, without any *a priori* assessment of social consequences. There are many examples including the Internet, and mobile telephony. The lessons from the Information Age so far are stark, but clear. The absence of socially inclusive systems development processes, which provide clear guidance on the social consequences of large scale technological deployment, has led to the Digital Divides we face today. A new social systems model is an essential precursor to the successful design and development of next generation technologies.

This paper briefly describes some of the key attributes that a systems design model for the next generation of ICTs will require. Of these, the most single most powerful feature to be developed will be the social impact assessment.

Key words: Social Impact, Pervasive Technologies

1. Background

Large scale deployment of communications technologies has produced major changes in the way we communicate for social and business purposes. Most of these deployments were technology led, without any *a priori* assessment of social consequences. There are many examples including the Internet, and mobile telephony. These technologies produced social disruptions, or what Thomas Kuhn so elegantly calls, "paradigm shifts" [Kuhn (1966)]. Technologically led change inevitably leads to new social problems. The lack of socially inclusive systems engineering processes is the main cause of the resulting negative social consequences for society as a whole.

These consequences include problems of trust, security and privacy, the creation of digital divides, and the widespread abuse of the technology for antisocial purposes. Efforts to repair the social deficit of technologically led systems development center around various schemes for the inclusion of user requirements. Socio-technical systems design [Eason (1988)], user centered design [ETSI (2002)], rapid prototyping, usability testing [ETSI (2000)], and other similar processes seek to put the user at the center of the design processes. These schemes have indeed had some success, for example in areas of human computer interaction (HCI), in the ergonomics of device design, and in some areas of systems analysis of relatively small systems [Eason (1988)]. However, the financial cost of large scale longitudinal trials is prohibitive in many cases. Despite the obvious benefits for some users, the negative social

consequences for many people of large scale technologically motivated systems deployment remain.

2. Next Generation Technologies

The communications power of the next generation technologies will go far beyond the limited functionality of today's devices. The current emphasis in research and development for future ICTs, emphasises pervasive and ubiquitous networking capability. [Raman (2002)] [Briscoe (2004)] There are three main technical drivers – wearable communications devices, embedded and ambient communications devices, and ad-hoc networking. The intention is to use these devices, together with enhanced versions of today's communications technologies, to create a new paradigm, "an internetworking of all things, regardless of device or platform, or whether the information is delivered via wired or wireless means." [1] With today's technologies, the users are in a sense external to the system. The next generation of technologies will make the user an integrated component in a world wide web of interacting communicating devices. The pervasive ability of these devices to create ad hoc sub-networks in social settings increases the scale and functionality of the communications pathways across our society. In a real sense, the user will start to become a part of the Web. Beyond the Next Generation, the integration of nano-technology, bio-technology, information-technology and cognitive-technology, the so called NBIC convergence, will literally make every human a node in the world wide web of information [Pearson (2006)].

3. Human communications

The Irish playwright Brian Friel wrote extensively about the problems of human communications. In one play, called "Translations" [Friel (1981)], he uses the device of having the principles speak to each other in different languages, in order to explore the difficulties humans have communicating face to face. A more humorous example occurs in "The Communication Cord", by the same author [Friel (1983)], where the hero, a junior lecturer in media studies, "without tenure", tries to explain his research into the nature of human discourse. His struggle to explain how an idea in the mind of one person is communicated effectively to that of another is a model of immense complexity, false assumptions, and faulty transmission and reception. The point is that this flawed process is the result of hundreds of thousands of years of trial and effort by our ancestors.

Humans find traditional interpersonal communication, using channels, protocols and norms, which have been acquired from generations of practice by our forebears, a difficult procedure. Using ICTs to create additional channels and modes of communication adds significantly to the challenge of effective communication between humans. The new pervasive, always on technologies currently in development will shatter in an instant, generations of practice, and give rise to entirely new ways of communication based on the power of the new range of wearable communicating devices.

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[1] "Next Generation" definition used in publicity for the conference "The Future Generation: Technical, Social and Legislative Implications of Standardization" 2/3 December 2004, ETSI, Sophia Antipolis, France.

Pervasive networking is a major challenge to the manner in which we communicate. A world wide web of always-on, interacting, communicating devices, storing gathering and broadcasting information freely about who we are, what we are, and our preferences in all areas of our lives, is a staggering concept, but only a few short years away from reality. The complexity will be difficult for even the brightest, and best educated mature adults to handle. What do we do about those less fortunate?

The questions we, as researchers need to ask are :

Will large scale deployment of these technologies reduce the digital divide?
Will such a deployment be more or less of a paradigm shift than was the Internet?
Will there be more or less social disruption as we move to the era of pervasive networking, than we had with mobile phones?

4. Social Implications

To the technologist, or perhaps to the business person, the benefits which would accrue from such a model may look attractive. However, from a social perspective the possible consequences are staggering. In widespread use, a few years from now, ad hoc networking will create an 'always on' type culture, allowing spontaneous communications between large almost randomly selected groups of people. Anyone wearing or carrying a communicating device will become 'logged on' to ad hoc network groups as they go about their daily business.

How will it be possible, in such a world, to exercise the precautionary principle in order to protect the vulnerable, such as children? If we think we have problems controlling the misuse of today's technologies, then the next generation of pervasive, ad hoc internetworking technologies, deployed on a large scale, will have profound implications for social change.

The deployment of modern ICTs has yielded enormous economic benefits. The social consequences have been no less dramatic. If the power and range of modern ICTs are increased dramatically, and these new technologies are deployed on a large scale without any consideration of the social consequences, then nothing will have been learned from the problems encountered in the transition to the Information Society.

5. Socially Inclusive Systems Approach

The lessons from the past are only of use to us if we learn from them. The lessons from the Information Age are stark, but clear. The absence of socially inclusive systems development processes, which provide clear guidance on the social consequences of large scale technological deployment, has led to the Digital Divides we face today. A new social systems model is an essential precursor to the successful design and development of next generation technologies.

Such a systems model for the Next Generation Technologies must have a number of key attributes.

5.1 Social inclusion as the starting point

Firstly, we must start from a socially inclusive systems perspective, not just a technological one. This means that we see the users' needs as the reason we are engaging in design, development and deployment. It is not the technological capability which informs the systems design processes, but the requirements of the people involved. This perhaps means a more limited technological realisation than might be possible. However this is the only way to ensure that the true owners of the system, its users, will get exactly what they want.

5.2 Autonomous system control as the default status

This in turn implies that the Next Generation systems model must come with a range of automatic control features at every level of the system, in order to protect the more naive or more vulnerable users. This is not as simple as providing, say a manual on/off switch on every device. What it means is that the protection of the vulnerable is a system feature. It is in effect, the default status of the entire system. The engagement of features which open up possible communications paths where there is an increased risk to the user is only available on demonstration of competence to handle the issues involved. There must be no way in which to work around these essential features.

5.3 Autonomous feedback control

One of the major features of the Next Generation systems model will be achieving a balance between various feedback loops in the system. Procedures must be in place to rapidly, and autonomously damp out feedback loops which have negative consequences, and to regulate the rate of positive loop feedback, in order to ensure system integrity. One of the most irritating, and socially damaging features of the present system information architecture is that it seems to operate in the reverse mode. For example, currently when a new virus is released, it takes a massive human effort, on a global scale, to stop the damage spreading, and to produce an antidote. Other examples include inadvertent shutdown of telecommunications switches or power stations due to faulty upgrade software. These kinds of problems have massive social consequences. The main reason for these problems is the poor systems design model we have at present, which allows key elements of the system to be used as weapons to destroy or cripple system integrity. The new systems model must act instantaneously to block access to the system by such rogue elements, and to repair any system degradation, which was caused by the initial release.

5.4 Social impact assessment

Since the complexity of the system is so high, it follows that linear standards and regulatory process models may be too inefficient to deal with the rapid pace of technological developments required to maintain progress. However, with an overall socially inclusive systems model, we can be more confident that conformance to the system's information architecture, and adherence to the system's design and operations rules will, of itself, ensure that new systems components do not degrade overall system integrity. Of course it will be essential that all new components are tested exhaustively before being allowed open access to the system.

Such testing must also include a 'social impact assessment', which will be essential for approval of all new technology developments. A useful analogy is the building, or

modification of a house, where, not only must there be comprehensive planning and design of the buildings, but in addition, an environmental impact statement must be provided before the plans are approved, and building can begin. A socially inclusive systems design model for the next generation of communications technologies must include a clear analysis of the social consequences of large scale deployment. A social impact statement must deal not only with the advantages to the user, but also deal with the negative consequences, and show how such consequences will be handled. This means that the responsibility for dealing with social divides caused by deployment of new communications technologies will belong to those who deploy those technologies. This latter requirement is analogous to the current EU policy on, for example, the recycling of obsolete electronic equipment, which is now the responsibility of the electronics manufacturing industry.

5.5 Strategic implementation of social values

Finally, the Next Generation information architecture has to be compatible with our society's overall value set. We value democracy, freedom of information, and effective regulation of markets. We also value an ethical or moral dimension to social interactions, and to the actions of individuals and groups, including organisations, in our society. These aspects must also be preserved in the new socially inclusive systems engineering model.

6. Conclusion

A new socially inclusive model of systems engineering for the Next Generation is the crucial development we need in order to ensure the internetworking of all devices, and the delivery of information regardless of platform, device or location. The short list of features of the next generation of ICTs is but a starting point, to which amny other attributes could be added.

This is the only way to meet the actual requirements of end users, while at the same time providing the necessary control of the system in order to prevent misuse and abuse. It is also the only way to avoid the pitfalls of a new 'Next Generation' social divide.

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