The Many Meanings of 'Technology Assessment'

Learning from the founding and early history of OTA.

By M. Anthony Mills

Scientific and technological advances are transforming the ways we communicate, produce goods and services, and conduct warfare, among other things. Yet our elected officials and institutions of government—the U.S. Congress, in particular—appear ill prepared to understand, much less address, the many challenges and opportunities posed by modern science and technology. Recent calls to equip government with more and better expertise are a response to this perceived gap between the technical capacity of our elected officials and the importance of science and technology for society as a whole.

This relative decline of technical expertise is part of a broader trend: a weakening of congressional capacity that has left the national legislature ineffective, not only lagging behind the private sector but also overly deferential to executive agencies.[1] While these agencies are populated with countless experts of all kinds, it is Congress, not the executive branch, that the Constitution empowers to make law and that is most responsive to democratic pressures. Leaving science and technology almost entirely to the executive branch means that unelected bureaucrats and political appointees—rather than the people's representatives—are making critical policy decisions about many of the most pressing issues of our time, from encryption, artificial intelligence, and content moderation to climate change and genetic engineering. At the very least, members of Congress must be adequately equipped to conduct oversight of those executive agencies.

Although many of the opportunities and challenges posed by science and technology today are new, the problem of congressional technical expertise is not. In fact, a similar dynamic was at work in the politics of the 1960s and early 1970s. Debates about the legislature's inability to grapple with scientific and technological changes and its resulting dependence on executive agencies culminated in the Legislative Reorganization Act of 1970—which, among other things, strengthened (and renamed) the Congressional Research Service (CRS) and bolstered the oversight functions of congressional committees—and the Technology Assessment Act of 1972, which led to the creation of the Office of Technology Assessment (OTA).

OTA was a congressional support agency—alongside CRS, the Government Accountability Office (GAO), and the Congressional Budget Office—created with the express purpose of supplying Congress with its own independent source of technical expertise. It operated from 1974 until 1995, when it was defunded by congressional Republicans as a symbolic move in their broader effort to shrink government. Today's advocates of increasing expertise in Congress look back on the ill-fated agency as both a source of inspiration and a cautionary tale. Current proposals range from calls to revive or modernize OTA (the statute that created it remains on the books) to attempts at re-creating some or all of its functions in another

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[1] Kevin Kosar, "How to Strengthen Congress," *National Affairs*, Fall 2015.

new or existing agency (especially the GAO, which took over some of OTA's functions after its demise and has recently redoubled efforts in this area).[2]

A long-overdue debate is now underway about how best to equip Congress with more expertise, including what lessons can be learned from the history of OTA. Some of the most vocal participants in this debate have been individuals who were themselves involved with OTA in one way or another; they provide valuable personal and institutional knowledge that should inform today's decision-making. But this debate would be well served by a more substantive engagement with the conceptual issues involved in integrating technical knowledge into the democratic process—issues that were front and center in the debates of the 1960s and '70s. In particular, it is worth thinking more carefully about the concept of *technology assessment*, especially as it was conceived of in its early days, with a view to ascertaining what lessons may be brought to bear on current policy debates.

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[2] See, e.g., Zach Graves and Kevin Kosar, "Bring In the Nerds: Reviving the Office of Technology Assessment," R Street Policy Study no. 128 (January 2018), https://www.rstreet.org/wp-content/uploads/2018/04/Final-128-1.pdf; Kevin Kosar, "GAO versus the Ghost of OTA: Who Will Win the Science and Technology Assessment Race?" (LegBranch.org blog post), March 20, 2019, https://www.legbranch.org/gao-versus-the-ghost-of-ota-who-will-win-the-science-and-technology-assessment-race/; Garrett Johnson and M. Anthony Mills, "Why Taxpayers Should Support Expanding the GAO," *The Hill*, December 28, 2019, https://thehill.com/opinion/finance/476007-why-taxpayers-should-support-expanding-the-gao; Kevin Kosar, "Congress's Tech Policy Knowledge Gap," *Cato Unbound*, June 10, 2019, and responses by Will Rinehart ("The Political Economy of Expertise," June 14, 2019), Betsy Wright Hawkings ("Congressional Tech Knowledge Must Start at Home," June 18, 2019), and Berin Szóka ("Technical Expertise Is Just the Tip of the Iceberg," June 21, 2019), all available via https://www.cato-unbound.org/2019/06/10/kevin-kosar/congresss-tech-policy-knowledge-gap; Justin Warner and Grant Tudor, "The Congressional Futures Office: A Modern Model for Science & Technology Expertise in Congress," paper, Belfer Center for Science and International Affairs, Harvard Kennedy School (May 2019), www.belfercenter.org/publication/congressional-futures-office; Mike Miesen, Maeve Campbell, et al., "Building a 21st Century Congress: Improving Congress's Science and Technology Expertise," paper, Belfer Center for Science and International Affairs, Harvard Kennedy School (September 2019), https://www.belfercenter.org/publication/building-21st-century-congress-improving-congresss-science-and-technology-expertise; Peter D. Blair, "Scientific Advice for Policy in the United States: Lessons from the National Academies and the Former Congressional Office of Technology Assessment," in *The Politics of Scientific Advice: Institutional Design for Quality Assurance*, J. Lentsch & P. Weingart, eds. (Cambridge: Cambridge University Press, 2011), pp. 297–333; Peter D. Blair, *Congress's Own Think Tank: Learning from the Legacy of the Office of Technology Assessment (1972–1995)* (New York: Palgrave Macmillan, 2013); Daniel D'Arcy, Addison Stark et al., "Congress Needs the OTA to Keep up with Science and Technology," report, Bipartisan Policy Center (2019), https://bipartisanpolicy.org/report/congress-needs-the-office-of-technology-assessment-to-keep-up-with-science-and-technology/; Michael Rodemeyer, Daniel Sarewitz, and James Wilsdon, "The Future of Technology Assessment," Woodrow Wilson International Center for Scholars (December 2005), https://www.wilsoncenter.org/sites/default/files/techassessment.pdf; Richard Sclove, "Reinventing Technology Assessment: A 21st Century Model," Science and Technology Innovation Program, Woodrow Wilson International Center for Scholars (April 2010), https://www.wilsoncenter.org/sites/default/files/ReinventingTechnologyAssessment1.pdf; and National Academy of Public Administration (NAPA), *Science and Technology Policy Assessment: A Congressionally Directed Review* (Washington, D.C.: initially released to Congress on October 31, 2019; subsequently released to the public on November 14, 2019), https://www.napawash.org/studies/academy-studies/science-and-technology-policy-assessment-for-the-us-congress.

My aim in this paper is to understand the original conceptualizations, motivations, and ambitions of technology assessment.[3] My hope is that a deeper understanding of technology assessment, and thus a more sophisticated conceptual tool kit, can enrich today's debates about integrating technical expertise into the legislative process. After considering three distinct conceptions of technology assessment in their historical and political contexts, I will conclude by offering some tentative suggestions for how we might proceed today, including prospects for a more ambitious and democratically responsive approach to assessing technology.

Historical Background

What do we mean when we say that Congress needs more or better "technical expertise"? What is expertise and how is it supposed to help or inform the lawmaking process? What is intended by the vague qualifier "technical"? And to what problems is "more technical expertise" an intended solution? How we answer such—too infrequently asked—questions has important policy and political implications.

One influential answer was offered by Rep. Emilio Daddario (D-Conn.) more than half a century ago. Daddario believed that the government—and the legislative branch in particular—needed to develop its own capacity to "assess" new and emerging technologies. But what, exactly, is technology assessment?

The term "technology assessment" dates to the early 1960s, when the newly formed House Subcommittee on Science, Research, and Development—a subcommittee of the Committee on Science and Astronautics—held a series of hearings on ways to improve Congress's "scientific and technical" decision-making capacity. According to Peter Blair, the term was coined by subcommittee counsel Philip Yeager during these hearings as a way "to describe the means of informing the Congress of the potential undesirable effects of new technology."[4] The term would be popularized by Daddario, chairman of the subcommittee, over the course of a protracted series of debates in Congress that spawned a scholarly literature devoted to technology assessment and, eventually, legislative action.[5]

In 1967, Daddario proposed the creation of a Technology Assessment Board (TAB), a congressional entity that would, among other things, "provide a method for identifying, assessing, publicizing, and dealing with the implications and effects of applied research and

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[3] That is to say, my aim is not to tell the story of OTA's rise and fall or to examine the ways in which OTA practiced technology assessment during its tenure, both of which have been chronicled authoritatively by others. See Bruce Bimber, *The Politics of Expertise in Congress: The Rise and Fall of the Office of Technology Assessment* (Albany: State University of New York, 1996) and Blair, *Congress's Own Think Tank*, op. cit., as well as Barry M. Casper, "Rhetoric and Reality of Congressional Technology Assessment," in *Science, Technology, and National Policy*, Thomas J. Kuehn and Alan L. Porter, eds. (Ithaca: Cornell University Press, 1981; article orig. published 1978) and Adam Keiper, "Science and Congress," *The New Atlantis* (Fall 2004-Winter 2005), https://www.thenewatlantis.com/publications/science-and-congress.

[4] Blair, *Congress's Own Think Tank*, op. cit., p. 12.

[5] Daddario is typically credited with introducing the term, including in "A Study of Technology Assessment," Committee on Public Engineering Policy, National Academy of Engineering (NAE), Committee on Science & Astronautics, H.R. Report (July 1969), p. 1.

technology."[6] The subcommittee commissioned three reports to study the proposal, one by the Legislative Reference Service (later CRS), one by the National Academy of Sciences (NAS), and one by the National Academy of Engineering (NAE). These reports resulted in another round of hearings as well as the commissioning of yet another report, this time by the National Academy of Public Administration. That report examined the organizational structure of a proposed Office of Technology Assessment, to be overseen by the TAB and housed in and primarily responsive to the legislative branch of government. Another round of hearings followed in 1970, which culminated with the creation, in 1972, of the congressional Office of Technology Assessment.[7]

What spurred Congress to act?

World War II had transformed the public role of science and technology in the United States. Technological innovation, driven by scientific discovery, became increasingly vital for social and economic life. And the federal government, which had begun during the war to make substantial investments in and exert considerable control over science and technology, played an increasingly active role after the war. By the 1950s, the federal government was by far the biggest patron of science, including both applied and basic research. Moreover, the wartime success of large-scale organized research—"Big Science"—most famously associated with the Manhattan Project, offered a new model for the practice of science and the means to obtain technological innovation.[8] The growth and creation of federal research institutions and projects in the postwar period, from the national laboratories to the Apollo program, exemplify this new partnership between science and government.[9]

These developments are pertinent to the origins of technology assessment in at least two interrelated ways.

First, as the government became more involved with science and technology, it was the executive branch—and the Department of Defense, in particular—that took the lead, rather than the legislature. Besides footing the (considerable) bill for both government-backed and government-controlled R&D, Congress played little more than a perfunctory role in science and technology policy. Executive entities, meanwhile—from the Office of Naval Research and the Atomic Energy Commission to the National Institutes of Health, the National Science Foundation, and the National Aeronautics and Space Administration—were spending more and more on basic and applied research, both in-house and in the nongovernmental research

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[6] Quoted in *Summaries of Activities of the Subcommittee on Science, Research, and Development 1963–1972* (Washington, DC: Government Printing Office, 1973), p. 75.

[7] OTA would not have funds appropriated and thus did not begin operating until 1974. For an overview of this early history see Blair, *Congress's Own Think Tank*, op. cit., pp. 12–21, as well as "Summaries of Activities of the Subcommittee on Science, Research, and Development 1963–1972" (Washington, DC: Government Printing Office, 1973), pp. 75–86.

[8] See Peter Galison and Bruce Hevly, eds., *Big Science: The Growth of Large-Scale Research* (Stanford: Stanford University Press, 1992).

[9] For an authoritative history see Daniel Kevles, *The Physicists: The History of a Scientific Community in Modern America* (New York: Alfred A. Knopf, 1978).

institutions supported by federal dollars.[10] Senator Edward Kennedy, chairman of the TAB—the board that oversaw OTA—described this state of affairs in 1975:

> The executive branch, with its vast resources, would develop complex programs which Congress had no capability to properly evaluate. So when the time came to vote on issues such as the ABM, the SST, or the Space Shuttle, it was extremely difficult for Congress to marshal the facts and arguments effectively.[11]

Not only had Congress ceded science and technology policy to the executive branch, it also found itself without the technical expertise needed for oversight of the executive branch in these increasingly important areas, including the allocation of federal dollars for R&D. Indeed, as Bruce Smith and Jeffrey Stine observe: "Before the 1960s, aside from the unique Joint Committee on Atomic Energy, Congress...had no formal advisory mechanisms devoted specifically to the provision of scientific and technical information."[12] This state of affairs contrasted starkly with the executive branch, in which scientific experts had come to play a decisive role during the war, epitomized by Vannevar Bush, President Roosevelt's science advisor and director of the wartime Office of Scientific Research and Development. After the war, the role of the presidential science advisor grew in prominence with the creation of the President's Science Advisory Committee in 1957, later renamed the Office of Science and Technology and eventually succeeded by the Office of Science and Technology Policy.

Second, although science and technology had helped win the war, the postwar period saw increasing anxiety over the pace and effects of developments in both fields. Along with a general "social consciousness" of the unintended effects of technology, there were specific fears over technology's ecological impacts—this was the beginning of the modern environmental movement. Other public concerns related to nuclear power and the arms race, as well as the alliance of technological development and the military, exacerbated by the Vietnam War.[13] Science was seen by a growing chorus of critics no longer as a servant of the public weal but as a handmaiden of the so-called military-industrial complex. Technology, which had been praised for aiding military victory and driving economic progress, was now, many feared, outstripping human control.

This is what the NAS report refers to as mounting popular concerns over "society's seeming inability to channel technological developments in directions that sufficiently respect

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[10] See Kevles, *The Physicists* (ibid.), as well as "Technology: Process of Assessment and Choice," National Academy of Sciences (NAS), Committee on Science & Astronautics, H.R. Report (July 1969), p. 24.

[11] Edward M. Kennedy, "Toward the Year 2000," address before the World Future Society, June 3, 1975, reprinted in the *Congressional Record*, June 17, 1975, p. S10787. Cited in Casper, "Rhetoric and Reality," op. cit., p. 328.

[12] Bruce L. R. Smith and Jeffrey K. Stine, "Technical Advice for Congress," in *Science and Technology Advice for Congress*, M. Granger Morgan and Jon M. Peha, eds. (Routledge, 2003), p. 31.

[13] See, for example, the NAS report, "Technology: Process of Assessment and Choice," op. cit., p. 1.

the broad range of human needs."[14] Environmentalists, social critics, and philosophers from Rachel Carson, Barry Commoner, and Ralph Nader to Jacques Ellul, Leo Marx, and Lewis Mumford cautioned against the imperialism of modern technology and the social, environmental, and moral dangers it posed.[15] There emerged a popular desire to "control" technology or even to arrest its development altogether. As Daddario himself put it in 1963, in the first report produced by the subcommittee he chaired:

> For 150 years the United States could and did depend mainly on ingenuity, industry, independence and pioneering of its people....Then the situation...shifted radically. The new need was technology. But Congress...finds itself squarely faced with the many social, political, and economic side effects created by the current technological revolution....Inevitably serious problems have accompanied progress....Indeed there are those who contend that the galloping technical revolution is threatening to outrun the number of talented people necessary to nourish it, as well as the time needed to plan and direct its course with some degree of wisdom.[16]

These two consequences of the postwar science and technology paradigm—the dominance of the executive branch and what we might call, for lack of a better term, a "techlash"—went hand in glove. The executive branch (especially the military) was seen to be complicit with the dominance of technology, while Congress, which was in theory more responsive to popular pressures, appeared unable to do anything about it. It is in this context that we should consider the development of the concept—or rather concepts—of technology assessment.

Semantic Ambiguities

A natural place to look when trying to understand technology assessment is the text of the Technology Assessment Act. Yet the statute is ambiguous about the meaning and purpose of technology assessment, emblematic of a broader ambiguity about the term, from the earliest debates about it through our own day.[17] At least three different motivations for—and attendant understandings of—technology assessment may be discerned in the text of the statute itself, each

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[14] Ibid., p. 1.

[15] See, for example, Robert M. Margolis and David H. Guston, "Origins, Accomplishments, and Demise of OTA," in *Science and Technology Advice for Congress*, M. Granger Morgan and Jon M. Peha, eds. (Routledge, 2003), pp. 54–55.

[16] House Committee on Science and Astronautics, Subcommittee on Science, Research, and Development, "A Statement of Purpose: The First Progress Report of the Subcommittee on Science, Research and Development," 88th Cong., 1st Session (Washington, DC: Government Printing Office, 1963), p. 1. Cited in Gregory C. Kunkle, "New Challenge or the Past Revisited?," *Technology in Society*, vol. 17, no. 2 (1995), pp. 175–196.

[17] I am using the term "ambiguous" in the technical, philosophical sense, according to which a term contains within it multiple possible clear meanings. Ambiguity is thus not to be confused with vagueness, which implies a lack of clear meaning.

of which has clear antecedents in the deliberations that led to OTA's creation as well as the scholarly literature from that period.[18]

The first is what might be termed *canonical technology assessment*. (Call it TA1, for the purposes of this paper.) According to this definition, technology assessment aims to "identify existing or probable impacts of technology or technological programs," in the words of the Technology Assessment Act.[19] More specifically, the act states that "it is essential that, to the fullest extent possible, the consequences of technological applications be anticipated, understood, and considered in determination of public policy on existing and emerging national problems."[20] The motivation here is to understand and anticipate the nature and the "physical, biological, economic, social, or political effects" of emerging technologies so that benefits may be reaped and deleterious effects avoided or mitigated.

This is what is often referred to as the "early warning" function of technology assessment.[21] In the words of the act: OTA will "provide early indications of the probable beneficial and adverse impacts of the applications of technology" and "develop other coordinate information which may assist the Congress."[22] This is convergent with Daddario's own characterization of technology assessment as "identifying the undesirable by-products and side-effects of...applied research and technology in advance of their crystallization and informing the public of their potential in order that appropriate steps may be taken to eliminate or minimize them," as he put it when introducing the first technology assessment legislation in the 1960s.[23]

Yet, the term "early warning" is potentially misleading in emphasis. While forecasting or foresight may play a role in the assessing of potential impacts of emerging technologies, what is significant about TA1 is not that it is future-oriented so much as that it is concerned with the so-called secondary and tertiary consequences of technology, that is to say, effects other than those intended by the technology itself, be they positive or negative.[24] Contained within TA1 is a wide-ranging and holistic evaluation of the nature and effects of emerging technologies—what economist Guy Black characterizes as a "cross-disciplinary, problem-oriented and generalist type of expertise."[25]

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[18] Casper cites two, rather than three, "principal rationales" for the creation of OTA, which roughly track TA1 and TA3 (Casper, "Rhetoric and Reality," op. cit., p. 328).

[19] Public Law No. 92-484, 92d Congress, H.R. 10243 (October 13, 1972).

[20] Ibid.

[21] See, e.g., the NAS report, op. cit., and Blair, *Congress's Own Think Tank*, op. cit., p. 13.

[22] Pub. Law No. 92-484, 92d Cong., H.R. 10243 (1972).

[23] Cited in the NAS report, op. cit., p. 7.

[24] See, for example, ibid., p. 26. The NAE report refers to "the use of technology assessment...as an alerting device" rather than an "early warning" system (op. cit., p. 20).

[25] Guy Black, "Technology Assessment—What Should It Be?," Staff Discussion Paper 211, Program of Policy Studies in Science & Technology, George Washington University (1971), p. 3.

A second, narrower motivation for—and understanding of—technology assessment may also be discerned in the Technology Assessment Act and surrounding debates. According to this view, technical advice on science and technology is needed as an input to guide the lawmaking process. As the statute puts it: "It is necessary for the Congress to equip itself with new and effective means for securing competent, unbiased information concerning" the effects of technology.[26] The idea here is not so much weighing the probable beneficial or adverse impacts of technology as ensuring that laws are formulated (or executive agencies overseen) in the light of the most up-to-date and reliable expert opinion. In this view, what Congress requires is more —and more reliable—technical information, typically of the quantitative variety. This is what might be termed *technocratic technology assessment* (TA2).

TA2's emphasis is on Congress's informational needs. As Rep. Marvin Esch (R-Mich.) declared during the debates in the early 1970s that led to the creation of OTA, the congressional office would have "informational functions; not functions of control, or even recommendation. These functions are designed to supplement existing systems of acquiring information, such as the hearing system."[27] This "information" is to be used by legislators to improve their decision-making—"solely to help us do a better job," in the words of Rep. Charles Mosher (R-Ohio), ranking member of the subcommittee on Science, Research, and Development.[28] Thus, Congress needs more expertise to help it make "smarter," which is to say, more technically informed, decisions. TA2 can be traced back to Congress's earliest deliberations about technology assessment, although it was less prominent in those deliberations than TA1.[29]

A third motivation for and attendant understanding of technology assessment is to provide Congress with its own in-house source of expertise, so as to enable it to exert more control over the executive branch—what we might call *legislative and oversight technology assessment* (TA3). According to the Technology Assessment Act:

> 1. the Federal agencies presently responsible directly to the Congress are not designed to provide the legislative branch with adequate and timely information, independently developed, relating to the potential impact of technological applications, and
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> 2. the present mechanisms of the Congress do not and are not designed to provide the legislative branch with such information.[30]

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[26] Pub. Law No. 92-484, 92d Cong., H.R. 10243 (1972).

[27] House of Representatives, *Congressional Record* (February 8, 1972), p. 3217. Quoted in Kunkle, "New Challenge or the Past Revisited?," op. cit. Similarly, Rep. John Davis (D-Georgia) refers to OTA as providing "informational aid for the Congress."

[28] H.R., *Congressional Record* (February 8, 1972), p. 3203.

[29] Indeed, the first series of hearings held by the SRD was expressly geared toward the challenge of "providing Congress with the necessary scientific and technical information to build its decision making in these areas" (cited in Blair, *Congress's Own Think* Tank, op. cit., p. 12).

[30] Pub. Law No. 92-484, 92d Cong., H.R. 10243 (1972).

The goal here is to make Congress less dependent on the executive branch and thus empowered to deliberate about technical policy challenges or else conduct meaningful oversight—rather than being mere "rubber stamps of the administrative branch of government," as Rep. George Miller (D-Calif.), chairman of the Committee on Science and Astronautics, put it in 1963.[31]

TA3 has two components. The first is to ensure that Congress has access to sources of technical information that are "independent"—independent, that is, of executive agencies. As Daddario put it during the initial debates surrounding the Technology Assessment Act,

> We have recognized the important need for developing independent means of obtaining necessary and relevant technical information for the Congress, without having to depend almost solely on the Executive Branch. In my view, it is only with this capability that Congress can assure its role as an equal branch in our Federal structure.[32]

Second, possessed of such independent means, Congress would have the necessary tools to deliberate about technical issues that come before it, including when conducting oversight of executive agencies. As the statute puts it, once equipped with "competent, unbiased information," Congress may "utilize this information...as one factor in the legislative assessment of matters pending before the Congress, particularly in those instances where the Federal Government may be called upon to consider support for, or management or regulation of, technological applications."[33] Congress's lack of technical knowledge is thus understood as a special—and especially significant—instance of a more general trend accelerated by the war: the weakening of Congress relative to the executive branch.[34]

These three conceptions of technology assessment are distinct. Consider that TA1, by itself, is neutral with respect to *who* performs technology assessments, at least in principle. If TA1 is a matter of evaluating the potential effects of emerging technology, then it is something that could be performed by any branch of government or qualified private organization. And, indeed, some early proposals included an executive branch technology assessment office or a

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[31] United States Congress, House Committee on Science and Astronautics, "Panel on Science and Technology, Fifth Annual Meeting, Proceedings," 88th Congress, 1st Session (Washington, DC: Government Printing Office, 1963), p. 37. Cited in Kunkle, "New Challenge or the Past Revisited?," op. cit.

[32] U.S. Congress, House Committee on Science and Astronautics, Subcommittee on Science, Research and Development, "Technology Assessment and the Environment: Hearings before the Subcommittee on Science, Research and Development," U.S. 91st Congress, 2nd Session (Washington, DC: Government Printing Office, 1970), pp. 739–740. Cited in Kunkle, "New Challenge or the Past Revisited?," op. cit.

[33] Pub. Law No. 92-484, 92d Cong., H.R. 10243 (1972).

[34] Kunkle is therefore right to insist that "Historically,...the OTA is best understood as a part of the broader congressional reforms of the 1970s, the most visible of which were the War Powers Act in 1973 and the creation of the Congressional Budget Office in 1974." For more on the erosion of congressional capacity and its consequences, see Kevin Kosar et al., "Restoring Congress as the First Branch," R Street Policy Study no. 50 (January 2016), https://www.rstreet.org/wp-content/uploads/2016/01/RSTREET50.pdf.

hybrid, while others documented the various federal entities that already performed technology assessment.[35]

TA2, for its part, need not encompass the more holistic, cross-disciplinary, and qualitative components that are central to TA1. On the contrary, such technical expertise is, even paradigmatically, considered to be quantitative, distinct in kind from the types of value judgments that prevail in the political sphere. Nor is there any prima facie reason to assume that such expertise should be housed in an explicitly political institution such as the U.S. Congress (as opposed to other governmental or academic institutions). On the contrary, it was precisely to insulate expertise from political pressures that so many administrative agencies were lodged in the executive rather than legislative branch.

In contrast to TA2, TA3 is explicitly political in motivation, intended to help Congress take power back from the executive branch. Here the importance of technical expertise is first and foremost institutional rather than technocratic. Where such expertise lives and who controls it are more important than whether it is accurate or authoritative.[36] Indeed, Congress's institutional demands need not—and as we shall see as a matter of historical fact did not—always align perfectly with expert (or popular) demands. This is most obvious in the case of the "early warning" function.

Assessing What?

It is too infrequently noted that the Technology Assessment Act refers to "technology" rather than "science." In fact, the term "science" appears only a handful of times in the text of the statute, and then only in the context of describing the activities of the National Science Foundation. The stated rationale for the creation of OTA is the fact that "technology continues to change and expand rapidly," with applications that are "(1) Large and growing in scale; and (2) increasingly extensive, pervasive, and critical in their impact, beneficial and adverse, on the natural and social environment."[37]

This emphasis on technology as opposed to science may be found in both the political and scholarly debates leading up to the creation of OTA. Indeed, when introducing legislation to create a technology assessment office in 1970, Daddario explained his rationale thus:

> Mr. Speaker, probably the greatest single force for both good and evil which is abroad in the land today is technology. In large part the destiny of the human race depends on what we choose to make of science and its handmaiden, technology. This is not just an isolated

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[35] See the NAS report, op. cit., as well as Vary Coates, "Technology and Public Policy: The Process of Technology Assessment in the Federal Government," Summary Report, Program of Policy Studies in Science & Technology (George Washington University, 1972).

[36] This bears some resemblance to (but is distinguishable from) what David Whiteman refers to as a "strategic" use of technology assessment. See his "Technology Assessment," in *The Politics of Technology Assessment*, David O'Brien and Donald Marchand, eds. (Lexington Books, 1982).

[37] Pub. Law 92-484 92d Cong., H.R. 10243 (1972).

> opinion. It is shared by an overwhelming majority of the most thoughtful and best educated people in this Nation.[38]

Similarly, the NAE report states its objective as developing "dependable means" to "identify, study, and forecast" the various types of "social impact of technological development."[39] And the NAS report states explicitly that its "concern...is not with the effects of science—what man knows or hypothesizes about his world—but with the effects of technology —what man can do and chooses to do with what he knows."[40]

This conception of technology assessment—which more or less aligns with what we have called the canonical conception, TA1—has four essential characteristics.

First, the emphasis on the secondary and tertiary consequences of technology means that technology assessment is not purely quantitative in nature. A theme running through the early literature is the inadequacy of purely quantitative methods of evaluating technologies, such as traditional cost-benefit analysis. The NAE report is explicit on this point: "The appraisal of the accumulated spectrum of consequences of technological developments must include the derivation and use of measures of social value pertinent to the 'quality of life,' in addition to the conventional economic and technical risk-benefit criteria."[41] Assessing technology therefore requires consideration of qualitative effects in addition to those that are measurable using traditional, e.g., mathematical, methods. As one scholar put it: "We have learned one thing well —that impacts and amenities which are unmeasurable or unquantifiable are nevertheless real and should be as integral to decision-making as quantifiable technical and economic considerations."[42]

A second essential characteristic of TA1 is the indispensable role played by value judgments in assessing technologies' impacts. As the NAE report puts it, "This approach demands an integrated combination of information and value judgment that cannot always be formulated explicitly....Technology assessments without social value measures will be incomplete."[43] If technology assessment goes beyond purely quantitative or empirical measures, it must make appeal to some other methods of evaluation. And these methods will necessarily be value-laden precisely because the technological impacts to be evaluated are not purely quantitative or empirical but concern social, cultural, political, and ethical factors. What would it

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[38] H.R., *Congressional Record* (April 16, 1970), p. 12110. Cited in Kunkle, "New Challenge or the Past Revisited?," op. cit.

[39] NAE report, op. cit., p. 3.

[40] NAS report, op. cit., p. 9.

[41] NAE report, op. cit., p. 5.

[42] Michael S. Baram, "Technology Assessment and Social Control," in *Science, Technology, and National Policy*, Thomas J. Kuehn and Alan L. Porter, eds. (Ithaca: Cornell University Press, 1981; article orig. published 1973), p. 456.

[43] NAE report, op. cit., pp. 17, 20.

mean to assess the moral and political stakes of nuclear proliferation, the behavioral and environmental impacts of a new transportation system, or the privacy implications of surveillance techniques—to name only a few of the issues cited by the NAS report[44]—without appeal to at least some social values? Clearly, "these and esthetic values which cannot be quantified are nevertheless part of the ultimate judgment of technological progress," as Daddario pointed out.[45]

Third, consideration of the secondary and tertiary consequences of technology means that technology assessment is inherently cross-disciplinary—"trans-scientific," in Michael Baram's phrase.[46] That is to say, adequate consideration of the full spectrum of possible impacts—physical, biological, economic, social, political, and so on—requires drawing on multiple disciplines from the natural and social sciences as well as the liberal arts. Therefore, besides the predominantly quantitative fields that provide various types of data, Daddario insists that technology assessment must also "integrate...the five value realms of science, economics, politics, society, and law."[47] A priori, such an approach renders highly unlikely and perhaps even undesirable the achievement of the type of disciplinary "consensus" that is often taken to be prerequisite for strictly scientific advice, such as that provided by the National Academies.

Fourth, in the TA1 conception, technology assessment must incorporate not just multiple disciplinary methods but also diverse viewpoints, especially those of the relevant "stakeholders." This includes not only special interests but also "those who feel excluded from power in an increasingly technical civilization."[48] Thus the multifaceted nature of technology assessment is not merely a disciplinary matter but has political import. As Daddario put it: "Technology Assessment must include many nontechnological factors....Other voices of society are also necessary for we are interested in assessment in terms of human values as well as natural science statistics."[49]

Considered in this light, the subject matter of TA1 is not only broader than "technical expertise," it is broader even than technology, at least as it is ordinarily understood. As the NAS report observes:

> Technology as such is not the subject of this report, much less the subject of this panel's indictment. Our subject, instead, is human behavior and institutions, and our purpose is

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[44] NAS report, op. cit., p. 1.

[45] Statement of Emilio Q. Daddario, Chairman, Subcommittee on Science, Research, and Development of the Committee on Science and Astronautics, U.S. House of Representatives, Ninetieth Congress, First Session. (Washington, DC: Government Printing Office, 1967), p. 15.

[46] Baram, "Technology Assessment and Social Control," op. cit., p. 455. The term "trans-science" was coined and popularized by Alvin Weinberg in a 1972 article published in *Minerva*.

[47] Statement of Emilio Q. Daddario, op. cit., p. 15.

[48] NAS report, op. cit., p. 1.

[49] Statement of Emilio Q. Daddario, op. cit., p. 15.

> not to conceive ways to curb or retrain or otherwise "fix" technology but rather to conceive ways to discover and repair the deficiencies in the processes and institutions by which society puts the tools of science and technology to work.[50]

Indeed, the term "technology" is, like the term "technology assessment," ambiguous. As Black points out, "technology is often thought of narrowly...as a synonym for science, scientific research, development and engineering."[51] By contrast, the concept of technology that is operative in TA1 is much richer, essentially linked to social arrangements and the implicit understanding of rationality therein. Drawing on the writings of French philosopher Jacques Ellul, Black calls this broader understanding of technology "technique":

> The term *technique*, as I use it, does not mean machines, technology, or this or that procedure for attaining an end. In our technological society, *technique* is the totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity.[52]

Now we can understand the significance of the "early warning" function of technology assessment. Temporality matters not because technology assessment inherently involves prediction but rather because, as the NAS report explains, it is in the "initial stages of technological development" and "technological application" that "alternative possibilities are [still] being explored" and "early performance is being evaluated."[53] Technology assessment provides a "mechanism to trigger such studies in a systematic way at early stages in the process of development and diffusion," before it is too late.[54] The goal is not prediction so much as deliberation: to develop a proactive and democratically responsive approach to technological change so as to prevent technology from mastering us, rather than we it.

The Eclipse of Canonical Technology Assessment

TA1 is clearly continuous with and responsive to mounting popular concerns about the potentially harmful effects of technology and "technological society" in general.[55] However, this

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[50] NAS report, op. cit., p. 15. The second sentence appears in italics in the original.

[51] Black, "Technology Assessment—What Should it Be?," op. cit., p. 4.

[52] Jacques Ellul, *The Technological Society*, p. xxv, cited in Black, "Technology Assessment—What Should it Be?," op. cit., p. 5.

[53] NAS report, op. cit., p. 25.

[54] Ibid, p. 27.

[55] As Kunkle notes, "It seems clear that there was more on Daddario's mind, and indeed more to the subcommittee's mandate, than merely improving scientific and technical advice available to Congress. In addition to being established for the purpose of coordinating scientific and technical information for the Congress, the Subcommittee on Science, Research and Development was created to take a greater role in directing scientific and technological development" (Kunkle, "New Challenge or the Past Revisited?," op. cit., pp. 175–196).

is not to say that technology assessment was originally the product of Luddism, or a simple desire to regulate technology, even if such motivations can be found among some of the early advocates of technology assessment.[56]

On the contrary, Daddario himself, along with both the NAS and NAE reports, took pains to emphasize the many benefits of modern technology as well as the need for further innovations to help in coping with technology's negative side effects.[57] The NAS report, for instance, cautions that "despite the long history of inattention to the wider consequences of technological change...our panel starts from the conviction that the advances of technology have yielded and still yield benefits that, on the whole, vastly outweigh all the injuries they have caused and continue to cause." In a similar vein, the NAE report insists that technology assessment requires pursuing

> with equal fervor the development of both the creative possibilities of technology and the defensive needs of society. Preoccupation with emerging problem areas, particularly those that seem to require regulatory legislation, can easily stifle innovative technical and social contributions.[58]

Nevertheless, such qualifications were not sufficient to prevent political opposition from gaining momentum during the early 1970s, partly fueled by the perception that technology assessment was just cover for regulatory overreach. As Kunkle observes: "Critics of governmental interference in the innovative process began deriding the concept as 'technology arrestment' and 'technology harassment.'"[59]

Accordingly, the political arguments in favor of OTA that won the day were not those that appealed to a democratic demand for "social control" of technology but rather—and perhaps unsurprisingly—those that appealed to Congress's institutional needs. OTA came to be seen first and foremost as a potential solution to the problem of congressional capacity, especially vis-à-vis the executive branch. As Rep. Mosher put it:

> Let us face it Mr. Chairman, we in the Congress are constantly outmanned and outgunned by the expertise of the executive agencies. We desperately need a stronger source of professional advice and information, more immediately and entirely responsible to us and

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[56] See, for example, Baram, "Technology Assessment and Social Control," op. cit.

[57] See, e.g., Statement of Emilio Q. Daddario, op. cit. Kunkle ("New Challenge or the Past Revisited?," op. cit.) also emphasizes this point vis-à-vis Daddario.

[58] NAE report, op. cit., p. 21.

[59] Kunkle, "New Challenge or the Past Revisited?," op. cit.

> responsive to the demands of our own committees, in order to more nearly match those resources in the executive agencies.[60]

That is to say, the imbalance of power between the legislative and executive branches of government was thought to be in part the result of an imbalance of expertise. Hence Congress needed "better information and advice" to "make decisions which involve the use of new technology."[61] In effect, TA2 was needed to shore up TA3, to empower Congress to make decisions about science and technology and to conduct oversight of executive agencies.

As has been extensively documented elsewhere, one result of this justification for technology assessment was that the "early warning" function tended to get overshadowed in the political deliberations about OTA and, ultimately, even in the practice of OTA itself.[62] As Blair wrote in 1994:

> The OTA was created in 1972 by the U.S. Congress to "provide early indications of the probable beneficial and adverse impacts of the applications of technology." This original mandate has evolved somewhat over time: the agency is now regarded as fulfilling a more general role of providing congressional committees, which are the key policy formulating vehicles in the Congress, with objective analysis of public policy issues related to scientific and technological change.[63]

Consequently, OTA evolved into a "more information-oriented agency, as opposed to a policy advocate 'assessing' alternatives," one that "more closely resembles the CRS than it did in its hypothetical stage."[64] Ironically, the political motivation for this technocratic view of technology assessment—Congress's effort to counterbalance executive power—would also recede. By the time congressional Republicans began calling for OTA's elimination, arguments about the separation of powers and the expansion of the administrative state—arguments that might have in principle appealed to conservatives—were conspicuous only by their relative absence. Instead,

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[60] U.S. Congress, House Committee on Science and Astronautics, Subcommittee on Science, Research and Development, "Technology Assessment and the Environment: Hearings before the Subcommittee on Science, Research and Development," U.S. 91st Congress, 2nd Session (Washington, DC: Government Printing Office, 1970), p. 3203. Cited in Kunkle, "New Challenge or the Past Revisited?," op. cit.

[61] House of Representatives, *Congressional Record* (February 8, 1972), p. 3203. Quoted in Kunkle, "New Challenge or the Past Revisited?," op. cit.

[62] See Peter D. Blair, "Technology Assessment: Current Trends and the Myth of a Formula," adapted from plenary remarks at the First Meeting of the International Association of Technology Assessment and Forecasting Institutions (May 2, 1994), https://www.princeton.edu/~ota/ns20/blair_f.html; Blair, *Congress's Own Think Tank*, op. cit.; Bimber, *The Politics of Expertise in Congress*, op. cit.; and Kunkle, "New Challenge or the Past Revisited?," op. cit.

[63] Blair, "Technology Assessment: Current Trends and the Myth of a Formula," op. cit.

[64] Kunkle, "New Challenge or the Past Revisited?," op. cit.

the debates over OTA's future tended to focus on whether OTA was duplicative of other information-oriented service agencies.[65]

Today, a quarter-century after OTA was shuttered, the canonical conception of technology assessment as a deliberative and democratically responsive mechanism by which to grapple with the social, ethical, and political ramifications of modern technology is largely absent from policy debates about congressional expertise. This is unfortunate, since such a mechanism is arguably what is most urgently needed now—and is something a revived and reformed OTA would be well positioned to help us achieve.

Conclusion

What would it mean to revive TA1 today? It would *not* mean jettisoning the other conceptions of technology assessment. Though distinct, TA1, TA2, and TA3 are interrelated, both conceptually and historically, and can serve to mutually support and counterbalance each other.

How so? First, assessing the secondary and tertiary impacts of technologies plainly requires authoritative technical information (TA2), including quantitative information, even if the latter is by itself insufficient for the task. TA2 can also provide a quantitative counterweight to any alarmist tendencies to which TA1 might give expression. Conversely, TA1 helps ensure that technology assessment does not ignore social and other factors that are not easily captured by quantitative methods, or perpetuate the illusion that policy analysis can ever be entirely insulated from value judgments.[66] TA3, for its part, leavens both TA1's latent tendency toward "social control" of technology and TA2's technocratic inclinations by situating technology assessment within a representative political body that is responsive to a plurality of viewpoints and interests. Finally, TA2 can help prevent Congress's use of expertise from becoming merely strategic or political, rather than guided by the best available evidence.

This dynamic interplay between conceptions of technology assessment may be illustrated by considering three objections to the idea of TA1 as it might be practiced in a revived OTA.

The first and most common objection is that there is simply insufficient demand for TA1—that rather than ponderous, lengthy reflections on technocratic society that no one has time to read, what Congress needs is reliable and easily digestible technical information. As a recent report on science and technology (S&T) advice for Congress puts it: "Congress desires that S&T products be provided in a manner that is easy to understand for non-S&T experts, allowing

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[65] Accusations of political bias, although less prevalent than considerations of "waste" and government bloat, can be said to follow the same pattern, since the earliest motivations for OTA were explicitly political in nature, rather than couched in the value-neutral language of "technical expertise."

[66] As Mark R. Berg points out: "Technology assessment...cannot be isolated from politics on the basis of its having 'objective' empirical and analytic content nor as a nonpartisan management tool. *All the way from the sources of demand for technology assessment to its final outputs and effects, TA is neither value free, nor value neutral, nor nonpolitical.*" From "The Politics of Technology Assessment," in *Science, Technology, and National Policy*, Thomas J. Kuehn and Alan L. Porter, eds. (Ithaca: Cornell University Press, 1981; article orig. published 1975), p. 476; emphasis in the original.

extremely busy staffs and Members to quickly grasp key information and, sometimes, central recommendations."[67]

The first thing to say about this observation is that it is not new. As one scholar put it in 1975, "The holistic, planful, systematic approach of TA runs counter to many characteristics of current policy-making processes such as short time horizons, nonholistic disjointed incrementalism, pluralistic power centers, and bureaucratic politics."[68] It has long been the case that members of Congress and their staffs are busy, operate on tight deadlines, and have to contend with a dizzying array of political forces, issue areas, and sources of information—leaving them insufficient time and attention to devote to complex technical problems. Another scholar, writing in 1982, described the organizational environment in which OTA operated as

> one that is sometimes hostile, sometimes supportive, but largely indifferent to [OTA's] work. Congressional politics has traditionally not been characterized by an interest in comprehensive, long-term assessments of the "physical, biological, economic, social, and political effects" of technological applications.[69]

As a result, any renewed attempt to give institutional expression to something like TA1 is bound to face considerable institutional obstacles, as OTA did. It is true that declining congressional capacity has worsened this state of affairs. But lack of demand is a highly questionable starting premise for considering proposed remedies for institutional dysfunction.

What's more, the claim that what we most need now are quick fixes to some of the most challenging and persistent problems posed by modern technology is puzzling on its face. Surely problems such as climate change or cybersecurity or encryption or digital disinformation are precisely those for which genuine solutions are most desperately needed. Developing such solutions—and doing so in a way that is both evidence-based and responsive to a wide range of stakeholders and citizen demands—may take time, indeed, but difficult problems tend not to be solved quickly. To object that there is little institutional demand for such solutions is merely to restate the problem to which TA1 is a proposed solution.

A second objection is that by including nonquantitative considerations, TA1 introduces "unscientific" variables into the practice of technology assessment, opening the door to anti-scientific points of view or irresolvable value disputes. Besides presupposing an implausible picture of scientific expertise,[70] this objection ignores the express purpose of TA1, which is to assess secondary and tertiary effects of new technology—precisely those effects to which a narrowly "scientific" approach is blind. As the NAS report puts it:

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[67] NAPA, *Science and Technology Policy Assessment: A Congressionally Directed Review*, op. cit., p. 20.

[68] Berg, "The Politics of Technology Assessment," op. cit., pp. 487–488.

[69] Whiteman, "Technology Assessment," op. cit., p. 51.

[70] See Daniel Sarewitz, "How Science Makes Environmental Controversies Worse," *Environmental Science & Policy*, vol. 7, issue 5 (October 2004), pp. 385–403 as well as Zach Graves and M. Anthony Mills, "Reviving Expertise in a Populist Age," *The New Atlantis* (Fall 2019).

> Selections among alternative technologies require that choices be made among competing and conflicting interests and values. To the extent that those choices are made and enforced collectively rather than individually, they are essentially political in character and must therefore be the responsibility of the politically responsive branches of government and of those publicly accountable bodies that are specifically entrusted with regulatory responsibilities in narrowly circumscribed areas. The making of such choices is, in principle, indistinguishable from the resolution of the many other conflicts that beset society. To entrust the resolution of all those conflicts to a single, all-encompassing authority would be incompatible with representative government.[71]

In other words, the impulse to address the problems posed by technology without due consideration of social values is essentially anti-political. Disagreements about values and clashing interests may lead to inefficiency or even technically suboptimal policy outcomes. But such disagreements and conflicts are the stuff that democratic politics is made of. To suppress these is to put rational efficiency ahead of other goods.

A final objection is that TA1 will lead to regulatory overreach. We have already seen that this objection, however historically significant, rests on an unfair characterization of TA1. Yet, what this objection rightly picks up on is the fact that TA1 is open to the possibility that there may need to be "some limits," if only to prevent the proliferation of technologies "without the gathering of fairly definite evidence...as to the character and extent of possible harmful effects."[72] Clearly, TA1 is not a purely laissez-faire approach and so it is liable to offend certain libertarian sensibilities. The NAS report is explicit on this point:

> The panel believes that there should be such limits....Society simply cannot afford to assume that the harmful consequences of prevalent technological trends will be negligible or will prove readily correctable when they appear; waiting until deleterious effects become evident entails too high a risk.[73]

At first glance, this passage appears to be a cut-and-dried statement of the so-called precautionary principle, according to which regulation of technology is permissible in advance of scientific evidence of harm. But closer scrutiny of the context surrounding this passage dispels this interpretation. Focusing only on such "precautionary" language ignores the *means* by which such limits are to be identified or imposed, if at all.

OTA never possessed regulatory powers. And this was not merely a political compromise, but rather flows from the earliest motivations for conceptualizations of the practice of technology

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[71] NAS report, op. cit., pp. 81–82.

[72] Ibid., p. 34.

[73] Ibid., pp. 34–35.

assessment. The NAS report, for instance, explicitly cautions against centralized regulatory means of redressing harms caused by technology:

> The panel would emphatically oppose any scheme that would empower an agency to decide, on behalf of something called "society" or "the environment," which technological developments will be permitted and which prohibited....Any new assessment entity we propose, therefore, should be empowered to study and to recommend but not to act. It must be able to evaluate but neither to sponsor nor to prevent.[74]

This is the significance of TA3: Technology assessment is intended to help the legislature deliberate about technological developments, thus empowering elected representatives—rather than unelected bureaucrats—to decide if and how to act.[75] Congress, not executive agencies, is the natural setting for such democratic deliberation. In this sense, despite libertarian fears, TA1 can be seen as a deliberative complement to, rather than a rejection of, a regulatory environment conducive to "permissionless innovation."[76]

It is perfectly reasonable to worry about the unintended effects of regulatory overreach on the development of technology. But it is also reasonable—indeed it is obviously desirable—for citizens and their representatives to deliberate together about the impacts of emerging technologies, and to do so with both requisite expert involvement and a plurality of stakeholders. Conservatives who balk at this proposition when it comes to certain domains, such as energy or the environment, may be more sympathetic when it comes to others, such as biotechnology. Conversely, progressives who characterize conservatives' attempts to impose moral constraints on certain lines of biotechnological development as "anti-science" often advocate the precautionary principle for environmental purposes. What this suggests (besides a certain degree of inconsistency in our politics) is a broadly shared conviction about the need for deliberation about the ethical and social impacts of technology, along with disagreements about *which* technologies and *what* impacts—a demand, in other words, for precisely the kind of democratic deliberation that technology assessment was originally intended to facilitate.

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74 Ibid., pp. 81, 82. The last two quoted sentences appear in italics in the original.

75 See Graves and Mills, "Reviving Expertise in a Populist Age," op. cit.

76 The term "permissionless innovation" was coined by Adam Thierer; see his *Permissionless Innovation: The Continuing Case for Comprehensive Technological Freedom* (Mercatus Center at George Washington University, 2016). He defines it as "the notion that experimentation with new technologies and business models should generally be permitted by default. Unless a compelling case can be made that a new invention will bring serious harm to society, innovation should be allowed to continue unabated and problems, if any develop, can be addressed later" (p. 1).