8 Key Questions for every National Politician and Political Candidate about Science & Technology Policy

Commentary by Blake White

The Strategic Technology Institute (STI) remains a vehicle for progressive science and technology proponents to investigate the business and public policy issues raised by science and engineering. It provides a platform for my colleagues and I to develop a more holistic worldview, especially as it relates to science, technology and society. This holistic approach seeks to build upon our careers as engineers, scientists, and business executives and enable a better understanding of innovation in the context of the economics, belief systems, ethics, and shared assumptions found in the history of the period. We seek to take into account social shifts, political contexts, class/race struggles, and the critical adoption rates associated with major scientific discoveries and their related technological uses. We know that, although science can be neutral, technology is never neutral. We have seen technology – that is always devoted to a specific aim – amplify inequities while making the impossible possible. There is clearly a role for government to ensure that science policy is ethical and fair, especially since we have seen that, if anyone is to be adversely impacted by a new technology, it is generally the poor, the powerless, and those of color.

I have been mulling over two powerful observations about the science-based questions we should be asking all candidates for national office in this 2016 election year. These impactful observations come from two ends of the social dialogue -- but not the two ends you may be thinking about.

The first comes from an NPR interview of Adam Frank, an astrophysics professor at the University of Rochester and a co-founder of the 13.7 blog. He was discussing the "*20 Science Questions for the Presidential Candidates*." (http://www.npr.org/sections/13.7/2016/08/17/490245464/20-science-questions-for-the-presidential-candidates) During the radio interview, Frank mentioned that we don't get much political discussion about science because most politicians are lawyers, perhaps a few business people, but very few scientists or engineers. Likewise, he mentioned the reason we don't get press coverage is perhaps because the press doesn't believe that the public is interested in science; and most reporters were journalism, communications, or political science majors who shunned science since the 5th grade.

The other impactful observation came, after the Republican and Democratic conventions, while watching HBO's Bill Maher, the host of *Real Time*, a political comedy show. Paraphrasing Maher, he noted that "facts are facts", but to some politicians, "beliefs are facts." He went on to show examples of politicians denying facts and insisting that what they believe are indeed the facts.

STI is not a political organization, in the sense that we generally keep partisanship out of our research and recommendations. But these two observations, when combined, got me thinking -- what would (or should) the public ask those who want our votes?

As informed public citizens of an increasingly technology-based society, we should not just ask the presidential candidates of the four major parties, but ask the candidates for House and Senate office as well (especially since they have to take voting positions on proposed funding bills impacting our collective future).

Here is my list of 8 questions, including contextual notes (as to why these issues are important) at the end of the paper. Please share it with your friends, colleagues, and family. At a minimum, I hope it provokes rational discussion beyond yes-no answers. Perhaps it will also find its way to those current and future government leaders who haven't thought seriously about these important issues.

1. **Fact-Based Science Policy**[1] - What is the role of the Education Department in demanding full respect for, and adherence by states and local government entities to, fact-based science education? Or, do you believe that each local school is allowed to have "their own set of facts" based on belief? In more general terms, what do you see as the importance of fact-based research on overall government policy positions and laws?

2. **Federal Research & Development**[2] -- To what degree do you believe that the Federal Government still has an important role in championing and funding pure R&D to stimulate technology development by private industry and entrepreneurs, as a global competitiveness issue, as well as a national economic imperative? What level of funding do you support and what are your top 3 areas for federal R&D focus?

3. **Climate Change**[3] -- The science behind Climate Change is beyond dispute among 90%+ of serious scientists, yet the two major parties seem to be at odds around not only the causes and implications, but even the facts themselves. What will you do to make sure the politicization of climate change does not keep us from irreversibly destroying our only ecological habitat on the erroneous bet that 90% of scientists are wrong?

4. **Nuclear Energy**[4] -- Do you see a cleaner and safer nuclear energy source as a viable alternative source for electric power than fossil fuels? If so, how? If not, what would need to be done to make it so?

5. **NASA**[5] -- Until very recently, NASA funding had been dwindling, as a percentage of the overall federal budget, since the Cold War ended, in spite of very significant beneficial spinoffs from the program. Do you believe in the innate value of scientific knowledge as a driver of the human spirit? How do you see the role of manned space missions as a driver of long-term technological advancement and as a means to fulfill national and global cohesion around a common human goal? Are you comfortable that we are dependent on Russia or in the future profit-oriented commercial companies to send our astronauts to the International Space Station? Are we only willing to spend resources when war looms, or do we see value in the medical, materials science, crop science, weather prediction, communications, and electronics advancements led by government sponsorship of space exploration? Though more cost-effective, do we get the same emotional and civic lift from robotic scientific missions?

6. **Genetic Engineering**[6] -- We have mapped the human genome and are on the cusp of revolutionary advancements (and risks) in human, animal, and crop manipulation through genetic modification. Do you support or reject the IP ownership of otherwise natural processes, such as seed licensing? Are there certain inalienable rights to food that should outweigh commercial profit? In what ways would you increase funding for R&D in genetics, and what bioethical principals and constraints would you put in place? In what ways should the FDA, Agriculture Department, Interior Department, EPA, and Congress for that matter, ensure the basic rights to sustenance to all citizens?

7. **Pandemic Tracking & Prevention**[7] -- In the face of communicable diseases seen over the past decade with Ebola, SARS, West Nile, and Zika, how do you see pandemic tracking and prevention as, not only public health and humanitarian issues, but as national and global security issues? What additional plans would you put in place at the CDC, NIH and other federal agencies for the rapid identification, prevention, tracking, and elimination of these types of diseases? What role and safeguards, if any, do you see for genetically manipulated antibodies and immunological agents?

8. **Information Infrastructure as a Utility**[8] -- It is almost undeniable that the pace of innovation and widespread adoption of modern communications and information services by commercial, educational, and government institutions, as well as the public at large, has made it a critically important vehicle for everyday life in the US. It's as critical as water, clean air, safe food, electric power, and transportation to the lifeblood of American society. When the Information Infrastructure reaches such a point of criticality, should it be viewed as a public utility, fundamental to the public

good? Or do you believe that, although originally funded with DARPA federal support, the evolved Internet (what Vice President Al Gore called the "Information Superhighway") should or should not be subject to the whims of profit-oriented commercial entities with less or more control by the Federal Communications Commission, as we have seen with the "Net Neutrality" debate?

Call to Action

In the past the actions of individuals or single industries or even single nations mattered little to the outcome of the world. Modern technology is quantitatively more pervasive in society and leads to quantum changes in the qualitative influences of technology (Mesthene 25). We have a whole new generation of weapons, microbes, and chemicals that can influence the future of the planet.

Many of today's ethical controversies can be traced back to an archaic set of assumptions regarding the rights of stakeholders. These rights often were developed at a time when the economic, social, and environmental conditions made their individual applications less of a problem than today. However, we live in a society that rapidly diffuses technology, each with intended and aggregative unintended consequences on the well-being of society, to an increasing number of rights claimants who each exercises the maximalist uses of technology. This ultimately leads to the destruction of the commons and degrades the overall social fabric. As such, the rights of stakeholders must, at a minimum be bounded by the constraints of the modern technological society and, in certain special cases, be restricted by government regulatory actions.

Engineers as a group and as individuals have special responsibilities as citizens, which go beyond those of non-engineer citizens. From this perspective, engineers and scientists must be part of the decision-making process. Traditional professional society codes of ethics cite a series of actions and practices that professional engineers or scientists should not engage in. It is a "thou shalt not" approach to ethics. Citing what one cannot do is tantamount to applying a deontological top's down approach to ethics. Designers and developers of technology can no longer seek moral solace from only seeking to minimize harm. They must proactively seek to maximize the most benefits for the largest number of people, while delivering the most benefit to those most negatively impacted, or likely to be negatively impacted, by the unintentional consequences of complex technology. They need to operate out of a new ethical paradigm; one that is a bottom-up, empirically based, neo-consequentialist set of personal morals and professional requirements. This renewed ethical imperative would lead to scientific research and product designs for the most positive consequences, rather than settling on the current approach of minimizing the maximum regret. (McGinn, Technology, 14-15).

"All citizens have an obligation to devote some of their time and energies to public policy matters. Minimal requirements for everyone are to stay informed about issues that can be voted on, while stronger obligations arise for those who by professional background are well grounded in specific issues as well as for those who have the time to train themselves as public advocates," as put forth by Philosopher Mike Martin and Engineer Roland Schizinger (Martin 29l).

The late Jacob Bronowski warned us, "…it should make us shiver whenever we hear a man of sensibility dismiss science as someone else's concern. The world today is made, it is powered by science; and for any man to abdicate an interest in science is to walk with open eyes toward slavery" (Bronowski 6).

About the Author

Blake White is the Founder & Principal of the Strategic Technology Institute. Over a 30 year career, he served both Silicon Valley and Hollywood communities, holding senior positions at Cognizant, PwC, Ascent Media Consulting Services, SGI, Apple, HP, P&G, and three startups. He helped develop and launch foundational technologies in the computer networking, Internet, graphics, and digital media industries, led digital transformation programs, consulted on the alignment of technology roadmaps with business strategy, and supported M&A decisions across the content value chain. An active industry speaker, Blake is also the author of a book on Technology Assessment and several articles for industry publications including: SMPTE Motion Imaging Journal, Broadcast Engineering magazine, MESA M&E Journal, Journal of Digital Media Management, as well as PwC-sponsored white papers. Blake holds an MLA from Stanford University, MBA from Xavier University, and a BS in engineering from North Carolina State University.

Contextual Notes

[1] **Fact-Based Science Policy** -- Science is the body of knowledge obtained by methods based upon observation. Derived from the Latin word *scientia*, which means knowledge, the modern usage employs the German concept of *wisenschaft*, which means systematic organized knowledge. Thus, science implies not mere isolated facts, but knowledge that has been put together in some organized manner (Bronowski). In particular, the science with which we are concerned is a body of knowledge which derives its facts from observation, connects these facts with theories, and then tests or modifies these theories as they succeed or fail in predicting or explaining new observations. In this sense, science has a relatively recent history – perhaps four centuries (Platt). In essence, it derives pure neutral knowledge extracted painfully from nature through systematic means for dissemination to all humanity.

[2] **Federal Research & Development** -- Science is the study of nature around us and subsequent development of scientific laws. Technology is the practical application of those laws, in sometimes non-rigorous ways, toward the achievement of some purpose -- usually material (Dorf, 1). Technology is not science. Technology is how we do things, not how we think of them. The basic motive for "bringing about technology" is the desire to obtain more or better material things. However, technology relies very heavily upon basic scientific knowledge in addition to prior technology. Technology is never neutral, since it is directed in specific instances toward specific material objects -- that is, toward the production of physical objects, driven by physical needs. Technology also involves our relationship with the environment. It involves our attempt to control and shape the environment and to make use of whatever resources are available in that environment (Fischer, 77). For our purposes, technology is science plus purpose.

[3] **Climate Change** -- NASA's Global Climate Change website notes that the current warming trend is of particular significance because most of it is very likely human-induced and proceeding at a rate that is unprecedented in the past 1,300 years. Ninety-seven percent of climate scientists agree that climate-warming trends over the past century are very likely due to human activities, and most of the leading scientific organizations worldwide have issued public statements endorsing this position.

The heat-trapping nature of carbon dioxide and other gases and their ability to affect the transfer of infrared energy through the atmosphere is the scientific basis of many instruments flown by NASA. There is no question that increased levels of greenhouse gases must cause the Earth to warm in response. All three major global surface temperature reconstructions show that Earth has warmed since 1880. Most of this warming has occurred since the 1970s, with the 20 warmest years having occurred since 1981 and with all 10 of the warmest years occurring in the past 12 years. NASA, citing specific scientific research studies, summarizes key climate change indicators:

- The oceans have absorbed much of this increased heat, with the top 700 meters (about 2,300 feet) of ocean showing warming of 0.302 degrees Fahrenheit since 1969.
- Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost 150 to 250 cubic kilometers (36 to 60 cubic miles) of ice per year between 2002 and 2006, while Antarctica lost about 152 cubic kilometers (36 cubic miles) of ice between 2002 and 2005.
- Glaciers are retreating almost everywhere around the world — including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa.
- Global sea level rose about 17 centimeters (6.7 inches) in the last century. The rate in the last decade, however, is nearly double that of the last century.
- Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30%. This increase is the result of humans emitting more carbon dioxide into the atmosphere and hence more being absorbed into the oceans. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 2 billion tons per year.
- The number of record high temperature events in the United States has been increasing, while the number of record low temperature events has been decreasing, since 1950.

Three fossil fuels — petroleum, natural gas, and coal—have provided more than 80% of total U.S. energy consumption for more than 100 years. However, general public and private recognition of the role of fossil fuels in global warming has led to positive initiatives, albeit late in the game. Chemical engineers see their design goal not simply as maximizing yield, but as finding a process with an acceptable yield that also minimizes pollution and safety hazards (Pool 291). In 2015, the renewable share of energy consumption in the United States was its largest since the 1930s at nearly 10%. The greatest growth in renewables over the past decade has been in solar and wind electricity generation. Liquid biofuels have also increased in recent years, contributing to the growing renewable share of total energy consumption. The most significant decline in recent years has been coal: U.S. coal consumption fell 13% in 2015, the highest annual percentage decrease of any fossil fuel in the past 50 years. According to the International Council on Clean Transportation, fuel economy standards are applied in approximately 80% of the global automobile market.

[4] **Nuclear Energy** -- In the 1980s, with only 6% of the world's population, the US consumed over one-third of its energy. Between 1990 and 2015, U.S. energy productivity rose by 58%, with improvements in every sector. Today, through conservation and efficiency efforts, as well as a concerted focus by the Obama Administration over the past 7 years on renewable energy sources and domestic oil production, demand for coal in the power sector reached its lowest level since 1987, natural gas accounts for 29% of total primary energy consumption, and the US is now a net exporter of crude oil at an average of 458,000 barrels per day. However, nuclear electric power had no growth between 2014-2015, at approximately 8 quadrillion BTUs (U.S. Energy Information Administration). However, make no mistake about it, the US considers energy important enough that is justifies war; so, disregarding our commitment to sustainable independent energy sources prepares us for a very rude awakening.

Nuclear power is, and will need to continue to be, in our national energy mix. The proponents and opponents of nuclear power argue their points of view vehemently, are armed to the teeth with statistics and conflicting scientific experts, and evoke the fears of the general public. Talking to any of them is typically a one-sided conversation with the truth lying somewhere between their extremes. The battle over nuclear power rages so violently that benefits are forgotten; so are hazards. It is true that nuclear power has the potential for being one of the least expensive methods of producing large commercially available supplies of electricity. The public concern is not merely concentrated on the issue of meltdowns for Three Mile Island type accidents. Genuine concern over nuclear waste is valid.

We the public, and our government representatives, must be technically literate enough to know that:

- It is untrue that no method of waste disposal is available — Professor Petr Beckman of the University of Colorado described a process in the late 1970s/early 1980s that could be used for reprocessing and burial, with most of the uranium and virtually all of the plutonium extracted chemically by acid, such that the remaining high-level wastes would be responsible for 99% of the radioactivity but only 1% of the volume (a small amount of highly radioactive waste).
- It is untrue that nuclear power poses the greatest health hazard to the population — Beckman showed back in 1980 that 0.01% by weight of nuclear waste (after proper processing) is actually radioactive and with remote burial, the victims of nuclear waste could be comparably negligible to the 37,000 victims of coal generated power.
- It is untrue that nuclear power adds to the radioactivity of the Earth — The uranium is already here and already decaying. Since the real danger lies in being too close to concentrations of it, we should place our power plants away from people.

Over the past several decades, engineers and contractors have to own their contributions to slowing the growth of safe nuclear power, not only fears of meltdowns. The long memory of the public and regulators are legitimate, given that of 43 plants under construction in 1981, the NRC rated 7 "below average" in quality, 36 "average", and none "above average", according to Jim Mintz, in his interview of Nunzio Palladino, former Chairman of the U.S. Nuclear Regulatory Agency for the American Association for the Advancement of Science's journal. Lawrence Kanous of Detroit Edison castigated the electric power industry in the post-Three Mile Island reviews, for paying “insufficient attention to the human side of such systems since most designers are hardware-oriented. They focus on what is important to the physical functioning of the machine and assume that the human operators are adaptable” (Pool 283).

Robert Pool observes that engineers do not think of what they do in social terms. However, as technologies become more complex, engineers will find it increasingly necessary to take human performance and, eventually, organizational factors into account in their designs (Pool 287). For example, Pool argues in favor of high reliability organizations that build safety into the systems and processes from the start, rather than adding it on as an afterthought. Pool argues for a design approach that accepts that people make mistakes and that organizations get sloppy and takes those factors into account in the engineering process. This is in stark contrast to the machine-centered philosophy of engineering, where one designs a plant so that it does its job efficiently, then expect people and organizations to adapt to it (Pool 280). When it comes to complex systems, the emphasis needs to be on making operators of technology more effective, instead of making machines more effective. The industry should consider systems that inform humans, in great and varied detail, rather than blindly automate and delegate important and risky operations to machines. “Creating such informed systems is an expensive process, one that is difficult to justify for such safe and mature technologies as coal-fired power plants. But nuclear plants are a different matter,” notes Pool (Pool 285).

[5] **NASA** -- The omnibus spending bill, released by House and Senate appropriators on Dec. 16 after extended negotiations, allocates $19.285 billion to NASA for fiscal year 2016. That total is $756 million above the administration’s requested budget and the total provided the agency in a House spending bill passed in August. It is nearly $1 billion above a Senate bill that appropriators approved in June, but was never passed by the full Senate (spacenews.com). Although generally unknown to the public and rarely cited by its critics, NASA receives just 0.4% of the $4.147 trillion federal budget. Compare that to the Department of Defense. Its budget is $523.9 billion, or 12.6% of the total. DoD's budget would pay for 29 NASA departments (www.thebalance.com).

The budget allows NASA to continue development of the Orion crew vehicle, Space Launch System, and Exploration Ground Systems that will one day send astronauts beyond low-Earth orbit. NASA's website provides the following highlights:

- The Space Launch System (SLS) is a new heavy-lift rocket, more powerful than any previously built. SLS will be capable of sending humans aboard Orion to deep-space destinations such as an asteroid and Mars.
- The budget proposal serves as a catalyst for the growth of the American commercial space industry, including development of commercial crew transportation. US Commercial Crew transportation Capability (CCtCap) contracts are being developed at the Florida spaceport with the goal of certifying safe, reliable and cost-effective access to and from low-Earth orbit and the International Space Station by the end of 2017.
- The 2016 budget allows NASA to continue developing and testing transformative capabilities and new technologies crucial to future exploration initiatives, such as a high-powered solar electric propulsion capability to drive the robotic segment of an asteroid retrieval mission and future exploration systems in deep space.
- NASA's budget also funds continued work toward a 2018 launch of the James Webb Space Telescope, successor to the Hubble Space Telescope and the largest observatory ever put into space.
- NASA's science funding supports research in a wide variety of areas, facilitating collaboration with more than 10,000 US scientists in universities, industry, and government laboratories through over 3,000 openly competed research awards. Some of the agency's aeronautics research is applied in every US aircraft and air traffic control tower. NASA scientists and engineers are working on new composite materials that will make future air and spacecraft lighter and more durable.

According to *The Balance*, since 1976, NASA created 1,400 inventions that wound up as products or services. It has been estimated that each dollar of NASA spending is a catalyst for $10 of economic benefit, due to NASA's unique position to provide some of the technological innovation that drives the space economy. This spin-off effect created many of the goods and services we take for granted every day:

- Heart defibrillators
- Kidney dialysis machines
- CAT scanners
- GPS
- Weather and communication satellites
- Freeze-dried food
- Other technologies developed for exploring space are now used to increase crop yields or search for good fishing regions.

NASA Administrator and former astronaut, Charles Bolden, emphasized his belief that NASA is a beneficial investment for our nation and for the world. "NASA is an incredible investment for our nation because what we do not only uncovers new knowledge, it helps raise the bar of human achievement," he said. "People everywhere are attracted to what we do, because exploration embodies our values as a nation -- resilience, hope, and overcoming the challenges faced" (NASA).

[6] **Genetic Engineering** -- We have been encouraged to believe that it is one thing for the biologist to know how to perform gene splicing, but it is quite another for biological engineers to actually create harmful forms of life. After all, when the threat of biological genocide due to a genetically engineered mutant virus having escaped a pharmaceutical laboratory confronts humanity, who is to blame?

In an era when scientific research can be used for both good or evil, as shown by biological research for cures that could also be helpful to bio-terrorists, has the assumption of the neutrality of facts outlived its usefulness? For example, aarguments were made for continuing the Australian research in mouse pox and genome sequencing of viruses based on convincing agricultural and medical benefits that are possible derivatives of the research (Pollack). Equally strong arguments can be made as to how publication of this research enables terrorists or rogue states to more quickly develop weapons of mass destruction (Pollack). As science (knowledge) and technology (applications) are increasingly intertwined, must we consider banning certain research, not just restricting the publication of the research? And, who decides?

As a demonstrative example, consider a scenario of human cloning for reproductive and therapeutic reasons.

- There is no compelling reason to apply scarce, rationed medical research funds to reproductive cloning, especially since there are other means of child bearing that are available for most people, including IVF, related egg donation, surrogate mothers, and adoption. The number of people not able to use these means is relatively small, in comparison to the proposed opportunity cost of medical research for reproductive cloning. In addition, the needs of existing life with promising social potential trumps the potential needs of potential life. However, there is a negative right, not to be prevented from reproducing. This negative right does not automatically imply an unbounded positive right to be provided medical assistance to reproduce by all possible means and at any unbounded social cost.
- Alternatively, There is a compelling reason to pursue therapeutic cloning (somatic nuclear transfer) to better understand the genetic makeup of disease and to research whether rejection-free transplantable organs can be grown in the laboratory. This positively impacts millions of people, is a better use of scarce medical research funds, and does the most good while minimizing the most harm. In addition, research can be performed under strict oversight, including ethics review panels, informed consent, registration of practitioners, a shared database of research results, and stiff legal penalties for misuse.
- There may be indirect positive benefits to reproductive cloning as well. If indirect benefits to reproductive cloning occur as a result of therapeutic cloning research, there is no compelling reason to prevent use of this research to further advance reproductive cloning. As a matter of casual observation, the current arguments against reproductive cloning are weak. They are based on

deontological reasoning, employ worst case scenarios, and pander to fear and subjective "revulsions." The same social results can occur through natural childbirth and child rearing.

Do these scenarios help society understand that a certain threshold must exist, beyond which it is unsafe to venture in the name of pure research? If we restrict knowledge, what makes us think that others won't eventually make similar discoveries? Is full disclosure safer than restrictions? The raging debate centers around what can be done to alleviate these threats and who should bear the responsibility for implementing solutions.

Also, in the United States, which represents a minority of humanity, market-driven allocations of resources have allowed the healthcare system and biomedical research to pursue, not just the basic needs of the many, but the vain desires of the few who have the ability to pay for what must be considered luxury treatments. The moral question that needs to be addressed is to what extent should market forces be allowed to create an unfair distribution of benefits to the few when humanity at large holds a claim on biomedical knowledge and each person has a right to basic healthcare? Even those who can afford to pay for luxurious treatments, such as cosmetic alteration, genetic enhancements, and extraordinary life support measures, may not have an unbounded positive right to do so when scarce medical resources prevent their fellow citizens from experiencing the most basic preventive care, such as clean water, sanitation, minimal nutritional requirements, prenatal care, inoculations, and relief from easily treated medical ailments, such as pain, dehydration, diarrhea, influenza, and the childhood diseases.

[7] **Pandemic Tracking & Prevention** -- As with other goods and services that are subject to resource constraints, preventive healthcare and clinical intervention are not available to hundreds of millions of people, most in developing countries in Africa, Asia, and South America. These regions represent the bulk of humanity and their medical needs are underserved.

Many people try to conveniently ignore the plight of the masses of humanity, as if their diseases will never reach the rest of us. For example, Garret Hardin, in *Lifeboat Ethics,* maintains that we have a duty not to help the poor and starving of other countries because they will overrun the lifeboat and sink us all. This short sightedness assumes that we live in isolation and presumes that the fates of those in the lifeboat are independent of the fate of those in the water. Others claim that aid does not work, that bureaucracies tend to perpetuate themselves at the expense of the poor, and that aid creates an unhealthy dependence, in the manner described in the parable of teaching the poor to fish rather than giving them fish. We ignore these people at our own peril. HIV-AIDS, tuberculosis, SARS, and plague are vivid reminders that the plights of the most remote citizens are shared by all. According to Farmer, "Complex social webs not only link the city and countryside but also link one country to another. An estimated one-third of U.S. tuberculosis cases occur among those born in another country, and this population is growing. The ways in which tuberculosis is transmitted mean that a local outbreak constitutes a global concern" (Farmer 277).

On a purely utilitarian argument, Peter Singer argues that we ought to seek to reduce the overall amount of suffering in the world, even at great cost to those of us who have more affluent lifestyles (Singer). While Henry Shue argues that everyone has a positive right to minimal subsistence, i.e., one that imposes obligations on the others to assist in meeting this right, the over-reliance on the libertarian market based allocation of food and medical resources seems to constrain society's abilities to provide a just distribution of medical services and benefits to those most in need (Shue). As Farmer keenly observes it, "If there is no role for any but profiteers, what sort of health care environment have we created?" (Farmer 279)

The moral question that needs to be addressed is to what extent should market forces be allowed to create an unfair distribution of benefits to the few when humanity at large holds a claim on biomedical knowledge and each person has a right to basic healthcare? As a matter of social justice, public policymakers have an obligation to: (a) ensure basic healthcare opportunities to all, regardless of income, (b) provide for equitable distribution of the real costs and benefits of extraordinary treatments, and (c) ensure that if anyone is to be negatively affected by medical research and unequal distribution of medical care, at least a proportional share of the benefits will accrue to the most negatively affected groups. In a connected world of travel and commerce, where pandemics threaten all of humanity, it is morally wrong and short-sighted to address these issues in any other manner than via a global strategy.

[8] **Information Infrastructure as a Utility** -- Do rights recognized in the non-digital world automatically transfer to the same rights in the digital realm? When it comes to the provision of government services and the subsidization or promotion of private services over what has become a public infrastructure, the answer should be yes.

In today's society, Information & Communications Technology is more than a consumer product that is subject to the economic rules of diffusion. ICT has become the de-facto foundation of the socio-economic infrastructure. Kathleen Cooper, the Under Secretary for Economic Affairs of the Economics and Statistics Administration and Michael Gallagher, Assistant Secretary and Administrator of the National Telecommunications and Information Administration proclaimed in the foreword to their joint 2004 report, *A Nation Online: Entering the Broadband Age*:

> Now, more than ever before, high-speed connections promise to enhance our Nation's productivity and economic competitiveness, improve education, and expand health care for all Americans. High-speed networks provide the power to erase geographic, economic, and cultural gaps. With high-speed connections, American workers can find jobs; small businesses can have global markets; rural doctors can consult with specialists; and students can take classes that are taught from across the country.

In the U.S., the provision of public infrastructure, such as electricity, has been seen as a public good that should be available to all since Franklin Roosevelt's Executive Order 7037 that established the Rural Electrification Administration in 1935. The current administrator of that order, the Rural Utilities Service of the Department of Agriculture, requires that all electric and

telecommunications service providers adhere to Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, and the Age Discrimination Act of 1975 (Anderson 1). In addition, Title II Section 201 of the Civil Rights Act of 1964 requires that all persons be entitled to equal enjoyment of the public goods, services, facilities, and accommodations without discrimination on the basis of race, color, religion, or national origin (Wright 589).

The U.S. government sees inherent benefit to making communications infrastructure available to all and it is willing to subsidize or mandate special programs for the poor. Focusing on the universal service provisions of the 1996 Telecommunications Act, the FCC issued rules based on four goals. First, all universal service objectives established by the Act must be implemented, including those for low-income individuals, consumers in rural, insular and high cost areas, as well as for schools, libraries, and rural health care providers. Second, rates for basic service must be maintained at affordable levels. Third, affordable basic phone service must continue to be available to all users with the help of a universal service fund which will subsidize phone service for those who qualify. Fourth, the benefits of competition in the telecommunications arena must be brought to as many consumers as possible. The Universal Service requirements of the Telecommunications Act of 1996 also mandated a 'Lifeline Assistance Program' to subsidize the cost of monthly telephone bills for the poor.

The Universal Declaration of Human Rights, originally adopted by the United Nations in 1948, also acknowledges the fundamental importance of and rights to communications and information access. It asserts that individuals have the right to seek, receive, and impart information and ideas through any media, regardless of frontiers, as a function of one's freedom of expression (Wilhelm 61). To the United Nations General Assembly, ICT is a not a luxury. Their 2002 report of the UN ICT Taskforce argued that, "Greater reliance upon this can do much to facilitate the work of governance, to promote economic opportunities and to improve education and health. ICT is not an alternative to other expenditures but is a requisite tool for development. Not only are the new technologies a key to unlocking economic growth; they impinge on and can impact virtually all aspects of development. It thus deserves priority attention even in conditions of limited infrastructure and budgets" (UN 1).

In the modern, technologically-intensive, democratic society of the United States, equal rights to access and use the public infrastructure is assured to all citizens. Title II Section 201 of the Civil Rights Act of 1964 requires that all persons be entitled to equal enjoyment of the public goods, services, facilities, and accommodations without discrimination on the basis of race, color, religion, or national origin (Wright 589). While the Civil Rights Act was meant to address public transportation, lunch counters, hotels, and theaters, the public market for goods and services, as well as the provision of government services, are increasingly based on computerized access to information available over the network infrastructure of the Internet.

The cumulative effect of these laws and policies is to legitimize global Information & Communications Technology, when used for the public provision and delivery of services, as a new type of public infrastructure to which all citizens have a right to access and use. Obviously, with the rapid globalization of manufacturing, the service sector, and now intellectual capital itself, and with the web of computers, online libraries, and information service providers, ICT has much more powerful implications to the overall economic opportunity of a society than a mere set of consumer electronics devices. ICT has become the modern infrastructure for opportunity.

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