Public Dimension of Technological Change: Impact on the Media, the Citizenry, and Governments—A U.S. Perspective, The

Christopher T. Hill

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I want to talk about the relationship of technology to society and about how society uses government to try to influence technology in both positive and negative ways. My background for this presentation includes my training as an engineer combined with twenty-eight years of involvement in the technology and science policy-making apparatus, both as an academic and as a government official. I have had titles for the last fifteen years with the words “technology policy” in them. Twenty years ago, no one would have had a job title containing the words “technology policy.” It was not a category that we really recognized. We saw technology policy as emerging out of science policy, economic policy, and national security policy, all of which had concerns with technology. But now technology policy has become important enough that there are U.S. congressional committees with “technology policy” in their names. Why is this? I think it is because the invention, development, use, and application of technology is extremely important in our society.

In some sense, technology is the quintessential human activity. Humanity’s ability to craft tools is an important aspect of what distinguishes us from the cows, pigs, cockroaches, and the rest. We are able to think, abstract, and use tools to shape our environment. When we talk about technology in the broadest sense, that is what we are talking about. In more practical terms, technology is the products, processes, devices, systems, and networks that we use to help us individually and collectively pursue our goals and our dreams.

Society enjoys many benefits from new technology and its applications. We develop new technology because it enables us to do things we could not do before, such as engaging in discussion with each other in real time at long distance. Before about 1850, that could only be done by means of mirrors, flashing lights, or waving flags. We do not do semaphore anymore – instead we do HTML and Java. We also develop new technology because it enables

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** Dr. Hill is Vice Provost for Research and Professor of Public Policy and Technology at George Mason University. He holds a B.S. degree from the Illinois Institute of Technology, and M.S. and Ph.D. degrees from the University of Wisconsin, all in chemical engineering.
us to do things we could already do, but at a lower cost, with higher quality, or with higher productivity. For example, we use much less energy now than we might have used a century ago to move things around, to produce things, to heat our food, or to make steel. We get much greater crop yields from an acre of land than we did in the old days.

In the aggregate, we know improvements in technology are important to our society and our economies. It has been estimated by economists, using a variety of methods, that fifty to seventy percent of economic growth in the industrialized economies in the twentieth century derives from the use of new technologies. Technology is central to our national security posture. It made it possible for us to conduct the recent Kosovo operation as we did.

As a society, we use public policy to enhance the benefits that may flow from new technology. For example, we subsidize research and development directed at new and better technology; we invest in the education and training of technical experts; we develop systems of standards to facilitate commerce in new technologies; and we seek to remove barriers to the use of new technology. These kinds of actions are the focus of what I call “developmental” technology policy. At the same time, society also uses public policy to control the consequences of the use of new technology. For, even as technology enables us to do things better, it poses new challenges of scale, scope, and impact to societies. For example, because it is now so easy and inexpensive to drive large cars, live in large homes, and consume energy for all sorts of purposes, our per capita consumption of energy is much higher than it was in earlier times, even though each particular use of energy is a lot more efficient than it might have been a century ago. I call society’s efforts to restrain and guide the use of new technology or to control its side effects “managerial” technology policy. Because technology is such a powerful force in society, it tends to drive demands for its public management. Let me illustrate.

Public health and medical technologies have enabled many more of us to survive our childhood and live to old age. This has resulted in an explosive growth in human population during the past century and has brought a host of new demands on the natural environment that sustains us here on Earth, as well as more prosaic things like the ever-growing costs of health care for the elderly. Many of the most important consequences for society of the development and use of new technologies are not foreseen by anyone at the time financial investments and other social commitments are made to use the technology to solve problems or improve productivity. Furthermore, many of the costs of technological applications are not borne by those who promote and benefit from their use. This leads to divisions in society between those who enjoy the benefits of new technology and those who bear its cost.
But more important than the consequences of the use of new technology and its direct costs and benefits, and more important than its distributional impacts on different groups, are the effects of new technology on core human values and norms of society. When new technology makes it possible to solve a problem that we used to think resulted from the working of God's will, it can upset long-established values. For example, early improvements in public health and medicine a century ago greatly enhanced the probability that a newborn child could survive into adulthood. I believe this had a lot to do with how we view children. It engendered the child labor statutes, and it caused us to be in a position where, as a society, we now will go to almost any length to save the life and health of a child. We might not have done that a century ago because we would not have attached ourselves to a child whose life was ephemeral. Today, we expect all children to survive, and we attach great value to their survival from the beginning. I believe that this new reverence for children's survival drives the abortion debate as well.

Closer to home, the widespread availability of the highly diverse, and sometimes objectionable, content on the Internet threatens a host of traditional values and attitudes held by many different groups in society who would like to bring Internet content under control.

In analyzing the place of values in society, philosophers distinguish between utilitarian perspectives, in which the right thing to do is determined by costs and benefits, and a more fundamental perspective, in which there are things that are not legitimately traded in the marketplace and not legitimately attached to monetary costs and benefits, like human life. In America, you cannot sell your kidney. It is not a question of the price, it is a question of fundamental values. Yet new technology can, over time, cause major shifts in our attachment to fundamental values. Once new medical technology creates a stronger probability that you can survive organ donation without severe complications, I expect it will become perfectly fine to sell organs.

I expect that privacy, about which there is so much debate today in connection with electronic communication and the Internet, will slowly fade away as a value. We all can know more and more about each other. And the value to us of the technological system that enables that to happen will transcend our concern for our privacy. I expect that, in fifty years, folks in a room like this will think it quaint that we in 1999 worried so much about privacy.

Here are some of the things that the federal government does to encourage new technology using a wide variety of public policies. For instance, we give tax preferences for technology development – businesses can deduct the
expenses of research and development in the year they are incurred.\(^1\) In addition, we offer a tax credit for incremental expenditures on research and experimentation above the average of the prior three years.\(^2\)

We offer direct financial subsidies, like the Small Business Innovation Research Program (SBIR), which is a program run by eleven or twelve federal agencies. It spends almost two billion dollars a year of federal money in providing what amounts to seed capital to small firms to develop new technologies.\(^3\) SBIR is much bigger than some of the highly controversial and politicized programs, such as the Advanced Technology Program in the Department of Commerce.\(^4\) We provide services to industry through government, such as the Manufacturing Extension Partnership Program, which has more than 200 centers around the United States that provide technical and business assistance to small and medium-sized firms.\(^5\)

A number of policies affect the rules of the game under which new technologies are developed. Prominent among these is the National Cooperative Research Act of 1984, which provides a safe haven in the antitrust laws for firms that wish to do research and development together— if they were willing to register with the Justice Department and the Federal Trade Commission.\(^6\)

The Federal Technology Transfer Act of 1986 changed the rules under which companies and government laboratories can collaborate. Companies can use the technology developed in the laboratory for private commercial

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\(^1\) See I.R.C. § 174 (b)(1) (C) (1994).


purposes. The Act provides assurance to the companies involved that their own intellectual property will be protected during that kind of an arrangement. 7

Much of the justification for public funding of research and development, for university education, and for government labs stems from the expectation that the new knowledge generated will find its way into practical application to meet economic, national security, environmental, and other national objectives. These are only a few of the things we do.

How much technology policy of this kind is enough? How do we know what to do? Economists analyze what is appropriate for government to do based on the theory of market failure, which argues that free markets left to themselves under-invest in new knowledge and new technologies, owing to spillover benefits for those who do not pay and to inadequately developed intellectual property rights, even with the patent system. While this theory creates a rationale for government investment in new technology, it can also be turned around to create arguments that limit the extent of government investment. It has been my experience in Washington, that those arguments are most persuasive in academic seminars and think tank meetings, but they are never terribly important to congressional and presidential consideration of policy. Instead, technology policy is more practically focused on trying to get things done that political leaders and their constituencies view as important. For example, the United States invested 100 million dollars a year for seven years in SEMATECH to help strengthen the U.S. semiconductor industry. Many would say that investment could not pass an economic test, but it certainly passed the political test with flying colors.

Soon after Bill Clinton took office in 1993, technology policy for the first time became an active tool in political debates. In 1993, the new President endorsed a number of previously low-profile technology policy programs, thus making them high-profile. When they became high-profile, Newt Gingrich, then the Speaker of the House, and a strong supporter of science and technology, attacked them, and there was a big fight over technology programs. That had never happened before to technology policy, and most of us who worked in it did not know how to deal with politics intruding into our little neighborhood.

In policy-making terms, I would argue that what drives public policy toward technology is the leaders of the scientific and technical communities in academia, industry, and government laboratories can make compelling arguments for why a nation simply must invest in fiber-optics, cancer research, space, high-energy physics, and so on. Those arguments almost always take

place independent of any consideration of economic benefits and costs, at least as economists would understand them.

Federal incentives for technology development are widely supported politically when they address a clearly identified public mission, like national security, space investigation, or solving health and environmental problems. But the public and political leaders are less supportive of such programs when they are simply intended to help the marketplace work better. We have not come to a societal consensus that there is a legitimate government role in developing new technology when the end point is a private good. We are very ambivalent about this. At the same time, there can be a lot of support when a technology offers to meet public and private missions simultaneously. A wonderful example is the Internet.

The Internet was developed by the Defense Advanced Research Projects Agency (DARPA) and the National Science Foundation (NSF). DARPA supported it early as a method for ensuring communication among military installations around the world in the event of substantial disruption of communication networks. NSF took over when the objective shifted to supporting access to high-speed digital communication for academic research and education. When the Internet became a commercial enterprise around 1995, it was a very controversial action. The "dot com"s came a long time after the "dot edu"s as legitimate users of the Internet. But, suddenly we have discovered that incredible things can come out of a mixed motivation for government involvement in the support of new technology.

Let me turn to managerial technology policy. We have a whole set of federal policies to manage and mitigate the undesirable consequences of new technology. I would identify three broad policy domains: 1) programs to gather and analyze information about the effects of new technology; 2) programs to manage and mitigate those effects; and 3) efforts to block the use of new technologies altogether.

Let me turn first to the blocking efforts. There are efforts from time to time to block the use of a new technology because somebody does not like what it does. For example, we have prohibited research on therapeutic uses of marijuana.8 We have forbidden the use of government funds to support research on fetal tissue for the improvement of the human nervous system.9

8 Rep. Barney Frank (D-MA) has proposed legislation in each of the past three Congresses to legalize the medical use of marijuana, but each bill has died in committee. See H.R. 2618, 104th Cong. (1995); H.R. 1782, 105th Cong. (1997); H.R. 912, 106th Cong. (1999).

Some years ago, objections were raised in California when the state was using state money to support research to improve tomato harvesters, because it threatened to put a lot of people who picked tomatoes out of work. There have also been proposals to ban the use of metal cans for beer and soft drinks. The chemical industry got really shaken quite deeply a few years ago when serious proposals were made by environmental groups to ban the use of chlorine-containing chemicals of all kinds.

Let me turn to the gathering and analysis of information. In 1972, Congress passed the Technology Assessment Act that created the Office of Technology Assessment (OTA) to do studies of the effects of new technology on society. The OTA existed for more than twenty years and was closed in early 1995. During that time it did more than 700 studies. You can buy all the OTA studies on CDs for about twenty-four dollars. Its demise in 1995, which was politically driven, came just as the need for a relatively objective source of data collection and analysis about the Internet became a top priority for the country. I believe the OTA would have been the host for important national debates about Internet taxation, content controls, privacy, security, international harmonization, domain name assignments, new technology investments, access rules, and so on.

To manage the effects of new technology, we usually turn to regulation. We sometimes use tax incentives to encourage the use of new technology in more acceptable ways, but usually we fall back on some form of direct regulation. The explosive growth of federal government regulation during the Progressive era, during the New Deal, and during the 1960s and 1970s was a direct consequence of the desire of society to manage the effects of new waves of technology. These effects included the monopoly power that flowed from the technology-facilitated growth of large corporations in the last part of the nineteenth century, leading to the Progressive era. Similarly, the imbalance of power between employers and employees in mass production enterprises led to a lot of the New Deal social regulation. The environmental risks and other risks that arose from the widespread use of advanced technologies in the mid-twentieth century led to the air pollution, water pollution, products safety, and other regulations of that period. In each case, public policies were adopted with the intent of causing the beneficiaries of new technologies to change their behaviors and/or redesign their technologies to

reduce or eliminate the harmful effects they would have on consumers in society.

American society believes strongly in the efficacy of research and technology development to solve our problems. So, when we regulate technology we turn to that same optimism. The policy process is firmly convinced that industry, if given the right set of incentives or constraints, can always find a way to meet a demand that society imposes on it. So, the policy process is quite comfortable with technology forcing regulations precisely because industry has shown itself over and over again to be able to meet new markets and new demands. New public policy is just another change in the market in which firms operate.

I would like to close with a couple of comments on technology policy for the Internet world. Despite its relative youth, the Internet has already demonstrated enormous capability to influence our lives for the better. We have only scratched the surface of its potential benefits in education, health care, government, politics, the economy, entertainment, cultural enrichment, communications, and so on. We recognize that the underlying technologies still offer potential orders of magnitude of further improvement in quality, in speed, in complexity, and in service. The future seems almost limitless, and things move more rapidly every day.

At the same time, it has become clear, often embarrassingly so, that the Internet also offers unlimited possibilities to do mischief and to challenge hallowed values. Since anyone with a personal computer and a modem can publish for the whole world, the Internet opens us to a barrage of communication, some pornographic, violent, or subversive, and otherwise disturbing. Many of these messages are unsuitable for the millions of children who “surf” the Internet every day, and who do it a lot more effectively than most adults. Our growing dependence on the Internet as a medium for communication and commerce has already made us deeply vulnerable to those who would disrupt or corrupt its operations, whether for fun, out of spite, for personal gain, or to serve the interest of foreign powers.

To a considerable extent, there is very little qualitatively new about the technology policies we need to develop the Internet or to manage it. Existing concepts of the role of government vis-à-vis the market, of the constitutional separation of powers among the branches and levels of government, and about the appropriateness of cost-benefit balancing for most public policy issues seem sufficient. Similarly, the constitutional concepts of free speech, privacy, and private property, including intellectual property, are sufficient as a framework within which to address the Internet’s undesirable effects.

On the other hand, the quantitative scope and scale of the problems created by the Internet make me wonder whether current institutions are up to
the task. The scale and scope of its reach into every home, institution, and business has created a plethora of very specific and difficult issues to be addressed. Current laws, regulatory frameworks, and government institutional structures may need to be revised or augmented. For example, states have struggled for years to collect taxes from those who mail order from out-of-state, thereby avoiding local taxation. It has not really mattered much because mail order has not been all that important to states’ economies. But Internet commerce threatens to take a very substantial proportion of retail sales out of the hands of local merchants, where they can be taxed, and put them into the hands of distant mail order houses, where they cannot effectively be taxed as of yet. It is no wonder that the states want to find new ways to tax the Internet. The Congress has established a national commission to take a look at what to do about Internet taxation.\footnote{12 The Advisory Commission on Electronic Commerce was created in October 1998 by the Internet Tax Freedom Act. See Omnibus Consolidated and Emergency Supplemental Appropriations Act of 1999, Pub. L. No. 105-277, Title XI, 112 Stat. 2681-719.} Old solutions are not going to work. We are going to need some new approaches altogether if states are going to continue to be able to raise money to operate. The cyber-libertarians would say this is wonderful, and that we have finally found a way to cut the states off altogether. I doubt that is a likely outcome.

As I noted earlier, we need an institution where we can have a national debate about Internet policy. We need a forum in which to study, analyze, and encourage constructive engagement among the diverse protagonists and arrive at a consensus about wise courses of action regarding Internet policies. I am happy to report that a group of academic, business, and other leaders in the northern Virginia and greater Washington region are now working to build such an organization. We are hoping that we can develop a situation in northern Virginia where we not only manage fifty percent of the world’s Internet traffic, but where we also play a major role in defining public policy toward the Internet for the twenty-first century.