'Technology Assessment: Democracy's Crucible for the Future Endorsement of Science and Technology in the 21st Century''

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Technology assessment [TA] has been known by different definitions down through the years and it is possible that the failure to secure a uniform definition lies in the differences which social scientists, classical scientists and the general public have about its core elements. Of course, another key issue is that open and democratic societies seem to favor the practice of technology assessment, despite variable ideas about what it means while more restrictive societies, with strict cultural and political sanctions on freedom of expression, tend to oppose TA. For our purposes, we should try to outline a workable definition which is symptomatic of a highly innovative, technologically acquisitive and scientifically robust society where political democracy and commercial entrepreneurship go hand in hand.

We should be prepared to provide a definition that reflects current reality and is expansive enough to encompass the next 25 years of political and technological development swaying precariously between the extremes of reckless democratic expressionism and rampant materialistic nihilism. So what is Technology Assessment?

> *Technology assessment is the systematic evaluation of innovative, novel and unique discoveries and developments in all fields of science and technology to examine both the immediate and long-term societal, political and ethical impacts of new ideas and advancements to ascertain whether their net impact is either positive or negative. It also estimates any expected or unexpected outcomes which could result from, or be triggered by, these new ideas, advances, discoveries and developments.*

Those vehemently concerned about TA, both historically and in contemporary times, may hold visions of modern day Luddites staunching every innovation or new scientific breakthrough because it contains an unknown level of risk to social stability. They point to Galileo and Copernicus, full of passion in defense of the pure pursuit of scientific knowledge, and quickly assert that all human progress is the direct result of scientific or technological innovation in one form or another. We can be proud of innovations in robotics, nanotechnology, genetic engineering, computer science and other fields. However, the reciprocal caution we clearly understand with crude technical insights is that new history making technologies bring unexpected costs as well as benefits. In the spirit of TA's original purposes we must consider its societal impact, negative political or economic consequences, the inadvertent triggering of new risks or unforeseen secondary hazards, while systematically examining the overall benefits and disadvantages of any new technology on our community's security and safety.

With the advent of carbon-based industrial processes, developments in atomic energy, and the creation of synthetic materials resistant to biodegradation we were brought face-to-face with profound new societal, political ethical and environmental challenges we are still trying to tackle many years after the new technology was unveiled. So we are not arguing against technological progress, innovation and fearless exploration of the unknown but instead argue that we must display pragmatic caution, leave room for reasonable doubt, and examine the downstream consequences in weighing not only the benefits and advantages derived from new technologies but also grasp their less well understood, and sometimes latently harmful, and often subtly negative consequences. Using a strained allegory here--It's not that progress cannot travel forward in time with society, instead a security check is needed before we board the aircraft to ensure that all passengers on the flight into the future pose no threat to each other.

Before we find ourselves poised to blindly accept, hesitantly embrace, or vehemently oppose new discoveries in science and technology we will need the benefit of facts and a willingness to provide a wide berth for critical analysis. Every advance in technology has admittedly breathtaking elements which hijack our imagination and pragmatic reserve long enough that our 'gee whiz' rapture gradually overtakes any sentiment we may have lingering that the gizmo in our hands, or the one driving our national aviation infrastructure, is benign at worst. We are fascinated with new technologies, breakthroughs in biomedical sciences which save or prolong life and handy 'societal software' that makes overall life easier and less prone to drudgery. So we say—bring it on—let the consequences be damned. Or we say, let's play with this thing long enough that we know with confidence it won't inadvertently harm or kill somebody. Somehow we must find a way to protect public health, agriculture, the environment and thwart further weapons proliferation through construction of a new TA system.

Examining the Risk Frontier

We face exciting and terribly beneficial discoveries in biotechnology, nanotechnology, plasma physics, materials science, space science, propulsion dynamics, artificial intelligence, cyber-engineering and other fields just to name a few. The tsunami-like wave of commercial endorsement for these discoveries and advancements is impossible to thwart even though many would argue that stifling obstacles in funding, restrictive boundaries on cutting-edge research domains, and enduring hurdles for new inventors threaten to keep us from leap-frogging to a much better life and economy. What is missing? It is the mechanism by which society, government and our major cultural institutions examine and experience newly emerging science and technology—*simply put we have no mechanism sophisticated enough, clear enough, and sensible enough to permit the comprehensive and objective endorsement of future technologies*.

As a result, we find ourselves in an uncomfortable and untenable position, We are forced to trust scientists, and our massive commercial-industrial infrastructure, with the task of not only producing the great new breakthrough product—but providing government and society with ironclad assurances that the immediate and long-term consequences for society, our political system, and our porous ethical standards will be

benign at worst. While it may seem that what TA really wants is greater regulation, stricter oversight of commercialization, tighter safety controls and programs to safeguard society by sharply restricting the release of new technologies that is not the goal. Nor is TA clinging to the notion of industrywide pledges of ethical conduct and personnel reliability programs to curtail unethical behavior among manufacturers or scientists.

The central problem is that no widely accepted, objective, reasonable and enforceable system exists for TA—simply put we lack a reliable TA mechanism at the very time in our fragile social and political history that one is deeply needed. This dilemma will hardly find adherents in most of the commercial world because such efforts will be seen as imposing a net market disadvantage on American goods, technologies and products in which other nations care not engage. The United States must assess how, and to what extent these TA issues will impinge on WTO agreements, world trade, market competitiveness and salutary profit-taking because the economic costs of investing in TA will be considerable. We cannot afford to forget how we accepted auto seat belts, poultry inspectors, and financial disclosure statements as part of daily life and made them instrumental to reinforcing those aspects of an otherwise free democratic economy we apparently cherish.

Six Key Areas of Concern

The lack of a viable TA mechanism that earns the support of scientists, the public and the media is especially troubling as we delve more deeply into the era of scientific experimentation and exploration in domains of high excitement and fascination—biotech, cybertech, nanotech, and hyperspace for example. In each of these exciting domains the green flag of welcome progress continues to fly proudly yet there remains no system in place for systematically assessing whether we understand the downside risks and outcomes which may indirectly or inadvertently result. This dilemma obtains for many advanced technologies to be sure but there are few which come closer to unraveling our societal and political fabric than these four and they deserve some closer scrutiny because they contain a high risk of dangerously adverse consequences.

Of course, as these advanced technologies are examined we must initially confront the issue of their inherently dual –use character and the very real risks that any one of them could potentially be exploited for weapons use or to inflict harm. This must be of special concern because while possession of atomic weapons reflects the most potent strategic weapon on earth as of today we have no ironclad guarantees that a new more lethal technology cannot be eventually discovered. One that equals, nullifies or surpasses the atomic bomb and which grants devastating destructive power to its owner.

We have procedures and some consensus on biosecurity, safeguards and other related notions designed to protect society against untoward discoveries of new bioweapons or deadly pathogens. However, there is much work to be done and the global pharmaceutical and biotech world routinely does not welcome intrusion or regulation although they appear committed to trying the newer biosecurity and biosafety

measures being proposed. We must also remember that a small highly skilled cadre of bioweapons scientists could be covertly compelled by rogue regimes or terrorist groups to develop crude biological devices without regard to such safeguards thereby raising the risks of deliberately inflicted pandemic for all nations.

Options for diverting legitimate advanced technology research into weaponization or misdirecting it for criminal purposes, are dimly understood and easily dismissed as near science fiction. However, it is much less clear in the cybertech world, the nanotech frontier and ongoing research into hyperspace possibilities. In each case advances in technology always reveal a crossroads of ethical ambiguity.

Genetic engineering, synthetic biology and related biotech advances can allow scientists to manipulate the DNA, genomic structure and related properties of certain diseases. Undesirable traits can be screened out, propensity for certain illnesses can be reduced and healthier, smarter or stronger people can be developed through cloning. Robotics, bio-mechanical hybrids, self-replicating nanobots, and emerging excursions into nanobiotechnology make it even more difficult to sort out what new discoveries could produce. Harmless technologies benefitting society in ways never imagined is the hope—revealing new avenues to undermine and exploit humanity or society is the nightmare. Quite simply, we are victims of our own enchantment because the desire to discover breakthroughs trumps any serious concerns about downside caution let alone the trivialities of risk assessment.

What is Needed

It is not the issue of complexity which seems to steer us away from serious TA mechanisms. We have tried these imperfect systems before laden with political and very nonscientific hyperbola and fright-mongering. What is needed is an explicit partnership between business, academia and government where the views of ordinary citizens are also considered. Genetically modified foods worked their way into the American diet almost clandestinely and were gradually accepted, no so in Europe. Little serious thought these days is now given to intensively examining genetically modified foods because they have been a part of our lives for more than 20 years. Downstream concerns about their generational effects, legacy impacts on public health and their contributing role in cancer, or other diseases must be discarded as hypothetical and irrational. We tend not to investigate that which we have socially accepted even if engaging in long-term scientific analysis to assure our citizens might prove or disprove that belief.

So apart from the need to create an entirely new TA mechanism for the United States which exhaustively examines cutting edge technologies to ascertain their positive and potentially negative aspects. There is a corresponding need to engage inventors, venture capitalists, academicians and other experts in the task of designing a viable TA system which can prove itself able to discharge its two most important functions—[1] to clarify, reveal and advance promising technologies tagging them for special endorsement and investment; and then [2] to identify as much as possible the potentially negative and harmful effects of these technologies and how they may directly or inadvertently cause ill

effects outside their intended areas of legitimate activity. We must show the way and demonstrate that such a process not only furthers science and technology but safeguards democratic society. But this is not enough.

Promoting the effective use of a TA mechanism outside the United States also makes sense and would contribute to global stability and security if it is managed properly. Just as the G-8 defines superpowers and the G-20 delineates prosperous economies we should seriously consider creating a G-35 group of the states with the most robust science and technology infrastructure. This G-35 group would devote its energies towards the evaluation of emerging technology anywhere in the world, garner support for its nascent development, examine and foster the trajectory for its advancement and safeguard it from nefarious manipulation into destructive outcomes or weaponization through a multilateral screening and evaluation mechanism. This will, of course, take many years and require the steady support and leadership energy of the G-20 membership. But it is not impossible nor inadvisable.

If we do nothing in either our domestic or international sphere we risk finding ourselves awakening to a new era of destructive and devastating technologies which either came upon us my accident, by malevolent design or by coercive manipulation of scientific energy. With a robust TA mechanism in place we have erected a broader safeguard against new future weapons more damaging than the atom bomb, the laser or hypersonic wave. We have purchased a measure of peace and bought precious time to allow existing and future democracies to flourish.

In many ways, the construction of a robust TA mechanism is democracy's crucible for filtering out destructive and inadvertently damaging technologies while ushering in an era of thoughtful, objective and analytical assessment of emerging technologies in terms of their direct benefits to society. We can measure the harmful effects of existing technologies by looking at their impact on our environment, public health, national security, and overall livelihoods. But what about tomorrow's technologies? Will we have the tools and mechanisms for knowing as early as possible what the good and bad may be on the newest technologies even as we embrace and support the ongoing appetite humanity so often displays for progress at any price?