## Robin Mansell
## Knowledge and the internet: the end of control?

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Thank you Vice Chancellor; good evening ladies and gentleman.

Are we facing the end of our own and our governments' capacities to shape the spread of the Internet and its influence on our lives?  Innumerable technologists, academics and policy makers will tell you that we are.  This evening I will convince you that we are not, at least not necessarily.

Information and communication technologies, including the Internet and a multitude of services, are much discussed topics these days.  We hear from the press, the Prime Minister, and many scholars that we, and the next generation, must acquire new skills if we want to participate in something that has come to be called the knowledge-based economy.  There is no consensus about what this term means.  I think probably we could agree, nevertheless, that something is in the air.  Something is happening in our economies that is worth paying attention to.  We also most likely could agree that, like it or not, the new digital technologies are becoming essential for many kinds of highly valued work and they are increasingly highly valued for education, entertainment and a growing number of other applications.  We hear very little, however, about who, with the exception of Microsoft's Bill Gates, can or should control, or influence, our individual and collective future in an economy where these technologies are playing an ever greater role.

Here is a technologist's viewpoint.  Professor Peter Cochrane is Chief Technologist at BT's laboratory in Martelsham.  His view is this, and I quote, 'digital television is exciting, not because the picture is better, but because it is going to be a point of transaction.  Most people

will never *master* the perverted interface of the PC, but they will be able to *control* the television set. Government, however, does not have a hope in hell of controlling any of this. [The digital economy] is devoid of shape, form, edges, and geography'.[1] Professor Cochrane's principal point in this speech was that chaos is the natural mode of organisation.

This is a man who has the ear of politicians in Whitehall and in Brussels. This is one of the self-proclaimed visionaries who occupy prominent posts in private R&D facilities that are devoting millions to designing new technologies and services. Professor Cochrane seems to believe that public intervention and governance in the Information Age is obsolete; it cannot work because innovation is a chaotic process. In his world-view, the major transformations in the economy and society, the new electronic commerce businesses, new public and private information services, and more people working and learning on-line – are best understood as emerging from inevitable and naturally chaotic processes of uncontrolled change.

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What does science and technology policy research indicate about this viewpoint? Our research in SPRU demands that we challenge this argument. I do not contend that we have incontrovertible evidence that Professor Cochrane is wrong. I do suggest that what he says reflects an all too familiar 'habit of thought'. This is the view that technological change and market evolution have a 'natural' course of development. This widely held belief is repudiated, however, by careful observation of the cumulative effects of innovations in technologies and in our institutions of governance, in recent and historical times. Professor Cochrane engages in 'millennial thought'; he holds the view that history, and all the continuities it implies, have ended, or are about to end. If this is so, I prefer evidence over rhetoric. He joins those who believe that economies operate with little or no reference to the legal and political processes in which they are embedded. This too requires evidence. Adam Smith's 'invisible hand' is firmly connected to the laws and conventions that make it possible for markets to operate.

The knowledge-based economy, or as the DTI calls it, the knowledge-driven economy, are labels used to capture a qualitative distinction in the organisation and conduct of modern life. In this kind of economy, the success of enterprises, and of nation states, is believed to rely upon how effective they are in generating and using knowledge. If we adopt Professor Cochrane's view, we need only clear the path for the new technologies and then sit back and

enjoy the ride.

But another 'habit of thought' suggests that we act in a different way. The quality of the emerging economy will depend upon active involvement with, and commitment to, modifying our economic, legal and technological systems. If such changes are to be to our advantage, it is *imperative* that we consider, systematically, how the new digital technologies are interacting with our institutions.

We need innovation, not only in technology, but also in how we comprehend and influence technological change. Rather than facing the 'end of control', we face new and subtle means of control with *ambiguous* implications for our social and economic welfare. Without informed policy action, based on better evidence about these developments, there is a good chance that chaotic outcomes will predominate in our everyday lives. As implausible as it may seem to you, we are engaged collectively in creating the new technological tools. We have far greater power to influence their development than commonly is appreciated.

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To convince you that this is so, my method this evening is to introduce you to what I call the digital wall. I am going to show you that this wall is moving and that this movement raises major issues for policy and for wider concerns about governance. First, however, we do need to identify the digital wall.

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To help me with this I am going to build on a metaphor created by another leading technologist. Dr. John Taylor, formerly Director of Hewlett Packard Labs UK, is now Director General of the Research Councils. Dr. Taylor draws a distinction between the technology systems 'behind the wall' and those 'in front of the wall'.[2]

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The systems in front of the digital wall are the ones we use at work and at home. They are the world wide web browsers, the PC banking services, and the software for word processing, for electronic mail, and for doing sums. We engage with technologies in front of the wall when we connect to networks delivering broadcasts using our televisions and when we connect to one another using our fixed and mobile telephones. It is often argued that these

are all converging towards a virtual 'looking glass' world that some people call 'cyberspace'.

The technologies behind the wall make cyberspace possible. They are built by software developers and technicians who design the new systems. They are being developed by entrepreneurs who are defining the services that are used to gain entry to cyberspace. These systems affect how you can use the technologies in front of the wall, what you need to know in order to use them, and who you must pay for their use. With a few exceptions - mostly young men who like to hack into computer systems and the Internet - the technological system behind the digital wall is not readily understood or subject to control by most users.

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And, in addition, this digital wall is moving. Let me illustrate how.

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Innovations in these technologies are providing a basis for 'appliance to appliance' communication and information exchange. This is a radical change, and it impinges upon our lives in subtle ways. For instance, when we sit in our cars - assuming, of course, we can afford a relatively new car - a cluster of computers elects whether to deploy protective airbags and when to augment our control of the braking system. Tomorrow, our appliances will communicate with one another about our habits, sometimes with our knowledge and sometimes not. It will be necessary to learn how to *modify* the decisions these appliances make on our behalf.

The idea being promoted by many engineers and Internet-based companies is that the technological system in front, and behind the wall is *neutral* with respect to our social experiences and economic prospects. As users, all we need to be concerned about is our capacity to select which appliances we want to use to interact with government, to be entertained and to learn, and to achieve gains in productivity for firms. From this standpoint, we need not be concerned about the systems behind the digital wall which we use to access cyberspace. Nor do we need to be concerned about the consequences of the fact that the digital wall is moving. It is moving because the systems behind the wall are making a substantially greater number of decisions on our behalf.

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Should we leave what goes on behind this wall to the technologists? Even if we understand that the choices about what goes on behind this wall matter in our lives, how can we influence them? Most of us will never be in a position to second guess the computerised

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choices that are being made on our behalf. Nor could we, in any meaningful sense, vote on the options even if we had the opportunity.

What is my argument then? It is that we can exercise some control over these choices by shaping the institutions that govern the deployment and use of the new technologies. Rather than accepting that technological change is neutral, we should expect that it is not. We need to investigate how it favours specific outcomes that perpetuate historical patterns of economic growth and social development, and, of course, how it favours departures. Precisely because of the scope and uneven spread of the new technologies, these outcomes are more important than is knowing what our appliances are saying about us behind our backs. These outcomes influence who we communicate with. They influence how we select and value information. They affect whether we can turn information into productive knowledge. These outcomes are increasingly setting the terms under which you, and your children, access education resources, health information, or earn a livelihood. They are affecting our hopes for the future and they are determining who owns the machinery for wealth generation in this century.

You may be thinking that exercising control over these outcomes must involve a kind of expertise that only a very few of us can ever achieve. My experience suggests otherwise, however. There always have been people who devote themselves to understanding what goes on both in front and behind my metaphorical digital wall. It is possible to translate this understanding into clear policy options and issues for debate. I have not always believed that this is so. Let me explain how I arrived at this view by reflecting for a few moments on my own intellectual trajectory. After that we will return to our discussion about the digital wall.

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My career has been characterised - those of you who know me well may say over-determined - by a persistence of interest, a stubborn singularity of focus, and a fascination with innovations in information and communication technologies. I was introduced to these technologies by a telecommunication engineer. In his retirement, one of his missions was to impart to me his knowledge about technical specifications, about how and why some technologies and services had been invented and then forgotten, and why others had found favour with suppliers and users. Richard Gabel is no ordinary engineer. He is extremely well-versed in the politics and economics of the North American communication systems

which he helped to build. I did not know in the 1970s, that the cables that we climbed into muddy trenches to touch, the wires and microwave towers, and digital information would come to be acknowledged as such a significant foundation for our economies.

Canadians like myself find it easy to accept that information and communication systems are pivotal to our social and economic lives. This notion is deeply embedded in our cultures, our geography, our intellectual traditions which focus on the importance of space, time and the media,[3] and much of our experience of nation building. Before my arrival on the academic scene, Marshall McLuhan, another Canadian, had claimed that 'electronic interdependence recreates the world in the image of a global village',[4] a phrase many of you may have heard. Vigorous debate about this rhetorical assertion created a formative intellectual environment for me. But my curiosity about the relationship between technological change, institutions of governance, and people's lives was irrevocably provoked by three other people.

Hilda Himmelweit was Professor of Social Psychology at the London School of Economics. She was the first to conduct empirical studies of social practices and perceptions of the media after television was introduced in Britain.[5] She emphasised, always, the importance of rigorous empirical research. She was fascinated by how media use was being accompanied by the formation of new social relationships and new kinds of active engagement. She was also, incidentally, the first woman academic whom I encountered as my own lecturer. When I studied for my degree at the LSE in the mid-1970s, Hilda was also interested in institutions of governance and how regulations influence the way new technologies develop. Around this time too, I read some of Chris Freeman's work and that of several others in SPRU.[6] When I was returning to Canada, Hilda insisted that I track down two people she had encountered. Both, she said, were economists, but she suggested I ignore this fault and pursue my studies with them anyway.

And so I did. One was a Canadian political economist. Dallas Smythe dedicated his life to a combination of scholarly work and political activism.[7] The other was William Melody who was immersed in research on the economics of the information and communication industry and the role of regulation.[8] He had a Machiavellian belief in the power of social science research as a foundation for policy change - more than 20 years on I think he continues to believe this. Both argued, in their different ways, that the power relationships that permeate the economy and the design and use of technologies affect our economies and social worlds

in crucial ways.  Both held that technological systems are not neutral. The principal questions for students of scientific and technological change must therefore be about asymmetries in economic and political relationships and institutional structures, and about how these asymmetries of power may be reduced or exacerbated through the use of the new technologies.

I had begun my studies in cognitive and clinical psychology. Imagine the shock waves to my intellectual system.  I had first jumped across what I thought was a very wide chasm into social psychology.   Now here I was, confronted by two economists who argued that institutional structure and power relationships were all there was!!  Where were the people in their analysis?  Where were their hopes, their fears, and their capacities for action?  Initially, I could see no common cause.  But I did have a hunch.  If the disciplinary walls between social theory, economics and engineering could be breached, we might produce a better analysis of how changes in technologies, institutions of governance and the economy, affect human welfare.   And so I suggest to you that interdisciplinary training and research offer one important means of breaching the wall between our in front of the wall digital appliances and the behind the wall systems.  This is a formidable task and it is becoming more difficult as these technologies mature and become more complicated.  But it is worth the effort.  This kind of interdisciplinary research yields insights into policy options and actions that help us to imagine new ways of governing technological change.  It also helps us to see how we may come to be in a stronger position to modify the way the new digital technologies and information affect our lives.

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Now let me return to my digital wall.  How do we go about breaching this wall?  Secondly, are there some breaches that it is particularly important to widen?  There are, and I am going to talk about three of these.  Finally, I am going to illustrate some of the implications of all this for policy and governance.

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First, what is involved in breaching the digital wall?  Attempts to breach the wall between the technology designers and the users of the new digital appliances encounter an emotional battleground.   In front of the wall, the emotions of fear, scepticism and loathing fuel a dystopian vision.   Believers in this vision cite evidence of system breakdowns such as

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software crashes that shut down airports, delay product shipments, and cause the London emergency services to go into grid-lock. They will offer you visions of 'out of control' global financial systems and intrusive surveillance of people at work and on the motorway. They will raise alarms about the growth of personal isolation produced by hours of working with a PC and concerns about the way the media fans the fires of ethnic terrorism. Supporters of this view may argue that people are disempowered by the new technologies or they may say that these outcomes arise from stupidity, avarice, or fanaticism. They worry about growing information poverty and information overload, and increasing divides between those who are affected in this way, and a smaller number of others who for one reason or another are not. They fear that the new digital technologies are too powerful for the ordinary user.

Another view is utopian, or at least allows that the new technological tools can be used to benefit, perhaps not everyone, but certainly a growing number of people. Instead of systems breakdowns, proponents of this view will tell you about globally dispersed production facilities creating employment for people in industrialised countries and the entrepreneurial corners of developing countries. They will produce evidence of streamlined supply chains and major reductions in the costs of services and manufactured goods. They will show you opportunities for greater inclusion of the poor through distance learning and improved health care delivered using telecommunication networks. They will demonstrate how information technologies are being used to monitor pollution and to help speed up responses to natural disasters and to other forms of human suffering. They forecast big breakthroughs such as the ability to simulate the entire biosphere, in short, to compute the 'uncomputable', thereby providing a stronger evidence base for policies aimed at, for instance, maintaining biodiversity.[9]

These beliefs are shared by optimists located behind and in front of the digital wall. Some have even greater hopes for the future as people band together to form what we call 'virtual communities'. They expect that the 'virtual' will become indistinguishable from the 'real'. They foresee that many people's needs for caring relationships will be met in the electronic Chat Rooms and through intimate email exchanges.

These two viewpoints - the dystopian and the utopian - co-exist today just as they have for centuries. Breaching the digital wall does not require that we resolve the controversies between those who hold markedly different beliefs about the new technologies. It does

require that we observe the developments in technologies and in our capabilities for governing and using them.

Breaching the digital wall means inquiring into the important connections between what goes on behind the wall and in front of it.  This is essential if we want to maximise the positive outcomes of technology development and use.  Proponents of the chaotic systems habit of thought which I described earlier will claim that no government can, or should, attempt to fiddle with the course of technological development.  They will deny that there are any particular directions or biases worth thinking about as a result of the connections between what goes on behind the wall and the world in front of it.

I contend that we can breach the wall and act upon what we learn about the significance of our interactions between the in front and behind the wall information and communication systems. As researchers, we have the opportunity to set ourselves the task of widening the breaches and ensuring that the results of our work contribute to a more pervasive habit of thought.  We must presume that technological change involves an examination of alternatives and that governance regimes are influencing the path of technology development.

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What breaches in the digital wall are worth widening?

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The first is an existing breach.  It involves building a 'digital culture'.  It is based on the cultural wellsprings that nourish developments on both sides of the wall.  The second is an emerging breach.  It involves the members of virtual communities who are reproducing and extending important social networks.  The third is an embryonic breach.  This one involves developing new forms of regulation and governance to support the 'electronic' high streets and workplaces where people will shop and labour in the coming years.

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First, building a digital culture.  Is there a digital culture and, if there is, where does it come from?  Those of us over the age of 40 will remember the Atomic Age where dreams of electrical power, too cheap to meter, alternated with the nightmare of nuclear annihilation. Atomic Age technologies were contained in vast sealed facilities tended by acolytes behind the wall.  A breach in this wall occurred when Three Mile Island and Chernobyl showed that the dream could become a nightmare.  To many it appeared that another of the Atomic Age

technologies, the computer, might follow a similar path. A sombre prospect in view of the thousands of nuclear weapons whose launch is controlled by computer systems. This threat has not disappeared, but the personal computer, a child of the 70s, has proven to be subject to domestication.[10]

The personal computer liberated the technology, transforming it into the information appliances in front of the wall that Dr. Taylor now talks about. The Atomic Age visions of centralised control and power gave way to dreams of stardom in cyberspace. Andy Warhol's premise that everyone can be 'famous for 15 minutes' has become the aspiration of many young men and a very few young women. Sherry Turkle and other analysts of digital culture have observed that the fascination with control and power that computers provide is particularly seductive to young men who have little chance of following the career path of Mick Jagger, for instance. [11] Michael Benedikt, president of an American software design company, suggests that 'cyberspace is the electronic equivalent of the imagined spiritual realms of religion'.[12] David Noble, an historian of technology, thinks that enthusiasm for the Internet and virtual experiences may fulfil a need 'to dwell empowered or enlightened on other, mythic, planes'.[13] How do we build a digital culture that is not as polarised as this?

In this country, women's participation in higher education courses on computer technology and engineering has collapsed just as their average performance in A level subjects has begun to outstrip that of their male counterparts. This is cause for action. But breaching this wall, which influences how a digital culture is formed, requires probing analysis of the social authenticity of the digital culture that is being constructed. What is needed for little girls and young women to aspire to a place at the control consoles behind the technology wall?

We can take a lesson here from Martin Buber, the philosopher, theologian and psychologist who observed that 'in the beginning is the relation[ship]'.[14] He was interested in how our experiences and culture are mediated by 'dialogue'. Participants in dialogues - even those mediated by services like electronic mail - establish relationships between themselves. There is research that looks at these changing relationships which motivate working and playing in virtual places and at how these are modified through interaction with behind the wall and in front of the wall technology systems.[15] To understand why women and some other social groups are largely absent from these dialogues we need to question the designs of human-machine interfaces and the cognitive tools that systems designers assume exist for

using them. The Internet's design, both behind and in front of the wall, is influencing which relationships we choose to develop socially and for commercial gain, whether these relationships are satisfying or turbulent, and how they fit into the rest of our daily activities. Any substantial effort to redress the imbalances in the emerging digital culture will require much more penetrating research than has been produced thus far. Redress will involve promoting the heroines, as well as the heroes of digital culture, and it will mean fostering ever-broader participation in that culture. This will require a focus on two areas that are important in expanding this breach in the digital wall.

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The first is *capabilities*. The absence of appropriate capabilities and skills makes us passive consumers of technologies. We should be asking our schools and our governments what they are doing to promote the acquisition of capabilities to build a more equitable digital culture in the future. So far, much of what we hear is empty rhetoric. The second is *diversity*. Diversity is not only about reducing gender inequalities that stem from our collective failure to find ways of encouraging broader participation in cyberspace. It is also about identifying problems and taking action to alleviate those types of social exclusion that can be compounded by certain developments in technologies for generating information and facilitating communication. Some of the new applications, appliances and systems exclude through their very design. Issues involving capabilities and diversity are crucial because they are tightly interwoven with new divides between the 'haves' and 'have-nots' of this world.

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We must redress the dearth of appropriate capabilities and skills as well as the biases in technological design which exclude. To do this, we must take action that will widen a second breach in the digital wall. This can be achieved by building virtual community activities that are not exclusively oriented towards commercial gain. People who are engaged in activities behind the wall form their own virtual communities. Virtual communities attract people with common interests who engage in voluntary association using the Internet and other technologies. These include the hacker culture, the open software movement, and a vast social network that reinforces their control of change. These members of communities are distributing messages, sharing their knowledge, and offering mutual support and co-operation for scientific and other purposes. These activities have great value for a vast spectrum of other social and economic activities. We need a much better understanding of how these

communities can be initiated, nurtured, and extended. This will require that we rethink how individual contributions to knowledge are valued. For instance, in scientific research we need to give credit to those who produce information *and* to those who distribute it. We need to develop new public information resources that foster better research. In the education field, for example, we need to value those who create and those who distribute the information for distance education.

If we can increase our successes in these areas, we will create constituencies of people with political interests and the capabilities to engage in a dialogue with those behind the digital wall. By encouraging the members of these virtual communities, each with their own needs and uses of the new technologies, we will be widening this emerging breach in the wall. We will have opportunities for building a foundation for increasing the variety of ways of valuing those who produce new information and knowledge, beyond those which focus only on commodities and profit.

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Let me turn to the third embryonic way of breaching the wall, new forms of regulation and governance. We need to examine what kinds of governance are needed to promote the acquisition of new capabilities, and to induce the degree of technological diversity that may help to forge a more cohesive world order. Such governance may be in the form of government legislation and regulation or industry self-regulation.

MIT's *Technology Review* proclaims that 'thanks to databases and the Internet, the ability to share immense amounts of data has grown rapidly … cutting edge collaborations bring with them new features: … the involvement of a broad geographical mix that includes participants from developing countries'.[16] But the situation looks rather different from Africa. Participants in a recent UN Africa Development Forum suggested, in contrast, that competition will prevail over co-operation and information sharing as the Internet becomes more widely accessible.[17] A European Commission report confirms this view on the basis of empirical evidence. And I quote, 'hardly any laboratory in the developing world has Web access to the important databases, which means that scientists working in these laboratories can never be equal partners in the world-wide enterprise of knowledge production'.[18] Asymmetries between the knowledge bases in many African countries and the wealthy countries will not decrease unless steps are taken to ease the costs of access and to build new

capabilities for participating in cyberspace.

Asymmetries in information access and sharing are not confined to the developing countries. The growth of networking using the Internet is one factor among many that are contributing to recognition of the interdependence of the components of the global economy. Our regulations and governance systems establish a context for the design of the systems behind and in front of the wall, and for the way they interact. These interactions can give rise to many kinds of asymmetrical outcomes in the distribution of the benefits of the new technological tools.

For example, current legislation encourages the efforts of Internet Service Providers to develop new technological means of collecting royalties for distributing or using scientific information, often funded by the public purse; it provides far fewer incentives for innovative communities who seek to share their information as 'gifts'. Current legislation seeks to protect digital information about you and your personal life, but it does not address what the computerised systems behind the wall are able to do with information that may jeopardise your privacy and which does not name you specifically. The interactions behind and in front of the digital wall may protect the commercial security of information, yet computer hackers get through to attack public information services, banks and national security services.

Explicit regulatory decisions and governance institutions are needed to enable the electronic high streets and workplaces to operate in ways that promote information sharing as well as commercial gain and competition, and in ways that protect individual privacy as well as permitting acceptable uses of digital information for profit and for national security. By pursuing a habit of thought that presumes the interactions of technologies and legislation are not neutral in their effects, we encourage investigations of important issues. For example, we are encouraged to examine how the determination of technical standards to achieve compatibility between different networks affects the information that you may access. It encourages us to assess how continuing efforts to strengthen the enforcement of intellectual property rights in digital information creates disincentives for cultural exchanges and the sharing of scientific and technical information.

In the commercial realm of electronic commerce and in the face of the furious pace of growth of *.com* companies, we also need to examine how the legislative environment influences the

structure of the market and its players. Probing into how commercial trading regulations affect the flows of capital that give rise to the new companies and their services yields insights into their motivations for developments behind the wall.

For example, the fact that the technological system behind the wall rests in the hands of AOL-Time Warner, a company that has been inundating us with adverts recently to join millions of Internet users, is not an issue for those who pursue the chaotic systems habit of thought. After all, as another contributor to MIT's *Technology Review* argues, the Internet is a global, open system that anyone can access if they have the proper hardware, software and a minimum level of skill. In front of the wall we can order books, music, insurance or travel tickets without leaving our offices or homes. But a behind the wall investigation reveals that this is not the complete story.

Corporate interests in open systems can change when the financial markets and the regulatory environments are conducive. Before the recent AOL-Time Warner merger, AOL was a very strong advocate of government intervention to maintain open access to the Internet. It wanted the US government to force the owners of cable and telecommunication networks to open them so that AOL could access their customers. AOL said policies and regulations were needed to ensure open access to the networks behind the wall. Immediately after the merger, the new company said that government intervention is wrong. The chaos of the 'free' market should dictate who can access the new Information Age networks. What changed? The merged company now has a dominant share of the cable television subscribers in the United States. It now wants to ensure that no competitor disrupts its access to all these customers.[19] The rhetoric of free markets and the jargon about the natural evolution of Internet services are being used to advance very specific financial interests with a goal of reducing variety, not of extending the options available to us.[20]

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Developments in these areas are all outcomes of public or private sector deliberations and dialogues. These dialogues and their outcomes result in selections from competing technological systems. When we acknowledge this, we can work at understanding how the accumulation of these choices affects what we can do in front of the digital wall. We can work on comprehending what interests are enabling the behind the wall systems to function in ways that are more or less beneficial to us. This habit of thought is consistent with widening the embryonic breach in the digital wall. The results of investigations of the

developments I have touched upon enable us to imagine new forms of governance that are consistent with encouraging new capabilities and diversity in our experience of the new dimensions of cyberspace.

The claims of the visionaries, the optimists and the pessimists, need to be investigated. We can widen these breaches in the digital wall - by building a digital culture, by encouraging the members of virtual communities, and by providing a better understanding of the interactions between technological innovation and our governance system. It is by widening these breaches that we will create a basis for dialogue between those people who are operating behind the digital wall and those of us who are affected by their choices. Policy action is needed to broaden participation in that dialogue. This can be achieved by encouraging new capabilities and by embracing diversity in our schools and other social institutions. It can be achieved by creating stronger incentives for generating variety and higher levels of competence in virtual communities. And it may be accomplished by developing a better evidence base for considering how regulation and governance interacts with technological change. Failure to meet these opportunities for breaching the digital wall means resigning our future to chance, and perhaps to chaos.

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Now to conclude. Heidegger wrote about 'unconcealment' as the process of deepest inqury.[21] Deep inquiry is needed if we are to 'unconceal' the choices and interests that are contributing to the shape of the technological system behind and in front of the wall. A principal aim of policy-relevant social science is to illuminate that which may be obscured by common habits of thought. A dialogue between the sceptics and enthusiasts of the Information Age is essential. Without a dialogue that 'unconceals', some people will receive extraordinary benefits from the development of the new information and communication technologies. They will feel comfortable with, and even welcome, the changes that these technologies bring to their lives. Other people will be excluded. For some this will be due to temperament, belief, or simply preference. But others will be excluded because of economic and social inequalities that will not be resolved simply by assuming that the trajectory of change is neutral and chaotic.

Widening the breaches in the wall calls for each of us to ask questions about our participation in the Information Age. Do I feel included in some part of the digital culture and am I

acquiring capabilities that will support my inclusion? How can I benefit, and see that others benefit, from participating in and supporting one or more virtual communities? Do I understand that public decisions are affecting whether I can modify the information appliances and behind the wall systems that are changing my life and the lives of future generations?

I hope I have convinced you that it is possible to mould the emerging knowledge-based societies. I hope I have not made you think that science and technology policy research is simply about breaching the real walls that you have been watching on the screen - behind me [the lecture was accompanied by a montage of images representing breaches in the wall]. Widening some of these breaches will require specialised capabilities and skills that only a very few of us will acquire. But building digital cultures, supporting virtual communities, and creating incentives for public, as well as for commercial, endeavour in cyberspace is a very much more inclusive agenda.

Thank you!

## Notes

1    Cochrane, P (1999) 'If you turn your back for a moment, you're dead', *Information Technology and Public Policy*, Vol. 18, No. 1, p. 227 based on a speech at a conference on the digital economy in 1999. Professor Cochrane holds the Collier Chair of Public Understanding of Science and Technology at the University of Bristol.

2    Inaugural Presidents Address, 'Engineering the Information Age', Institution of Electrical Engineers, Savoy Place, London, 1 October 1998. Dr. Taylor defined 'behind the wall' systems as information utilities and entrepreneurs, and 'in front of the wall' systems as information appliances and individuals.

3    See the work of Canadian economic historian, Professor Harold Innis, Innis, H. A. (1950) *Empire and Communication*, Toronto: Oxford University Press; Innis, H. A. (1951) *The Bias of Communication*, Toronto: University of Toronto Press.

4    McLuhan, H. M. (1962) *The Gutenberg Galaxy: The Making of Typographic Man*, University of Toronto Press, p. 31.

5    See for example Harper, D., Monro, J. and Himmelweit, H. T. (1974) 'Social and Personality Factors Associated with Childrens' Tastes in Television Viewing: Summary of Study', London: Pamphlet Collection; Himmelweit, H. T., Oppenheim, A. N. and Vince, P. (1958) *Television and the Child: An Empirical Study of the Effect of Television on the Young*, Oxford: For the Nuffield Foundation by Oxford University Press.

6    Chris Freeman's *Economics of Industrial Innovation*, First Edition was published in 1974 by Penguin. For the most recent edition, see, Freeman, C. and Soete, L. (1997) *The Economics of Industrial Innovation*, Third Edition, London and Washington: Pinter A Cassel Imprint. By the time my studies at the LSE were completed, *Progress and Problems in Social Forecasting: Disciplinary Contributions to an Interdisciplinary Task*, edited by Chris Freeman, Marie Jahoda and Ian Miles had been published in 1976.

7    See for example, Smythe, D. W. (1957) *The Structure and Policy of Electronic Communications*, Chicago: University of Illinois Bulletin; Smythe, D. W. (1977) 'Communications: Blindspot of Western Marxism', *Canadian Journal of Political and Social Theory*, 1(3): 1-27; Smythe, D. W. (1981) *Dependency Road: Communications, Capitalism, Consciousness and Canada*, Norwood NJ: Ablex.

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