

Reinventing Technology Assessment

As the pace of technological change continues to accelerate worldwide, the far-reaching social ramifications are frequently not understood until after new technologies become entrenched. Historically, this has resulted in important lost opportunities; significant economic, social, and environmental costs; and the channeling of societal development down long-term unhealthy paths. The U.S. health care system, for example, has long been skewed toward expensive high-tech treatment of illness to the relative neglect of preventive strategies.

Technology assessment (TA) is a practice intended to enhance societal understanding of the broad implications of science and technology (S&T). Its use creates the possibility of preparing for or constructively influencing developments to ensure better outcomes. From 1972 to 1995, the United States led the world in institutionalizing TA. Then Congress reversed course, closing its Office of Technology Assessment (OTA).

Meanwhile, there are now 18 TA agencies in Europe. They have developed many promising practices, including highly effective methods involving participation by everyday citizens. Participatory technology assessment (pTA) enables laypeople who are otherwise minimally represented in S&T politics to develop and express informed judgments concerning complex topics. In the process, pTA deepens the social and ethical analysis of technology, complementing the expert-analytic and stakeholder-advised approach to TA that was used by the OTA.

One widely emulated European pTA method is the “consensus conference,” pioneered in the late 1980s by the Danish Board of Technology (DBT), a TA agency that serves the Danish Parliament. A consensus conference provides a window into ordinary citizens’ considered opinions concerning emerging S&T developments, while also stimulating broad and intelligent social debate on these topics. For each consensus conference, the DBT recruits a panel of about 15 laypeople that roughly reflects the demographic breadth of the Danish population. A carefully planned pro-

gram of reading and discussion, culminating in a public forum with balanced expert and stakeholder testimony, ensures that the participants become well informed. After deliberations, the lay panelists present their findings and recommendations at a press conference in the Danish Parliament building.

Consensus conference reports are only advisory; they are not intended to determine public policy. They have, however, had a direct influence on policy in some cases. For instance, conferences held in the late 1980s influenced the Danish Parliament to limit the use of genetic screening in hiring and insurance decisions and to exclude genetically modified animals from the government’s initial biotechnology R&D program. The Danish method has now been adapted and used dozens of times in at least 16 nations on five continents.

As their number has grown, European TA agencies have also become adept in sharing methods and results and undertaking selected TA activities on a collaborative transnational basis. During the past two decades, European TA has stimulated a number of European nations, as well as the European Union, to reach important and inventive decisions in areas such as promoting new green industries, regulating manufactured chemicals, adapting to climate change, and guiding the development of genetic technologies.

There are compelling reasons to reestablish a national TA capability in the United States, incorporating both expert and participatory methods. The Internet can help a new TA institution be more effective and cost-efficient than was previously possible. Creating a modernized TA capability would also complement Obama administration initiatives to make government more transparent, accessible, and responsive to popular concerns.

Learning from the OTA

Incorporating an oversight and prepublication review process that ensured nonpartisanship, OTA studies supplied extensive useful information. But OTA’s approach also had limitations that, if understood, can lead to improvements in TA

and ultimately to better decisionmaking.

For one thing, some members of Congress complained that OTA reports, which often took two years or more to complete, were delivered too slowly to serve the pace of legislative decisionmaking. The OTA also contributed to the impression that public policy analysis can be objective, obscuring the value judgments that go into framing and conducting any TA study. For instance, OTA analysis routinely incorporated norms such as technical effectiveness and efficiency, economic growth, human health and safety, environmental protection, and national security. Although these are widely upheld norms in our society, they nonetheless reflect value preferences and not all command unqualified or universal respect. For instance, an increasing number of scholars have argued against economic growth as a norm, especially when it is defined by gross domestic product.

The OTA's deficiency was not in conducting value-informed analysis but in failing to explain that it was doing so, and in arbitrarily favoring certain values over others that can arguably be defended as meriting attention. Why, for instance, should a TA organization routinely consider how technological change affects economic growth and productivity but not, for example, its effects on work satisfaction, parenting, gender and race relations, and corporate power relative to that of workers and local communities? Social values of one kind or another are inescapable and necessary to conducting sound analysis. Particularly within a culturally diverse democracy, TA must learn to be overtly pluralistic in the values that it incorporates.

Partly as a consequence of striving to appear objective, OTA reports were not consistently successful in elucidating the ethical and social implications of new technologies. For instance, establishing and perpetuating a society's basic democratic structure is a preeminent social value that should always be included and arguably even prioritized in TA. For example, there is a risk that online commerce, by draining revenue from local economies, could erode community vibrancy, public spaces, and the buffering that a robust local economy affords against the vagaries of impersonal global market

forces. All three factors could impair conditions contributing to healthy democratic self-governance. The OTA, however, did not generally make even a token effort to consider any given technology's potential bearing on the structural conditions of democracy. In addition, the OTA generally overlooked the reality that the most important social repercussions can arise from interactions among complexes of seemingly unrelated technologies. The agency likewise made little effort to elucidate circumstances in which a technology can dynamically influence subsequent sociotechnological developments. One important instance is when the use of a technology deters nonusers from adopting otherwise desirable technological alternatives. For example, the danger of being hit by a car can inhibit the choice to travel by health-promoting, nonpolluting bicycles. Finally, the OTA never developed a capacity to cultivate, integrate, or communicate the informed views of everyday people.

Since 1995, OTA supporters have made numerous attempts to revive the agency or to strengthen the TA capacity of institutions such as the Government Accountability Office (GAO) or the National Research Council. The congressional response thus far has been cautious. Beginning in 2002, Congress directed the GAO to conduct several pilot expert TA studies, and in November 2008, Congress asked the GAO to establish a permanent TA function. GAO is moving slowly, contemplating initial production of one or two expert TA studies annually, less than 1-10th of the OTA's output. Notably, the efforts to recreate a national TA capability have taken little account of OTA's limitations or of promising recent innovations in TA. OTA-style expert analysis has a vital contribution to make, but it requires improvement and supplementation.

Virtues of participation

Participation by laypeople is essential to redressing a number of the OTA's deficiencies. There are multiple reasons to include citizen participation:

- Lay citizens are ethically entitled to direct participation or effective representation in technological decisions

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as a matter of democratic right.

- Experience with pTA shows that laypeople tend to excel in articulating ethical concerns, making and explaining value judgments, and developing normatively informed insights and analysis. Unlike experts, they are not constrained by the risk that they will violate professional standards or sacrifice political stature by expressing their values. In exercises such as consensus conferences, in which lay participants are chosen to proportionally approximate the demographic characteristics of the wider citizenry, their collective judgments provide an otherwise unobtainable—albeit inexact and therefore illuminating but not definitive—representation of informed popular opinion and of the common good.

- Citizen participation creates a broader knowledge base. Animated and informed by social values, pTA gathers and integrates life experiences and other social knowledge that expert analysis omits or undervalues. According to the 2008 National Academy of Sciences report *Public Participation in Environmental Assessment and Decision Making*, “public engagement can be essential for ‘getting the science right.’”

- pTA tends to reduce cost, controversy, and delay. By addressing potential or nascent technological developments on an informed, anticipatory basis, pTA provides a valuable indicator of what general public opinion will probably become in the future if those technological potentials become widely realized. It is then possible to select research and innovation trajectories that, by taking social concerns into account at an early stage, can reduce time-consuming and costly downstream social controversy. Diverse kinds of pTA projects have contributed to well-received decisions regarding the responsible development of nanotechnology in Belgium and Switzerland and the use of robotics in health care and of genetic engineering in developing new medicines in Denmark.

- Participatory methods typically take 2 to 12 months to orchestrate and complete, a more useful time frame for decisionmakers than the two years typical of OTA reports.

Although helpful in essential ways, pTA is not a panacea

for all that is lacking in TA methods and performance. Hence there is a need for further innovation in both expert and pTA concepts and methods. Some of this innovation is taking place in the United States.

Various European pTA methods have been adapted, tested, and proven in the United States at least 16 times on an ad hoc basis by university-based groups and independent nonprofit organizations. One example is the 2008 National Citizens Technology Forum (NCTF) on Nanotechnology and Human Enhancement, coordinated by the Center for Nanotechnology in Society at Arizona State University. The NCTF examined the implications of using biotechnology, nanotechnology, information technology, and cognitive science to radically enhance individual human capabilities. The NCTF included 74 laypeople from six states (New Hampshire, Georgia, Wisconsin, Colorado, Arizona, and California), chosen to be demographically representative of their respective regions. The NCTF deliberations combined two weekends of face-to-face meetings at six regional sites with nine intervening, two-hour Internet-mediated sessions of the entire 74-person group. Using the Internet made it possible to expand the geographic diversity of the lay participants at reduced cost and included opportunities to pose questions online to a balanced panel of experts.

The lay panelists at each site wrote their own concluding statement of consensual findings and recommendations. Next, the organizers prepared a report synthesizing the outcomes from the six sites. As a result of participating in the NCTF, the proportion of lay panelists anticipating that the social benefits of enhancing human capabilities would exceed the risks declined from 82% to 66%. All six sites registered significant concern about the effectiveness of government regulations for human enhancement technologies. Five sites assigned higher priority to funding treatment of diseases than to enhancement research. The organizers later described the NCTF at a congressional briefing, and there are indications that the NCTF may have influenced language mandating “deliberative public input in decisionmaking processes” within a 2009 Senate bill seeking to reauthorize

the National Nanotechnology Initiative.

Experience indicates that expert TA and pTA can be strongly complementary. Expert TA plays a vital role in informing pTA processes. pTA can likewise provide insights and identify gaps in social understanding that can inform expert TA analysis. For example, the lay participants in a 2006 Boston Consensus Conference on Biomonitoring, organized by Boston University's Environmental Health Department, suggested that new surveillance programs that gather data on the industrial chemicals found in peoples' bodies could be used by companies and government researchers to stimulate innovations in green chemistry, the development of alternatives to potentially toxic and persistent chemicals. In addition, the participants agreed that biomonitoring could be a stimulus and encouragement to start new green companies. An April 2009 article in *Environmental Health Perspectives* considered this suggestion important and not previously propounded by experts. But although creative, this pTA-derived recommendation is not fleshed out. It could thus potentially become a fruitful topic for further expert TA investigation.

Criteria for a TA capacity

Given the range of benefits it can provide, the overarching aim of pTA should not be reduced to providing a veneer of legitimacy to predetermined government decisions. Neither should it be misconstrued as citizen engagement merely for its own sake. Rather, the realistic ambition is to design pTA practices so that, in concert with complementary expert and stakeholder TA, they can inform and improve decision-making, thereby contributing to better societal outcomes. Toward that end, a new national TA capability should aspire to fulfill the following criteria:

- **Participation and expertise.** Incorporate effective citizen participation methods to complement expert analysis.
- **21st-century structure.** Develop a partially decentralized, agile, and collaborative organizational structure, seeking TA effectiveness, low cost, and timeliness.
- **Continual innovation in concepts and practices.** En-

courage, evaluate, and as warranted, adopt new TA concepts and methods, including avenues for more effectively integrating TA into decisionmaking.

- **Nonpartisan structure and governance.** Establish the ethos and institutional structures needed to ensure that any new TA institution is strictly nonpartisan. When there are divergent normative perspectives on a topic, individual TA projects can benefit from a balanced, overtly value-pluralistic or multipartisan approach.

- **Commitment to transparent process and public results.**

A typical OTA study cost \$700,000 to \$1.4 million, and the agency's total annual budget was about \$31 million (in today's dollars). The cost of a participatory TA exercise can vary greatly depending on process design characteristics, but as one illustrative benchmark, the budget of the 2008 NCTF was roughly \$500,000. There is evidence that TA pays for itself many times over. For instance, the OTA was able to document a case in which just one of its expert analyses helped the U.S. government realize more than \$500 million in cost savings. Another OTA study helped save about \$85 million.

Inasmuch as pTA provides many social benefits that complement the benefits of expert TA, developing a robust pTA capability is apt to prove a smart and cost-effective social investment. For instance, a May 6, 2010, *Nature* editorial said that a pTA capability "might have helped" the U.S. government to avoid spending 30 years and \$9 billion to develop the Yucca Mountain nuclear waste repository in Nevada, a project that the Obama administration has decided to abandon because of long-time local opposition.

Should a reinvented TA capability be an agency of Congress? Let's compare that option with an alternative: a nationwide expert-and-participatory TA institutional network called the Expert & Citizen Assessment of Science & Technology (ECAST) network. Recently launched in nascent form, the ECAST network will be independent of government, nonprofit, and gradually expand to comprise a complementary set of nonpartisan policy research institutions, universities, and science museums in the United States (see

Envisioned Complementary Institutional Capabilities Within the ECAST Network

Nonpartisan Policy Research Organizations	Universities	Science Museums
Policy relevance	Innovation in TA concepts and methods	Direct public interface
Interface with decisionmakers	Research, analysis, and evaluation	Trust as public educators
Broad dissemination of results	Training of researchers/practitioners	Innovation in citizen-friendly pedagogy

box). The founding partners of ECAST are the Woodrow Wilson International Center for Scholars; the Museum of Science Boston; the Consortium for Science, Policy and Outcomes at Arizona State University; ScienceCheerleader; and the Loka Institute.

Establishing a substantial expert TA and pTA capability under congressional auspices would automatically confer a measure of influence on the practice of TA at the national level. However, Congress is almost entirely unfamiliar with pTA, so success would at a minimum entail a substantial educational effort. Moreover, the staff of any new congressional OTA would be acutely aware of the demise of the previous OTA and thus apt to be highly cautious. This could make it difficult to implement the trial-and-error learning and innovation necessary to begin addressing OTA's weaknesses.

In contrast, the ECAST institutional network would have the flexibility to organize TA not only for Congress but also for the executive branch and for state and local governments. By incorporating into its mission the fostering of societal discussion and broad public education, ECAST can inform business and other stakeholders' decisionmaking and enhance the quality of popular engagement with S&T-intensive policy issues. An ECAST network can select and frame topics more creatively and with greater participation than could

an agency such as the OTA, which, although it did informally suggest topics to Congress, was largely forced to focus on the topics assigned to it. Operating outside of the direct line of fire of partisan congressional politics, an ECAST network can also experiment more freely with new TA concepts and methods.

On balance, the ECAST option appears more promising in the short run. In fact, however, these two options can potentially function sequentially or coexist complementarily. Juxtaposing the sweeping influence of contemporary S&T with the new organizational forms and participatory capabilities made possible in part by the Internet, the accomplishments of European pTA, and an executive branch committed to advancing citizen engagement in governance, there are compelling reasons to integrate a modern, expert-and-participatory TA capability into our nation's civic life.

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