The Congressional Futures Office

A Modern Model for Science & Technology Expertise in Congress

Grant Tudor
Justin Warner
“Nothing has had more impact on the quality of life than the application of science both positively and negatively. The obvious challenge is to apply our scientific knowledge in ways that will maximize the positive and minimize the negative. But for every force there is a counterforce. For every giant step we take for mankind, we seem inexorably to slip backward a little. For every button we push on the gigantic game board of science, another seems to pop up elsewhere on the board.”

Russell W. Peterson, 1979
Director, Office of Technology Assessment
ACKNOWLEDGEMENTS

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<td>AAAS</td>
<td>American Association for the Advancement of Science</td>
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<td>CBO</td>
<td>Congressional Budget Office</td>
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<td>CRS</td>
<td>Congressional Research Service</td>
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<td>CFO</td>
<td>Congressional Futures Office</td>
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<td>DOE</td>
<td>Department of Energy</td>
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<td>FAS</td>
<td>Federation of American Scientists</td>
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<td>GAO</td>
<td>Government Accountability Office</td>
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<td>JCST</td>
<td>Joint Committee on Science and Technology</td>
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<td>JTBD</td>
<td>Job(s)-to-be-done</td>
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<td>NASEM</td>
<td>National Academy of Sciences, Engineering, and Medicine</td>
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<td>NRC</td>
<td>National Research Council (of the National Academies)</td>
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<td>OMB</td>
<td>Office of Management and Budget</td>
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<td>OSTP</td>
<td>Office of Science and Technology Policy</td>
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<td>OTA</td>
<td>Office of Technology Assessment</td>
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<td>S&amp;T</td>
<td>Science and Technology</td>
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<td>STAA</td>
<td>Science, Technology Assessment and Analytics</td>
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EXECUTIVE SUMMARY

This report interrogates the widening gap between responsive lawmaking in Congress and the deepening complexity of advancements in science and technology. It finds that certain weakened capabilities have atrophied the organization’s *absorptive capacity*, or the ways by which it recognizes the value of, assimilates, and makes use of knowledge outside of itself. We propose the design of a new internal body – the Congressional Futures Office – as an optimal response among a set of considered options.

* * *

Federal lawmaking is failing to adequately address issues of public interest associated with S&T advancements. We observe that legislative outcomes, ranging from inefficiencies in public programs to antiquated regulatory frameworks, do not reflect most lawmakers’ intentions. Inadequate or unresponsive lawmaking to S&T-related challenges is not likely a deliberate decision of Congress. Instead, lawmakers struggle to devise effective legislative responses.

The problem is not a lack of technical information. Instead, internal capabilities are unable to cope with a surfeit of external expertise, which is typically unattuned to congressional needs. Decreases in congressional resources in terms of people and funding have handicapped the institution. Further, phenomena such as hyperpolarization and the circumvention of committees have increasingly curbed internal information processing functions. While there exists bipartisan appetite to address select S&T-related issues – variable by topic and committee of jurisdiction – partisan and present-focused priorities also limit the role of expertise.

These weakened organizational capabilities have atrophied Congress’s absorptive capacity: its ability to recognize the value of new, external information, to assimilate it, and to apply it to desired ends. For private firms, absorptive capacity is essential to long-term survival; innovation rests on recognizing new knowledge in the external environment and integrating it into internal activities. For Congress, a decreasing ability to successfully exploit external knowledge generates poor legislative outcomes.

External entities and internal support bodies are failing to address these institutional constraints. Large technology companies have expanded lobbying capacities to preempt or influence regulation, biasing their expansive sources of expertise. Increasing ideological bias also colors the work of civil society actors such as think tanks. Questions of credibility and usefulness plague both sources. Further, Congress’s existing support functions (e.g., CRS, GAO, NASEM) are limited in their S&T-relevant capacities to support policymaking given current mandates, methods, and products. Expanding their services is unlikely to comprehensively address the widening gap between lawmaking and S&T advancements.
Congress previously had a body exclusively dedicated to providing analytical support on S&T-related policy matters. The Office of Technology Assessment (OTA) was embedded inside Congress, formally producing ‘technology assessments’ and informally engaging with members and staff on complex S&T issues. While it generated substantial value – as reported by members and staff themselves and as reflected in various indicators of legislative impact – the usefulness of its products faced legitimate criticisms. It was also subjected to political criticisms of partisan bias. OTA was defunded in 1995 after 23 years in operation, made possible by having directly served only a narrow constituency within Congress.

Simply reinstating OTA, however, is not an appropriate solution to today’s problems. Successful attributes of the body, including its intimate access and frequent interactions with members and staff, suggest necessary features of any intervention to enhance Congress’s absorptive capacity. However, significant institutional changes within Congress, combined with prior operational weaknesses of OTA, would not position a reinstated body for success. Historical political challenges, moreover, hamper what should otherwise be a bipartisan effort to address congressional constraints.

Efforts to build OTA-like capacities at existing congressional support services exhibit limited potential for impact. Recent approaches, such as the creation of STAA at GAO, address a limited scope of heterogeneous and pressing congressional needs as diagnosed in this report; services typically mirror OTA-like products, themselves of limited use in today’s environment. Additionally, a lack of embeddedness within Congress is disadvantageous for addressing the nuanced institutional constraints weakening Congress’s ability to make use of external knowledge across an expanse of S&T-related policy domains.

Congress should establish a new and deeply embedded internal support body better suited to its needs and contemporary context. Strengthening Congress’s capabilities requires a reinvented model for integrating external expertise into the policymaking process. We propose the Congressional Futures Office (CFO) as a novel model of congressional support. OTA exemplified a breakthrough approach for its time – later copied widely across Europe. Rather than replicate past solutions, Congress should again take the lead in science and technology policymaking with a deliberate, modernized, and experimental approach.

CFO models how a modern support body would enhance Congress’s ability to transform external knowledge into better legislative outcomes. Its institutional design reflects a response to Congress’s central problem of low absorptive capacity. As an embedded function, CFO is designed to generate value for a broad congressional constituency, gradually strengthening capabilities through open-ended product-service design and dispersed global networks of expertise. It takes the approach that addressing large and difficult S&T issues starts with satisfying proximate and pressing congressional needs.

Through the model, we additionally illustrate how factors both external and internal to Congress examined in this report would influence a new body’s design and draw upon learnings from the
This report provides policymakers and other analysts with analysis underlying the approach and a blueprint to make it practically operational.

### Congressional Futures Office: Summary of primary design elements

| **Mandate** | CFO should be established to enhance Congress’s abilities to **collect**, **process**, and **make use of** technological and scientific knowledge |
| **Strategy** | Prioritizing the **proximate needs** of a broad congressional constituency through **open-ended product-service design** and **expansive networks of expertise** under partisan constraints |
| **Product-Service Design** | Products are designed in response to identified needs: the **proximate challenges** members and staff face (“jobs-to-be-done”) relating to S&T expertise across policymaking. Product prioritization and design considers each product’s potential to **build absorptive capacity** and likelihood to be **valued by a congressional audience** |
| **Governance** | Led by an **empowered Director**, selected and authorized by a newly-established Joint Committee on Science & Technology (JCST) |
| **Structure** | Organized according to **type of products**, rather than topical domains, with deliberate **interdependencies** between product groups |
| **Operations** | Director meets congressional demand under resource constraints through **demand management**, **supply management**, and **topic selection** |
| **Priorities** | Bias towards hiring **problem-focused experts**, as opposed to subject-matter experts, on permanent bases while utilizing **flexible structures** to involve topical expertise as-needed |
| **People** | Culture of **risk-tolerance** and **rapid experimentation** developed through formal structures, choice of Director, and operational decisions |
| **Culture** | Rigorous internal assessment mechanism facilitating broad communication of the value generated by CFO, with metrics aligned to the motivating values of different groups |
| **Evaluation & Adaptation** | Rapid learning and experimentation through intimate access and daily interactions with congressional members and staff |
MOTIVATION: What’s at stake?

A national panic and an old report

In the months following the September 11th attacks, an anthrax scare rippled across the Eastern seaboard. Anonymous letters traced with the lethal substance made its way into mailrooms, media company offices, and eventually the U.S Congress. By that November, five had died and dozens had tested positive.¹

As Congress scrambled to understand the nature of the threat and the best available options to protect civilians, legislators and their staff pulled from a 1992 report, *Proliferation of Weapons of Mass Destruction: Assessing the Risks*. It packaged together an analysis “of what nuclear, chemical, and biological weapons can do... [and] the technical aspects of monitoring and controlling [them],” along with “the array of policy tools that can be used to combat proliferation.”² Included was policy-relevant information on biochemical attacks, including anthrax.

At a Congressional hearing that November, legislators cited the report’s decade-old findings: for example, that given the right weather conditions, 100 kilograms of the bacteria released in the nation’s capital could kill up to 3 million people – a casualty outcome on par with a hydrogen bomb. According to Dan McGraw of the American Society for Engineering Education, “in the rush to sort out fact from fiction, rumor from real scientific fact, Congress was using reliable information from a group that was charged with studying the real ramifications of bioterrorism.”³

The group, the Office of Technology Assessment (OTA), was an organ of the U.S. Congress: created by Congress in 1972 to serve it exclusively on all matters of science and technology, and defunded by Congress in 1995. The first ‘technology assessment’ body of its kind for a legislative institution, OTA inspired others to follow suit, from Germany to the United Kingdom; dozens of technology assessment-like functions now serve legislative bodies around the world. While by November 2001 OTA’s doors had long since been shuttered, the impact of its work could still be felt by its creators.

Increasing complexity and decreasing comprehension

Major headlines so far this year have included the roll-out of fifth-generation (5G) wireless broadband; the piloting of autonomous vehicles; the encryption of cellular devices; the rapid advancement of artificial intelligence (AI); proposed applications of large-scale geo-engineering; sustained increases in opioid-related overdose deaths; the proliferation of advanced gene editing; the expansion of cryptocurrencies in the U.S. financial system; the development of ring dikes and...
other flood control measures for major metropolises; a surge of cyber attacks on the U.S. military and its industry partners; the commercial use of autonomous flying vehicles (AFVs); and the fidelity of verification technologies used in the enforcement of nuclear agreements.

Each carries profound policy implications. 5G wireless promises speeds of up to 100 times faster than current wireless connections, enabling other promising emerging technologies like autonomous vehicles and remote surgery. But the new and largely unsecured networks may also be at-risk of foreign hacking. The promise of geoengineering to mitigate climate change is coupled with ecological risks to forest cover and freshwater sources. CRISPR gene editing holds the potential to combat diseases from sickle-cell anemia to the Zika virus, but with controversial implications for heritable genetic changes in humans. Advances in machine learning and AI promise to enhance data collection and analysis capabilities for U.S. intelligence agencies while also increasing the sophistication of AI-enhanced data forgery.

Lawmakers have increasingly struggled with their complexity. Consider the Compliance with Court Orders Act of 2016 drafted by the Senate Judiciary Committee with largely bipartisan participation. Never formally introduced, the Act sought to regulate end-to-end encryption – in practice, disabling it – on cellular devices, permitting easier access by law enforcement. The Committee drafted the legislation shortly after a highly visible dispute between Apple and the FBI earlier that year, in which Apple protested the FBI’s demand to access encrypted consumer data during an investigation.

Issues of encryption are complex: certainly in terms of competing values such as privacy and security, but also in technical terms. Regarding the latter, the Act was met with a wall of resistance from scientists and technologists. Kevin Bankston, Director of the Open Technology Institute, charged that the Act was “easily the most ludicrous, dangerous, technically illiterate proposal I’ve ever seen.” A group of fifteen computer scientist and security experts compiled a report to help explain the scale of unintended but predictable consequences from the legislation. Senior government intelligence officials issued their own warnings. Riana Pfefferkorn, a cybersecurity expert at the Stanford Cyber Initiative, called the legislation “technologically tone-deaf,” critical that it assumed the existence of a “golden key” to user data available only to law enforcement, when in fact any “built-in means for accessing encrypted data can, and will, be used by the bad guys too.” The proposed policy surfaced a trade-off: broader accessibility by both law enforcement and “bad guys.” But did the draft legislation reflect an understanding on the part of lawmakers that the policy, given the technical elements of end-to-end encryption, would equally broaden access for both?
As Congress’s in-house group of S&T experts, OTA was charged with translating an issue’s complexity into relevant knowledge for members and staff and illuminating potential trade-offs associated with different courses of policy action. As mandated by the Technology Assessment Act of 1972, OTA would “identify existing or probable impacts of technology or technological programs; where possible, ascertain cause-and-effect relationships... [and] make estimates and comparisons of the impacts.” In light of scientific uncertainty and disagreements, OTA analyzed the scope of what was known and presented lawmakers with an array of policy approaches coupled with their possible trade-offs. Technical expertise contributed to an evidenced understanding of what different choices might entail.

“OTA provides options, yet doesn’t take sides on issues beyond the point where facts and strong consensus may carry OTA’s findings. There are many advocates of particular solutions – even the scientific community is an advocate in its dealings with the Congress – but OTA is unique in its almost idealistic mandate to remain free of advocacy.”

John Gibbons, 1984
Director, Office of Technology Assessment

Among major scientific bodies that weigh-in on public policy, this approach was unique. For example, the National Research Council (NRC), the operating arm of the National Academies of Science, Engineering, and Medicine (NASEM), provided a report to Congress on automotive fuel economy in the early 1990s. So, too, did OTA. The NRC’s report “studied the feasibility of various technical standards and recommended the standard that was scientifically the most valid. The OTA report, on the other hand, gave Congress a range of options, weighing the tradeoffs on fuel economy with economic issues, and the willingness of the public to go along with such reforms.”

By helping members of Congress to better understand the nature of a problem, and to provide a technical basis for the scope of policy choices available to them, OTA not only helped to educate and focus the debate on a policy issue, but also helped to inject a source of neutrality into it. To some degree, this counter-acted the influence of certain external information, including lobbying. A bill in 1980 was intended to require chemical marking of commercial explosives during the manufacturing process, in order to aid law enforcement agencies in investigating bombings. OTA was asked to research the utility of such a program, which was strongly opposed by explosives manufacturers. When the agency described three alternatives for legislative action in its study, the subcommittee considering the bill structured its report around the agency alternatives, voting explicitly among “OTA Option 1,” “OTA Option 2,” and “OTA Option 3.”
OTA worked in exclusive service to the Congress. Congress, in turn, enjoyed its own source of expertise.

Efforts to resurrect a version of the Compliance with Court Orders Act were reignited last year. A news outlet reported in April 2018 that “[s]taffers for the Senate Judiciary Committee have been speaking with representatives of large U.S. technology companies in recent months to receive feedback for potential future legislation...These representatives have so far included trade group associations and lobbyists for technology vendors.” Notably absent were Congress’s own internal experts.
CASE: Big, Preventable Failures

In 2009, Congress enacted the Health Information Technology for Economic and Clinical Health (HITECH) Act in an effort to modernize the country’s antiquated patient medical records system. The inability of patient records to move securely and seamlessly between healthcare providers has long placed large financial burdens on America’s healthcare system while harming clinical outcomes due to issues like information-related medical errors.

The HITECH Act, a proposal of the Obama Administration, allocated $30 billion in incentives for providers who digitized their records. By this measure, HITECH has been an extraordinary success: by 2014, three-quarters of hospitals had adopted a basic Electronic Health Records (EHR) system—an eightfold increase since 2008. While it remains unclear how much of the uptake can be attributed to HITECH, the sudden and steep increase since the Act’s passage is suggestive. However, digitizing health records matters only insofar as those records can be shared and deciphered among providers. As subsequent evaluations of HITECH have found, the Act failed to “prioritize ‘interoperability’ – the ability to transfer a medical file from one hospital to another.” Six years after the bill’s passage, less than a quarter of hospitals had received EHRs and integrated them into their own systems. U.S. Senators have publicly voiced concern that the promised cost savings have yet to materialize from the $30 billion federal investment.

A 2014 report by the Government Accountability Office (GAO) concluded that the standards required to transmit EHRs between systems did in fact exist but were likely insufficient. “Information that is electronically exchanged from one provider to another must adhere to the same standards in order to be interpreted and used in EHRs, thereby permitting interoperability,” the evaluation explained. However, there appeared to be “a lack of sufficient standards to support exchange.” As one former House staffer noted, “this whole thing could probably have been avoided if there was just one person in the room when the legislation was being drafted that knew the right question to ask: what about interoperability?”
CASE: Outdated Regulatory Regimes

In 2018, the American Vision for Safer Transportation Through Advancement of Revolutionary Technologies (AV START) Act stalled in the U.S. Senate, in practice killing the bill at the end of the 115th Congress. Had it passed, the Act would have been the first major overhaul to motor vehicle regulation since the National Traffic and Motor Vehicle Safety Act of 1966.

From 2014 to 2017, according to an analysis by the Brookings Institution, global investments into AV technologies approached $80 billion, with most investment activity concentrated in the U.S. Despite the growth of the AV industry, as one industry lobbyist involved with AV START observed, “AVs have been a small bubble of people,” with regulators and lawmakers not among them. “It shouldn’t be a surprise that Congress is not fluent in this arena.” Industry players, struggling with variable state-by-state regulations, have been responsible for pushing Congress to update the decades-old federal regulatory regime.

According to researchers, the success of AVs in accomplishing goals of high public value – such as a substantial reduction in road fatalities – is contingent upon modernized regulation. The National Highway Traffic Safety Administration, the responsible federal regulatory agency, has to date only provided voluntary and unenforceable guidelines for industry. Meanwhile, independent experts have identified a suite of new rules that would clarify the regulatory environment and support market development, including standardized and mandatory data reporting to aggregate information on safety issues identified during testing and deployment; industry-wide standards for testing and development prior to deployment on public roads, along with protocols for testing on public roads; and methods for detecting and responding to cybersecurity threats targeted at AVs.

According to one transportation expert, there are currently “73 federal vehicle safety regulations that incorporate 257 standards, with half of them dating back before 1980. Nearly all federal auto safety regulations codify technical standards that are years, if not decades, out of date.” That these regulations have failed to keep pace with technological developments in transport carries implications for industry competitiveness.

For example, adaptive driving beam (ADB) headlamps have been available for years in Europe and Japan. With ADB headlamp setups, an onboard camera detects oncoming or leading vehicles, whose drivers could otherwise be temporarily blinded by headlamp glare, and raises or lowers the ADB lighting—made up of dozens of LED bulbs—accordingly. However, in the United States, regulations relying on decades-old technical standards that require headlamps to have distinct high- and low-beam settings make this safety-enhancing technology verboten.

Members of the House, who successfully passed a version of AV START, voiced concern that the Senate’s failure to pass corresponding legislation would cede U.S. industry’s “innovation edge” to Germany, Singapore, and China, where AV investments are also growing and where regulatory regimes are being updated to accommodate the new technologies.
OBSERVED PROBLEM:
What’s confronting Congress?

The scale and complexity of S&T issues relevant to public policy raises the urgent question: are our lawmakers – rarely professionals with scientific backgrounds themselves – engaging in democratic decision-making based upon a foundation of relevant knowledge? Are the technical dimensions of S&T-relevant legislation understood, and are the trade-offs associated with different policy options well interrogated?

“Science and technology are a part of the fabric of nearly everything Congress now does, even if it doesn’t always realize it.”

Peter Blair, Executive Director, 2019
NRC Division on Engineering and Physical Sciences

A 2019 report by the Congressional Research Service (CRS) anticipates ten categories of major S&T issues likely to confront the 116th Congress (Exhibit 1). Each category includes a basket of pressing policy topics. The selected topics range from the proliferation of advanced gene editing tools to emerging crises in water quality and scarcity. This sample of fast-moving and technically complex issues carries profound social, economic and security implications for the U.S. Lawmakers have increasingly struggled with their complexity. The list, too, is getting larger and more complex: compared to a similar report prepared for the 115th Congress, 14 S&T issues were added to the agenda while only 5 were taken off.

As a result, devised policies (or an absence of policies) are generating unintended consequences (e.g., Compliance with Court Orders Act), permitting large-scale waste of federal dollars (e.g., HITECH Act), and stalling regulatory overhauls necessary for U.S. competitiveness (e.g., outdated vehicle standards). Legislative responsiveness to the challenges associated with S&T issues has deteriorated as the complexity of S&T issues has considerably deepened, with far-reaching implications.

The observations of legislation (or lack thereof) that struggles to respond to the challenges associated with S&T advancements are not intended to impute a value for legislative outcomes. For instance, that AV development is proceeding absent an updated regulatory framework does not suggest that certain regulations – or regulation at all – is a priori desirable. But these observations do suggest that legislative outcomes – significant waste in EHR programs, stalled U.S. automotive competitiveness, and so forth – do not reflect most lawmakers’ intentions.

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1 CRS notes that its list is only a selection, not an exhaustive set of S&T-related issues with federal policymaking implications.
### Exhibit 1 | Anticipated science & technology issues in the 116th Congress

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<th>S&amp;T Issue Category</th>
<th>Associated Policy Topics</th>
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<td>Federal Science and Technology Policymaking Enterprise</td>
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<td>Adequacy of the U.S. Science and Engineering Workforce</td>
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<td>Science, Technology, Engineering, and Mathematics Education</td>
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<td>Cell-Cultured Meat</td>
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<td>The Food and Drug Administration: Medical Product Innovation</td>
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<td>Oversight of Laboratory-Developed Tests (LDTs)</td>
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<td>Stem Cells and Regenerative Medicine</td>
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<td>CRISPR: Advanced Genome Editing</td>
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<td>R&amp;D in the Department of Homeland Security</td>
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Legislative responsiveness to the challenges associated with S&T issues has atrophied as the complexity of S&T issues has considerably deepened. Vivek Wadhwa of Stanford University traces the lag-time between policymaking and technology from the printing press to the present, but observes how today the “gaps are growing as technology advances ever more rapidly.” As a consequence, federal lawmaking is failing, and at a faster rate, to adequately address issues of public interest associated with advancements in science and technology.

Therefore,

1. understanding the complexity of interacting forces widening the gap between S&T challenges and responsive lawmaking (Diagnosis);
2. selecting the most responsive, feasible, and durable approach to make progress on the issue (Decisions); and
3. detailing the actionable design of that approach (Design)

is the task of this analysis.

STRUCTURING OUR APPROACH:
How to address the problem?

This work is structured as three phases: Diagnosis, Decisions, and Design (Figure 1).

The Diagnosis examines the intersection of technical expertise and policymaking in Congress. It spans an historical analysis of OTA, an assessment of contemporary forces external to Congress including influences across industry, science, and civil society, an internal assessment of expertise in Congress, and an investigation into the current expertise-related needs of congressional members and their staff.

Leveraging the findings of the Diagnosis, three sequential Decisions are made to determine the approach taken to address the observed problem:

- Decision #1: What sort of intervention is needed to address the problem?
- Decision #2: Where should this intervention be implemented?
- Decision #3: Which model should be used for this intervention?

For each of these decisions, a mutually-exclusive list of options is developed to which a set of decision criteria are applied.

Finally, an appropriate Design is specified by developing an internally cohesive mandate, strategy, product-service offering, operational model, and adaptive approach of an intervention linked to the Diagnosis.
Methods

A combination of primary and secondary sources was consulted in carrying out this report. S&T today threads itself through an expansive scope of public policy issues; the research required to investigate it proved to be necessarily as expansive.

Secondary research draws on a large body of political science and public administration literature on the experience of OTA specifically and on technology assessment broadly, as well as on Congress and its relationship to technical expertise. Additionally, we review recent research on the changing institutional dynamics within Congress. Finally, we borrow and adapt select theories and frameworks from the management literature, acknowledged throughout.

Primary research activities were comprised primarily of structured interviews with those inside Congress and those who have a strong stake in what happens inside Congress. Among the more than 40 individuals interviewed for this report, a majority represent those formerly or currently in Congress; academics and civil society leaders from organizations such as AAAS and FAS researching and working on S&T-related policy issues; and those formerly associated with OTA. Others were drawn from bodies that work partly or wholly in service of Congress such as GAO, CRS, and NASEM; executive branch S&T-related bodies such as OSTP and DOE; and technology industry executives. Additional primary research activities included analysis of select datasets to illuminate trends and sourcing of archival material.

Additional detail is provided in Appendices 1 and 2.

See: Primary Sources
What explains the gap between responsive lawmaking and advancements in S&T? This section casts a broad investigative net, moving from the past to the present to the future.

We initially examine the history of technology assessment (TA), extrapolating lessons from the experience of OTA and briefly from the European experience. Next, we examine the contemporary forces external to Congress – trends across science, industry, and civil society affecting S&T-related policymaking – and the issues within the institution constraining its capabilities. Finally, we examine the current congressional environment, analyzing how patterns ranging from polarization to balances-of-power might affect any future intervention.

See Figure 2 for a summary of the Diagnosis.
### Figure 2 | Summary of Diagnosis

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<th>Element of diagnosis</th>
<th>Key findings</th>
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| **Systemic analysis** | **Congress**  
Severely weakened capabilities have atrophied Congress’s absorptive capacity, or the rate at which it can learn and use scientific, technological or other external knowledge  
• Diminished financial and people resources and increased reliance on lobbyists  
• Circumvented processes for transforming expertise into legislation  
• Partisan priorities do not preclude the use of S&T expertise but present constraints  | To improve policymaking on S&T issues, interventions must specifically address Congress’s lack of absorptive capacity  |
| **Science**           | The scientific community struggles to engage lawmakers given changes in funding, limited clout, and communication challenges; meanwhile, the pace of discoveries is accelerating  | Modern S&T expertise is globally distributed, noisy, fast-moving, and faces credibility challenges; solutions must be tailored accordingly  |
| **Industry**          | The structure of the technology industry, dispersion of participants, and aversion to regulation among the tech elite present challenges for tapping industry expertise  |  |
| **Civil Society**     | Diverse civil society actors are responsible for producing large volumes of information, but their policymaking influence is curbed by credibility and relevance issues  |  |
| **Needs assessment**  | There are many “jobs” in Congress requiring S&T expertise which present opportunities for new solutions; however, the needs required for Congress to legislate effectively on complex S&T topics may not neatly align with the perceptions of members and staff  | Solutions must begin by addressing Congress’s perceived needs  |
| **Landscape assessment** | The current context presents numerous challenges with which any solution much cope  
• Power imbalances with the executive branch leave legislative expertise vulnerable  
• Congressional support bodies exhibit limited capacities to engage on S&T issues  
• Severe polarization constrains opportunities for expertise in policymaking  | Solutions must be designed in response to this unique operating environment to survive  |
| **OTA history and international models** | OTA created substantial value for Congress, reflecting a useful solution for its time  
• OTA emerged from historical contingencies, rather than a desire for learning  
• Its expertise cut across Congress’s agenda, generating value thru close engagement  
• It remained responsive and politically credible thru flexible and inclusive methodologies  
• A narrow constituency within Congress made it vulnerable to political winds  
Variation in technology assessment models across Europe suggest that they are inseparable from their particular political and institutional environments  | Modern solutions emulating successes from the past or from international contexts must be careful not to replicate their weaknesses  |
ASSESSING ‘TECHNOLOGY ASSESSMENT’:
What does history tell us?

Experience of the Office of Technology Assessment

Lessons from the OTA experience should inform any contemporary efforts to improve S&T-related policymaking. The initial conditions that generated its emergence, the evolving model by which it operated, and the causes of its eventual demise offer learnings relevant to the decisions later chosen in this report.

“By 1972, it had become clear that the public demand for answers and the corresponding pressures placed upon governmental decision makers to provide them had outstripped the capacity. In order to meet this challenge, 1972 legislation created a Congressional Office of Technology Assessment (OTA) that commenced operation in January of 1974.”

Lester Palley, 1976
Department of Physics, State University of New York

OTA’s Emergence

Key takeaway:
A unique confluence of factors created OTA, few of which had to do with a desire by Congress to be ‘better educated’ on S&T issues.

Observations

- The years preceding its creation witnessed record-increases in S&T research and development by the U.S. government
- Highly public debates on S&T-related questions became reflected in Congress
- Congress had preoccupied itself with balance-of-power issues between the legislature and the increasingly powerful executive

The wave of S&T issues facing Congress by the end of the 1960s elevated the conversation around members’ capacities to make informed judgments about S&T-related legislation. From 1965 to 1972, lawmakers faced policymaking decisions on supersonic transport, the desalination of seawater, the development of nuclear power, trace metal poisons, pesticides, antibiotics in cattle feed, strip-mining techniques, space exploration, seabed mineral resources, Antarctic explorations, global atmospheric research, and a host of defense technology issues.”
Beyond concerns of lawmakers’ capacities, at least three other factors brought OTA into existence. First, the years preceding its creation witnessed record increases in S&T research and development by the U.S. government. By 1972, the government’s R&D budget had reached $17 billion, compared to $3 billion in the mid-1950s. But while Congress was tasked with appropriating ever-larger amounts to S&T-related public programs, “it had very limited ability to internally evaluate these investments.”

Second, issues from nuclear weapons to acid rain heightened the saliency of S&T in public life. As the political historian Christopher Hill observed of the era, “The auto brought pollution as well as mobility; DDT controlled malaria, but accumulated in the food chain with potentially disastrous results; and pharmaceuticals could save lives and reduce suffering, but lead as well to birth defects and a multitude of complications. Furthermore, the military technology that helped win wars gave us seemingly unlimited capacity to destroy.” As both consumers of the national news and as representatives of concerned constituents, members of Congress reflected the emerging debates over the increasingly complicated role of S&T in American life.

Lastly, Congress had preoccupied itself with balance-of-power issues between the legislature and the increasingly powerful executive. As the executive amassed extensive S&T expertise both within the White House and across executive agencies, Congress came to rely heavily on it “for information vital to Congress’ legislative and oversight functions.” During debate on the Technology Assessment Act of 1972 – which would bring OTA into existence – House Republican Charles Mosher of Ohio, the ranking minority member on the Science, Research and Development subcommittee, framed OTA as an issue of balancing power: “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 responsive to the demands of our own committees, in order to more nearly match those resources in the executive agencies.”

“We are not the rubber stamps of the administrative branch of the Government. [...] We recognize our responsibility to the people and the necessity for making some independent judgments. This is the thing we are trying to get at when we do not particularly have the facilities nor the resources that the executive department of the Government has.”

George P. Miller (Democrat-CA), 1963
Chairman, House Committee on Science and Astronautics

The Act was in part an institutional reaction. In 1961, the White House had created its Office of Science and Technology Policy (OSTP) and in 1970 the Office of Management and Budget (OMB). According to Peter Blair, who served as an Assistant Director of OTA, many viewed the “creation of OTA and... [CBO], as well as the expansion of CRS and GAO, as part of a congressional reassertion...
of authority responding to Richard Nixon’s presidency." Throughout its life, OTA contributed to this reassertion of legislative authority. In the early 1980s, for example, an OTA report on the federal government’s response to the emerging AIDS epidemic chastised “the Administration for not seeking appropriations from the $30 million fund established [for emergency purposes]... despite the designation of AIDS as the ‘number one health priority’ of the Department of Health and Human Services." OTA, as a captive source of expert analysis for Congress, aided in Congress’s oversight authorities.  

OTA would become the first agency exclusively accountable to the legislature in five decades since the creation of GAO in 1921.  

OTA in Operation

Two key organizational components defined OTA. The first, the Technology Assessment Board (TAB), was a twelve-member body comprised equally of Democrats and Republicans, House members and Senators, with the chairmanship alternating each Congress between the parties. This bicameral and bipartisan group authorized the assessments requested of OTA, approved assessment budgets, authorized the delivery of final assessments, and appointed OTA’s Director and members of the Technology Assessment Advisory Council (TAAC). TAB actively screened any requests for assessments made by Congressional committees; it alone would approve subjects for assessment. Comprised of members of Congress, TAB ultimately ensured that OTA was exclusively in service of the legislature.  

3 Of note, OTA also influenced executive agencies. For instance, “in 1988 the Federal Aviation Administration reorganized its research program following OTA’s study ‘Safe Skies for Tomorrow’, the Agency for International Development has taken up OTA’s work on African development and on project assessment methods; and EPA set up its Office of Pollution Prevention following OTA studies of waste reduction.” See: Rhodri Walters (1992)  
4 The OTA’s Director sat on the TAB as a 13th non-voting member.  
5 Tellingly, the original TAB in draft legislation was to be populated by Presidential appointees along with members of Congress. Congress devised an amendment to eliminate executive influence, ensuring that TAB was solely a Congressional being. See: Kunkle, G. C. (1996)
Second, **TAAC was designed to provide OTA with “input from physical and social science communities and industrial and public interest groups.”**\(^{51}\) The Council’s statutory authority was limited to “review and advice of OTA’s activities,” but it was nonetheless intended to serve an important role in connecting Congress to technical communities. For example, its members “served as experts on assessment task forces, recommended persons to fill OTA staff positions or participate in assessments, testified on behalf of OTA before congressional committees and assisted in the development and conduct of assessments.”\(^{52}\) These members included the Comptroller General (the director of GAO), the Director of CRS, and ten TAB appointees. These appointees were comprised of “prominent science and technology academics, industry leaders, and other professionals.”\(^{53}\)

In its 23-year history, OTA produced over 750 assessments ranging from global telecommunications policy and drug abuse to biological pest control and intellectual property.\(^{54}\) S&T issues cut through an expansive set of policy domains. As one scholar observed, “the breadth of the subjects the agency tackled is astounding.”\(^{55}\) There were few policy terrains where “applied science” had no role.\(^{56}\) OTA’s assessments were rarely attempts at original research, but instead “provided an overview of the surrounding facts and theories, identified consensus and controversies about the topic, and pulled everything together into a suite of policy-relevant options.”\(^{57}\) These assessments were almost always large, long endeavors. By the early 1990s, “a typical OTA assessment took 18 months to complete and cost... $500,000 in direct expenses.”\(^{58}\)

Over time, however, **OTA shifted from producing only lengthy reports to complementing those final products with other means of delivering analysis.** By the late 1980s, recognizing that lengthy reports were failing to best meet congressional needs, OTA began producing “shorter and reader-friendly summary reports and report briefs,” coupled with an emphasis on “staff briefings and testimony to deliver study results.”\(^{59}\) However, OTA did not shake the legacy of its reports. As one former House science advisor commented, “I frankly wasn’t aware until after OTA was gone that they did anything but long reports.”\(^{60}\)

**Its most substantive value to Congress, though, laid less with reports and more with OTA’s process for creating them.** OTA’s staff became deeply embedded within Congress, commenting on legislation at the request of committee staff, providing informal advice on specific policy options under consideration, and helping the reports’ consumers to understand its most important dimensions through informal communication.\(^{61}\) As one evaluation of OTA’s operations described, “OTA was a lot more than its 700 reports; it was ~110 technical people embedded in the policy process, who showed up at meetings with committee members and stakeholders, and who elevated the debate by their participation.”\(^{62}\) For example, referencing OTA’s Alzheimer’s work, one former staffer “conceded that the core pieces of legislation related to the study were passed six months before OTA’s report came out in April 1987. However, OTA’s research informed the legislative process throughout.”\(^{63}\) The staff and recruited experts responsible for studies became readily available to committees and their members during and after the formal assessments.\(^{64}\) As an embedded body, the informal relationships between OTA staff and the committees they served best characterized its value. “Congressional staff often pointed out that they relied on
specific individuals at OTA whom they trusted... [and] claimed that personal contacts, telephone calls, meetings, and briefings were just as important if not more so than written reports.\textsuperscript{65}

Finally, \textbf{the breadth of expertise that OTA brought into regular contact with Congress far exceeded the capacities of more traditional mechanisms, such as congressional testimony}. According to one analysis, "in a typical year OTA brought approximately 5,000 people into its process. These experts provided advice, took part in workshops, served as members of advisory panels, and participated in OTA’s peer review process. And they came from all walks of life: academia, industry, public interest and citizen groups, and government."\textsuperscript{66} OTA created expansive linkages between the legislature and those with expertise on S&T issues confronting the public.

\textbf{OTA’s Demise}

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**Key takeaway:**
While the value OTA provided was substantial, its constituency within Congress was narrow, making it especially vulnerable to political winds.

**Observations**

- OTA analyses informed a broad scope of legislation; members and staff who employed OTA services recognized its value
- Given the cost savings resulting from OTA studies, the return on its investments were high
- Arguments about the efficacy of OTA had developed over the years, many of which surfaced important shortcomings of the office.
- Perceptions of liberal bias additionally hurt its reputation; but what made OTA uniquely vulnerable was its weak internal constituency

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"It is perhaps worth recalling how difficult an assignment was given to this new agency. OTA was to be a part of Congress, overseen by a congressional board and servicing congressional committees; yet it was also to be nonpartisan, objective, and technically expert enough to command the respect of the professional scientific community. OTA’s expertise was to cover the entire span of the physical, biological, and social sciences... It was to assess the full range of implications of technological change — economic, technical, social, environmental, political, military, health, etc. — as appropriate. It was to do all this in a manner that would fit congressional timetables and committee jurisdictions. This is a very tall order, indeed. What is remarkable is the extent to which OTA is now fulfilling its mandate."\textsuperscript{67}

Representative Morris Udall (D-AZ), 1981
Vice Chairman, Technology Assessment Board
OTA accumulated a track-record of successes. Various studies suggest that OTA analyses informed a broad suite of legislation and that members and their staff who employed OTA services recognized its value. A 1990 study by the Carnegie Commission on Science, Technology, and Government found that OTA reports were “very useful” to half of surveyed congressional staff, “useful” to 41 percent, “somewhat useful” to 9 percent and “not useful” to 0 percent. Another study in 1993 by the American Enterprise Institute and the Brookings Institution found that “the agency is considered highly credible by members of both parties and is well regarded for its technical competence.” Others have noted the frequency with which OTA studies were cited in legislation as a proxy for legislative impact.

As another indicator, the federal government realized substantial cost savings as a result of OTA studies. According to one analysis, OTA “conducted a series of studies during the early 1980s on synthetic fuels that helped secure approximately $60 billion in savings.” Another study in 1994, “helped Congress evaluate the Social Security Administration’s massive computer procurement strategy leading to total savings of $368 million.” Another was documented as having saved the U.S. government $85 million, and another $500 million.

Given that typical OTA studies ranged in cost from $700,000 to $1.4 million, and that “a major technology decision often involves billions of dollars [in spending],” the returns on those investments were substantial. Indeed, some of the aforementioned studies yielded savings that paid for OTA’s annual budget – $31 million in inflation-adjusted dollars between 1980 and 1995 – many times over. As one analyst framed its return, “If conducting a technology assessment costs less than one-tenth of one percent of the money at stake in a decision, and increases the odds that we’ll get the decision right, that is a considerable bargain.” OTA did not make an effort to communicate its ROI until its last year.

A new Republican majority defunded OTA in 1995. The stated reason was to downsize the federal government, starting ‘at home’ with Congress itself. Given that OTA’s budget was $22 million in 1995, “a veritable rounding error in the legislative branch’s $4.4 billion budget,” concerns about legislative branch spending were unlikely to be the only reason for shuttering the office. Arguments about the efficacy of OTA had developed over the years, many of which surfaced important shortcomings of the office. For example, a critic that had advocated for abolishing OTA as early as 1980 maintained that the office was redundant. OTA “conducted a study about what to do with nuclear waste at the same time that the Tennessee Valley Authority was undertaking a $2 million study on its own on disposal of such wastes.” Less concerned that OTA was a legislative body and not an executive one, he argued that “many of its studies are in areas where entire federal agencies are performing identical work.”

Another argument criticized the nature of OTA’s lengthy and technical products. As voiced by a member of the House Appropriations Committee in its early years, “there seems to be an inordinate amount of technical content in some OTA reports. Technical matter tends to distract the intended primary consumer of OTA information.” To some extent, OTA was responsive to the
criticism, adapting its formal products and services over time. Yet the flagship product – a lengthy report – never did change.

Its reputation also suffered from accusations of political bias. Despite bipartisan support for its creation, OTA had regularly been the subject of political skepticism. Orrin Hatch, a Republican Senator from Utah, called the OTA in its early years “a sort of Brookings Institution inside the Congress” – referring to a prominent think tank perceived as left-leaning. (Sen. Hatch would later become a staunch defender of OTA.) In 1980, a widely-read conservative critic averred that OTA was “not altogether objective.” As scholar Adam Keiper notes, some in the Republican Party viewed the work of OTA as “a way of giving a supposedly scientific rationale for liberal policy ideas and prejudices.”

Certain events suggest that the conservative perception was not altogether unfounded. OTA’s architect, Dr. Emilio Daddario, was a Democratic member of Congress who would also become its first Director, while its “greatest patron in its early years was liberal icon Edward Kennedy.” Daddario’s succession was soured due to “the widely-reported claim that Kennedy forced Daddario to quit so that a long-time Kennedy aide could be installed in his place.” Later, when OTA’s third Director moved to the White House during the Clinton Administration, “he took several senior OTA staff members with him, reinforcing the not-unreasonable impression of political affinity between OTA and the Democratic side of politics.” As one scholar notes, Republicans over time began to see the OTA “as a challenger to their political goals.”

The perceived challenge bore itself out in infrequent but high-visibility confrontations between OTA and Republican Administration policies. In 1988, OTA was commissioned to study concerns that an agreement with the USSR had been breached. The report “found no basis... for charges that the Soviet Union has violated the 1974 Threshold Test Ban Treaty (TTBT),” contradicting claims by the Administration. Most notable was a report on the Administration’s Strategic Defense Initiative (SDI). “In the OTA’s judgment, there would be a significant probability... that the first (and presumably only) time the [SDI] system were used in a real war, it would suffer catastrophic failure.” The rebuke was swift. The Heritage Foundation, for instance, released a paper arguing that OTA must be “reassessed.” “The controversy triggered by OTA reviews of several key Reagan defense proposals indicates that OTA... may be influenced by political considerations.”

OTA was not the only legislative body that struggled to weather political storms. What made OTA uniquely vulnerable, though, was its weak constituency. At the time of its shuttering “there were large numbers of new members of Congress and staff... unfamiliar with the work of OTA.” Despite cultivating a respected reputation among S&T communities and policy analysts, OTA’s base of support inside the Congress proved fatally small. When the Republican majority proposed defunding it, “[o]nly a few supporters from both parties, including members of OTA’s governing board, went to bat for the agency.” OTA may have been broadly impactful, but by 1995, not broadly appreciated.

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6 See: Evaluating Technology Assessment
7 SDI was popularly known as ‘Star Wars’.
That OTA tended to directly serve only a small, concentrated community within Congress was a product of its institutional design. While the TAB was never vested with statutory powers to set a legislative agenda, it was entitled to ‘screening’ powers, deciding which assessments to authorize and which to dismiss. In effect, the twelve-member body exercised considerable control over OTA’s agenda. For example, “virtually all requests made by TAB members” were authorized, with these requests typically reflecting their own committees’ priorities. In fact, “about one-quarter of the agency’s studies were performed for committees chaired by one of its board members.” OTA’s chief client was TAB.

Meanwhile, the rest of Congress had minimal interaction with the office. Because assessment requests could only be made by committee chairs or their ranking minority members, “it was not a resource for the less powerful and less experienced members.” Consequently, “[m]ost rank and file members of Congress felt no direct connection to the agency... it had no dedicated constituency among the junior members.” While members may have indirectly benefited from more informed legislation, enhanced debate, and so forth, removing OTA from Congress affected most members very little. Nor could OTA appeal to a constituency outside of Congress; dispersed S&T-related communities did not form concentrated interest groups. It is unsurprising, then, that junior members helped to defund OTA in 1995 at the behest of a party leader. They “had relatively little reason to protect [it].”

Without much of a constituency, some argue that OTA became a logical target as Republicans sought to “send the message that we’re downsizing our agencies and ourselves,” in the words of one Republican congressman at the time. Peter Blair, a former OTA Assistant Director, concurred: “OTA’s diminutive size, comprising less than 1 percent of the Legislative Branch annual budget, provided a convenient target for new legislative leaders who were eager to use OTA’s closure as evidence of their budget discipline by closing an entire agency within the Congress.” Its elimination would send a signal, and its loss would be directly felt by very few.

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8 See: What’s happening with science?
The European Experience

Key takeaway:
The variation in TA models across Europe suggest that they are inseparable from their particular political and institutional environments.

Observations

- The political motivations for developing TA capabilities inspired by OTA varied greatly between European countries.
- Different institutional models developed to suit the circumstances of differing contexts, driven by the needs of political actors and prevailing parliamentary structures.

TA was exported to Europe following the establishment of OTA. The political motivations for developing TA capabilities varied greatly between European countries, including the reclamation of political control over energy policy from experts (France), improved understanding of S&T issues among parliamentarians (U.K.), and broadened public debate on S&T policies to address societal concerns (The Netherlands).\(^\text{98}\) These differing objectives became reflected in the design of the TA institutions themselves, which proliferated during the 1980s and 1990s. By the time OTA was shuttered, institutional TA had been widely established elsewhere.\(^\text{99}\) Today, there are over 20 TA bodies in Europe. The European Parliamentary Technology Assessment Network (EPTA) plays a coordinating role across 12 national parliamentary institutions, including the TA body of the European Parliament (see Appendix 3 for a list of these institutions).\(^\text{100}\)

As TA bodies spread across European parliaments, different institutional models developed to suit the circumstances of differing contexts. Particularities included the role to be played by the body (for example, creation of policy analysis versus facilitation of public deliberation), the needs of political actors (for example, increased knowledge versus political control), and prevailing parliamentary structures. During the 1980s, the French Parliament came to the conclusion that it was unable to assess the government’s major S&T policies, like its nuclear program. Therefore, it structured its TA body as a committee of Parliament, charging its own members with leading studies and writing reports, thus providing greater control over the work.\(^\text{101}\)

Debate in the U.K. Parliament intensified over the formation of a TA body after a parliamentary visit to OTA. It formed the Parliamentary Office of Science and Technology (POST) in 1989 as a bicameral office, rather than as a committee, so that it could serve both Houses of the U.K. Parliament.\(^\text{102}\) Switzerland’s Centre for Technology Assessment (TA-SWISS) is fully independent from the government as a unit within the Swiss Academies of Arts and Sciences. The institution is designed to engage a broad set of stakeholders in a public setting to foster dialogue on the societal impacts of new technologies while remaining independent from political interests. Such models may be less suited to providing timely and independent advice on S&T issues to parliamentarians (as is the aim of the U.K. POST) due to their separation from parliamentarians.
Specific archetypes for S&T advisory bodies suggested by the European experience are later discussed in detail.⁹

The European experience highlights the variation in TA functions tied to their environments. The use of TA – or technical expertise more broadly – in a congressional setting will require identifying issues specific to U.S. institutions and designing interventions responsive to their idiosyncrasies.

Evaluating Technology Assessment

Key takeaway: OTA’s treatment of TA methodologies as flexible and highly inclusive allowed it to be responsive to Congress and command political credibility.

Observations

- OTA enjoyed the freedom to devise its own TA methods, ensuring TA was a practical rather than academic effort.
- TA’s neutrality constrained any inclinations to be prescriptive to Congress; to the contrary, it permitted OTA to provide expansive policy option-sets
- OTA’s approach to TA commanded credibility by casting a wide net of external expertise; the approach also functioned as a funnel to focus the debate

“Until fairly recently, it was assumed that all scientific and technological change must represent progress. However, with deterioration of the physical environment, increasing population, increasing energy problems, and so forth, technology and its role in society have been increasingly questioned... General concerns about technology led to the development of the field of technology assessment.”⁴¹

H. David Banta & Clyde J. Behney, 1981
Office of Technology Assessment

Debates about best-practice TA are not the focus on this analysis. Instead, the methodological experiences of OTA give insight into ways of successfully engaging Congress with technical expertise. They offer at least three learnings for any future efforts to engage Congress on the challenges of S&T-related policymaking.

First, the Act that created OTA stipulated its general purposes, organization, powers, and duties, but not the processes by which it would conduct technology assessments. Methodological
decisions were left to OTA directors and their staff.\textsuperscript{104} OTA’s approach reflected an understanding of TA as “a comprehensive form of research that examines short- and long-term social consequences (e.g., societal, economic, ethical, legal) of the application of technology... and it is especially concerned with unintended, indirect, or delayed social impacts.”\textsuperscript{105} It functioned not to add to the body of scientific knowledge but to improve decision-making.\textsuperscript{106} It was in this sense a practical effort.

Devising methods to aid congressional decision-making became the task of OTA, as opposed to perfecting methods aligned with ‘best-practice’ TA. As a result, ‘TA’ became ambiguous. This was largely because “OTA was at the command of Congress, so it did not have the luxury of engaging in the theoretical rumination of its academic counterparts.” Scholars have criticized OTA for its “case by case” approach to TA, whereby different projects used different assessment methods: an absence of “a basic analytic approach.”\textsuperscript{107} However, this was probably for the best. “[I]n many ways, the agency’s pragmatic disposition was important for establishing its role as a leader of practice.”\textsuperscript{108}

Second, both in scholarship and in OTA’s practice, TA has been advice-neutral. Its goal is “to provide decision makers with information on policy alternatives, such as allocation of research and development funds, formulation of regulations, or development of legislation.”\textsuperscript{109} In practice, it should aid decision making by illuminating what is known about potential consequences associated with different courses of action: by “anticipating potential impacts and feeding these insights back into decision making, and into actors’ strategies.”\textsuperscript{110} This is distinct from “a strictly technical study of a technology,” which would not constitute TA.\textsuperscript{111} TA’s neutrality constrained any inclinations to be prescriptive to Congress; it permitted OTA to provide policy option-sets with corresponding consequences.

“This assessment process does not identify a single course of action for the decision maker or offer a best alternative from an overall policy view. Instead, technology assessment presents the policy maker with a choice of alternatives. He may then decide which alternative best reflects the values of the society he represents. The analysis of consequences is the objective of technology assessment.”\textsuperscript{112}

Walter A. Hahn, 1975
Congressional Research Service

This neutrality is in part a consequence of the nature of S&T itself. Given that these domains are characterized by often profound uncertainties and unknowns, TA typically examines a broader “array of contextual elements and policy outcomes than is often the case in policy analyses” such as the more “parsimonious methods of economics and operations research.”\textsuperscript{113} Thus, S&T-related interventions among policymakers should be distinct from those embodied by entities like the Congressional Budget Office (CBO). One key distinguishing feature is an emphasis on expansive possibilities and corresponding policy options – with room for a diversity of views.
Third, OTA’s approach to TA, even if “case by case,” commanded credibility by casting a wide net of external expertise. OTA’s stakeholder engagement model became central to the integrity of its work to both S&T communities and to congressional consumers.

Each of OTA’s assessments relied on a set of networked activities: the creation of an expert advisory panel; employment of specialist contractors to support OTA project teams; workshop convenings with an array of experts and stakeholders; and the use of extensive peer review of its draft reports. These activities signify a deep reliance upon outside expertise. Adam Keiper refers to this dimension of OTA’s work as the “multiplier effect” whereby a couple hundred staff would bring in thousands of others. As documentation of one 1989 study illustrates, a few dozen project staff were complemented by 30 specialist contractors, and an additional 1,300 people were engaged through advisory panels and workshops.

Exhibit 2 | Diversity of an OTA advisory panel
Workshops and advisory panels, for example, would typically include a diverse population of participants and perspectives, from academia to government to industry. A panel for a 1990 study on air quality “included representatives of the National Resources Defense Council, the American Lung Association, Ford Motor Company, Procter & Gamble, regional regulatory agencies, and universities.” A 1976 workshop as part of a study on materials conservation in manufacturing and product use included representatives from MIT, the Chamber of Commerce, Ford Motor Company, the U.S. Navy, Bell Laboratories, the National Science Foundation, and United Airlines, among others. An assessment of the defense technology base requested by the Senate Armed Services Committee used an advisory panel consisting of representatives across industry, academia and the military (Exhibit 2). Rather than presenting policy options conceived of by a small circle of experts, OTA furnished analyses illuminating the diversity of perspectives it had encountered. This lent OTA credibility by its equally diverse congressional consumers.

In addition to lending credibility, the approach focused policy debates for members, consolidating large volumes of expertise into a scope of plausible policy options and associated trade-offs. As one 1992 study of OTA observed, the office “presents issues of public policy in a way which ensures that the scope of the debate is laid out and subjected to scrutiny. The involvement of the principal authorities and opinion holders in the field in the OTA process – through workshops, advisory panels, and review – facilitates this. With the debate defined and narrowed, Congress is more easily able to confront a problem.”

SYSTEMIC ANALYSIS:
What are the problems and where do they sit?

The gap between responsive lawmaking and S&T advancements is symptomatic of other challenges. To make sense of them, and to in turn derive from them diagnoses that better explain the problem, the below analysis interrogates dynamics across science, industry, and civil society affecting the policymaking process. It also identifies and analyzes institutional dynamics within Congress constraining its capabilities. A comprehensive look at ‘science’ and ‘industry’ and ‘civil society’ broadly is not the goal. Instead, the analysis elevates the most important factors relevant to federal lawmaking on S&T issues.
What's happening with science?

Key takeaway:
Against a backdrop of rapid advancements, the scientific community struggles to engage with Congress given changes in funding, its limited constituency-base, and communication challenges.

Observations
- Science has become an increasingly distributed, industry-led exercise across R&D
- The science community is limited and largely ineffective as a political constituency
- The communication of scientific evidence for policymaking faces inherent challenges
- The pace of scientific discovery is accelerating and its complexity deepening

Science has become an increasingly distributed, industry-led exercise across both research and development. Between 1975 and 2015, the federal government’s share of research and development funding fell from 52 percent to 23 percent while funding by private industry and universities have commensurately increased in share (Figure 3). The trend is visible across basic research, applied research, and development. Similarly, the federal government performs a smaller share of federally-funded R&D activities itself, instead opting to fund research activities carried out at universities and in industry.

The drivers behind this trend are numerous but in part relate to a general reversal of Cold War-era research spending. Defense-related federal R&D rose to a peak of 70 percent of total federal R&D in 1986, then gradually shifted away from government-developed technology and towards commercial-off-the-shelf (COTS) solutions.\(^{122}\) Defense-related R&D has since fallen to 45 percent of federal R&D while funding for the National Institute of Health (NIH), which awards more than $8 of every $19 in appropriations extramurally, has risen from 10 percent of federal R&D in 1975 to 25 percent in 2017.\(^{123}\)
The scientific community is limited as a political constituency. There are an estimated 550,000 life and physical scientists in the U.S., a small constituency on its own. Science as a profession is also generally not well-organized around public engagement for policy purposes. Of the top 50 lobbying spenders in 2016, not a single entity directly represents research institutions or scientists outside of the pharmaceutical industry. As one advocate for the scientific community commented, “Politically, we don’t behave like farmers, and that’s the heart of our problem.”

The scientific community itself is relatively distributed rather than concentrated, with over 20 national scientific societies engaging in their own policy and advocacy across the country. The American Association for the Advancement of Science (AAAS), with over 120,000 members, and commanding a formidable budget of nearly $100 million in 2013, helps to play a coordinating role by engaging in broad science advocacy and commenting frequently on issues related to the intersection of science and policymaking. That said, differences in the underlying interests of various science groups – for instance, between anthropologists and cell biologists – and the lack of an overarching unifying issue hinder coordination. Moreover, much of its political engagement is limited to protecting its sources of funding.

Scientific and public opinion frequently diverge, particularly as it relates to the public’s perception of scientific uncertainty on salient topics. The American public is, generally, trusting of the scientific community. In a 2016 study by the Pew Research Center, 76 percent of respondents stated that they have at least “a fair amount” of trust in scientists to act in the best interests of the public, second only to the military (79 percent); elected officials (27 percent) ranked the lowest of occupations mentioned. That said, there are significant differences between
scientists and the public on many key issues. For example, according to a 2014 Pew study, 88 percent of AAAS scientists believe in the safety of GMO foods (versus 37 percent of surveyed adults), 98 percent believe in evolution (versus 65 percent of surveyed adults), and 87 percent believe that climate change is mostly due to human activity (versus 50 percent of surveyed adults).

Various hypotheses seek to explain the divergences. For instance, some research suggests that an individual’s perceptions of scientific consensus on an issue is linked to their preexisting values. A 2011 study demonstrated that when individuals are presented with evidence from a scientist that conflicts with their values, they are less likely to perceive the scientist as an expert; consequently, perceptions of scientific uncertainty on the topic are enhanced. Indeed, it is not uncommon for individuals on both sides of an issue to believe that a fair assessment of the science is on their side. Other research suggests that those who identify as conservative have less trust in science that identifies environmental and public health impacts of economic activity (“impact science”) but have more trust in science that supports new inventions or innovations (“production science”). Regardless of explanations, the communication of scientific evidence for policymakers faces inherent challenges.

Finally, it is almost axiomatic today to observe not just profound changes in science and scientific capabilities, but that the pace of scientific discovery continues to accelerate. Much literature has been dedicated to studying this quickening pace. Technological innovations in machine learning and quantum computing, for instance, in turn drive scientific breakthroughs. As the cofounder of Singularity University Peter Diamandis explains, “we are using faster tools to design and build faster tools.” As the pace of discovery accelerates, it also becomes more complex as technologies interact with each other. Recent breakthroughs in bioinformatics, automation capabilities, and precision medicine, for instance, will in turn drive further innovations, in part by interacting with each other, and more quickly. Beyond the scope of most scientists and innovators is how our policymaking adapts.

Despite the tremendous implications of its advancements, the scientific community is alone not a formidable bloc of political influence, at least outside of industry. The federal government’s decreasing R&D investments and the field’s limited constituency base, along with inherent challenges to scientific communication to the public, limit its role in policymaking.
What's happening with industry?

**Key takeaway:**
The structure of the technology industry, dispersion of participants, and aversion to regulation among the tech elite present challenges for tapping into the collective expertise of industry.

**Observations**

- Technology companies, both large and small, have become disproportionately important to the U.S. economy, with large incumbents developing significant lobbying capabilities that small players lack.
- Technologists are both physically distant from federal policymakers and increasingly dispersed across the country and the world.
- There is a strong aversion to regulation among some in the U.S. technology community.

Technology companies, both large and small, have become disproportionately important to the U.S. economy. In 2016, firms in 10 technology-based industries\(^\text{139}\) made up 3.8 percent of all businesses but contributed 6.2 percent to GDP, comprised 27.2 percent of exports, and were responsible for 70.1 percent of business R&D investments.\(^\text{140}\) Further, it has been argued that for every science, tech, engineering and math (STEM)-related job created, an additional 4-5 jobs are generated in other local goods and services sectors (compared to 1-2 for traditional manufacturing).\(^\text{141} \, 142\) Technology startups are also collectively influential, making up nearly one-third of employment in the aforementioned technology-based industries.

In recent years, large industry participants have developed significant lobbying capabilities. In 2016, the country’s five largest technology companies\(^\text{11}\) spent a combined $65 million lobbying the federal government, larger than the amount spent by any lobbying group other than the Chamber of Commerce and the National Association of Realtors.\(^\text{143}\) Meanwhile, small technology startups often lack the resources to effectively lobby for policies important to their growth.\(^\text{144}\) As put by one Silicon Valley-based startup executive, “incumbents in our industry have the regulator’s ear, and so rules get designed more so in their favor.”\(^\text{145}\) Indeed, nearly 80 percent of start-up owners surveyed by the Kauffman Foundation believe that government policies favor established businesses.\(^\text{146}\) While the number of tech-based startups in the U.S. increased by 47 percent between 2007 and 2016,\(^\text{147}\) such high-growth companies successfully scale at lower rates than in the 1990s and 2000s.\(^\text{148} \, 149\) The reasons behind this are likely complex, but certain regulatory regimes may in part be to blame. These apparent disparities raise questions concerning incumbent bias and competition in technology-related policymaking and regulation.

Apart from incumbent power, other issues complicate the relationship between technology companies and federal policymaking. For instance, technologists are both physically distant from federal policymakers and widely dispersed across the country. Original research using data from the U.S. Patent and Trademark Office (USPTO) complicates the popular association

\(^{11}\) Alphabet, Facebook, Amazon, Microsoft, and Apple
between innovation and Silicon Valley (Figure 4). In 2015, only 17 percent of all patents issued were
granted to holders in the greater San Francisco Bay Area, with the remaining patents granted to
holders residing in technology hubs both large and small across the country. Further, the number
of metropolitan areas beyond the Bay Area generating large numbers of patents has increased
substantially since 2000. Start-up activity is relatively more concentrated, with 54 percent of “first
financings” – or the first round of venture capital for new companies – taking place in just five
metropolitan areas (San Francisco, New York, Los Angeles, San Jose, and Boston). The next 10
metropolitan areas (including Seattle, Austin, and Washington DC, among others) account for only
21 percent of “first financings”, suggesting that the remaining high-growth start-ups are more
widely distributed across the U.S.\textsuperscript{150}

**This increasing dispersion of innovation is also seen globally.** The United States’ share of global
venture capital investments has declined from more than 95 percent in the mid-1990s to
approximately 50 percent in 2017.\textsuperscript{153} China has emerged as a major home and funder of
innovation. Shenzhen, for example, submitted more patent applications under PCT\textsuperscript{12} per year than
Silicon Valley as early as 2011,\textsuperscript{152} and three of the top ten venture capital (by dollars invested)
destinations in the world are Chinese cities other than Shenzhen.\textsuperscript{153} This story, however, is not only
a Chinese one. The top 20 global cities by number of venture capital deals in 2015-17 includes
Paris, Delhi, Tel Aviv, Berlin, and Mumbai. The fastest-growing cities for venture capital deals
extends the geography even further to Thailand, Indonesia, Nigeria, and Bulgaria, among others.\textsuperscript{154}

**Figure 4 | Distribution of patents granted by MSA\textsuperscript{155}**

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<thead>
<tr>
<th>Patents by Metropolitan Statistical Area (MSA)</th>
<th>MSAs by number of patents received</th>
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<tbody>
<tr>
<td><strong>Percent of patents awarded</strong></td>
<td><strong>Number of MSAs</strong></td>
</tr>
<tr>
<td>Remaining 350+</td>
<td></td>
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<tr>
<td>Top 20 MSAs (ex-Bay Area)</td>
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<tr>
<td>Bay Area\textsuperscript{1}</td>
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\textsuperscript{1} Includes San Jose-Sunnyvale-Santa Clara, CA and San Francisco-Oakland-Fremont, CA Metropolitan Statistical Areas (MSAs)

\textsuperscript{12} PCT patents are international patents filed under the Patent Cooperation Treaty
Finally, there is a strong aversion to regulation among some in the U.S. technology community. In a 2018 survey of over 600 ‘elite’ technology company executives, researchers at Stanford University found that respondents favored “liberal redistributive, social, and globalistic policies but conservative regulatory policies—a bundle of preferences rare among other economic elites.” In fact, opposition to regulation significantly exceeded attitudes held by both the average surveyed Democrat or Republican. This does not suggest that elites fail to recognize problems requiring better policy solutions. As one commented, “You aren’t going to run into anyone in the Valley that is going to say policymaking isn’t broken.” Rather, it is that solutions involving regulation are looked upon unfavorably.

In contrast to elite opinion, nearly 70 percent of California technology workers in a 2019 survey reported believing that the technology industry has been under-regulated, a figure roughly in line with the way Californians more broadly answered the same question. Indeed, it would be a mistake to assume that because many of today’s technology industry elite eschew regulation, the rest of the technology community feels similarly.

Tapping into contemporary sources of technology expertise for policymaking may require building avenues for reaching into today’s global centers of technology – including, but not limited to, Silicon Valley – while accounting for bias, the potential for industry capture, and by pursuing engagement with different levels of the technology community.

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13 There are notable exceptions. In 2018, for instance, the President of Microsoft took the highly unusual step of publicly calling for the federal regulation of its own facial recognition technology, concerned with the gap between the implications of the technology and the absence of regulatory restraint. See: Smith B. (2019).
What's happening with civil society?

**Key takeaway:**
Diverse civil society actors are responsible for producing large volumes of information, but their policymaking influence is curbed by credibility and relevance issues.

**Observations**
- Given the diversity of roles played by civil society actors, policymakers interact with a broad range of stakeholder groups on S&T issues.
- Civil society actors produce large amounts of information on S&T topics.
- This volume of information, however, carries question of credibility and relevance to the policymaking process.

Given the diversity of roles played by civil society actors, policymakers interact with a broad range of stakeholder groups on S&T issues. A 2019 report by the World Economic Forum outlines six distinct roles civil actors play in regards to emerging technologies: an advocate, watchdog, solidary supporter, definer of standards, representative, or a capacity builder. For example, ProPublica, an investigative journalism non-profit, found in 2016 that predictive algorithms employed in the criminal justice system were systematically biased against African-Americans (a “watchdog” role). Separately, the Internet Society engages in policy advocacy for internet standards and protocol development with funding from the Internet Engineering Task Force, an internet standards development non-profit (a “standards setting” role). No single organization is able to simultaneously play all of these roles credibly, necessitating policymaker engagement with many different types of organizations.

“It’s not just that we have the internet, it’s the whole set of issues around the different ways in which information, data, and knowledge are transacted than the ways when the OTA was set up. It’s a vastly more plural environment.”

Dave Guston, Co-Director
Consortium for Science, Policy and Outcomes, ASU

Civil society actors produce large amounts of information on S&T topics. According to the Think Tank and Civil Societies Program housed at the Lauder Institute of the University of Pennsylvania, there are over 1,800 think tanks in the United States, a number that has more than doubled since 1980. The closest countries in terms of number of think tanks are China (435), the United Kingdom (288), and India (280). Using Open Think Tank, a smaller but publicly accessible global database of think tanks, the authors estimate that more than half of think tanks in the U.S. address issues related to S&T, suggesting that there may be over 900 think tanks producing S&T-related content (Figure 5).
This volume of information, however, carries questions of credibility and relevance to the policymaking process. In 2012, researchers empirically investigated the relationship between think tanks and economic policy and found little evidence of direct policy influence.\textsuperscript{166} Separate research suggests that, while think tanks have swelled in number, their influence as a group has not grown commensurately in part due to ideological biases,\textsuperscript{167, 168} and that these biases may be increasing over time.\textsuperscript{169} Credibility issues are not specific to small or less reputable think tanks. In 2016, The New York Times reported that, in 2013, the Center for Strategic and International Studies (CSIS) used funding from large defense contracting companies to conduct a study that ultimately recommended the lifting of export restrictions on unmanned drone systems – a favorable position for its funders.\textsuperscript{170} The Times also released a 2014 memo revealing that the Brookings Institution, seeking donations from a large construction company, agreed to “use [their] convening power, research expertise, network connections and knowledge of innovative practices to help further drive the ultimate impact and success” of the construction company’s project.\textsuperscript{171} While think tank research sponsored by private sector entities or other interested groups are not inherently compromised, neither are they immune. These anecdotes suggest that evaluating the credibility and impartiality of individual pieces of think tank research can be challenging, regardless of the institution from which it originated.

In a crowded community, civil society voices struggle to be heard over one another. Absorbing increasingly large volumes of information and discerning its objectivity, meanwhile, is a challenging task for those on the receiving end – particularly if not attuned to congressional users.
What's happening with Congress?

**Key takeaway:**
Congress suffers from atrophying capabilities driven by resource constraints and disruptions to information processing functions, while partisan priorities may be less of a disability than assumed.

Members of Congress and their staff struggle to wield S&T technical expertise in service of policymaking. But why? We posit that an analysis of organizational capabilities offers a way of understanding and diagnosing the observed problem.

Borrowing from the literature on organizational capabilities, we analyze three dimensions of capability constraints: resources, processes, and priorities. In the context of a private enterprise, these constraints prevent necessary change to remain “relevant” and accomplish organizational objectives, such as continued innovation. Constraints along these dimensions impair a policymaking body’s ability to effectively legislate, or to construct relevant policies in the face of new science and emerging technologies. We borrow this framework as a way of organizing and analyzing Congress’s capabilities as they relate to legislating on complex, technical topics. The analysis that follows generates insights into the forces constraining Congressional capabilities.

**Resources**

**Key takeaway:**
Volumes of external information have outpaced internal capacities with people and financial resources unable to cope, increasing the reliance on external ‘expertise’ such as lobbying.

**Observations**
- Congress enjoys access to an extraordinary volume of S&T-related information.
- However, financing for these internal resources have contracted over time
- People resources for Congress have also sharply declined
- Financial and people resources have considerably shifted within Congressional offices
- The decreases in financial and people resources within Congress explain an increased reliance on external resources, such as lobbying and personal networks; most staff appear concerned with levels of support

Resources are what can be “hired and fired, bought and sold, depreciated or built.” Because resources are typically visible, evaluating the degree to which the organization is housing and leveraging resources is a matter of measurement. Trend data, along with individual interviews with members and their staff, reveal substantial resources in some respects and significant shortcomings.

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14 The framework’s use here is an adapted version for this use-case.
in others. Specifically, we evaluate patterns in information resources, financial resources, and people resources.

**Congress enjoys access to an extraordinary volume of S&T-related information.** External expertise from privately-funded policy research bodies are regularly referenced in interviews with members and staff as top-of-mind resources. Sources of external expertise have swelled over time. According to interviews with representatives at S&T-focused nonprofits, think tanks, and advocacy organizations, including AAAS, the Federation of American Scientists (FAS), and NASEM, the information and analyses delivered to Congress is exhaustive. In 2016, for instance, AAAS, the world’s largest general scientific society, spent $40 million on “education, policy, and other programs.”175 “We are constantly pushing out our findings on key policy issues directly to Congress through our networks,” according to one think tank representative. “It is just as much our job as doing the research itself.”176

External resources are in large part a function of the sharp upward growth in lobbying activities, 80 percent of which is funded by businesses. Controlling for inflation, lobbying expenditures experienced a sixfold increase from $200 million in 1983 to $3.24 billion in 2013.177 These figures do not capture the ‘indirect information’ from lobbying activities, such as spending on advertising and public relations. For example, the American Petroleum Institute (API), a trade organization representing national oil and natural gas companies, paid $327.4 million to a public relations firm between 2008 and 2012, dwarfing its direct lobbying activities during that time period.178 As with the activities of API, a substantial scope of contemporary lobbying activities – such as those spanning medicine, infrastructure, energy, and so on – touch on S&T issues.179

While much is supplied to Congress whether asked for or not, much is also regularly requested. Two of Congress’s internal support bodies, the GAO and CRS, produce information and analysis on topics requested by members and staff. In 2017, members and staff accessed CRS reports and other research products more than 658,300 times; 8,600 congressional participants attended CRS seminars and training programs; and CRS produced 11,100 reports and other products requested by Congress.180 These large volumes are not only a contemporary phenomenon. During a four-year period in the 1960s, “Congress received nearly 400 reports on energy policy, totaling some 20,000 pages, just from one source,” GAO.181

However, **financing for internal resources has contracted over time.** For example, Congress appropriated $569 million182 to GAO for the 2018 fiscal year, compared to an inflation-adjusted $770 million in 1978 ($200 in nominal terms),183 representing a 26 percent decline in real funding. CRS, far smaller than GAO, increased in funding over the same period (from an inflation-adjusted $88 million in 1979184 to $108 million in 2017185) but has remained flat in real-terms over the last 15 years.186 Congress as a whole has grown its own operating budget by only 9 percent in real terms – versus 200 percent growth in the executive branch15 – between 1976 and 2016.187 In fact, the authors find that almost all growth in appropriations (in real terms) over the past two decades is attributable to non-legislative activities such as operations and maintenance of the Capital

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15 Includes 14 of 15 executive departments, excluding Department of Defense
Complex (Figure 6). Financing for external resources substantially outweighs financing for internal ones. As of 2014, business expenditures on reported lobbying activities ($2.6 billion) surpassed what Congress spent on itself ($2 billion).\textsuperscript{188}

**Figure 6 | Minimal growth in legislative appropriations, 1995-2015**

Commensurate with decreases in financial resources, people resources for Congress have also sharply declined. Between 1985 and 2015, staff at CRS and GAO experienced reductions of 29 percent and 41 percent, respectively.\textsuperscript{16} As with support bodies, congressional committee staff – tasked with providing specialized expertise for the committees’ policy domains – have declined by 35 percent over the same time period. Committees with jurisdiction over S&T-related policymaking have experienced even sharper declines. From 1985 to 2015, staffing decreased by 42 percent for the Senate Committee on Commerce, Science, and Transportation, by 42 percent for the House Committee on Science, Space, and Technology, and by 49 percent for the House Committee on Energy and Commerce (Figure 7).\textsuperscript{189} As Representative Bill Pascrell Jr. observes, Congress’s “expert policy staffs are dwarfed by the lobbying class.”\textsuperscript{190}

\textsuperscript{16} As Congress downsized its support body staff, demands for their services have remained substantial; between 2001 and 2011, for example, GAO received over 10,000 requests from members. See: Coburn T. (2011)
Financial and people resources have considerably shifted within Congressional offices over time. Spending on constituent services and communications staff has outpaced spending on policy functions. A 2017 Congressional Capacity Survey revealed that “despite the large share of staff resources allocated explicitly to dealing with constituent response... Legislative staffers in members’ personal offices often pick up the slack in meeting the demands of constituent service and communication.” A full third of legislative staffers in members’ offices report managing constituent mail “a great deal.” As demands on congressional offices have increased—from digital communications to campaign fundraising—internal capacity has not kept pace.

Finally, the decreases in financial and people resources within Congress correspond to an increased reliance on external resources, such as lobbying. As a Legislative Director for a House member commented, “we know that there is always a bias, but they [lobbyists] do a lot of the heavy lifting for us, which is a lot of the value they know they’re providing.” Other staffers describe a reliance on a patchwork of personal networks both within and outside of Congress for specialized expertise. Staff “know which member office to call” for expertise given the policy issue. “We all specialize to some degree in certain issues,” describes one. Staff also describe cultivating their rolodex of external ‘experts’.

A reliance on these informal networks, however, appears insufficient to address broader resource constraints from the staff perspective. A 2017 study of senior congressional staffers found that only 5 percent are “very satisfied” with the human resources support and infrastructure to support their official duties; 24 percent are “very satisfied” that members and staff have access to high-quality
and non-partisan policy expertise; and 11 percent are "very satisfied" that their chamber has adequate capacity and support. Across dimensions, the survey illustrates a picture of a constrained institution despite the increasing volumes of external resources.

Congress is awash in available external resources, particularly from sources such as lobbying groups. However, the financial and people resources over which it directly controls, such as those related to its standing committees and support bodies, have significantly declined. Remaining resources, moreover, have considerably shifted in their practical deployment away from where S&T-related sources might otherwise be embedded, such as policy staff.

Processes

Key takeaway:
Polarization, underutilization of hearings, and centralization of lawmaking in party leadership has curbed processes of transforming expertise into legislation.

Observations

• Resource constraints generate process constraints, with staff and members struggling to coordinate, interact with, and engage with relevant expertise
• As polarization has increased, committees have focused internal processes more on political problems and less on policy solutions
• The use of hearings as an interactive and deliberative feature of the lawmaking process has substantially decreased
• The centralization of lawmaking authority in party leadership has curbed traditional processes by which information and expertise are transformed into legislation

Processes refer to how an organization transforms resource inputs, such as information and analysis, into outputs of value, such as legislation. These means include "patterns of interaction, coordination, communication, and decision making." An examination of congressional processes – particularly as they relate to engaging more technical topics – reveals significant constraints. Specifically, we examine both individual and organizational processing challenges and find that phenomena such as staff with insufficient support, hyperpolarization, and the circumvention of committees have increasingly curbed internal information processing functions.

Resource constraints generate process constraints. Without adequate staff and financial resources, and with a surfeit of external information, **individual staff and members struggle to adequately engage with relevant technical information and expertise.** Many find themselves without the time and attention they state is required. According to a 2017 survey of senior congressional staffers, only 6 percent are "very satisfied" with the amount of time and resources required to adequately "understand, consider, and deliberate policy and legislation." A 2019 study by AAAS found that nearly 8 in 10 staffers reported how "not having enough time" made using science in policymaking difficult. A current Legislative Director in the House observed in his experience an
inverse relationship between ability to adequately engage with policy and staff seniority. "As you rise in the staffing ranks, you have less and less time to pay attention to what we would probably consider important policy nuances, or even just generally to be curious." Absent resources to enhance staff and member processing capabilities, a high volume of information may not itself be useful.

At an organizational level, the systematic use of expertise has traditionally been the realm of committees. By "connecting outside expertise to the members who actually make the decisions, committees are critical stages in the flow of information within the institution." Committees also serve as a chief vehicle by which members’ “perceptions and attitudes can be influenced by the nature of the information” as legislative staff incorporate external expertise into the policymaking process. The ways in which congressional committees interact with, deliberate, and advance decisions on policy issues has considerably changed, carrying significant process implications.

As polarization has increased, committees have focused internal processes more on perceived problems and less on policy solutions. Researchers have observed over time "a fundamental change in how committees are processing information" driven by committee members using their positions to “obtain information useful for partisan warfare, but not particularly useful for solving problems.” Confirming this observation, a 2016 study reviewing 40 years of committee hearings concluded that committees have been increasingly used to spotlight problems aligned with partisan perspectives, and less to discover policy solutions. Spotlighting problems typically requires less expertise than devising solutions, diminishing its use. As researchers speculate, there is consequently less demand for expertise that would otherwise support the development of informed legislation.

As demand for expertise has diminished, so too have the mechanisms by which that expertise is utilized. The use of hearings – an interactive and deliberative feature of the policymaking process – has substantially decreased. After a series of legislative branch reforms in the 1970s, the House reached a peak in the frequency of its hearings, holding “some 6,000 hearings per year.” That figure has since been on the decline, “from a tick above 4,000 in 1994 to barely more than 2,000 in 2014.” As historian Tevi Troy avers, "the drop in the number of hearings in recent years suggests that the heyday of the hearing may be behind us." Given their processing function to absorb and transform inputs such as information and expertise into legislative outputs through learning, discussion, and debate, their demise suggests a further constraint on capabilities – particularly given the absence of new mechanisms to supplant them.

Finally, decision making has shifted away from committees as party leadership has centralized legislative authority. Increasingly, traditional processes are being replaced by ones that weaken
the processing function of committees. “Formal committee stages of the legislative process are frequently bypassed – including hearings and mark-ups – as major legislation is negotiated and drafted in informal, behind-the-scenes meetings,” where party leadership exerts more influence. It is no longer infrequent that “after a bill has been reported” – after it has left committee – “but before it reaches the floor, major substantive changes are worked out via informal processes.” In the 113th Congress, approximately 40 percent of big-ticket legislation bypassed committees. Consequently, today’s committees can no longer rely on protected processes to influence legislation.

As committees have weakened, party leadership has strengthened. Funding patterns illustrate this trend: “While there was a 35 percent decline in committee staffing from 1994 to 2014, funding over that period for leadership staff rose 89 percent.” And while laws are supposed to be evaluated and ‘marked up’ by committees, observes Rep. Bill Pascrell Jr., “in real life, nothing moves through committees unless the party leader says so.” The integration of expertise into policymaking may be suffering as a result. According to research on information processing within congressional committees, shifts in power towards party leadership may be increasing partisanship at the expense of expertise. By design, “the committee system allows different kinds of information to enter the system simultaneously; the information that party leaders provide, by contrast, is typically used to structure a binary choice and highlight the dimension most amenable to partisan advantage.”

These shifts have been driven by various forces. A significant driver is the weakening of seniority rules that previously insulated the legislative power of committees from party politics. Since the mid-1990s, the selection of committee chairmanship according to seniority has been increasingly replaced by the discretion of party leaders. According to one study, “Violations of committee chair seniority have proceeded to reach 32.4 percent of chairmanships in the decade of the 2000s, and... 63.3 percent in the current decade” as party leaders exercise discretionary authority. Committee processes have been a chief casualty. “The congressional literature widely acknowledges the decline of formal deliberations in Congress” and the increased power of party leaders to control legislative content.

The centralization of lawmaking authority in party leadership has curbed traditional processes by which information and expertise are transformed into legislation.

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17 The process for deciding OTA’s termination is indicative. In 1995, it was party leadership’s decision “to debate the future of OTA in the appropriations process rather than through the agency’s authorizing and oversight committees, the Senate Rules and House Science Committees,” bypassing the committees within Congress with traditional jurisdiction over the agency and where support for OTA existed. See: U.S. Congress, Office of Technology Assessment (1996)
Priorities

Key takeaway:
Partisan priorities are not necessarily handicapping S&T-related capabilities; expertise will need to operate within their natural constraints.

Observations
- Partisan priorities compete to drive organizational priorities, but they do not obviate the usefulness of external expertise
- There may be a broad array of S&T-related policy issues members and staff perceive as ripe for bipartisan interests
- Congressional priorities tend to elevate near-term concerns
- Congress will reject any efforts to subordinate political priorities to expert priorities

Finite resources are processed into higher-value outputs contingent upon the priorities of the organization. Priorities direct scarce resources and incentivize certain processes, helping to determine what the organization will and will not accomplish. Given certain priorities, select information and expertise is either elevated or demoted. We find that the usefulness of expertise likely varies across Congress, and that partisan and present-focused priorities limit its role.

Much scholarship has been dedicated to understanding how Congress sets its priorities, from the influence of committees and the swelling power of party leadership to the role of diverse lobbying coalitions. This analysis is not interested in solving the questions of congressional agenda-setting, but instead more narrowly focused on the relationship between external expertise and internal priorities. In what ways do external resources such as specialized expertise shape priorities, or not? How do priorities direct expertise in their service well, or not?

“If OTA’s experience is any guide, circumstances under which legislators make political choices chiefly on the basis of expert claims are indeed rare. Legislators did no cast votes because OTA instructed what was best; rather, they employed OTA’s expertise to sift among the problems and frame potential solutions. They then made political judgments – as they are elected to do.”

Bruce Bimber, 1996
Massachusetts Institute of Technology

Unlike most organizations that attempt to set cohesive, organization-wide priorities, Congress, of course, cannot. Partisan priorities compete to drive organizational priorities. The competition to elevate a party’s agenda is the defining feature of the institution’s priority-setting. External
resources, then, are commonly marshalled in service of partisan priorities. Indeed, in partisan environments, expertise is often used selectively and to support pre-existing positions, rather than to inform and shape them. An early assessment of OTA’s work found that TA “is best used to justify political action rather than provide rational appraisals” and that members “use the products of assessment to support and explain their partisan positions.”

However, partisan priorities do not obviate the usefulness of external expertise. Congress is not a monolith, and so degrees of partisanship matter: partisanship characterizes different spaces within Congress differently. A 2018 study of House committees from the 104th through the 114th Congresses identified which “reported bills [to the full House] that had the greatest level of support from the minority party” as a measure of bipartisanship. The findings illustrated significant variation in partisanship from committee to committee. A 2015 study on “perceived conflict in different committees’ environments” across both chambers similarly distinguished high-conflict committees, such as House and Senate Budget, from low-conflict committees, such as House and Senate Agriculture.

Figure 8 | Relative partisanship across committees

Many advocates for more technically-informed policymaking lament that science has itself become ‘too partisan’ an issue to be utilized as a neutral input to the policymaking process. Indeed, some issues have dominated partisan battles, such as climate change. However, it is not clear that the
hyperpartisanship characterizing today’s Congress has necessarily pushed science to the sidelines. While research suggests that “the information that committees are acquiring, synthesizing, and, in turn, using, is more one sided today than it was in the 1970s,” qualitative findings suggest that a fatalistic perspective on the role of S&T-related expertise is unwarranted.

According to one former Representative who recently sat on the House Science, Space, and Technology Committee, “Many of the issues are of course contentious. But many more are far less partisan than people would think – or even the rest of Congress might think.” In fact, the six House committees that directly cover most S&T-related issues, including the House Science Committee, are on average less partisan than all other committees (Figure 8). Interviews with current and former members and their staff reveal an array of S&T-related policy issues perceived as ripe for bipartisan interests: worker automation and re-skilling; AI and defense policymaking; groundwater sustainability and quality; cybersecurity for critical infrastructure; U.S. industry competitiveness; natural disaster preparedness; federal funding for basic research; and agricultural biotechnology, to name a few.

Others contend that S&T-related policy issues fail to be sufficiently prioritized. This is certainly true for some and less so for others. A major distinguishing characteristic is the degree to which S&T issues are concrete and immediately relevant to pressing political needs. The most salient S&T issues in Congress are so because they are no longer abstracted future concerns but have instead reached into the present. Congressional priorities tend to elevate near-term concerns; S&T issues are no exception.

This challenges the forward-looking nature of S&T issues. The development of CRISPR as a gene-editing tool, for example, is dated by nearly a decade. The journal Science named CRISPR the scientific breakthrough of the year in 2015. Although as scientists celebrated its arrival, many also called for policymakers’ attention. A 2018 article in Stanford Medicine highlighted how “the rapid pace of discovery has raised questions about the regulation and oversight of this gene-altering tool.” The modification of human embryos, the reduction or elimination of malaria-carrying mosquito populations, the increased pace and variety of genetically modified crops, and the use of advanced gene editing for cancer treatments are all frontier applications of CRISPR with profound ethical and social implications. Yet despite its implications, its arrival on the congressional agenda is nascent. As a 2018 CRS report summarizes, the 116th Congress may begin to face “substantive questions about how (or whether) the products resulting from these technologies are to be regulated, and if so, under what statutory authorities.” Yet Congress “can barely manage what’s going on today, never mind tomorrow,” reflected one former Representative. Policy prioritization in Congress is biased towards the present.

An experience of OTA provides another illustration of present-biased priorities. OTA’s statutory mandate stipulated that its “basic function” should be “to provide early indications of the probable beneficial and adverse impacts of the applications of technology.” However, OTA would soon abandon this horizon-scanning directive in favor of nearer-term issues as dictated by the needs of

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Further, should Congress want to develop a more forward-looking posture, problems remain. According to Matt Bun, a nuclear policy expert at Harvard, “There are always a lot of forces drawing Congress’s attention to the present. But when it comes to the future, it may simply not know the right questions to ask.”

Finally, Congress will reject any efforts to subordinate political priorities to expert priorities. When Russell Peterson, OTA’s second Director, developed his own list of S&T-related policy priorities, he “outraged many legislators who recognized it as a rejection of Congress’s own agenda-setting processes.” The fate of TAAC is also suggestive. The advisory body was soon eclipsed by TAB, the governing body comprised solely of members of Congress, which preferred sole discretion over OTA’s agenda-setting. Formal influence of unelected experts through TAAC was sidelined nearly from the outset. These episodes reveal a fundamental tension between expertise and politics.

Bruce Bimber, in a study of OTA shortly after its termination, found that legislators “were frequently more animated by the possibility that expertise from the agency might harm them – usually by undermining an interest or contributing to the cause of a rival – than by the possibility that it might help them directly.” Political priority-setting, then, can be understood as a necessary form of control over the uncertain consequences of infusing expertise into the politics of the policymaking process. Charles Lindblom and Edward Woodhouse once referred to this dynamic as policymaking’s “deep conflict.” “People want policy to be informed and well analyzed,” the two observed in 1968. Yet “they also want policy making to be democratic and hence necessarily an exercise in power.” The conflict, they concluded, requires that elected officials “call on the services of analysts and experts without abdicating political authority to them.”

To exert influence, subordinated expertise must operate within the partisan and present-focused priority limitations of Congress.

Diagnosis: Congress suffers from low absorptive capacity

The above analysis interrogated the factors affecting Congress’s organizational capabilities. But what exactly is Congress not ‘capable’ of doing? And why do capabilities matter?

The gap between responsive lawmaking and S&T advancements in Congress is symptomatic of the capability constraints observed through the lens of its resources, processes, and priorities. Constraints on capabilities matter insomuch as Congress is unable to apply technical knowledge towards effective legislating – a weakened aptitude to learn and respond to an uncertain future. They suggest a failure of absorptive capacity: the ability of an organization to recognize the value of new, external information, to assimilate it, and to apply it to desired ends.

Absorptive capacity is “the measure of the rate at which an organization can learn and use scientific, technological or other knowledge that exists outside of the organization itself.”
Severely weakened capabilities have atrophied the organization’s absorptive capacity.

Absorptive capacity and innovation are tightly linked for private firms. For a policymaking body, we can extrapolate a similar relationship between absorptive capacity and effective legislation. Given that “outside sources of knowledge are often critical” to the strong performance of an organization, as the innovation literature goes, and that Congress’s capabilities to identify its value, process it, and transform it into strong legislative outcomes appear increasingly handicapped, how might we reinvigorate Congress’s absorptive capacity?

As long as capabilities remain weak, no amount of additional or better external expertise will sufficiently address the problem. It is precisely Congress’s atrophied ability to make use of expertise that defines its central problem: how to continually absorb and make sense of new knowledge and put it to use in service of lawmaking that keeps pace with the world.

NEEDS ASSESSMENT:
What would be of value to congressional consumers?

Key takeaway:
There are many “jobs” in Congress requiring S&T expertise which are not being done well; to make progress, interventions must solve problems that members and staff actually want solved.

Observations

- “Jobs-to-be-done” are specific ends that congressional stakeholders are hoping to achieve
- Primary research suggest that there are 9 specific “jobs” related to S&T expertise that are currently not being done well; some of these jobs are not salient problems for members and staff but are still important to the observed problem
- Interventions to improve congressional capacities must solve problems members and staff actually want solved rather than focusing only on experts’ perceptions of the problem

When Congress enacted the National Defense Authorization Act of 2017, charging the Commission on the National Defense Strategy with the task of reporting on “issues of U.S. defense strategy and policy more broadly,” members of Congress were not buying a report. Rather, members were hiring the Commission to perform specific jobs for them: a scan of potential defense issues, an evaluation of policies past-and-present, a credible voice to leverage for their own agendas in defense and foreign policy, among others. As Peter Drucker quipped: “the customer rarely buys what the business thinks it sells them.”

Reports like these and others sit on the shelves of congressional members and staff waiting for a relevant “job-to-be-done.” When think tanks produce research on emerging S&T issues, it can take hours for staffers to find insights and implications relevant to their work. In the words of one
former staffer, "Congress is absolutely inundated with information...reports, briefs, policy analyses...the longer it took me to find what I was looking for, the less likely I was to finish reading it." Policy analytical products are often developed with the agenda of the author in mind, not the needs of the user. This staffer’s experience is an important reminder that an analytical service is not an end unto itself. Rather, it fulfills a specific job. Until congressional staff have a job to “hire” it for, it will not be used.

Therefore, to be useful, interventions to improve S&T-related policymaking must address one or more specific “jobs-to-be-done” (JTBD). These reference the specific ends that members and their staff are hoping to accomplish, or what they require at a moment in time to do so. Identifying these specific “jobs” makes possible our ability to pinpoint where S&T expertise may be relevant, the places members and staff currently look to “hire” others to perform them, and where opportunities for improvement exist.

JTBD force a user-centric view of the challenges facing members and staff. This analysis seeks to elevate those challenges, as well as lay the groundwork for interventions that will generate proximate value. Interventions that fail to address real needs and generate real value will have a short shelf-life; its users are unlikely to see them as worth investing in and sustaining. Notably, this user-centric analysis surfaces an important tension. The needs required for Congress to legislate effectively on complex S&T topics may not neatly align with the perceptions of members and staff. For instance, members and staff may feel that an analysis of policy options and trade-offs is not a priority job for which they need to “hire.” To members, deliberating the Compliance with Court Orders Act may have been perceived as thorough and complete. External experts disagreed. Indeed, many of the S&T issues facing Congress are perceived by external experts as neither sufficiently salient nor well understood; members and staff may disagree.

A central challenge for outside expertise, then, is to find areas where there is alignment between internal and external perceptions of need. The experience of various S&T fellowship programs, which place technical experts in congressional offices on short-term bases, is illuminating. As one interviewee remarked, “the most successful Fellows are ones that align themselves with a member that has a shared interest they can work on together.” There are several reasons why experts may fail to achieve this alignment. For example, some S&T issues are simply not salient. As one senior staffer remarked, “everything [in Congress] happens in two-day news cycles...policy follows the news.” To become salient, a technical policy issue may have to wait for a news event, intervention by constituents, or a passionate champion to mobilize Congress to work on that issue.

Other issues may be too salient wherein additional expertise is in fact counterproductive. According to one study, in highly public environmental debates such as climate change and genetically modified foods, scientific expertise tends to amplify rather than help resolve political disagreements. Debates about scientific evidence obscure the underlying values conflicts, instead leading both parties to collect the evidence that is consistent with their value sets; and scientific uncertainty is confused (and exploited) as scientific disagreement, further inflaming controversy.

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19 See: Increasing complexity and decreasing comprehension
The solution proposed is for values-based differences underpinning these disputes to be made explicit and adjudicated by political means before scientific evidence can play a role in resolving environmental conflicts. Experts should be cautious with their contributions, as “political controversies with technical underpinnings are not resolved by technical means.”

This report posits that it is unlikely for future solutions to find a footing inside Congress absent addressing real needs and generating real value through the eyes of members and staff. Interventions may also need to address issues where there is misalignment between what is needed to improve policymaking and what members and staffers want to “hire” for. To be successful, such interventions cannot be at the expense of solving problems that members and staff actually want solved.

Looking for “Jobs-to-be-done”

Primary user research suggests that congressional members and staff have needs that span at least 10 activities across three broad dimensions: priority-setting, policy development, and governing (Figure 9). These activities are meant to represent the most important, rather than a comprehensive list of, activities members and staff engage in as it relates to the policymaking and governing responsibilities of Congress. Other activities are certainly relevant to today’s congressional office (e.g., reelection activities) but are not considered in this report.

Importantly, the depiction of policymaking as a linear process is for the convenience of analysis – to helpfully categorize congressional activities. In reality, of course, members and staff do not move sequentially along the stylized path depicted by Figure 9. Rather, these actors frequently and nonlinearly shift from activity to activity. Moreover, this stylized representation includes the desired elements in the policymaking process; the schematic is not to imply that these activities are done well, or even at all. Not all of the referenced elements are regularly executed in practice (e.g., anticipating future policy problems), but instead represent idealized activities as detailed by members and staff themselves.
From these 10 general activities, 32 individual "jobs-to-be-done" were identified (Figure 10). Not all of these "jobs" require S&T expertise. Some jobs, like "translating problems into value of constituents" – a job requiring that members interpret policy decisions based on demands placed on them by constituents – are not exercises where S&T expertise is helpful. For other jobs, the expertise required is based on the content of the problem or the particular bill under consideration. The relevance of these jobs is dependent upon the underlying policy issue. Of these 32 jobs, 20 have the potential to benefit from S&T expertise.
Figure 10 | The “jobs-to-be-done” related to primary congressional activities

1. Understand current demands
   - Search for problems across relevant constituencies (e.g., voters, the media, industry)
   - Evaluate credibility of what is learned

2. Anticipate future policy problems
   - Identify future issues potentially warranting policy attention
   - Develop questions for further investigation

3. Develop legislative priorities
   - Assess the magnitude of the problems identified
   - Translate problem into constituent preferences
   - Weigh importance against current priorities

4. Collect information and expertise
   - Get up to speed on current status and history of the issue
   - Develop baseline technical literacy
   - Cultivate and maintain networks of expertise
   - Collect information from sources of expertise
   - Keep track of what is learned

5. Make sense of information
   - Assess the credibility of the information provided
   - Synthesize information into actionable insights
   - Conduct policy analysis of options
   - Translate findings into constituent preferences

6. Review and write legislation
   - Writing legislation and supporting memos
   - Solicit feedback from relevant constituencies
   - Manage committee review process

7. Mobilize other lawmakers
   - Inspire others to care about (and do work on) the problem
   - Build credibility for the desired solution

8. Vote on legislation
   - Understand key terms in the bill
   - Assess credibility of the analysis
   - Translate impact of policy into constituent preferences

9. Monitor and oversee executive agencies
   - Identify issues requiring attention
   - Craft information requests from relevant agency officials
   - Assess credibility of information received
   - Search for and evaluate potential remedies (e.g., guidelines, budgets, amendments, reorganization)
   - Take legislative or oversight action

10. Engage with constituents
    - Evaluate impact of policy on constituents
    - Collect and track constituent comments and concerns
    - Conduct constituent communications

Source: Author interviews
Where might value be generated for congressional consumers?

Each of these 20 jobs were then evaluated against the degree to which they are currently being “done well” by the groups that tend to perform them (Figure 11). Of course, any such evaluation depends upon the perspective of the evaluator. For example, a congressional staffer may consider him- or herself to be quite skilled at “assessing the credibility of information provided” by outside experts. In our analysis, however, we consider whether the capability constraints identified above reasonably lead us to believe that the way in which the job is currently being carried out hinder Congress’s ability to legislate in the face of new S&T developments.

Interviews suggest that 9 of these 20 jobs are currently not being done well as it relates to S&T expertise (Figure 11). An additional 8 jobs were flagged as being done well only sometimes. Not all of these jobs are equally important for policymakers, however, and their own perception of which jobs are not being well in some cases may be quite different. These discrepancies will carry important implications for activities considered later. Below are three illustrations of jobs currently not being done well, drawn from interviews with members and staff.

1. Cultivating Networks
   A member of Congress interrogating electoral security issues had learned of voter roll technology error rates. The members’ legislative director (LD), who had heard of blockchain technology’s potential application to the problem, set about gathering information. He sent a request to CRS, which provided him with a review of basic technical information on blockchain; but investigating this specific application of the technology proved difficult, and beyond the scope of what CRS had provided. In addition to online research, the LD contacted a close friend with a technology background working in another member’s office. A few weeks passed before assembling enough information perceived as credible before the LD briefed his principal.247

Offices across Congress specialize in issue-areas, serving as distributed sources of internal expertise. As a former LD commented, “when we needed to know about PEPFAR, or about the PATRIOT Act, we knew which offices to call for information.”248 Offices also develop their own networks of expertise outside of Congress. These informal networks are called upon frequently. However, they are typically patchwork, failing to reach deeply into S&T communities of expertise; they are not always responsive to the timelines of congressional needs; and they tend to favor seniority, as more junior members generally have more inchoate networks.

[20] See: What’s happening with Congress?
2. **Assessing Credibility**
   As one member griped, “We all have our biases here [in Congress], but we also sometimes just want information we actually think is free of political leanings. This is harder to find than you think.”249 Most of the time, as this member explained, “we just rely on the source. Do we trust these guys? Do they seem to know what they’re talking about?” Consistent with much of the literature on credibility evaluation and cognitive heuristics,21 members and staff describe relying on regular ‘trusted’ sources in lieu of interrogating the credibility of individual pieces of information produced by that source. Members and staff are also highly time-constrained, often exhausted, and typically lack technical expertise themselves. These constraints limit their capacities to assess the credibility of technical information. While some sources are regarded as nonpartisan and highly credible, such as CRS, many others that members and staff acknowledge may have some bias are nonetheless regularly consulted, including for complex S&T-related issues, in the rapid day-to-day of congressional work.

3. **Searching for Problems**
   An LD, who holds a personal interest in a particular emerging technology, dedicated time last year beyond his regular responsibilities to learn about issues related to its regulation. The technology had not yet been broadly discussed by Congress and was, according to him, not on any other office’s agenda. He hoped to change that, and in the process make his principal a go-to expert on the issue.

   Learning about the full scope of the technology’s social and economic implications, as well as plausible policy approaches to supporting its innovation while mitigating its downsides, became a stress. As the LD commented, “it took too much from me.” He also perceived that his effort was unique. “I don’t think others at my level are doing this... People here are managing the day-to-day.” Scanning the horizon for frontier S&T issues is not among most day-to-day activities. For those who choose to take an interest in emerging technologies, their capacities to comprehensively analyze them are limited.

JTBD focuses attention on what would be of value to congressional members and staff. Interventions that fail to generate proximate and evident value will likely fall short. However, interventions need not be limited to only addressing a JTBD. If an intervention is performing many services of value, it may have authorization to weigh in on other areas that do not reflect proximate and evident needs but are nonetheless critical to improving S&T-related policymaking.

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21 For an example of credibility heuristics used in evaluation of online information, see: Metzger, M. J., Flanagin, A. J., Medders, R. B. (2010)
## Figure 11 | Which S&T-relevant jobs are currently not being done well?

<table>
<thead>
<tr>
<th>Activity</th>
<th>“Jobs-to-be-done” that requiring S&amp;T expertise</th>
<th>Who does this job today?</th>
<th>Is it generally being done well?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Understand current demands</strong></td>
<td>Search for problems across relevant constituencies</td>
<td>Lobbyists, staff</td>
<td>No: Information from lobbyists and interest groups may crowd out smaller voices, failing to incorporate broadly distributed S&amp;T knowledge</td>
</tr>
<tr>
<td></td>
<td>Assess credibility of what is learned</td>
<td>Staff</td>
<td>Sometimes: Staff may develop skills over time but are ultimately vulnerable to bias; frequent staff turnover results in loss of expertise</td>
</tr>
<tr>
<td><strong>Anticipate future policy problems</strong></td>
<td>Identify future issues potentially warranting policy attention</td>
<td>Think tanks, GAO (recently)</td>
<td>No: Policy priorities driven primarily by short-term interests with less time spent ‘looking forward’ (“Washington runs on a two-day news cycle”)</td>
</tr>
<tr>
<td></td>
<td>Develop questions for further investigation</td>
<td>Lobbyists, staff, personal networks</td>
<td>No: Lack of technical expertise can make it difficult to know the right questions to be asking</td>
</tr>
<tr>
<td><strong>Develop legislative priorities</strong></td>
<td>Assess the magnitude of the problems identified</td>
<td>Staff</td>
<td>Sometimes: Proximity to constituents facilitates understanding of potential impacts</td>
</tr>
<tr>
<td><strong>Collect information and expertise</strong></td>
<td>Get up to speed on current status and history of the issue</td>
<td>CRS, staff, personal networks</td>
<td>Yes: CRS develops reports on the legislative history of various issues; staff engages personal and internal networks of staff to acquire baseline knowledge</td>
</tr>
<tr>
<td></td>
<td>Develop baseline technical literacy</td>
<td>CRS, staff, personal networks</td>
<td>Sometimes: Some basic primers on technical topics from CRS exist but limited in breadth; existing resources (e.g., online search) not developed for policy-oriented audiences</td>
</tr>
<tr>
<td></td>
<td>Cultivate and maintain networks of expertise</td>
<td>Staff</td>
<td>No: Networks can be difficult to maintain, time-consuming to develop, and difficult to call upon on quick notice; creates a strong bias in favor of veteran members and staff</td>
</tr>
<tr>
<td></td>
<td>Collect information from sources of expertise</td>
<td>Personal networks</td>
<td>No: Networks can be too narrow to provide full range of potential views; potential for influential staffers to drive party understanding of an issue</td>
</tr>
<tr>
<td><strong>Make sense of that information</strong></td>
<td>Assess the credibility of the information provided</td>
<td>Staff</td>
<td>No: Time-constraints and lack of technical expertise leads staffers to rely on heuristics, like the source of information; risk of confirmation bias; CRS rarely engages outside experts</td>
</tr>
<tr>
<td></td>
<td>Synthesize information into policy-relevant material</td>
<td>Staff</td>
<td>Sometimes: A primary responsibility of staff, who are time-constrained and are increasingly being pulled away from policy work and into constituent-facing activities</td>
</tr>
<tr>
<td></td>
<td>Conduct policy analysis of options</td>
<td>Committee staff, think tanks, CRS</td>
<td>No: Many external sources for policy analysis but quality and credibility are highly variable; internal capacities to conduct rigorous analysis are constrained (e.g., technical skill, competing priorities like constituent work)</td>
</tr>
<tr>
<td><strong>Mobilize other law makers</strong></td>
<td>Build credibility for the desired solution</td>
<td>Members, staff, personal networks</td>
<td>Sometimes: Potentially constrained by lack of collective understanding of what constitutes “credible” evidence; may leverage networks to pull in new evidence</td>
</tr>
<tr>
<td><strong>Vote on legislation</strong></td>
<td>Understand key terms in the bill</td>
<td>Committee staff, personal networks, CRS</td>
<td>Yes: Committee may supply overview memos alongside legislation; otherwise, staffers leverage internal networks (e.g., offices of members that are domain experts)</td>
</tr>
<tr>
<td></td>
<td>Assess credibility of the analysis</td>
<td>Staff, networks, think tanks</td>
<td>Sometimes: Existing resources (CRS, GAO) rarely perform such functions; public comments period on legislation may fill this role</td>
</tr>
<tr>
<td><strong>Monitor and oversee executive agencies</strong></td>
<td>Identify issues requiring attention</td>
<td>Media, industry, committee staff</td>
<td>Sometimes: Statutory protocols and structures create mechanisms for issues to be surfaced; external groups also surface issues</td>
</tr>
<tr>
<td></td>
<td>Craft information requests from relevant agency officials</td>
<td>Committee staff, personal networks</td>
<td>No: Expertise needed to ask the right questions; potential conflict of interest between agency experts and oversight activities</td>
</tr>
<tr>
<td></td>
<td>Assess the credibility of the information provided</td>
<td>Committee staff</td>
<td>No: Most staff lack the technical training; potential conflicts of interest between agency experts and oversight activities</td>
</tr>
<tr>
<td></td>
<td>Search for and evaluate potential remedies</td>
<td>Committee staff, GAO, CBP</td>
<td>Sometimes: Resources exist but solution-set limited by breadth and depth of networks</td>
</tr>
<tr>
<td><strong>Engage with constituents</strong></td>
<td>Evaluate impact of policy on constituents</td>
<td>Staff</td>
<td>Yes: Proximity to constituents facilitates understanding of potential impacts</td>
</tr>
</tbody>
</table>
LANDSCAPE ASSESSMENT:
What environment must a solution cope with?

Any intervention directed towards Congress must navigate a legislative landscape that differs considerably from the one in which OTA existed. While innumerable characteristics of today’s environment will have implications for any novel intervention, we spotlight here those that notably contrast with the past. The increasing hyperpolarization of Congress; changes in the balance of powers between the executive and legislative branches; and the evolving functions of the existing legislative support bodies, all represent important landscape changes with direct implications for potential interventions.

Hyperpolarization in Congress complicates the role of technical expertise

Key takeaway:
Severe polarization, as opposed to partisanship, may shrink the opportunities for expertise to contribute to problem-solving.

Observations

- Congress is now more polarized than at any time since the end of Reconstruction
- The observation that Congress is an increasingly polarized environment is distinct from its partisanship; expertise will necessarily always serve partisan purposes
- Polarization, however, characterizes the severity of the conflict and the space for expertise to productively contribute to problem-solving

According to a research project that tracks members’ ideological differences, the 114th Congress (January 2015 - January 2017) reached an historic high. Using roll-call voting records, researchers illustrated how “Congress is now more polarized than at any time since the end of Reconstruction,” demonstrating historic levels of legislative gridlock. While the American public’s policy views have exhibited a relatively stable distribution since the mid-1950s, the same cannot be said of Congress whose members’ policy views over time continue to diverge from the public’s.

The observation that Congress is an increasingly polarized environment is distinct from its partisanship. Expertise in a political environment will necessarily serve political ends. It is not expected that technical expertise substitute for conflicts over values and interests, but it ought to improve the quality of partisan interaction. Documentation of legislators’ behaviors, such as during speeches on the floor, demonstrate that analysis conducted by OTA was used both to rationalize existing preferences as well as help formulate policy preferences. Its expertise was no substitute for politics. As one scholar notes, “it is impossible to identify a single bill where an OTA study was clearly decisive to the outcome.” Still, while never enough to “obviate the need for political
judgments," expertise can helpfully function to "narrow the range of legitimate disagreement." This frames a realistic role for expertise in a political environment.

Polarization, however, says something different about the possibilities for technical expertise. It characterizes the severity of the conflict and the space for expertise to productively contribute to problem-solving. In literal terms, polarization indicates how ‘far apart' opposing parties are from one another, with implications for how the parties view and engage with each other. In a hyperpolarized environment, where political interactions tend to deepen conflict more so than resolve them, what would constitute a realistic role of technical expertise? How might it meaningfully improve partisan interactions, or how constrained would it be? Hyperpolarization may lessen the practical ways expertise can help to focus political debate.

Imbalances of power leave legislative support bodies vulnerable

**Key takeaway:**
Expertise that empowers Congress vis-à-vis the executive is vulnerable at a time when the legislature is ceding its authority.

**Observations**

- While OTA was subject to skepticism at its birth, common interests across partisan lines helped to establish political support, including a desire to reassert legislative authority.
- Today, the absence of powerful common legislative branch interests may pose a challenge to the formation and sustainability of any novel S&T-focused intervention.
- Congress has subordinated many its powers; worsening imbalances of power curb the demand for and the protections provided to legislative support bodies.

While OTA was subject to skepticism at its birth, common interests across partisan lines helped to establish an important initial base of political support. Mounting concern in the early 1970s about the expanding scope of executive power brought partisans together. John Gibbons, a former OTA Director, attributes “the establishment of the agency to a desire by the legislators to gain greater control over the power to make policy” from the White House: to create a “captive source of expertise.” Congressional reforms in the 1970s helped to reassert legislative power; reforms in the 1990s initiated a period of reversal. Today, the possible absence of powerful common legislative branch interests may pose a challenge to the formation and durability of any novel intervention directed towards Congress.

From war authorizations to trade negotiation powers, an exhaustive literature illustrates the ways in which Congress has subordinated its own powers since the mid-1990s. The contemporary appropriations process is illustrative of the trend. In 2013, only 35 percent of federal spending was appropriated and voted on by Congress, with the rest increasing automatically and without

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22 See: OTA’s Emergence
congressional direction. Former Congressman Mickey Edwards notes that it is by choice that Congress “wait[s] for presidents to submit their proposed federal budgets before beginning serious discussions about spending decisions... not because [presidents] are entitled to tell Congress what to do, but only because Congress has tasked the president with doing so...”

Imbalances of power curb the demand for and the protections provided to legislative support bodies. Unlike the legislature, federal agencies have “significant financial resources and large staffs assembled and cultivated over decades.” James Capretta, a healthcare and budget policy expert, gives the example of a complex issue like Medicare regulations, where Congress has “largely ceded responsibility... to the Department of Health and Human Services.” When Congress wishes to understand the issues better, or interrogate executive activities, it relies heavily on the executive’s own experts. Demand for expertise is now regularly directed towards executive agency experts. According to a veteran scientist at the Department of Energy (DOE), there is “a constant stream of requests coming to us from Congress.” While experts regularly engage with Congress in response, “what we provide is limited... It must be balanced against the positions of whatever Administration is in power. We’re a very limited tool for them.”

Further, balance-of-power dynamics also carry implications for the survivability of expertise in exclusive service to Congress. In 2017, the White House’s Director of the Office of Management and Budget (OMB) stated that “the days... of the CBO have probably come and gone.” At issue was a CBO analysis provided to Congress on the estimated effects of the White House’s proposed healthcare legislation. The White House criticized CBO’s analysis through a social media campaign for using “bad numbers.” The OMB Director suggested changing the Congressional Budget Act of 1974 that brought the CBO into existence, advocating that Congress significantly pair down CBO’s activities. Various members from both party leadership and the rank-and-file aligned with the White House in impugning the credibility of the CBO. This posed a real threat to the office, and likely to Congress as a whole. As a former assistant director at OMB observed, “were it not for CBO, the policy debate would be dominated by an administration’s estimates of the effects of its own initiatives.” If this view is not broadly shared by Congress itself, the risks posed to internal bodies of expertise is non-trivial.

The tug-of-wars between the legislature and the executive that place nonpartisan agencies in the cross-fire “are as old as the agencies themselves,” according to a former CBO Director. The CBO’s lifespan is dotted with examples where the executive, facing resistance from Congress, mounted criticisms of the office. What may be more novel today is the degree to which the legislature, when party-aligned to the White House, does not mount a robust defense of its own sources of expertise. The hyperpolarization of the current political environment may meaningfully increase the risks posed to any future bodies tasked with exclusively serving Congress.
Existing legislative support functions exhibit limited S&T-relevant capacities

Key takeaway:
Organizational mandates, methods, and current product suites have curbed support-service bodies’ capacities to engage on difficult S&T-related issues.

Observations

- The reportorial nature of CRS products, its inability to engage in dialogues with outside expertise, an internal emphasis on government activities, and its history-biased knowledge structure constrain S&T-focused analytical services
- STAA’s emphasis on large products with long timelines, limited ‘customer base’, and lack of embeddedness within Congress suggest limitations on S&T-focused analytical services
- The limited utilization of NRC by Congress, large products with long timelines, and a focus on narrower technical questions illustrate an important but limited S&T-focused support function for Congress

Any approach to close the gap between responsive lawmaking and advances in S&T joins a landscape of existing support body activities. Aside from the executive agency experts called upon by Congress, the legislative landscape is not absent S&T expertise. While the resources available to Congress were previously reviewed, of concern here are the post-OTA functions of legislative support bodies tasked with S&T-related mandates. We briefly review the functions of CRS, GAO, and the National Academies as they relate to S&T expertise. Any intervention would necessarily co-exist or contend with the evolving functions of existing entities.

Congressional Research Service
CRS first established a science-focused function in 1965 with its Science Policy Research Division. The group was later disbanded and its employees subsumed by other units, including the Resources, Science, and Industry Division. The Division today covers a substantial breadth of policy domains, including natural resources, environmental management, industry, and infrastructure, in addition to S&T. Among the 1,100 new products produced by CRS in 2017, 7 percent constitute S&T topics. The organization’s historical capacities to furnish Congress with analytical expertise on complex S&T issues, however, has been limited. The reportorial nature of CRS products, an inability to engage in dialogues with outside expertise, and its history-biased knowledge structure constrain S&T-focused analytical services.

While CRS products range considerably, from “one-sentence answers to specific questions to occasional book-length studies,” its core product consists of issue briefs, typically 10-20 pages, summarizing topics requested by congressional consumers. “When members and staff need facts and figures or modest technical explanations, they can get assistance from [CRS].” This product emphasis allows the organization to provide “highly targeted information, including technical information, on very short notice.” This also considerably limits its ability to provide substantive

23 See: Resources
analysis, particularly in uncertain terrains – a defining feature of most emerging S&T topics. As one scholar notes, its approach “tends to be reportorial rather than analytical.”

“We’d heard about blockchain technology being able to help to change voter rolls more reliably, as when someone passes away, to decrease errors. Our office asked CRS for blockchain information. They provided one piece of information, but we needed a lot more... It took weeks to collate the research, get perspectives, and get a grasp of the issue.”

Legislative Director, 2019

Other features of the CRS approach also complicate its ability to provide robust analysis of complex S&T issues. Because CRS “operates under strict rules protecting the confidentiality of its work... [it] tends to freeze out external input.” Former staff have reflected on this limitation, noting how infrequently CRS engages in dialogue with outside experts. Instead, CRS relies heavily on written materials for analytical inputs. Sourcing high-value insights from “the frontier of science and tech,” according to one, “just simply isn’t possible without that active dialogue.”

Finally, CRS is an “existing repository of knowledge; it is not analyzing the future.” Particularly given its disinclination to engage external expertise, CRS draws on what has already been well documented. Taken together, CRS is not aptly positioned to analytically engage with gray-area, forward-looking problems. Novel interventions to enhance congressional S&T capabilities would be unlikely to duplicate or negatively contend with CRS.

Governmental Accountability Office
GAO, Congress’s oldest and largest support body, is largely tasked with “looking back” in order “to determine whether the public is being well served by public programs and expenditures.” It serves as a “congressional watchdog” by examining “how taxpayer dollars are spent.” This accountability mandate is supported by its core auditing functions. (While currently the Government Accountability Office, GAO was previously named the Government Accounting Office.) Traditionally, its focus has not been “on the implications of scientific discoveries or technological activities but instead on government program implementation and finances.” In practice, this means that the “bulk of GAO’s work is retrospective.”

GAO’s emphasis on S&T has evolved over time, starting with a science policy staff that was eventually disbanded as a separate entity. Since then, technical expertise has largely resided in the Applied Research and Methods Group. In 2002, however, GAO was directed by Congress to pilot a TA function inside the organization, later made into a permanent, albeit small, unit in 2008. Most recently, in early 2019, GAO inaugurated the new office of Science, Technology Assessment and Analytics (STAA), a 70-person unit focused mostly on the production of large reports requested by Congress. STAA’s work will be roughly allocated between studies commissioned by legislation (10
percent), studies requested by members (80 percent), and studies self-initiated at the direction of the organization’s Comptroller General (10 percent).  

The implications of STAA as a new entity for the legislative landscape are yet unknown, including the degree to which any novel intervention designed to improve S&T-related policymaking would complement its work. However, STAA’s impact on S&T-related policymaking, while potentially important, may be limited. **STAA’s emphasis on large products with long timelines, its limited ‘customer base’, and a lack of embeddedness within Congress suggest limitations on S&T-focused analytical services, at least in the present.**

In 2018, GAO, which unlike CRS produces much larger-scale products for Congress, completed 14 explicitly S&T-focused reports among a total of 633, representing roughly 2 percent of its report work. These technology assessments are large, long endeavors. A 2018 report on chemical innovations was developed over 28 months; a 2018 report on financial technologies was developed over 19 months; a 2017 report on medical devices was developed over 23 months; and a 2015 report on water use in the energy sector was developed over 34 months. The nature of large assessments serve a limited role. According to a current Senate staffer interrogating facial recognition technology, "we’ve gotten GAO to initiate a study, but it hasn’t started yet. It will take at least 6-8 months to staff up the project... So I’m doing my own research for now." It remains unknown whether STAA services might be expanded beyond the current emphasis. For now, STAA appears primarily focused on producing knowledge rather than building network linkages between experts and Congress, for instance, or addressing other congressional needs as previously examined.

Its current product emphasis is also geared towards a limited congressional constituency. Mirroring GAO’s protocol for congressional requests, and given the resource-intensive nature of the product offering, STAA prioritizes report requests from committees, in practice biasing them towards member seniority. Further, unless STAA deviates significantly from GAO’s arms-length relationship with much of Congress, it is unlikely to become a deeply embedded function. Congressional staff do not enjoy a direct personal relationship with the organization; engaging staff would be a “significant departure for GAO.” Given these methods for engaging with Congress and its demands, it is unlikely that members and staffs will be able to “connect directly with appropriate experts on short notice, with minimal go-between/transaction costs,” limiting the breadth and depth of its value to most members and staff.

**Any novel intervention may need to complement or subsume existing STAA capacities. However, there is likely ample space to innovate methods to improve S&T-related policymaking beyond STAA’s probable activities.**

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24 See: Existing legislative support functions exhibit limited S&T-relevant capacities
“Of course, we considered carefully whether this TA function should be placed in the already existing GAO or Congressional Research Service, and the evidence was convincing that it should not be. To be effective it should be separate. GAO makes its examinations after the fact, after the water is over the dam. The essence of our bills is to anticipate far more accurately in advance the consequences of our decisions here. And even though the Congressional Library has great competence in many respects, it does not have the type of competence, nor traditionally the thrust, the interests and attitudes intended by this new legislation.”

Charles Mosher, 1972
Ranking Republican, Science, Research and Development Subcommittee

National Research Council of the National Academies

Finally, the National Research Council (NRC), the operating arm of the National Academies, carries out studies principally for executive agencies, but also for Congress when commissioned to do so through legislation. These commissioned studies typically total no more than a few dozen for each Congress. NRC, along with sibling units within the National Academies, absorbed some of Congress's requests for S&T-focused support after 1995. Congressionally mandated NRC and IOM studies jumped after OTA’s defunding. This bump, however, was short-lived. Utilization of the NRC by Congress is difficult. A study must be “mandated in legislation and... implemented and paid for through appropriations to a federal agency” that will contract with the NRC.” Congress enjoys only an indirect relationship to the entity.

Reports from the Academies are developed using consensus-style committees, as opposed to the trade-off framing of policy options that defined OTA’s reports. Thus, they tend to be focused on conclusively answerable and narrower technical questions upon which consensus can in fact be reached. While large-scale reports, as with GAO’s technology assessments, remain the bedrock of its work, the NRC is experimenting with an expanded range of activities including workshops and roundtables with various experts, and standing committees that convene continuously as sources of ongoing expert opinion.

The limited utilization of NRC by Congress, large products with long timelines, and a focus on narrower technical questions illustrate an important but limited S&T-focused support function for Congress.
The complexity of interacting issues detailed in the Diagnosis leads us to varied approaches for making progress. The multifaceted constraints on congressional capabilities, as well as changes in Congress’s broader operating environment – across science, industry, and civil society – inform potential solutions. In this section, these findings are considered through a structured decision-process to arrive at a recommended course of action.

To progress from an expansive set of possible approaches to a recommended one, we establish three criteria against which to evaluate options (Decision Criteria). We then move through three winnowing phases to sequentially narrow the basket of approaches (Decisions): First, an exhaustive option-set is developed that considers intervention mechanisms both external and internal to Congress. Second, we determine the optimal and specific location for the decided approach. Third, given its location, we evaluate various models to deliver the intervention.

- **Decision #1: What** sort of intervention is needed to address the problem?
- **Decision #2: Where** should this intervention be implemented?
- **Decision #3: Which** model should be used for this intervention?

Taken together, we recommend a new body that sits internal to Congress utilizing an Office model and featuring elements of a boundary organization. An internal intervention is preferred to external ones ‘owned’ by non-Congressional entities, as internal functions are better positioned to learn and navigate challenges constraining the institution. While some ‘internal’ bodies exist – such as GAO and CRS – and could in turn be used, none are sufficiently embedded within the legislature, and each showcases considerable shortcomings to address the challenges diagnosed in this report. Finally, an Office model is selected as the one most responsive to congressional needs, compared to alternative models used primarily in Europe. See Figure 12 for a summary of Decisions.

OTA employed an Office model. However, the option of reinstating OTA as it was, or with minor variations, is rejected below. The recommendation suggests significant departures more appropriate to the contemporary context. We explore these departures thoroughly in the section that follows.
## Figure 12 | Summary of Decisions

<table>
<thead>
<tr>
<th>Options for improving absorptive capacity in Congress</th>
<th>Decision criteria</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| **Decision #1**<br>What sort of intervention is needed to address the problem? | **Responsiveness**<br>
- Educate members and staff<br>
- Invest in select centers of knowledge<br>
- Empower existing expert institutions<br>
- Expand existing ‘deployed’ experts<br>
| **Feasibility**<br>
- Is it responsive to the diagnosis?<br>
- Is it practical, given the environment?<br> | **Durability**<br>
- Is the impact likely to be sustained?<br> |<br>Do not pursue<br>Do not pursue<br>Do not pursue<br>Do not pursue<br> |
| **Decision #2**<br>Where should this intervention be implemented? | **Internal to Congress**<br>
- Expand internal capacity through a current or new body<br>
| **Decision #3**<br>Which model should be used for this intervention? | **Existing congressional support bodies**<br>
- Congressional Research Service (CRS)<br>
- Government Accountability Office (GAO)<br>
- Revived Office of Technology Assessment (OTA)<br>
- New internal support body<br>
| **Traditional models**<br>
- Committee model<br>
- Office model<br>
- Interactive model<br>
- Boundary organization<br>
| Pursue<br>Do not pursue<br>Do not pursue<br>Pursue<br>Do not pursue<br>Do not pursue<br>Pursue<br>Consider specific design features<br>
DECISION CRITERIA:
How should an approach be selected?

To evaluate potential solutions, we borrow and adapt the “balanced breakthrough” model as a decision-making framework. By balancing the competing needs of responsiveness (‘is it responsive to what’s been diagnosed?’), feasibility (‘is it practical in the given environment?’), and durability (‘will the impact be sustained?’), the decision process can select solutions that are most likely to be impactful. The decision criteria are visualized in Figure 13.

Figure 13 | Overview of decision criteria

Responsive

The scope of possible solutions to address the gap between S&T challenges and responsive lawmakers is expansive. Indeed, innumerable organizations and efforts are currently dedicated to improving legislative outcomes in S&T issue areas.

However, this analysis is chiefly concerned with Congress’s absorptive capacity. While mindful of broader S&T-related trends, this report primarily spotlights the atrophied capabilities of the legislature. Factors external to Congress were analyzed – such as across civil society and industry – but with a direct eye towards their effects on the lawmaking body. Thus, we hope to ensure that the scope of plausible approaches are directly responsive to the diagnoses illuminating the challenges facing Congress. Options that might otherwise hold promise – such as mobilizing scientists as an electoral constituency, as suggested by some interviewees – are beyond this scope.

In practice below, ‘responsive’ helps to evaluate the degree to which the considered approaches address the identified issues, and how comprehensively.
Feasible

The scope of possible approaches may range from the easy to the impractical given considerations for constraints. Approaches that might satisfy the responsiveness criterion may also carry impractical implementation requirements. This criterion looks ahead to the practicality of implementation.

If an approach requires radical changes to the political system, for instance, or demands a scale of resources unlikely to materialize, we have excluded them from the option-set entirely. For those within the option-set, this criterion forces consideration of the practical limitations of an approach, focusing decision-making attention on resource requirements. Resources here are broadly conceived to include factors beyond financial ones, such as political and administrative resources implied with an approach.

Durable

Congress and its operating environment experience substantive changes over time, from the role of external resources to fundamental shifts within the institution. Approaches conceived of today ought to be positioned well for future relevance.

Durability evaluates the inherent adaptability of a potential option; that is, the degree to which it might be capable of co-evolving with Congress to meet future needs in future states. Adaptability suggests a bias towards flexibility and an aptitude to internally adjust in response to changes in context. Of note, durability does not imply longevity of a solution for its own sake. Instead, it points towards the likelihood of an approach to respond well to emergent challenges over time.

DECISION #1:
How could this problem be addressed?

Identifying potential options

Interventions are initially distinguished between those external to Congress and those internal to Congress. Internal interventions highlight opportunities to build upon existing support-services relevant to S&T-related issues, or to conceive of new institutional mechanisms altogether. External interventions, while directed towards Congress, are ‘owned’ by non-congressional entities. These intervention options are segmented into five broad categories, four of which are external to Congress (Figure 14).

Training: educate members and staff on foundational S&T topics. New training programs might be designed to equip members and staff with knowledge on foundational S&T topics using methods designed specifically for congressional consumption. Such training programs can be
organized around topical areas of public interest (e.g., emerging issues in AI) or, to enhance their relevance, can be designed to improve the ability of members and staff to complete one or more of the JTBD currently not being executed well (Figure 11).

A variety of organizations are currently providing trainings to congressional members and staff. The Congressional Management Foundation (CMF) offers trainings and online-accessible resources related to office management and operations. In 2017, the CMF trained over 1,400 staff through over 60 congressional trainings. Remarking on their effectiveness, a Senate Chief of Staff observed that “CMF really understands the congressional workplace, and they have been an invaluable resource for me on everything from designing mail systems... to providing training for staff members.” The Government Affairs Institute (GAI) at Georgetown University and the Project on Government Oversight (POGO) support congressional operations and oversight activities, respectively.

**Targeted expertise: invest in select centers of knowledge on specific issues.** There exists no shortage of S&T-related information and expertise outside of Congress. Where S&T knowledge gaps exist, Congress could select and invest in targeted centers of knowledge across this landscape, transmitting knowledge back to the institution. For instance, given the specialization of many civil society actors, the approach would link those with deep expertise in key S&T domains directly to Congress on an issue-by-issue basis. Civil society actors often attempt to create these links currently, but lack adequate resources, sophistication, or access to impact policymaking. Broad Institute, for example, is well-known for its expertise in advanced gene editing technologies. Intervention activities could entail scanning the external landscape, selecting and investing in centers of knowledge, and better linking their work to Congress.

**Enhanced expertise: empower existing expert institutions.** Congress could work to elevate the resources and responsibilities of existing sources of external expertise – particularly those already utilized by the legislature. By identifying one such institution, or a small handful of institutions, Congress may be able to better coordinate and leverage the research activities of various S&T-related disciplines towards issues of the public interest. These generalist bodies could be employed to aid in various S&T domains, rather than selectively given the domain area. The National Academies of Sciences, Engineering, and Medicine (NASEM) would be a natural candidate for such a role.

**Deployed expertise: expand efforts of existing ‘deployed’ experts.** Various organizations currently coordinate the efforts of external actors interested in providing expertise to members and staff. With additional support, they may be better able to identify emerging S&T issues with policy implications, assist in making prioritization decisions, direct congressional attention, and provide hands-on analytic support. Organizations such as AAAS (through the Congressional Science and Engineering Fellowship Program) and TechCongress (through the Congressional Innovation Fellowship) take this approach by placing S&T experts inside Congress, serving as a conduit between external expertise and offices and committees.

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25 See: What’s going on with civil society?
**Internal support: expand upon or build new support bodies.** An approach to leverage existing or developing new support services within Congress could serve to augment its current resources, enable better processes, or respond to internal priorities in ways that close the gap between responsive lawmaking and S&T-related challenges. This option could be approached by extending the mandates of existing congressional support bodies (e.g., CRS, GAO), by reinstating OTA, or by establishing a new support body. The creation of STAA at GAO serves as an illustrative case of the first approach. S&T-related support capacities also exist within the Resources, Science, and Industry Division of CRS. Reinstatement of OTA – which would require appropriating funds by Congress, as OTA was defunded but its legislation never repealed – has been attempted multiple times, most recently in 2018 with a proposed $2.5 million in appropriated funds; reinstatement bills such as in 2001 and 2003 attempted to appropriate $20 million.

**Figure 14 | Intervention approaches to address the problem**

<table>
<thead>
<tr>
<th>Options</th>
<th>External to Congress</th>
<th>Internal to Congress</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Approach</strong></td>
<td>Educate members and staff</td>
<td>Invest in select centers of knowledge</td>
</tr>
<tr>
<td><strong>Case studies</strong></td>
<td>CMF, GAI, POGO</td>
<td>Empower existing external expert institutions</td>
</tr>
<tr>
<td><strong>Overview</strong></td>
<td>Training</td>
<td>Enhanced expertise</td>
</tr>
<tr>
<td></td>
<td>Targeted expertise</td>
<td>Deployed expertise</td>
</tr>
<tr>
<td></td>
<td>Broad Institute</td>
<td>Internal support</td>
</tr>
<tr>
<td></td>
<td>National Academies</td>
<td>TechCongress, AAAS Fellows</td>
</tr>
<tr>
<td></td>
<td>Provide trainings on core S&amp;T topics to members of Congress and their staff</td>
<td>Augment an existing body outside of Congress to serve as a trusted advisor on S&amp;T issues</td>
</tr>
<tr>
<td></td>
<td>Invest in centers of knowledge where S&amp;T knowledge gaps exists; transmit these learnings to Congress</td>
<td>Provide tailored support to Congress by filtering less useful or actionable expertise</td>
</tr>
<tr>
<td></td>
<td>Augment an existing body outside of Congress to serve as a trusted advisor on S&amp;T issues</td>
<td>Expanding S&amp;T capacity in existing support bodies, make them more useful for policymaking, or develop a new support body</td>
</tr>
</tbody>
</table>

**Applying decision criteria**

'**Training**' suffers from low responsiveness and durability, despite being the simplest to execute. Trainings presuppose that a lack of education on S&T topics is a determining factor in the challenges of S&T-related policymaking. Trainings geared towards members and staff who still suffer from a paucity of financial and people support may increase technical literacy on particular issues, but resource constraints remain. Without deep integration and institutional buy-in, trainings may also risk facing continuous practical barriers to regular uptake. Lastly, trainings may prove to be 'one-off' measures that struggle to sustain their impact over time, although they are simple to execute.

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26 The amendment for reinstatement, included with the Energy and Water Development and Related Agencies Act, failed to pass by 45 votes.
'Targeted expertise' is unresponsive to the constraints facing Congress and may be challenging to execute well in practice. Deciding in which centers of knowledge to invest, facilitating the transfer of knowledge, and embedding that knowledge into Congress presupposes a substantial degree of coordinating capacity, suggesting barriers to feasibility absent an existing actor imbued with congressionally designated authorities to play an orchestrator role. Additionally, this approach may be hampered by Congress’s weakened information processing functions that are increasingly less amenable to utilizing sound external expertise. Moreover, it is unclear if better ‘targeted’ expertise in particular domain areas will compete well with the extraordinary volume of information currently directed towards Congress.

'Enhanced expertise' is a high-feasibility option though with low responsiveness to Congress-specific challenges. Existing expert institutions such as NRC are well-regarded for their rigor and credibility. Given their existing practices of serving Congress, enhancing the relationship would require only commissioning additional work. However, because NRC generates a consensus view on the reports for which it is commissioned, and generally recommends a clear policy choice, its experts are employed to study typically narrow, technical issues. This vein of ‘authoritative advice’ is an important but limited role. Further, relying more heavily on existing expert institutions must contend with a model “dominated by... executive branch needs.” Bodies with primary accountabilities elsewhere would likely fail to respond to the suite of institution-specific issues facing members and staff.

'Deployed expertise' is a high-feasibility and low-durability option, with potentially mixed implications for responsiveness. This approach builds internal capabilities through high-skilled professional placements. While programs such as the Congressional Science and Engineering Fellowship presently only place a few dozen specialists in Congress, expanding the effort may address a real institutional constraint. It further has the distinct advantage of being a practiced set of programs upon which to build. However, many of these professionals are transient, risking fluctuations and only temporary capability building. Evidence also suggests that “like harried professional staffers, [they] rarely have time to investigate technical matters in depth.” Individual placements may not substitute for the building of robust and formal networks of support.

Each of the options external to Congress may ultimately struggle to ‘know’ Congress: pivots in priorities, idiosyncrasies of process, and needs of strained staff and members wrestling with technical topics. Being adequately responsive to these users and to the problems they face, and adapting strategies to sustain impact over time, will prove particularly challenging for those not operating within a highly distributed, complex, and often opaque institution. Finally, solutions offered (or imposed) from the outside will encounter a cautious Congress. Political priority-setting subordinates technical priority-setting; and absent being captive to Congress, those with alternative priorities might rightfully be met with skepticism.

27 See: Looking for “jobs-to-be-done” in Needs Assessment
'Internal support' offers the most probable high-responsiveness and high-durability option, though with unclear implications for feasibility. The legitimacy conferred to internal organs – created by and captive to Congress – increases the likelihood of sustained interventions made durable through this relationship. However, feasibility judgments range significantly depending upon the location of intervention internally, such as reinstating OTA versus enhancing STAA. Also depending upon the location of intervention, challenges remain with the ability of internal bodies to provide robust and relevant S&T-related services that meet Congress’s contemporary challenges. Feasibility and responsiveness depend mostly upon the specific body.

Despite these unknowns, internal options are innately better positioned to respond to Congress’s needs and navigate its terrain (Figure 15). Given the weakened absorptive capacity of Congress, priority should be given to interventions most likely to improve its ability to identify, assimilate, and transform external expertise – processes more difficult to understand and support externally. An organization’s absorptive capacity “does not [only] depend on the organization’s direct interface with the external environment.” It also depends on the ability of the organization to intake, translate, and transfer knowledge across its many component parts which “may be quite removed from the original point of entry.”

Bodies external to Congress are unlikely to perform this vital role optimally. Notably, Congress enjoys a plethora of existing and complex knowledge transfer practices. Members’ offices – Congress’s component parts – frequently become ‘experts’ in a given topic, for which their peers look to them for consultation, advice, and vote signaling. Office staff become go-to experts in particular policy domains, called upon by others when needed. More formally, while Congress’s process capabilities are increasingly curbed, processes exist, albeit imperfect and complicated. Internal interventions may be best positioned to learn, navigate, and better support the organic functions of Congress to make them more capable.

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28 See: Decision #3
**Figure 15 | Recommendation and rationale for Decision #1**

<table>
<thead>
<tr>
<th>Options</th>
<th>External to Congress</th>
<th>Internal to Congress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educate Congress and staff</td>
<td>Invest in select centers of knowledge</td>
<td>Expand internal capacity through a current or new body</td>
</tr>
<tr>
<td>Training</td>
<td>Targeted expertise</td>
<td>Internal support</td>
</tr>
</tbody>
</table>

**Recommendation Rationale**

- **Do not pursue**
  - Fails to build enduring capacity; a ‘one-and-done’ solution susceptible to staff turnover (*low responsiveness and durability*)
  - Absorptive capacity already constrained and will challenge knowledge transfer efforts (*low responsiveness and feasibility*)
  - Authoritative, consensus-based focus misaligned to congressional needs; requests will compete with executive branch (*low responsiveness*)
  - Builds capacities in Congress only temporarily; short-term placements inhibit institutionalization of networks and other forms of learning (*low durability*)

- **Pursue**

**DECISION #2:**
Where should this intervention be implemented?

**Identifying potential options**

Considering an intervention internal to Congress presents its own sub-set of further options given the institution’s existing support bodies: CRS, GAO, and CBO.\(^{29}\) Indeed, both prior to the formation of OTA as well as after its termination, lawmakers debated the propositions of placing a TA function within either CRS or GAO.\(^{30}\) Much has changed since then. We consider the responsiveness, feasibility, and durability of using existing support bodies as vehicles for intervention; of reconstituting OTA; and of developing a new support body altogether (Figure 16).

\(^{29}\) CBO is not evaluated as a plausible option here given its mandate to provide budgetary and economic information and analysis to Congress.

\(^{30}\) For an overview of CRS and GAO, see: Existing legislative support functions exhibit limited S&T-relevant capacities.
Applying decision criteria

We provide a more extended analysis for this Decision, given that current discussions among analysts and advocates about S&T expertise in Congress focus largely on where interventions should be implemented. Debates weigh the benefits and drawbacks of reconstituting OTA, expanding STAA, investing in CRS, and so forth – particularly given the existing S&T-related capacities of these congressional bodies (see Figure 17 for a summary).

Congressional Research Service

S&T-related functions of CRS were previously reviewed, detailing how the nature of its products, limitations on its engagement with outside expertise, and the characteristics of its knowledge structure may presently constrain S&T-focused services. However, an expanded analysis of the organization is appropriate to ascertain its strengths and weaknesses as a location for future interventions.

CRS is poorly positioned to respond to key JTBD (low-responsiveness).

First, the development and maintenance of networks of expertise for members and staff – a priority JTBD – is intensive and typically results in limited penetration into S&T communities of expertise. CRS staff rely almost exclusively on written works to source information and provide assistance to Congress, not on networks. Given that CRS does not actively engage in dialogue with external networks of expertise, the organization would be unlikely to bridge external networks with member needs. As one former CRS researcher observed, the “operating norms simply do not

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31 See: Existing legislative support functions exhibit limited S&T-relevant capacities
allow for it. If we were to engage in conversations with ‘outsiders’, it would internally call unwanted
attention to what you’re up to... CRS has decided to stick to what it can find that’s already
published.”

“The attitude is, ‘Anyone outside of our walls, they have an agenda.’ This cuts
CRS off from a lot of knowledge – especially in ambiguous areas like
technology where there aren’t clear answers.”

Former staff member, 2019
Congressional Research Service

Second, this disposition may also present challenges to aiding members and staff with assessing
the credibility of differing views on complex topics, another priority JTBD. Pressing S&T
questions “are usually disputed questions that require a whole range of opinions, and
interdisciplinary questions that one person has a handle on.” While CRS has rigorous internal
capacities to perform analysis on well-researched topics, its ability to do so in gray-areas of S&T is
less clear. For instance, CRS is well-suited to field the question, “What is the existing scope of
federal investments in quantum computing capabilities?” This is dissimilar from, “How might
quantum computing impact the future of our defense capabilities?” CRS may struggle to field the
latter because “CRS emphasizes fact-gathering and reporting, not thorough analyses with input
from diverse stakeholders.” A 2018 report on CRISPR explains the gene editing technology, its
current and planned applications, and an overview of some concerns; it does not analyze the
different possible effects of new regulatory approaches.

The provision of investigative assistance, a third priority JTBD, entails support for developing lines
of appropriate inquiry to learn about an emerging S&T issue. For instance, what questions
should be asked to interrogate issues of AFVs? How should staff assigned to the issue structure
their inquiry as they gather and assemble input? Whereas CRS is by design a reactive body –
exclusively responding to inbound requests from members and staff – this JTBD represents a
proactive need. Further, this vein of assistance also suggests a need for “being in the room,” as
Travis Moore, founder of TechCongress, observed. The organization’s congressional fellows, who
bring S&T expertise into select members’ offices, pose technical questions throughout internal
deliberations. “It’s about having someone in the room who can spot that something’s missing – or
hasn’t really been thought through – before legislation makes an unintended mistake.”

Finally, CRS’s strength sits with its ability to synthesize what it sources at “lightning speed.” It is not unusual for services to be delivered the same day as a request: a high-value proposition
for constrained policy staff increasingly pulled away from policy analysis work.
Leveraging CRS as an implementer raises questions of capacity (low-feasibility).

When Congress defunded OTA, some lawmakers argued for the ability of CRS to carry out OTA’s work. However, the expectation that CRS would fill the institutional void left by OTA never materialized.320 (In fact, CRS would later eliminate its Science Policy Research Division, with its staff assigned elsewhere.) Today, the feasibility of the CRS option is in large part contingent upon its internal capacities. As one analysis observes, “With far too few experts to cover the myriad technological topics facing Congress, individual CRS analysts tend to be stretched thin and usually are not able to engage in the kind of lengthy, ‘deep-dive’ analysis that is useful in policymaking decisions.”321

CRS operates with a risk-averse culture (low-durability).

Evolving an intervention’s approach to meet the dynamic needs of Congress in relation to an evolving technical landscape requires adaptability. Adaptability in turn requires a degree of risk-taking. However, various characteristics of the organization suggest a high degree of risk-aversion. For instance, CRS does not generally collaborate with other organizations but instead “has its walls up.”322 CRS likely derives its credibility with Congress from this strategy of purposeful distance; members and staff generally view the organization as unbiased. This distance, however, may not be well suited to forming adaptive capabilities. The organization’s characteristic cautiousness can be understood as an institutional response. “They remember when GAO got a 25 percent cut, when OTA got zeroed out. There isn’t a clear incentivize for risk-taking. It’s not what they were designed to do.”323

Government Accountability Office.

S&T-related functions of GAO were previously reviewed, detailing how its newest unit (STAA) emphasizes large TA products with long timelines, targets a limited ‘customer base’, and is not deeply embedded within Congress. While these features limit S&T-focused analytical services, the expanded analysis below details its strengths and weaknesses as a location for future interventions.

Lack of embeddedness is a barrier to addressing congressional needs and priorities (low-responsiveness).

The responsiveness of GAO can be assessed both by examining its newest effort, STAA, along with broader considerations of the institution itself. As STAA expands its abilities to assess S&T issues on behalf of Congress, the unit may become more integrated into Congress itself. Presently however, and as with GAO, STAA is not an embedded function. The purposes of its products (e.g., large-scale TA reports) and the processes for interacting with Congress (e.g., well-established protocols for fielding and channeling formal requests) do not require that STAA engage deeply with members and staff.32 Regarding responsiveness to the challenges identified in this report, this has key drawbacks.

32 For instance, unlike the experience of OTA, STAA and Congress do not informally enjoy ‘shared staff’ between the body and congressional committees.
For much of Congress, engaging GAO is difficult. According to one Senate staffer, “Our office is able to access GAO because my principal [member] is relatively senior and we know how to navigate the process. That’s not true for many of my colleagues.” In fact, while GAO (through STAA) prepares to write a report, “I’m still mostly using my contacts in this space to get the information I need.” Moreover, to whom GAO responds and with whom it communicates is limited. Thus, its services operate at arms-length from much of Congress; staff do not traditionally enjoy direct personal relationships. STAA would require a significant break with GAO protocol to operate differently in relation to Congress.

“Any attempt to improve how science is received in Congress requires knowing Congress intimately, which is another way of saying forming relationships day in and day out with members and staff. It’s impossible to do that unless you’re fully engaged.”

Ali Nouri, 2019
President, Federation of American Scientists

Further, while STAA receives requests from members for studies, its lack of embeddedness may hamper its ability to respond to diverse congressional priorities. This consequence is in part a function of GAO’s governance: because no TAB-like structure exists, and given GAO’s discretionary authority to decide which requests to accept, its work is not a full reflection of the congressional agenda. For instance, a senior member or group of members may succeed in securing a study; but this does not imply that the work mirrors Congress’s broader priorities. As one analyst observed, prior technology assessments by GAO suggested “a narrow agenda relative to the wide ranging major S&T issues facing Congress.”

Its existing S&T function is a low-barrier option for implementation (high-feasibility).

GAO has been authorized by Congress to expand its S&T function through STAA. As a newly operational arm of the organization – with both dedicated financial and people resources – STAA stands in contrast to other options such as CRS, where new capacities would likely need to be authorized and developed. Further, while STAA is currently staffed with 70 employees, the unit is authorized to expand its internal resources over the coming years.

Distance from Congress and an auditing mandate weaken adaptive potential; however, impact potential more ‘protected’ within a large institution (medium-durability).

Prior to STAA, analysts suggested that efforts to enhance GAO’s S&T-related services would require that its offerings “be built out substantially, with associated changes in resources, staffing, and culture – when GAO currently lacks similar models to draw on from elsewhere in its
STAA may be an effort to address these issues. Thus, assessing its durability may be premature, but certain features of its home institution elevate key challenges.

STAA’s ability to adapt to Congress over time may foremost be hampered by its arms-length relationship to members and staff. If adaptation is a function of careful observation, feedback, and adjustment, how STAA might co-evolve alongside its client absent deep embeddedness is unclear.

Additionally, that “GAO’s primary function is government auditing, not policy analysis and forecasting” may handicap efforts to innovate new methods or adapt existing ones. The needs of Congress as they relate to ambiguous areas of S&T are distinct from Congress’s oversight and auditing needs. STAA may develop into an ‘agency within an agency’, featuring its own distinct culture and methods. Presently, however, STAA’s mandate appears substantially influenced by its home institution’s: in addition to providing technology assessments to Congress, STAA will also audit S&T programs at federal agencies, and launch an internal audit innovation lab “to explore, pilot, and deploy new advanced analytic capabilities, information assurance auditing, and emerging technologies that are expected to greatly impact auditing practices.”

Investigating complex S&T issues for Congress’s more difficult policymaking challenges appears to be a component part of a broader auditing-oriented mandate.

However, should STAA prove to be an adaptive and innovative space, it would also be more ‘protected’ (e.g., from political winds) given its location within a much larger and respected organization – as compared to a stand-alone function such as OTA.

Office of Technology Assessment

Political resources for reinstatement have been insufficient (medium-feasibility).

On nearly 10 differently occasions, bills and amendments have been introduced to Congress that would reestablish and fund OTA. All failed to pass, with votes generally falling along party lines. A 2018 attempt to provide funding for OTA failed to pass the House by less than two dozen votes, suggesting that its reinstatement may be plausible pending political momentum.

Reinstatement along party lines would harm legitimacy (low-durability).

If OTA were to be reinstated, a dearth of bipartisan support may leave it continually vulnerable. Defunding OTA was decided along party lines, leaving the agency with “political baggage.” OTA carries political associations that may hamper its legitimacy from the start and in turn harm its prospects for survivability.

The defining features of OTA – its governance, flagship product, and ways of working – are less appropriate for the current context (low-responsiveness).

33 Funding for reinstatement was $2.5 million, compared to previously attempts for $20 million.
First, while OTA’s value was substantial and dispersed, it serviced a narrow direct constituency within Congress. TAB directed OTA’s services towards itself through the committees to which it was linked. Consequently, a limited group of members directly experienced and gained from OTA’s value. This made the body vulnerable to political winds and was ultimately a reason for its demise. Further, TAB is unlikely to function well in today’s hyperpolarized Congress: instead of nimbly responding to congressional demands, OTA may be gridlocked by a TAB that is unable to determine a mutually agreeable set of topics for TA reports. OTA’s governance thus threatens it with dysfunction in the current environment.

Second, TA reports were subject to legitimate criticisms from members and staff regarding their usefulness. For example, the long timelines required to produce TA reports inhibited the responsiveness of OTA to congressional priorities. Primary research also suggests that an expansive set of congressional needs (JTBD) as they relate to S&T issues remains unattended to, and which large reports are unlikely to adequately address.\(^\text{34}\)

Third, OTA worked exclusively in service of committees rather than member offices. The weakening of committees as information processing centers may limit this model’s effectiveness. Significant institutional reforms that reinvigorated committee functions would likely be a prerequisite to re-employing this approach if a comparable level of effectiveness were to be expected of OTA today.

Its most responsive attribute, however, was its deep embeddedness. By interacting intimately with members and staff – particularly in informal capacities, outside of the confines of the formal TA process – OTA addressed constraints on the institution’s abilities to intake, assimilate, and make use of technical expertise. Leveraging its research and analysis, OTA staff regularly explained, advised on, and testified to S&T-related issues in close coordination with committees and their staff.

Because OTA is no longer in operation, assessing its responsiveness in the contemporary context is difficult. Still, it is clear that since 1995 much has changed. Any attempt to revive the body would most likely need to be coupled with changes to its mandate, operations, and products.

**New Internal Support Body**

Marshalling resources for a new body is challenging, while a clear S&T mandate could support easier implementation (medium-feasibility).

The feasibility of creating a new internal support body is neither low nor obviously high; it would neither enjoy the ease of investing in an existing function (STAA) nor would it carry ‘baggage’ as with OTA. Given the absence of proposals to date for this option, evaluating feasibility against political reactions is difficult. A new body, though, could build capacities specific to S&T-related challenges more easily than CRS if inaugurated with the clear mandate to do so. Dedicated capacities may in turn support easier implementation.

\(^{34}\) See: Needs Assessment
A mandate to cover an expanse of unmet needs, and an opportunity for deeper embeddedness to address institutional constraints (high-responsiveness).

Among the considered options, it is the most responsive. According to the JTBD assessment, along with an analysis of existing legislative support functions, congressional needs relevant to S&T issues are broadly not being met. From the poor positioning of CRS to address complex S&T issues to GAO’s auditing-specific mandate and recreation of OTA products, incremental efforts to invest in and expand these functions are unlikely to suffice.

Instead, a body exclusively dedicated to addressing these needs would enjoy the opportunity to develop responsive products and services. While there remains a tension between what Congress ‘wants’ (JTBD) and what the problem requires – what experts might advise – it is only through a deeply embedded function, a weakness of other options, that a body would acquire the necessary legitimacy and authorization to make progress on key problems. A novel internal option could borrow from OTA’s past ethos of embeddedness while correcting for its shortcomings, more broadly addressing constraints on congressional capabilities beyond a limited constituency and designing a contemporary suite of products and services to do so.

Opportunity for broad value generation and new ‘legitimacy of origin’ (high-durability).

Establishing a function designed to be highly responsive to unmet congressional needs would support its durability. Sustained impact is predicated on many members finding value in the problem-solving service and deciding to support it over time. While difficult to assess in advance – durability is dependent upon performance – it may enjoy an opportunity to be designed with sustained impact through responsiveness as an objective. Additionally, durability may also in part depend upon the ‘legitimacy of origin’; a new body constituted with only single-party support may suffer from the same durability prospects of reinstating OTA. But free of the latter’s political association, a new body may in turn be better positioned to secure broad political backing.
DECISION #3:
Which model should be used for this intervention?

Identifying potential options

Numerous S&T-focused legislative support bodies developed within congresses and parliaments after the creation of OTA. These have generated a diverse laboratory for a range of models for study and consideration (see Appendix 5 for different classification schemes which have been used to describe European parliamentary technology assessment). The choice of model is strongly associated with the types of problems in the policymaking process for which it is best suited. Four different models are reviewed here: the Committee model, the Office model, and the Interactive model; a fourth model, a boundary organization, offers an alternative from the traditional literature. A summary of these four models is included in Figure 18 below.

### Committee model: Legislators own the work
Parliamentarians and legislators are responsible for conducting S&T-related studies themselves. These committees “tend to invite experts to their meetings or organize workshops and conferences” to gain scientific support for their own deliberations and decision-making. At the close of a study, the parliamentarian assigned to lead it produces a report for use by parliament. Such committees may be structured much like other committees in the legislature. What distinguishes them is the nature of their work: to generate “dialogue [within] government on major future problems [related to technology] and how to solve them,” not to review legislation. These models are effective at generating internal discussion about major S&T-related issues and providing legislators with control over the topics addressed,

<table>
<thead>
<tr>
<th>Options</th>
<th>Existing congressional support bodies</th>
<th>Potential congressional support bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommendation</strong></td>
<td>Congressional Research Service (CRS)</td>
<td>Do not pursue</td>
</tr>
<tr>
<td></td>
<td>Government Accountability Office (GAO)</td>
<td>Do not pursue</td>
</tr>
<tr>
<td></td>
<td>Office of Technology Assessment (OTA)</td>
<td>Do not pursue</td>
</tr>
<tr>
<td></td>
<td>New Internal Support Body</td>
<td>Pursue</td>
</tr>
<tr>
<td><strong>Rationale</strong></td>
<td>Poorly positioned to respond to key JTBD, with stretched general capacity and a risk-averse culture (low responsiveness, feasibility, durability)</td>
<td>Not deeply embedded within Congress and influenced by a clear auditing mandate, though easily operational (low responsiveness and durability, high feasibility)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Political handicaps affect its reinstatement and ‘survivability’, while products fail to address key JTBD and favor a limited constituency (medium feasibility, low durability and responsiveness)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Opportunity to design responsive services and learn through embeddedness, with unproven political will (medium feasibility, high durability and responsiveness)</td>
</tr>
</tbody>
</table>
how studies are conducted, and how the findings are framed. Examples of countries using a Committee model include France (OPECST), Finland (Committee for the Future), Greece (Greek Permanent Committee of TA), and Italy (VAST).

**Office model: Advisory unit for legislators.** A legislative body establishes its own office or support unit to conduct studies and other S&T advisory work. The office may, in turn, outsource specific pieces of work to external scientific organizations. Organizing a body in this way provides some degree of autonomy to expert staff in the office to conduct their work while ensuring some degree of proximity to legislative needs. The operations of the office itself, however, may vary greatly based on the authorizing legislation and the governance structures put in place to manage it. This was the model used by OTA. Examples of other countries currently using an Office model include the United Kingdom (POST), Sweden (PER), Germany (TAB), and the European Parliament (STOA).

**Interactive model: Facilitate public participation.** The legislature establishes, authorizes, and (generally) funds a separate body that operates at a distance from the legislature though nonetheless treats it as its primary client. This body may, as is the case in Switzerland, act jointly with other national or international research institutes to conduct pieces of work. The distance from the legislature allows the body to select topics based on its own independent evaluation, potentially supplemented with input by external experts and civil society groups, rather than on the needs of legislators. Independence also facilitates broad participation by non-expert groups, including citizens. Examples of countries using an Interactive model include Denmark (DBT), Switzerland (TA-SWISS), and the Netherlands (Rathenau Institute).

**Boundary organization: Negotiate internal and external demands.** A boundary organization “facilitate[s] collaboration and information flow between diverse research disciplines and between the research and public policy community.” Such organizations have been used to connect science and policy communities in domains such as health technology and environmental policy. Boundary bodies in these contexts “straddle the divide between politics and science.” In principal-agent theory, the creation of an organization can be understood as a delegation of authority from a principal to an agent. Rather than attempting to isolate themselves from political influence, these organizations respond to multiple principals, with obligations on either side of the boundary between science and politics (or between technology and politics). Through frequent collaboration between scientists and non-scientists and the creation of products (e.g., analytical reports), a boundary organization facilitates “co-production” of both knowledge, through its responsiveness to science, and social order, through its responsiveness to politics.

A U.S.-based example is the Health Effects Institute (HEI), which conducts original research and literature reviews on the impact of motor vehicle pollution on public health. Founded as a kind of ‘joint venture’ between the EPA and the auto industry following the 1977 Clean Air Act, the Institute’s Board of Directors included leaders from both industry and the political community. The Board continues to serve as HEI’s “guardian of credibility.” The term ‘boundary organization’ has also been selectively used to describe OTA. According to one scholar, “As a politically neutral
organization, OTA did not teeter atop a narrow divide between Democrats and Republicans, but it internalized partisan differences, negotiated them for each study, and produced [reports] that either party could use for its own purposes.” In this case, OTA was jointly accountable to both Republicans and Democrats, instead of scientific and political actors.

A new congressional support body could encourage “co-production” on S&T-related issues by creating formal accountability mechanisms to S&T stakeholders, not just politicians. This could be accomplished by including representatives from both groups in its governance, consistent with the existing literature on boundary organizations.

**Figure 18 | Range of potential ‘internal’ models**

<table>
<thead>
<tr>
<th>Options</th>
<th>Traditional models for S&amp;T support bodies</th>
<th>New model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Approach</strong></td>
<td>Committee model</td>
<td>Office model</td>
</tr>
<tr>
<td>Legislators own the work</td>
<td>Advisory unit for legislators</td>
<td>Facilitates public participation</td>
</tr>
<tr>
<td><strong>Case studies</strong></td>
<td>France (OPEST), Finland (Committee for the Future)</td>
<td>U.K. (POST), Germany (TAB)</td>
</tr>
<tr>
<td><strong>Overview</strong></td>
<td>Parliamentary committees invite experts and organize workshops or conferences to gain scientific support for debates</td>
<td>Office internal (UK) or external (Germany) to parliament conducts TA studies according to information needs of parliament</td>
</tr>
</tbody>
</table>
Applying decision criteria

The Committee model suffers from both low responsiveness and low feasibility. In the U.S. context, this might look like the creation of a new joint committee on S&T in which the committee is exclusively responsible for generating analysis. The Committee model fails to build legislative capacity by containing resources within the committee. Politician-led workshops and expert sessions would also be subject to the same forces of politicization of modern congressional hearings. Further, creating such a committee would require greater technical and human capability, especially member and staff time, required to actually conduct studies and draft reports than currently exists in today’s Congress.\(^ {35}\) A new committee, however, may be more robust, and thus durable, in the face of potential budget cuts, as it would ostensibly involve the lowest investment in new resources.

The Office model is the most responsive – and potentially the most durable – model considered. In the U.S. context, this suggests a new congressional support body. This approach would facilitate placing the day-to-day needs of members and staff at the center of the body’s mandate without commissioning them with the analytical work itself. Further, by orienting the new body as a congressional support unit exclusively in service of Congress, and embedding it deeply within the institution, an Office is well positioned to respond to nuanced and heterogeneous member and staff needs, and pivot more easily as priorities change. If the Office is able to create value for members across Congress, its impact may also be durable; (many) users of high-value products may hesitate before dismantling their source. Such an Office need not require substantial budgetary investment, at least not initially,\(^ {36}\) although the potential for association with OTA may create feasibility challenges.

The Interactive model is the least responsive to the capability needs of Congress, reflecting a solution to a different problem. In the U.S., this might look like funding a new partnership with external bodies (such as NASEM) to conduct participatory studies of S&T topics. Due to the greater distance from Congress and dissociation from political interests, the products produced by such a body may struggle to differentiate themselves from the vast quantity of information already being produced by think tanks and other civil society actors meant to represent societal interests. Further, the potential for the topics covered and the findings of studies to strongly diverge from congressional interests may expose it to threats in a hyperpolarized context. It would be the least resource-intensive option, however, as external partners like NASEM and interested foundations may be willing to supply the financial and human capital required. Additionally, such a model would be effective at enhancing public deliberation, including the perspectives of diverse sets of interests into TAs and other analytical products. There may be a role for greater public deliberation on S&T issues, but prioritizing such participation at the expense of congressional needs is unlikely to improve Congress’s own absorptive capacity.

A boundary organization is unlikely to survive a hyperpolarized political context, but certain design elements may be worth implementing in an Office model. The distinguishing feature of

\(^ {35}\) See: What’s happening with Congress?
\(^ {36}\) See: Appendix 6
boundary organizations is their dual form of accountability that internalizes the preferences of both political and scientific actors. The model may better facilitate information flows between scientists and politicians and ensure that the interests of the S&T communities are appropriately reflected in the body’s work, in theory greatly increasing Congress’s capacity for learning on S&T-related topics. Unfortunately, a body governed jointly by S&T actors on one hand and both Democrats and Republicans on the other is likely to break down. Should S&T actors find a natural coalition with just one of the political parties, the outstanding party risks being systematically excluded. With time, that power differential may motivate the excluded party to dismantle the organization once they find themselves in the majority. A new body must first and foremost internalize the demands of both political parties, being careful to avoid benefiting one party systematically at the expense of the other. A boundary organization bridging scientists and politicians is unlikely to achieve that.

Nevertheless, the motivation behind the dual accountability of boundary organizations offers an important perspective: a new body will need to create value for scientists and technologists, as well as political stakeholders, to ensure that these technical communities are incented to lend their expertise. This may be achieved by establishing bidirectional information flows and/or creating knowledge products which are of mutual value for both political and technical stakeholders, even if the primary beneficiary and audience is Congress (Figure 19).

Figure 19 | Recommendation and rationale for Decision #3
DESIGN

“When, however, a firm wishes to acquire and use knowledge that is unrelated to its ongoing activity, then the firm must dedicate effort exclusively to creating absorptive capacity.”

Wesley Cohen & Daniel Levinthal, 1990
Carnegie Mellon University & University of Pennsylvania

The below specifies an internal support unit for legislators and their staff – an Office model with features of a boundary body. This section is intended not as a set of general recommendations, but instead as an actionable blueprint for the design and operationalization of a new institutional support body: the Congressional Futures Office (CFO).

See Figure 20 for a summary of the Design.
### Figure 20 | Summary of Design

| **Mandate** | CFO should be established to enhance Congress’s abilities to **collect**, **process**, and **make use of** technological and scientific knowledge |
| **Strategy** | Prioritizing the **proximate needs** of a **broad congressional constituency** through **open-ended product-service design** and **expansive networks of expertise** under partisan constraints |
| **Product-Service Design** | Products are designed in response to identified needs: the **proximate challenges** members and staff face (“jobs-to-be-done”) relating to S&T expertise across policymaking |
|  | Product prioritization and design considers each product’s potential to **build absorptive capacity** and likelihood to be **valued by a congressional audience** |
| **Governance** | Led by an **empowered Director**, selected and authorized by a newly-established Joint Committee on Science & Technology (JCST) |
| **Structure** | Organized according to **type of products**, rather than topical domains, with deliberate **interdependencies** between product groups |
| **Operations** | Director meets congressional demand under resource constraints through **demand management**, **supply management**, and **topic selection** |
| **People** | Bias towards hiring **problem-focused experts**, as opposed to subject-matter experts, on permanent bases while utilizing **flexible structures** to involve topical expertise as-needed |
| **Culture** | Culture of **risk-tolerance** and **rapid experimentation** developed through formal structures, choice of Director, and operational decisions |
| **Evaluation & Adaptation** | Rigorous internal assessment mechanism facilitating broad communication of the value generated by CFO, with metrics aligned to the motivating values of different groups |
|  | Rapid learning and experimentation through intimate access and daily interactions with congressional members and staff |
PROPOSED MODEL:
How could a body be operationalized?

The CFO model is comprised of five interrelated parts. Each part, visualized in Figure 21, identifies a necessary component to operationalize the body in response to the challenges identified by this report. Taken together, the components are intended to form a tightly aligned system, each supporting the other.

- **Mandate**: What is expected of the body?
- **Strategy**: What is the smallest set of choices to optimally guide the organization towards sustained performance?
- **Product-service design**: What products will effectively address the “jobs-to-be-done” of members and staff?
- **Operations**: How will the formal structure, people, and culture be aligned to its strategy and product-service offerings?
- **Evaluation & Adaptation**: What mechanisms will best ensure the organization remains responsive to the needs of Congress over time?

Additionally, we detail recommendations for approaching the initiation and growth of CFO.37

Figure 21 | Congressional Futures Office: Design Framework

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37 See: Getting Started
We use this design exercise to:

1. **Reflect a necessary response to Congress’s central problem of low absorptive capacity.** The prior section (*Decision*) explored an expansive set of options for addressing the issue. The CFO model is intended to express a detailed set of recommendations for how the problem might be best addressed through a modern internal function.

2. **Illustrate how factors external and internal to Congress examined in this report would influence a new body’s design.** To address the central problem effectively, the design of an internal function requires attentiveness to the constraining and enabling factors of the contemporary context. These factors, unique to its operating environment, are addressed through the design decisions of the CFO model.

3. **Draw on learnings from the strengths and shortcomings of OTA and other existing support bodies.** OTA offers a rich history to inform contemporary efforts. The CFO model is in part a set of improvements upon OTA relevant to today’s context. We also do not envision the CFO model as a replacement for existing services, such as STAA. Instead, the model demonstrates solutions to problems not currently addressed across the existing landscape.\(^{38}\) The proposed design is contrasted with other bodies – OTA and STAA – in the *Conclusion* of this report in Figure 36.

Finally, key decision choices for CFO are summarized in Figure 22, contrasted against the choices employed by traditional technology assessment bodies. These choices and others are detailed throughout the rest of this section.

**Figure 22 | Preview of key design choices**

<table>
<thead>
<tr>
<th>What purpose will the body serve?</th>
<th>Articulated by a <em>problem-driven</em> mandate ... in place of an <em>activity-driven</em> mandate</th>
</tr>
</thead>
<tbody>
<tr>
<td>What kind of work will it produce?</td>
<td>Determined by prioritization of <em>proximate congressional needs</em> (<em>jobs-to-be-done</em>) ... rather than priorities formulated by S&amp;T experts, such as horizon-scanning</td>
</tr>
<tr>
<td>Who will it produce work for?</td>
<td>Emphasis on building a <em>broad constituency</em> across Congress ... instead of focusing efforts by seniority, committee, or other narrow audiences</td>
</tr>
<tr>
<td>How will it develop its products?</td>
<td>Through <em>adaptive and iterative</em> product-service development ... rather than pre-established product forms, such as TA reports</td>
</tr>
<tr>
<td>How will the body be organized?</td>
<td>Organized around <em>product offerings</em> (i.e., specified congressional needs) ... rather than by domains of topical or technical expertise</td>
</tr>
<tr>
<td>How will it mobilize resources?</td>
<td>Cultivating <em>broad global networks</em> used for targeted internal activities ... instead of developing and maintaining most expertise in-house</td>
</tr>
<tr>
<td>How will it be governed?</td>
<td>An <em>empowered Director</em> elected by a joint committee with narrow authorities ... in place of a board of members with expansive authorities</td>
</tr>
</tbody>
</table>

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\(^{38}\) See: Landscape Assessment
Mandate

An organization’s mandate specifies what is expected of it.

Mandates in statutes by Congress may specify what is expected from a body while refraining from prescribing how it might go about fulfilling that expectation, beyond general guidelines. For instance, GAO is mandated to perform oversight and auditing functions across the federal government in response to congressional directives; the ways in which auditing methodologies are developed and refined over time are left to the organization. We align CFO’s mandate with this principle.

However, Congress also often articulates activity-driven mandates: the activities, however generally defined, Congress expects a body to perform. For CFO, we detail here (1) a proposed shift from an activity-focused to a problem-driven mandate; (2) a mandate that reflects the central issue of Congress’s low absorptive capacity; and (3) what CFO is not expected to do. Taken together, this approach to specifying expectations provides a focus later reflected in CFO’s strategic decisions, product-services offerings, operational choices, and adaptive approach.

Activity-focused mandates suggest or dictate how an organization ought to go about its work. Typically embedded in activity-focused mandates are implied solutions. OTA’s legislative mandate emphasized technology assessments (Exhibit 3): a set of proposed activities to address the problem identified by Congress of inadequate services to inform the legislature of the impacts of technology. Specifying a problem, rather than a set of activities, permits the body to experiment and evolve its product-service offerings. We find that OTA’s anchor to TA products handicapped its adaptive capacities, only slightly adjusting its offerings over time. While OTA created value beyond formal assessments, the activity remained the office’s flagship feature. For OTA, a hypothetical problem-focused mandate could have alternatively been: to elucidate policy approaches and their trade-offs with technically complex topics. Formal assessments may have constituted one of multiple approaches to address the problem. Rather than a prescriptive mandate for a particular product, we propose de-emphasizing activities in favor of elevating the problem to be addressed.

39 See: OTA in Operation
Thus, as a problem-driven mandate, we recommend that

**CFO should be established to enhance Congress’s abilities to collect, process, and make use of technological and scientific knowledge.**

The mandate supports any set of activities that strengthens these essential elements of Congress’s absorptive capacity.

Lastly, delineating what CFO should *not* be established to do is equally important, modifying an otherwise expansive purpose. Given current dynamics both external and internal to Congress, three functions are explicitly identified that the mandate should not accommodate.

1. **CFO should not be an entry point for scientific or industry groups.** Congress’s central challenge is not an issue of access to external knowledge but developing the capacity to transform it into effective legislation. Additionally, the increasing power of technology companies with certain policy preferences, such as minimal regulation, risks subjecting CFO to capture. Thus, CFO should engage groups externally insofar as it aids Congress in making better use of large volumes of distributed expertise. Engagement should function to channel expertise, not interests.

2. **CFO should not be tasked with creating new scientific knowledge.** Given its distributed nature, the difficulties of communicating scientific information, and issues of assessing the credibility of external expertise, assembling and making more useful existing external

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40 See: *Diagnosis: Congress is constrained by low absorptive capacity*
41 See: *What’s happening with industry?*
42 See: *What’s going on with science?*
43 See: *What’s going on with civil society?*
knowledge better addresses Congress’s shortcomings. This, additionally, was a principle set by OTA.44

3. **The technical expertise marshalled by CFO should not be an attempted substitute for politics.** Technical expertise cannot resolve conflicts of values and interests, nor can it solve for uncertainty or a lack of scientific consensus.45 Particularly with frontier S&T issues, where uncertainty and disagreement are expected, CFO will not “obviate the need for political judgment.”46 Instead, its expertise should aim to improve the quality of political interaction rather than supplant it.

**Strategy**

Strategy characterizes the unifying logic of an organization’s decisions. For example, do operational decisions and product design decisions fit well together? We borrow the idea of strategy as “core guidance,” defined as “the smallest set of choices to optimally guide others’ choices towards sustained performance.”45 Practically, an articulation of strategy allows the actors inside of an organization to “anticipate what others will do and align their actions.”46

“Performance” refers to the objectives of the organization – here, the mandate of CFO. Strategy, therefore, should be devised in support of enhancing Congress’s absorptive capacity, or its ability to collect, process, and make use of technological and scientific knowledge. Strategy also supports fulfilling this mandate over time, or as long as the diagnosed problem confronting Congress continues to exist. Performance over time means the body must survive. Thus, strategy should equally enable *sustained* performance, taking the long-term implications of its guidance into account.

We recommend the following **five essential choices**:

1. **Proximate needs.** Expertise in policymaking will fail to influence outcomes if it is not also immediately helpful to its users. Addressing Congress’s central problem – enhancing its ability to intake and make better use of external knowledge – must work through the exigent demands of its members and staff.47 Needs are qualified as “proximate” to indicate an appreciation of present-focused congressional priorities. While future-focused work

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44 See: *Evaluating Technology Assessment*

45 Neither are policymakers perfectly rational nor are experts omniscient. For a critique of ‘policymaking rationality’, where “the ideal rational public policymaker obtains the best technical advice on the complete range of feasible policies, and of all the likely consequences of implementation of each of them, then chooses among them according to his society’s preferences,” see: Gershuny, J. I. (1978)

46 See: *Priorities in What’s going on with Congress?*

47 See: *Needs Assessment*
may find footing in select circumstances when CFO has explicit authorization from Congress, an analysis of congressional priority-setting and its implications for the limits of expertise suggests a requisite focus on exigent demands.48 Efforts to veer away from satisfying this requirement risk decreasing the perceived value of CFO to the members responsible for sustaining it.

2. Broad constituency. Given that OTA suffered most from a limited constituency within Congress – comprised principally of TAB and high-ranking members49 – and that a focus on committees as principal customers as principal customers fails to recognize changing institutional dynamics and disruptions to committee functions,50 CFO must be broadly appealing to heterogenous needs across Congress. Activities should generate value that helps to build a deep base of support that favors investing and protecting CFO, as well as enhance broad-based capacity through expansive congressional engagement beyond the exclusive purview of committee processes.

3. Open-ended product-service design. Congress does not suffer from a paucity of external expertise,51 but expertise does struggle to make itself useful.52 Open-ended product-service design suggests an adaptive and iterative approach to CFO offerings that meets the idiosyncratic demands of Congress. The approach is adaptive in that it responds to changing needs – both of the institution, and at the level of individual members – and iterative in that offerings adjust as they experience trial and feedback. Improving how knowledge is assimilated and transformed into effective legislation inside Congress will necessarily require this inclination towards experimentation.

4. Expansive networks of expertise. Given that knowledge is increasingly distributed across fragmented spaces,53 that the legitimacy of expertise rests on a diversity of perspectives,54 and that S&T issues themselves are increasingly complex and diverse,55 CFO should cultivate and exploit expansive external networks. This places CFO in a boundary-spanning position between its host institution and an expansive external environment of technical experts. Moreover, given the surfeit of external expertise, CFO should be capable of doing more with less, leveraging existing knowledge bases outside of itself. This will preempt potential budgetary concerns, as the new body will not need to hire as many in-house experts to generate value.

5. Partisan constraints. Expertise in politics requires an overt acknowledgment of its context in order to be maximally effective. Acknowledging partisan constraints leads to choices that intentionally navigate them. Specifically, a commitment to neutrality is necessary but insufficient. CFO must actively search for accommodating partisan environments within

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48 See: Priorities in What’s going on with Congress?
49 See: OTA’s Demise
50 See: Processes
51 See: What’s going on with civil society?
52 See: Resources
53 See: What’s happening with industry/civil society?
54 See: Evaluating Technology Assessment
55 See: Backdrop
Congress, capitalizing on the degree to which partisanship varies.\textsuperscript{56} As expertise is less likely to be useful in hyperpolarized environments,\textsuperscript{57} CFO should prioritize resources where impact is more probable. Further, offerings should be tailored to priorities determined by political actors, not by experts.\textsuperscript{58} Efforts to do otherwise could not only fall short of being useful to such actors, but also endanger its political standing.

Finally, strategic choices interact with one another. As such, and as a litmus-test of their efficacy, they should positively reinforce one another rather than create contradictions. For example, an open-ended product-service approach (#3) should support value generation for proximate needs (#1) as well as inform an operational model that is agile and responsive to heterogenous demands across a broad constituency base (#2). Further, CFO’s strategy should help to identify unaligned decisions, or choices inconsistent with the unifying logic. For example, traditional, intensive, and peer-reviewed TA products may not meet proximate needs, may struggle to find resonance with a broad constituency across Congress, and may prove difficult to iterate upon over time.

A summary of how these strategic choices appropriately guide CFO in service of its mandate while raising the likelihood of sustained performance – of survival – is included in Figure 23.

\textbf{Figure 23 | How strategic choices support CFO’s mandate}

| Mandate: CFO should be established to enhance Congress’s abilities to collect, process, and make use of technological and scientific knowledge. |
|---|---|---|
| These 5 strategic choices… | …appropriately guide CFO in service of its mandate | …while raising the likelihood of survival |
| Proximate needs | …by working through the demands and priorities set by members | …by creating value that is visibly apparent to members and staff |
| Broad constituency | …by building capacity expansively in Congress, not just thru seniority | …by creating value that more members will seek to defend |
| Open-ended product-service design | …by adapting products through trial and feedback to make them useful | …by ensuring products do not become irrelevant as needs evolve |
| Expansive networks of expertise | …by tapping into the distributed nature of external expertise | …by preempting budgetary concerns, promising more with less |
| Partisan constraints | …by deploying expertise where it is more likely to be used | …by subordinating ‘expert’ priorities to partisan ones |

\textsuperscript{56} See: Priorities in What’s going on with Congress?
\textsuperscript{57} See: What’s going on with science?
\textsuperscript{58} See: Priorities in What’s going on with Congress?
Product-Service Design

Linking strategy to practice, CFO must develop offerings that address the needs of a diverse audience of members and staff. This suggests a close relationship between the design of these offerings and the heterogeneous needs of members and staff as they see them. Partisans utilize expertise in line with political priorities. Thus, offerings should be attuned to those goals. Such an approach avoids a common pitfall in policy analysis whereby both internal and external experts “spend heavily on analytical inputs, only to find them not usable.”

It is worth first clarifying that CFO will not be a ‘technology assessment’ body. First, STAA is building capacities specifically in assessment activities; CFO should avoid duplication. Second, the value OTA generated as a TA body was dependent upon well-functioning committee processes, where both formal reports and informal (e.g., staff-to-staff) communication focused debate and informed legislation. Traditional committee processes today, however, are frequently bypassed. Technology assessments have typically been tailored for committees as customers; these methods may find themselves constrained by the current institutional environment characterized by weakened committee processes. Third, what Congress demands is not S&T-related content but rather solutions to specific problems (“jobs”) of members and staff.

We develop an initial product-service mix by answering three questions. We first examine which jobs CFO should address by considering both what problems Congress wants solved and what will add most to enhancing Congress’s absorptive capacity. Next, we outline a set of specific products and services (hereafter, ‘products’) to appropriately address these jobs. Finally, we discuss a framework and potential mechanisms for how CFO can best match jobs to different sources of expertise.

Which jobs should CFO address?

This report identified 17 jobs involving S&T-related expertise currently ‘not’ being done well or only being done well ‘sometimes’. The analysis provides a starting point for next identifying areas for improvement. However, CFO could not possibly address all identified shortcomings, nor should it strive to. Pursuing too many paths at once would create organizational confusion, risking misalignment between organizational choices and the problems being addressed.
To prioritize, we evaluate jobs along two dimensions: the value congressional members and staff would place on that job being done better ('importance to audience') and the impact such an improvement would have on policymaking ('potential to build absorptive capacity') (Figure 24). Both dimensions are critical to consider, as doing work that fails to build capacity will have little impact, while doing work that Congress does not want risks positioning the body as irrelevant to members and staff, making it vulnerable. For example, the job ‘Identify future issues potentially warranting policy attention’ is unlikely to be immediately important to users as it does not reflect near-term needs that dominate congressional attention. While CFO may receive formal or informal authorization from Congress to pursue such a job, such authorization is unlikely if nearer-term needs are left unaddressed.

What emerges is a two-dimensional view of S&T-related jobs (Figure 25), each falling into one of three broad categories:

1. ‘Win-wins’ are jobs of high importance to a congressional audience with high potential to build absorptive capacity if addressed. These jobs should be considered the highest priority for product development as they do not require a trade-off between congressional interest and potential impact.

2. ‘Constituency-builders’ are important jobs from the perspectives of members and staff but with less potential for enhancing absorptive capacity. This may be the result of limited relevance to the policymaking process (e.g., ‘Craft information requests from relevant agency officials’ or ‘Develop questions for further investigation’) or because the job is already being done well at least sometimes (e.g., ‘Synthesize information into policy-relevant insights’). Developing products to address these jobs will build political support and legitimacy with the constituents for whom those products were developed.

3. ‘Capacity-builders’ are jobs that address some of the most binding constraints to absorptive capacity in Congress but may fail to generate interest from members and staff. This may be due to short-termism (‘Identify future issues...’), lack of interest (‘Conduct policy analysis’), or failure to recognize the problem to begin with (‘Identify [oversight] issues requiring attention’). These issues are most closely related to Congress’s ability to identify important problems, collect and process high-quality expertise, and take action based on the findings. Thus, they will be critical to address if policymaking for S&T-related issues is to be improved significantly.

CFO’s effectiveness will be predicated on developing products that address jobs across all three categories. ‘Win-wins’ involve no trade-off between congressional priorities and impact and should be addressed with the highest priority. The other two must be pursued selectively and sequentially. ‘Constituency-builders’ provide legitimacy and political cover to address ‘Capacity-builders’, or issues which are less salient to lawmakers or may be politically riskier to address.

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65 See: Priorities in What’s going on with Congress?
Figure 24 | Evaluation of jobs by needs and potential impact

a. Jobs ‘not’ being done well

<table>
<thead>
<tr>
<th>Activity</th>
<th>Jobs ‘not’ being done well</th>
<th>Importance to audience ('Do members and staff want the problem solved?')</th>
<th>Potential to build absorptive capacity ('Will fixing it address the real issue?')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand current demands</td>
<td>Search for problems across relevant constituencies</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Anticipate future policy problems</td>
<td>Identify future issues potentially warranting policy attention</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Develop questions for further investigation</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Collect information and expertise</td>
<td>Cultivate and maintain networks of expertise</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Collect information from sources of expertise</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Make sense of that information</td>
<td>Assess the credibility of the information provided</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Conduct policy analysis of options</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Monitor and oversee executive agencies</td>
<td>Craft information requests from relevant agency officials</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Assess the credibility of the information provided</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

1 Rapid response to pressing issues (e.g., an issue in the news) may have a large impact, as resources to respond quickly are constrained; over a longer horizon, information collection may have lower impact, since capacity constraints are less binding with more time.

b. Jobs ‘sometimes’ being done well

<table>
<thead>
<tr>
<th>Activity</th>
<th>Jobs ‘sometimes’ being done well</th>
<th>Importance to audience ('Do members and staff want the problem solved?')</th>
<th>Potential to build absorptive capacity ('Will fixing it address the real issue?')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand current demands</td>
<td>Assess credibility of what is learned</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Assess the magnitude of the problems identified</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Develop legislative priorities</td>
<td>Develop baseline technical literacy</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Collect information and expertise</td>
<td>Synthesize information into policy-relevant material</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Make sense of that information</td>
<td>Build credibility for the desired solution</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Mobilize other lawmakers</td>
<td>Assess credibility of the analysis</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Vote on legislation</td>
<td>Identify issues requiring attention</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Monitor and oversee executive agencies</td>
<td>Search for and evaluate potential remedies</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
Figure 25 | Final prioritization of “jobs” to be addressed by CFO

- **Bold: job ‘not’ being done well (vs ‘sometimes’)**
  - **Capacity-builders:** address to the extent constituents are supportive
    - Search for problems across relevant constituencies
    - Identify future issues warranting policy attention
    - Assess magnitude of problem
    - Identify (governance) issues requiring attention
  - **Conduct policy analysis of options**

- **Win-wins:** high priority to address
  - Cultivate and maintain networks of expertise
  - Collect information from sources of expertise (rapid response)

- **Constituency-builders:** selectively address to build trust and support
  - Develop baseline technical literacy
  - Assess the credibility of: (information, analysis, …)

- Building a constituency provides legitimacy to engage in issues that are less salient to policymakers or riskier to address

- **Importance to audience**
  - (*Do members and staff want the problem solved?*)

- **Potential to build absorptive capacity** (*‘Will fixing it address the real issues?’*)

- **Higher**
- **Lower**
What products should be developed to address these jobs?

The resulting set of jobs prioritized for product development are enumerated in Figure 26. These jobs reflect the high prioritization given to ‘Win-wins’ as well as the selective and sequential approach to addressing ‘Constituency-builders’ and ‘Capacity-builders’.

Not all jobs were prioritized for development. Deprioritized jobs include: those that require significant people resources to address but with only modest potential for impact (‘Synthesize information...’); involve a high risk of fostering political conflict (‘Assess the credibility of information, analysis...’ and ‘Build credibility for the desired solution’); or that were strictly dominated by other jobs in terms of priority. ‘Search for and evaluate potential remedies’, for instance, has less potential for impact than ‘Search for problems...’ but with similarly low importance to congressional audiences.

Table: Jobs prioritized for attention

<table>
<thead>
<tr>
<th>Win-wins</th>
<th>Constituency builders</th>
<th>Capacity builders</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cultivate and maintain networks of expertise</td>
<td>• Develop baseline technical literacy</td>
<td>• Conduct policy analysis of options</td>
</tr>
<tr>
<td>• Collect information from sources of expertise (rapid response)</td>
<td>• Develop questions requiring further investigation</td>
<td>• Search for problems across relevant constituencies</td>
</tr>
<tr>
<td></td>
<td>• Craft information requests from relevant agency officials</td>
<td>• Identify future issues warranting policy attention</td>
</tr>
<tr>
<td></td>
<td>• Collect information from sources of expertise (longer horizon)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Proposed product</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Futures ‘Network’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Futures ‘On-call’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Futures ‘Briefs’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Futures ‘Support’</td>
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<tr>
<td></td>
<td></td>
<td>Futures ‘Perspectives’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Futures ‘Scans’</td>
</tr>
</tbody>
</table>

This section shares an overview of the proposed products. Before discussing the rationale and key design elements of each, four considerations should inform product development and deployment across the product portfolio:

1. **Products should utilize shared language wherever possible**, translating external expertise into the language of CFO’s home institution. Given the decline in staffing of S&T-related committees\(^{66}\) and that members are rarely technical experts themselves,\(^{67}\) the intended audiences for most products will not be technically fluent. But they will communicate in ways unique to the congressional environment. This requires that CFO perform a translator function, especially given the known challenges of communicating scientific evidence.\(^{68}\)

\(^{66}\) See: Resources
\(^{67}\) See: Observed problem
\(^{68}\) See: What is happening with science?
2. Technical expertise cannot seek to dictate the policy outcome.\textsuperscript{356} Other legitimate considerations such as political interests and values will chiefly determine political decision-making. Therefore, borrowing from the success of OTA’s neutral approach,\textsuperscript{69} products should avoid proposing specific policy recommendations.

3. CFO should address policy issues in an even-handed fashion, reflecting the full range of technically-legitimate views in its products – a strength of OTA that built credibility.\textsuperscript{70} Products released publicly should also be accompanied by an opportunity to request private briefings where analysis may be discussed away from forums subject to political scrutiny, which interviews suggest allow for less politicized discussions.\textsuperscript{357}

4. Political actors will use products for political ends.\textsuperscript{71} As such, CFO and its leaders should avoid commenting on the use, or perceived misuse, of its products released publicly. Doing so may threaten to subsume political priorities to technical priorities.

General policies governing product development such as these can be experimented with over time but should err on the side of political caution as the organization is building legitimacy. Products themselves can, and should, evolve as well. Fully specifying the product up-front without experimentation and deep consultation with users will result in a failure to properly complete the intended job. As such, detailed specifications of prototypes are not developed here. Instead, a brief description of the proposed products (Figure 27), including their primary functionality and rationale for how they address the relevant prioritized job, are summarized.

\textbf{Futures ‘Network’} is a living global database of S&T experts willing to engage with members and staff and each other, accompanied by a set of tools for convening customized groups for different purposes. The Network addresses the deficiencies and biases in the personal and informal networks of congressional members and staff, the disparities between junior and senior staff in ‘networkedness’, the time-consuming nature of developing and maintaining such networks, and the risk of capture by special interests.\textsuperscript{72} It does so by building, centralizing, and providing shared access to expertise mediated by CFO and instituting processes and practices which ensure broad perspectives, rather than narrow ones, are collected.\textsuperscript{73} Additionally, it is leveraged to produce other CFO products, serving as an infrastructural backbone to CFO.

\textbf{Futures ‘On-call’} is rapid technical commentary delivered, often same-day, to Congress on high-profile issues of national importance as they enter the public debate. Commentary may also be accompanied by briefings, conference calls, and other methods of providing guidance in a format desired by members and staff that are appropriate for the sensitivity of the issue. On-call provides a common base of technical understanding in contexts where member offices are most constrained by time and most at-risk of technical misunderstandings.\textsuperscript{74}

\textsuperscript{69} See: OTA in operation
\textsuperscript{70} See: Evaluating Technology Assessment
\textsuperscript{71} See: Priorities in What’s going on with Congress?
\textsuperscript{72} See: Needs Assessment
\textsuperscript{73} CFO mediates between external sources with interests and biases and internal needs.
\textsuperscript{74} See: Resources
Futures ‘Briefs’ are short memos providing members and staff with essential base knowledge necessary to begin engaging on technically complex policy issues. These may be delivered in advance of key legislative debates or at the behest of individual members and staff – for instance, in response to media events of political interest. These Briefs address the challenge of quickly developing a baseline of technical literacy required to begin more thoughtful investigation of policy options, engage in debate, or explore whether an issue warrants further attention by a member office or committee. Through development of a standardized format useful to lawmakers, the production of Futures Briefs may eventually be scaled rapidly by distributing the responsibility to many outside experts through the Futures Network.

Futures ‘Support’ is flexible and targeted investigative assistance that empowers members and staff in their own work rather than conducting deep policy research on their behalves. ‘Support’ builds upon existing policymaking processes, rather than recreating or subverting them, increasing the likelihood that expertise will be utilized. What form Support takes can be adapted over time based upon member and staff needs and the capacity constraints of CFO. Examples of potential support activities include facilitating connections to external networks and hosting virtual/physical convenings (e.g., via Futures Network), preparing technical comments for information requests and policy analyses, or joining meetings with external actors (e.g., academia) to provide general technical assistance in real-time.

Futures ‘Perspectives’ are policy analyses in extended memo format defining and framing the impacts of potential policy choices. Perspectives achieve this by incorporating the broadest range of technically-legitimate perspectives on an issue, providing a frame for technical uncertainty – an approach comparable to OTA’s. Recognizing partisan sensitivities as well as the limits of expertise in policymaking, policy analysis also refrains from prescribing recommendations. Perspectives address the dearth of useful policy analysis produced along timeframes relevant to the policymaking process.

Futures ‘Scans’ are brief ‘red flag’-style reports delivered periodically (for example, bi-annually) that flag S&T issues of public interest for congressional attention. Scans may take the form of a living dashboard, a list of pressing issues, or some other format deemed useful for communication to congressional leadership, who are disproportionately responsible for crafting priorities. Futures Network provides a mechanism for external participation and may utilize open mechanisms like deliberative voting to evaluate issues. Given the short-termism of congressional priorities, Scans should be developed utilizing few resources and only after legitimacy and capacity are built through other products.

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See: Evaluating Technology Assessment

See: What’s happening with science? and Priorities in What’s happening with Congress?

See: Priorities in What’s going on with Congress?
Figure 27 | Summary of recommended product-service mix

<table>
<thead>
<tr>
<th>Product</th>
<th>Brief description</th>
<th>Rationale</th>
<th>Inspirations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Futures ‘Network’</td>
<td>A living global database of science and technology experts, accompanied by a set of tools for convening customized groups for different purposes and guarding against capture by special interests</td>
<td>• Gives Congress-wide access to a shared pool of global expertise, regardless of party affiliation or seniority</td>
<td>• Profiles Research Networking Software (RNS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provides the expertise and networking tools needed to power all other ‘Futures’ products and services</td>
<td>• FDA “Network of Experts”</td>
</tr>
<tr>
<td>Futures ‘On-call’</td>
<td>Rapid technical commentary delivered (same-day) to Congress on high-profile issues of national importance as they enter the media spotlight</td>
<td>• Provides a common base of technical understanding during times when member offices are most constrained</td>
<td>• Explainers (e.g., Vox, TheUpshot, WSJ)</td>
</tr>
<tr>
<td>Futures ‘D Briefs’</td>
<td>Short memos (2-4 pages) providing members and staff only what they need to know to begin engaging on policy issues of technical relevance</td>
<td>• Ensures basic technical and policy literacy</td>
<td>• POST notes, POST briefs (U.K. Parliamentary Office of Science &amp; Tech)</td>
</tr>
<tr>
<td>Futures ‘Support’</td>
<td>Flexible and targeted investigative assistance that empowers members and staff in their own work rather than conducting research for them.</td>
<td>• Builds upon existing policymaking processes rather than recreating them</td>
<td>• N/A</td>
</tr>
<tr>
<td>Futures ‘Perspectives’</td>
<td>Policy analyses in extended memo format (8-15 pages) defining and framing the impacts of potential policy choices by incorporating the broadest range of technically-legitimate perspectives on an issue but providing no direct policy recommendations</td>
<td>• Bring clarity and focus to debates involving technical issues, clearly separating issues of values and stakeholder preferences from technical considerations</td>
<td>• N/A</td>
</tr>
<tr>
<td>Futures ‘Scans’</td>
<td>Brief ‘red flag’ report delivered bi-annually which flags important S&amp;T issues for congressional attention. May take the form of a living dashboard or a ‘pressing issues’ list.</td>
<td>• Leverage of Futures ‘Network’ facilitates broad participation in the process</td>
<td>• World Economic Forum’s annual Global Risks Report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Can be delivered publicly to create pull from constituents to Congress to address the issues</td>
<td>• Tech (Reilly) Top 10 List</td>
</tr>
</tbody>
</table>
How will these products leverage technical expertise?

Research suggests that to be influential, information crossing the boundary between science and policymaking must have at least three characteristics: it must be relevant to addressing the needs of decision-makers (‘salient’); it must be authoritative, believable, and trusted (‘credible’); and it must be provided through a process perceived to be fair and that considers values, concerns, and perspectives (‘legitimate’). How to balance treatment of these three competing, although not necessarily mutually exclusive, characteristics is a central challenge for any congressional support body. Given the varied nature of the jobs the aforementioned products are meant to address, **CFO must draw on expertise that is well-matched to the needs of the job.** Expertise that is “well-matched” must also be expertise that is appropriately salient, credible, and legitimate to complete the job in the eyes of congressional members and staff. A rigorous analysis of what constitutes satisfactorily salient, credible, and legitimate for each job is outside the scope of this report. Addressing this tension is likely best-suited through learning and experimentation by CFO itself, but a starting point is considered here.

The potential sources of information CFO may call upon are diverse, each with different benefits and drawbacks (Figure 28). Closed methods of accessing expertise, such as expert panels, conferences, and literature reviews, lend credibility by limiting participation to individuals and groups traditionally considered to be experts on an issue, such as scientists, managers, and scholars. For problems that can be reasonably solved by a small group of authorities, closed methods may be an appropriate solution. Such approaches, however, require an ability to define what expertise is required and locate the people who have it precisely. The desired experts might not be available when they are needed: a challenge for problems requiring immediate attention. Simple screening mechanisms used to identify these experts for their inclusion may also fail to find the most relevant experts for the problem. For example, the FDA’s Center for Devices and Radiological Health (CDRH) launched its Innovation Pathway program in 2011 to leverage a vetted list of experts to serve as external reviews. In doing so, “it relied on membership in professional organizations [such as the American Academy for Neurology] as a proxy for expertise without any means to ‘match’ people to problems with any specificity.” Literature reviews, on the other hand, may lag current research or be subject to bias, depending on the review’s construction.

Open sources of expertise, however, face different challenges. Methods of crowdsourcing, such as communities and prize-backed contests, have been shown to help improve outcomes on issues of scientific interest through broad collaboration on incremental innovations (communities) and through the volume and diversity of ideas they generate (contests). Opening discussions on

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*Critical knowledge does not simply include substantive, technical knowledge; it also includes awareness of where useful complementary expertise resides within and outside the organization. This sort of knowledge can be knowledge of who knows what, who can help with what problem, or who can exploit new information.*

Wesley Cohen & Daniel Levinthal, 1990  
Carnegie Mellon University & University of Pennsylvania
topics of public interest to citizens, through public workshops or other deliberative mechanisms, can help enhance procedural fairness and perceived legitimacy of the outcome. In the absence of an ability to target populations with relevant expertise, success requires accessing a large enough population of diverse perspectives and an ability to parse through and evaluate the potentially vast quantities of information and ideas generated. Public deliberation may allow for bias though the inclusion of self-interested perspectives or introduce concerns irrelevant to the needs of decision-makers (‘salience’), making the outputs less useful.

The concept of expert networking attempts to bridge the categories. By using technology to target holders of the most relevant expertise and mobilize them for collaboration and work, expert networking attempts to deliver the legitimacy and value of open mechanisms with the credibility of closed systems. Tools and approaches that “automate the process for expressing, locating, and matching expertise within and across organizations”, sometimes referred to as expert networks, are emblematic of this approach. Such tools are a central motivation for the Futures ‘Network’ described above.

**Figure 28 | Overview of information searching mechanisms**

For CFO, traditional closed methods, while well-established in policy analysis, will not be sufficient. CFO must be able to access expertise that is highly distributed, rather than localized to small numbers of easily identifiable experts, and it must do so quickly to respond to the immediate needs of Congress (see Strategy). Closed mechanisms fair poorly in both regards. On the other hand, much has been written on how to design and attract participation to communities and contests to address specific challenges. But there has been little empirical exploration of alternatives for how government institutions can engage broad groups of experts to solve problems in real-world contexts. This suggests that experimentation will be required to discover how best to build and maintain the Futures ‘Network’ and utilize it and other open mechanisms to develop products for Congress. Areas potentially warranting experimental attention include:

1. How best to identify and match experts to particular types of requests.
2. What forms of engagement and collaboration (e.g., virtual conferences, long-distance teams) are most effective for generating expertise viewed as ‘credible’ and ‘legitimate’.

3. What exchange of value might be needed (e.g., academic publication, public recognition, compensation), if any, to compel the best experts to participate in a policy domain.

4. How to maintain the ‘legitimacy’ of CFO in the eyes of experts over time. Boundary organizations accomplish this by remaining dually accountable to both technical and political stakeholders. While institutionalizing this approach for CFO’s governance is not recommended, governance over the ‘Network’ may be strengthened by alternative forms of accountability through technical (e.g., peer-based or user ratings of work produced by experts) or informal (e.g., an external advisory council) means. Such an approach may further enhance ‘credibility’, protecting the network from capture by special interests.

Operations

CFO’s proposed operating model is intended to deliver on its strategy. Operations here is broadly conceived as the design and management of the organization’s systems and processes.

We detail five elements of the operating model below: decisions regarding governance, the organization’s formal management structure, the process for prioritizing work with scarce resources, the organization’s approach to staffing, and characteristics of its culture. Key choices are summarized in Figure 29.

Figure 29 | Outline of operational choices

<table>
<thead>
<tr>
<th>Strategic choices</th>
<th>Operational choices</th>
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<tbody>
<tr>
<td>Proximate needs</td>
<td>Governance: Led by an empowered Director, selected and authorized by a newly-established Joint Committee on Science &amp; Technology (JCST)</td>
</tr>
<tr>
<td>Broad constituency</td>
<td>Structure: Organized according to type of product, rather than topical domains, with deliberate interdependencies between product groups</td>
</tr>
<tr>
<td>Open-ended product-service design</td>
<td>Priorities: Director meets congressional demand under resource constraints through demand management, supply management, and topic selection</td>
</tr>
<tr>
<td>Expansive networks of expertise</td>
<td>People: Bias towards hiring problem-focused experts, as opposed to subject-matter experts, on permanent bases while utilizing flexible structures to involve topical expertise as-needed</td>
</tr>
<tr>
<td>Partisan constraints</td>
<td>Culture: Culture of risk-tolerance and rapid experimentation developed through formal structures, choice of Director, and operational choices</td>
</tr>
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</table>

See: Decision #3
Governance

Each of the existing legislative support bodies is governed differently, reflecting different mandates and the priorities of Congress at the time of their conceptions.\(^{79}\) There is no blueprint for governance.

Governance for technical expertise determines the basic institutional arrangement by which politicians and experts engage with one another. Most fundamentally, it establishes for whom an expert works. Whether experts service a concentrated set of political objectives or a more pluralistic set is shaped by initial governance decisions. At stake is the demand for expertise – the breadth of members that expect CFO to be at their service – as well as the political legitimacy of expertise, or whether its governance reflects a special versus heterogeneous set of interests.

We first consider the strengths and drawbacks of TAB, OTA’s bicameral and bipartisan board that elected OTA’s director, authorized OTA’s assessments, and exercised budget authority over OTA’s assessment activities. Because producing assessments was OTA’s central function, TAB exhibited a high degree of influence over the office’s work.\(^{80}\) We then consider an alternative governance structure to fit the strategy, product-service focus, and operational needs of CFO, proposing an ‘empowered’ director elected by a bicameral and bipartisan group of lawmakers but with greater operational independence.

TAB has been celebrated for ensuring OTA was responsive to members; through the board, members set the body’s agenda. While this analysis has posited that OTA was mostly responsive to TAB – not to Congress broadly\(^ {81}\) – we discard the approach of reinstating TAB as-is for three additional reasons. First, operationalizing TAB is a less feasible option today given Congress’s hyperpolarization. While levels of polarization meaningfully differ throughout the institution,\(^ {82}\) Congress is nonetheless characterized by “a near-permanent state of gridlock.”\(^ {366}\) Establishing a bipartisan board with direct control over CFO’s regular operations – authorizing regular activities and associated expenditures – risks handicapping its ability to perform basic functions. Second, TAB centralized OTA’s constituency base, inconsistent with CFO’s strategic decision to build inclusive internal constituencies servicing a broader variety of political objectives.\(^ {83}\) As this analysis has argued, TAB politically weakened OTA over the long-term, focusing it on a narrow set of clients who were unable to protect it when political winds shifted.\(^ {84}\) Finally, the TAB model is a poor fit with CFO’s proposed product-service mix. A high-involvement governing body could be reasonably expected to deliberate and authorize large, long-term TA products. It is less reasonable to perform an equivalent function with a suite of faster-moving and evolving set of offerings.

\(^{79}\) For example, the Comptroller General of the United States, who serves as the director of GAO, is appointed by the President and confirmed by the Senate, with a fifteen-year term. By contrast, CBO’s director is jointly appointed by the Speaker of the House and the President pro tempore of the Senate, with recommendations provided by both chambers’ budget committees, and for unlimited four-year terms.

\(^{80}\) See: OTA in Operation

\(^{81}\) See: OTA’s Demise

\(^{82}\) See: Priorities in What’s happening with Congress?

\(^{83}\) TAB is credited with having offered political protection in the short-term, providing day-to-day ‘cover’ for OTA; when assessments with evidently partisan motives arrived at OTA’s door, TAB played the role of denying requests that might endanger OTA. See: Blair P. (2013)

\(^{84}\) See: OTA’s Demise
We propose an evolved governance structure to maximize the pluralistic demands for S&T expertise and support CFO's political legitimacy. The arrangement is characterized by two key features: a joint committee – termed here the Joint Committee on Science and Technology (JCST) – and an 'empowered' director. Principally, JCST would assume the narrow but legitimizing task of selecting the office's director. Structurally, it would (1) include equal membership from both chambers; (2) be established with the aforementioned narrow jurisdiction, and without authority to report legislation; and (3) feature an equal bipartisan composition. TAB has itself been compared to a joint committee; however, while structurally comparable, Figure 30 details key differences. An elected director by JCST would otherwise assume broad discretion over CFO's day-to-day operations.

Four principal justifications support this arrangement.

1. **Enhanced political legitimacy.** Maintaining a bicameral and bipartisan method for selecting CFO's leadership through JCST enhances the political legitimacy of the body – compared, for instance, to a majority vote in one or both chambers, or selection by a party leader. Given contemporary threats to legislative support bodies, as well as the importance of political legitimacy conferred by TAB to OTA, we find this characteristic for CFO essential. Bipartisan and bicameral director selection is one chief mechanism to enhance it, signaling that CFO is equally in service of both chambers and parties.

2. **Insulation from centralized power.** A body that performs basic oversight functions, as detailed in Figure 30, also functions to insulate CFO from the centralized power of party leadership. A layer of authority between party leaders and CFO's operations can help to buffer against polarizing partisan influence. (Additionally, unlike TAB, whose members were selected directly by party leadership, the joint committee’s members are drawn from relevant standing committees.)

3. **Greater demand across Congress.** Greater operational control allocated to CFO prevents limited demand for its services. Because product offerings are not subject to direct authorization by a small group of members constituting the JCST, as was the case with TAB’s assessment authorizations, CFO remains free to respond to a broad constituency across Congress. This arrangement decouples the governing body from the primary client. Unlike the OTA-TAB relationship, CFO would not operate primarily in service of JCST.

4. **Buffer of internal support.** Drawing JCST members from the House and Senate Science committees links the committees to CFO. Evidence from the CBO experience suggests that relationships with relevant committees help to insulate nonpartisan bodies from attempts to politicize or weaken them. While the House and Senate Budget committees criticize

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85 See: *Imbalances of power*
86 See: *OTA in Operation*
87 See: *Processes*
88 See: *OTA in Operation*
CBO from time to time, they ultimately have a vested interest in protecting a body over which they carry influence.

A Note on Assessments
While we do not recommend long-form TA reports akin to OTA’s or those currently produced by STAA, in the event that CFO is requested to perform an assessment, JCST should assume an authorizing role. TA reports are traditionally high-profile. Bipartisan and bicameral authorization would ensure that highly polarizing topics are subject to partisan negotiation and prevented from politicizing CFO. Technical expertise can exacerbate rather than mediate conflict when inserted into controversial policy domains, and lessons from OTA’s experience suggest that involvement in such domains harms the political standing of the technical body. JCST would here function much as the TAB had, subsuming an authorizing role from the director.

Figure 30 | Overview of CFO governance

Finally, while JCST draws chief inspiration from the strengths of TAB (e.g., political legitimacy through bipartisan and bicameral oversight), and improves upon weaknesses or outdated elements (e.g., devolves greater authorities to the director), governance of CFO is possible absent a joint committee. Removing JCST from CFO’s governance structure would suggest a model more akin to CBO. For example, a director might instead be recommended by House and Senate Science committees and approved by party leadership.

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89 See: Product-service design
90 See: What’s happening with science?
91 See: OTA’s Demise
Structure

CFO’s organizational structure must closely support strategy while remaining compatible with the constraints of its environment, both internal and external to Congress. Based on CFO’s strategic decisions and the issues raised in the Diagnosis, four motivating challenges emerge:

1. Satisfying proximate congressional needs will require close collaboration and rapid experimentation with members and staff. This ‘closeness’ must contend with complex and difficult institutional dynamics, such as information-processing challenges and the centralized power of party leadership.92

2. The skills and capabilities required to produce the proposed products are different across each product, suggesting a need for specialization.93 For example, providing effective day-to-day support to members and staff requires a fluency with congressional processes and broad technical literacy. These skills and capabilities are distinct from the deep technical expertise in a narrow scientific domain required to complete rigorous policy analysis.

3. The specific topical domains where deep expertise is needed is difficult to predict and may shift quickly, given the near-term orientation of congressional priorities.94

4. CFO may be constrained in its ability to attract leading S&T experts on a permanent basis. With S&T expertise increasingly distributed and disproportionately located within industry,95 experts have competitive alternatives for employment that pose recruitment challenges for a government body. Further, CFO may face competition with other institutions for that same expertise (e.g., CRS, STAA, NASEM).

These challenges reflect pressing considerations that should guide CFO’s organizational structure. While new structures may necessarily respond to future challenges, they should nonetheless remain aligned with the organization’s strategy. The proposed structure that addresses these challenges, is aligned with CFO’s strategy, and that will deliver CFO’s product offerings, is presented in Figure 31. The key features of the proposed structure include:

1. Organized by product rather than topical domain. This organizational form best facilitates focused hiring and development of expertise in solving specific congressional problems (e.g., policy analysis, expertise collection) and enabling rapid experimentation of individual products. Such experimentation is guided by a Head of Product, supported by Product Leads in each group, who will lead efforts to tailor products in ways that best meet the needs of congressional users. Such product-centric roles allow those jobs to be filed by individuals with deep experience in product management and agile methodologies, as opposed to topical experts. Within Research & Analysis and Investigative Support, the

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92 See: Processes
93 See: Product-service design
94 See: Priorities in What’s going on with Congress?
95 See: What’s going on with science? and What’s going on with industry?
groups requiring the most in-house technical expertise, teams may further self-organize by
topical areas (e.g., health, security) or technical domain (e.g., computer science, biological
science) to facilitate group operations. This topic-driven structure has been adopted by
STAA\textsuperscript{369} and was also used by OTA.\textsuperscript{370}

2. **Deliberate interdependencies between product groups.** Interdependencies enable the
full expertise of the organization to be brought to bear to serve congressional needs.
Resources will be mobilized, in part, at the behest of customer-facing gatekeepers (e.g.,
Staff Advisors), who will have the closest and most frequent contact with members and
staff. Research & Analysis, in addition to the production of Briefs and Perspectives, can be
pulled to provide \textit{ad hoc} but deep policy analytic and subject matter expertise. Expert
Networking provides tools and processes for all other groups, and ultimately to members
and staff themselves, to exploit external networks using convening structures suited to their
needs. Network Managers further act as intermediaries to protect against political capture,
providing guidance to ensure broad perspectives are represented. In turn, these groups
give guidance to Expert Networking on where to focus network-building efforts.

3. **Distinction between problem experts and subject matter experts.** Problem experts
(Policy Staff, Staff Advisors, Future Scanners) are those skilled at designing specific products
and are thus hired, potentially on an at-will basis, with the intention of long-term retention.
Subject matter experts (Expert Fellows) are meant to augment internal capabilities with
deep expertise on specific topics for defined periods of time (e.g., 1-6 months): for
example, to conduct a specific piece of policy analysis or provide technical assistance in
support of a specific piece of legislation. This facilitates an ability to grow, shrink, or
otherwise redirect in-house expertise in response to shifting needs. Leveraging of the
Futures Network further facilitates the delivery of expertise to Congress even with few in-
house subject matter experts, who may be difficult to attract and retain.

4. **Addressing a range of constituencies across product groups.** Investigative Assistance,
including the group’s ability to leverage the Futures Network, will be open to all members
and staff, enabling the creation of a broad constituency and wider capacity development
within Congress. Research & Analysis may be more constrained in doing so, given the
resources required to produce policy analyses; the Group Head and CFO Director will
ensure that resources are directed in a balanced fashion to address issues of concerns to
both parties.\textsuperscript{96} Given the importance of party leadership to the development of
congressional priorities, however, the primary audience for Risk & Opportunities may be
party and committee leadership.

Finally, it is worth noting that this structure will need to evolve. CFO will not be able to begin
delivering all intended offerings immediately – for example, learning how best to convene outside
experts will take time and experimentation – and will need to steadily increase its scope over time.
This will be addressed in-depth in \textit{Getting Started}.

\textsuperscript{96} See: Priorities in Operations
Figure 31 | CFO organizational structure

**Key roles**

- **Director**
- **Chief of Staff / Admin**
- **Head of Expertise**
- **Head of Systems**
- **Head of Product**

**Group**

- **Research & Analysis**
  - **Group Head**
  - **Product Lead**
  - **Policy Staff (permanent)**
  - **Expert Fellows (flex)**

- **Expert Networking**
  - **Group Head**
  - **Product Lead**
  - **Network Managers**

- **Investigative Support**
  - **Group Head**
  - **Product Lead**
  - **Staff Advisors**

- **Risk & Opportunities**
  - **Group Head**
  - **Product Lead**
  - **Futures Scanners**

**Description**

- **Research & Analysis**
  - Leverage policy analytic and subject matter expertise, flexed to match legislative priorities, to provide policy analysis and deep technical support.

- **Expert Networking**
  - Develop systems, processes, and relationships to enable expert networking.

- **Investigative Support**
  - Primary access point for expertise and day-to-day support for members and staff.

- **Risk & Opportunities**
  - Scan for issues requiring attention and elevate them on the legislative agenda.

**Flagship products**

- **Research & Analysis**
  - Futures ‘Briefs’
  - Futures ‘Perspectives’

- **Expert Networking**
  - Futures ‘Network’

- **Investigative Support**
  - Futures ‘Support’
  - Futures ‘On-call’

- **Risk & Opportunities**
  - Futures ‘Scan’

**Primary constituency**

- **Research & Analysis**
  - Members and staff
  - CFO ‘Investigative Support’ team

- **Expert Networking**
  - CFO teams

- **Investigative Support**
  - Members and staff

- **Risk & Opportunities**
  - Committee and party leadership

**Overview of staff roles**

- **Chief of Staff**: Lead people-resourcing, monitor the budget, and coordinate activities across groups.
- **Head of Expertise**: Drive experimentation with innovative approaches for engaging experts.
- **Head of Systems**: Develop and support organizational infrastructure (e.g., convening tools, analysis libraries).
- **Head of Product**: Oversee the development and iteration of products tailored to congressional needs.

- **Group Head**: Manage group operations and priorities.
- **Product Lead**: Manage product development (e.g., templates) for group.
- **Policy Staff**: Analytic experts bringing rigor to broad S&T policy issues.
- **Expert Fellows**: Temporary-term (1-6 month) subject-matter experts.
- **Network Managers**: Develop and manage Futures ‘Network’ and support other CFO teams in accessing external expertise (e.g., convenings).
- **Staff Advisors**: Policy advisors with technical expertise in broad domains.
- **Futures Scanners**: Monitor and build awareness of S&T developments.
Priorities

Prioritizing work is a key operational challenge for a congressional advisory body. For OTA, TAB prioritized the body’s work by serving as the primary authorizer for any TA projects.\(^\text{97}\) JCST will not assume this role, but a need to prioritize work given resource constraints remains. The challenge, therefore, is to devise methods that prioritize work with the potential for impact and that simultaneously respond to congressional authority.

In this section, a framework and supporting analysis are provided to guide the satisfaction of congressional demands with potentially limited resources. The intention is not to recommend specific policy issues for consideration or offer a fully-specified formal prioritization scheme. Rather, we mean to provide a diagnostic approach for making prioritization decisions that can be refined with experimentation.

**Ultimate responsibility for prioritization decisions reside with the Director**, who is provided authority for product development and staffing. In doing so, the Director must be thoughtful about (1) the spaces within Congress to direct efforts, (2) creating relationships with members and staff of varying degrees of power across both chambers, and (3) anticipating existing and future needs arising from the policymaking process. Thus, the Director must be politically savvy and deeply knowledgeable of congressional processes, in addition his or her technical competencies. The JCST will play an indirect role through its selection of the Director and review of CFO annual reports, although may also serve as an institutional check on CFO’s highest visibility products.\(^\text{98}\)

In carrying out these responsibilities, the Director has three available levers to pull: (1) managing the demand from Congress for CFO’s products, (2) managing CFO’s own capacity to deliver products, and (3) selecting what topics to cover.

**Managing demand**: While CFO should not, and largely cannot, influence congressional priorities, various ways exist to influence the volume and nature of inbound requests for expertise. The organization is likely to be most capacity-constrained during its early phases of operation, when staffing resources may be limited, and while piloting new products, when the organization will be focused more on learning than efficient delivery. During its ‘start-up period’, CFO should direct its support **towards deliberately selected members and staff** (see ‘Topic selection’ below). In doing so, the Director should play a sourcing and relationship-management role, identifying particular needs within member offices and committees where CFO can conduct contained experiments led by Product Heads. This will allow CFO to manage the expectations of members and staff to avoid frustration with the organization’s nascent capacity. After a full ‘launch’ of new products, CFO should monitor incoming requests through a centralized tracking system that provides visibility into the demand for its services, which may inform future relationship-management efforts.

**Managing supply**: The Director’s next role involves staffing the organization in relation to demand for its services. An analysis provided in Appendix 5 suggests that satisfying congressional demand

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\(^\text{97}\) See Priorities in What’s happening with Congress?

\(^\text{98}\) For example, with resource-intensive TA products, should CFO ever be commissioned to do produce them.
can be reasonably accommodated with a limited staff. Staffing decisions require not only understanding current demand but also anticipating future demand, as the lead time between identifying needs, acquiring new appropriations, and making successful hires will be significant. Use of flexible, short-term employment structures for Expert Fellows (see ‘Structure’) will partially address the issue by allowing CFO to adjust staffing to meet changing congressional priorities. Further, by keeping rigorous track of demand for CFO services, the Director will be able to use demand data as justification for adjusted resources during appropriations. Finally, it may in fact be beneficial for CFO to staff itself below levels required to meet full coverage; such resource constraints will pressure the organization to innovate with Futures ‘Network’ to provide support more efficiently.

**Topic selection:** While responsibility for the day-to-day actions of CFO staff should be devolved to the staff themselves, the Director has ultimate authority for which policy domains CFO should, and should not, lend support. The topic selection process is not simply about addressing mismatches between supply and demand, although it does play a role in this regard. Rather, intentional topic selection will allow CFO to enhance its impact, build a broad constituency, and thoughtfully avoid politicization. Discussion of how the institution can stage the growth of its products and the issues it addresses is covered in ‘Getting Started’. Here, a framework is offered to provide the Director with criteria questions when deciding which issues to select for product support (see Figure 32 for guiding questions).

- **Impact:** Not all policy issues – even those directly affected by S&T – are conducive to support from technical expertise. In fact, the intrusion of expertise into domains where there is high conflict in values can inhibit political settlement and damage the credibility of participating scientists. CFO should prioritize issues where technical expertise can improve congressional decision-making by enhancing the quality of partisan interaction while avoiding issues where it might exacerbate political conflict.

- **Efficiency:** Working with limited resources, CFO should prioritize efforts where value can be created using less of the organization’s capacity. Topics where the Futures ‘Network’ can be leveraged to further reduce the internal resources required to address the issue should be further prioritized.

- **Constituency:** CFO must place a premium on building broad constituencies with its work, resisting the temptation to serve the same constituencies again and again. Policy issues that will allow CFO to build a new constituency or reinforce a constituency that is otherwise underserved by CFO should be prioritized.

- **Partisanship:** Congress is more complicated in its partisanship than is often assumed, with some committees and policy issues being more ripe for bipartisan work than others. CFO

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99 See: What’s happening with science?
100 See: Priorities in What’s happening with Congress?
should be thoughtful about directing its attention towards topics of bipartisan interest and otherwise crafting a portfolio of coverage that balances the needs of both parties.

Figure 32 | Framework to guide prioritization decisions

<table>
<thead>
<tr>
<th>Guiding Questions for topic prioritization</th>
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<tr>
<td>Impact</td>
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<tr>
<td>Efficiency</td>
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<td>Constituency</td>
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<td>Partisanship</td>
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People

*To integrate certain classes of complex and sophisticated technological knowledge successfully into the firm’s activities, the firm requires an existing internal staff of technologists and scientists who are both competent in their fields and are familiar with the firm’s idiosyncratic needs, organizational procedures, routines, complementary capabilities, and extramural relationships.*

Wesley Cohen & Daniel Levinthal, 1990
Carnegie Mellon University & University of Pennsylvania

This section details how the organization should staff the organizational structure described above. Given the uncertainty regarding the congressional demand for the respective products described, it would be imprudent and falsely precise to project what CFO staffing might ultimately look like in terms of its magnitude or mix of employees. Rather, we propose four principles for guiding staffing decisions to ensure consistency between CFO’s strategy, structure, and people.

1. **Match people to problem-specific roles.** CFO will not be organized akin to a research institution or university, characterized by cadres of subject matter experts grouped by discipline. The characteristics, competencies, and knowledge of its people should instead be aligned to the specific problem their role is tasked with solving. This means that many roles will not need to be filled by deep subject matter experts, such as an authority figure of a particular scientific domain.
2. **Prioritize capabilities over credentials.** For those roles requiring significant technical expertise, there is no reason that CFO should require traditional technical credentials (such as doctorates) or that staff originate from academic backgrounds. Expert Fellows brought in to address issues at the frontiers of AI or cybersecurity, for example, might just as well come from the private sector. Staff Advisors working with committee staffers on broad ranges of S&T issues might come from think tanks or other civil society organizations, where broader policy expertise and a deeper understanding of congressional process are more valuable than deep knowledge of a narrow topic.

3. **Align length of employment to task time horizons.** Problems that will likely need to be solved again and again or that require the accumulation of significant knowledge, as in the ‘Investigative Support’ group, should be kept on staff year after year. Retention in these roles may be challenging, as the proposed organizational structure embeds little hierarchy and thus limited opportunities for vertical advancement. Utilizing a more generous compensation scheme than that of the federal civil service pay scale, at the discretion of the Director, may provide some retentive capacity. Group Heads, however, should explore practices for the sharing and institutionalization of knowledge from Staff Advisors, Network Managers, and Policy Staff. Subject matter experts like Expert Fellows, on the other hand, are needed only for as long as the policy priorities of Congress require (see Figure 33 for summary). Short-term contracting arrangements or formal fellowship programs akin to the AAAS Fellows program may be models of acquiring such talent.

4. **Adjust staffing to anticipated congressional demand.** Since congressional priorities are inconstant, staffing must be responsive to changes. The Director and Group Heads should remain close to congressional developments and anticipate needs. Flexible staffing structures should enable Expert Fellows to be onboarded quickly and later discharged when appropriate. Over time, this might require the overall level of staff and their mix to adjust to reflect congressional needs. Should subject matter-intensive products like Perspectives and Briefs become popular with congressional consumers, a significant portion of CFO staff may be shorter-term Expert Fellows. OTA took the opposite approach, staffing mostly on a permanent basis – 143 of OTA’s 197 employees in April 1989 were permanent; the rest were temporary\textsuperscript{374} – so that staff could be more deeply trained to navigate the partisan environment.\textsuperscript{375} CFO can better accommodate more temporary staffing by (1) using permanent employment for roles that are most exposed to partisans (Investigative Support), and (2) encouraging frequent interaction and coordination between product groups\textsuperscript{101} so that political knowledge can be shared.

\textsuperscript{101} See: Culture
Culture

The systems and process of an organization’s operations are the product of both formal planning and informal forces. Culture, the “tacit social order of an organization,” affects the latter. It is hard to plan and elusive to manage. Nonetheless, the key qualities of an organizational culture that support its strategy and mandate are describable; they represent desirable characteristics towards which management should look.

We place an importance on examining culture as an operational feature given that it regulates what is encouraged and discouraged of people. By shaping attitudes and beliefs, culture regulates the ways in which people make daily decisions about how to carry out the organization’s work. According to one review of the literature, two central dimensions of organizational culture appear across organizations no matter the kind.\textsuperscript{102} We consider both of these fundamental characteristics here and examine their implications for CFO.

1. People Interactions. According to researchers, the ways in which an organization’s people engage with one another “fall[s] on a spectrum from highly independent to highly interdependent.”\textsuperscript{376} Organizations that place greater value on individual autonomy and competition characterize an independent culture, while those that value integration and cooperation characterize an interdependent one.

Along this spectrum, CFO calls for an orientation towards the latter. Operationalizing CFO’s structure requires not just deploying staff to perform their respective tasks but ensuring coordination. For example, the formation of (informal) teams \textit{across product areas} would ensure that (formal) teams are leveraging expertise and value from one another. Given that CFO’s proposed products are themselves interdependent, staff interaction and coordination should reflect this. For example, Futures Briefs must leverage the Futures Network to mobilize external expertise for its policy analyses. Or, while Staff Advisors interact daily with members and staff, learning about needs, Policy Staff are tasked with examining the impacts of potential policy choices: the former obtains intelligence on user needs, while the

latter requires that intelligence to perform the relevant analyses. **Deep coordination is required to produce interlaced products.**

Fostering these interdependencies must be an intentional focus of the organization. Generating an interdependent culture requires an emphasis on “integration, managing relationships, and coordinating group effort.”

2. **Response to Change.** Whereas some organizational cultures "emphasize stability—prioritizing consistency, predictability, and maintenance of the status quo—others emphasize flexibility, adaptability, and receptiveness to change." Organizations that emphasize the former tend to strive for efficiency and predictability through features like staffing by seniority and hierarchical management structures. Those that emphasize the latter encourage experimentation and emphasize a longer-term orientation.

Given CFO’s design decisions, we anticipate a tension between standardizing systems, processes, and products for efficiency while still encouraging experimentation. For instance, some of CFO’s proposed products suggest a need for significant experimentation (e.g., Futures Perspective and Future Scans) while others may benefit from standardization or incremental change (e.g., Futures Briefs). Further, we expect that this tension will be magnified given CFO’s context: embedded within an institution not known for rewarding risk-taking and experimentation. This places **premium importance on management’s ability to dedicate space for risk-taking, and with authorization and protection from its governing body.**

Over time, the culture that emerges from the organization will be the result of staff repeatedly solving problems together, discovering what works and is rewarded in the process. These ways of operating will, through organizational culture, “be taught to new members as the correct way to perceive, think, and feel in relation to those problems.” This places a significant responsibility on the initial conditions set by CFO management.

**Evaluation & Adaptation**

Where OTA failed to communicate its value broadly, CFO should institutionalize an internal assessment mechanism for its own work and share the results widely. In doing so, it should speak to the motivating values held by different groups of members and staff rather than focusing narrowly on only one form of impact. This will allow the organization to build constituencies that may have different orientations towards S&T expertise or seek to use CFO in different ways. For example, it may consider its impact on the policymaking process (e.g., depth and breadth of policy issues it addresses); the expertise it allows Congress to access and absorb (e.g., frequency and

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103 See: OTA’s Demise
104 For example, some members may prioritize cost-savings from evaluating federal programs, whereas others may prioritize the effective delivery of social services. 'Motivating values' for CFO’s work will be variable across the political spectrum.
nature of expert consultations facilitated); and the cost efficiencies it enables (e.g., staff hours saved through use of external networks, cost savings in federal S&T-related programs).

Such measures on their own, however, will be insufficient to guide the organization through continued learning and adaptation. Deliberate organizational practices are required that enable CFO to evolve itself and the ways in which it creates value. We offer a framework for these practices organized by four categories of learning and adaptation (Figure 34).

1. **Day-to-day delivery of value.** The most critical dimension of adaptation, CFO must rapidly learn through daily interactions with members and staff. These interactions will undergird CFO’s ability to continually evolve the design of products and operational practices to best address congressional needs. To enable this learning, significant authority and responsibilities over product design and operational processes must be devolved from the Director to Product Leads, Group Heads, and other staff.

2. **Exploration of opportunity.** CFO should utilize periodic experiments, driven by congressional needs, to guide new product launches and make changes to the way CFO accesses expertise and develops and delivers its products (for example, using the Futures Network develop crowd-based method to source specific elements of Briefs and Perspectives). This will require a deliberate approach for constructing and internalizing the learnings from experiments\(^{105}\), supported by the capabilities and responsibilities devolved to the Heads of Product and Expertise.

3. **Organizational scaffolding.** CFO must gradually evolve and invest in the organizational structures, systems, and processes that enable the body to deliver value. Some of these organizational elements have to do with the ways by which the organization makes day-to-day decisions (for example, the processes that prioritize the work of product teams). Others relate to the technological infrastructure that powers its activities. To enable flexible investment, a discretionary budget should be established that the Chief of Staff and Head of Systems can draw on, with supervision from the Director, to take advantage of opportunities.

4. **Vision and direction.** Finally, CFO may ultimately adjust its mandate or strategy in response to significant changes in congressional needs or challenges that the organization fails to solve through other forms of adaptation. Such changes must be made deliberately infrequent to prevent the organization from being distracted by short-term problems and prematurely diverted from its purpose of strengthening the institution’s absorptive capacity. This could be instituted statutorily (for example, requiring that any revisions to the mandate undergo a multi-year review period) or through more informal means (an internal strategy-setting process).

\(^{105}\) See *How will these products access expertise? in Product-Service Design*
The intimate access and frequent interaction required to evolve its day-to-day delivery of value would not be possible were it not an internal body embedded within Congress.

**Figure 34 | Approach for organizational adaptation**

<table>
<thead>
<tr>
<th>Description</th>
<th>Institutional elements</th>
<th>What is needed to operationalize</th>
<th>Who is responsible</th>
<th>Mechanisms</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrequent to prevent distraction and diversion</td>
<td>Mandate and strategy</td>
<td>Systems to monitor and evaluate KPIs</td>
<td>Director, JCST</td>
<td>Formal reviews with JCST</td>
<td>Annually or longer</td>
</tr>
<tr>
<td>Gradual evolution and investment</td>
<td>Organizational structure, systems, processes</td>
<td>Discretionary budget to support investments</td>
<td>Director, Chief of Staff, Head of Systems</td>
<td>Team check-ins</td>
<td>Periodic</td>
</tr>
<tr>
<td>Experiments driven by congressional requirements</td>
<td>Product-service launches, team practices and priorities</td>
<td>Approach for internalization of learnings (e.g., post-mortems)</td>
<td>Heads of Expertise and Product</td>
<td>Pilot programs</td>
<td>Periodic</td>
</tr>
<tr>
<td>Rapid learning through daily interactions</td>
<td>Product-service design, operational practices</td>
<td>Devolution of power to product teams</td>
<td>Product Leads, Group Heads</td>
<td>Consultation with members and staff</td>
<td>Continuous</td>
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</table>

**GETTING STARTED:**

How will the body be initialized?

CFO will not be able to develop and deliver each of the proposed products across all S&T-related policy issues immediately. It will take time and deliberate experimentation to design products that satisfy congressional needs and build the requisite external networks and internal expertise required to produce them. Further, creating impact with Capacity-Building products such as ‘Perspectives’ and ‘Scans’ will require institutional legitimacy to draw congressional attention to issues it may not otherwise be predisposed to address.

To address these challenges, CFO should follow a staged development path (Figure 35) aligned to the categories of products identified in Product-Service Design (Win-wins, Constituency-Builders, and Capacity-Builders) that leverages the adaptation approach identified above.

1. **Create immediate value.** During the first 6-24 months of its operation, CFO should focus primarily on Win-wins (Futures Network, Futures On-call). Developing expert networking capabilities while providing targeted support on pressing issues in relatively bipartisan spaces within Congress such as Armed Services, Agriculture, and Science[^106] will allow CFO to create value while building the network infrastructure upon which future products may

[^106]: See: Priorities in What’s happening with Congress?
be built. Pilots of more intensive support (Futures Support) may also be run to prepare for their eventual expansion.

2. **Build constituency.** During the next 2-4 years of its operation, CFO should prioritize development and expansion of its Constituency-Builders (Futures Support, Futures Briefs). The Investigative Support team should expand its reach and issue-area scope. The Research & Analysis should also pilot and launch Futures Briefs on issues where an in-depth understanding of technical issues is needed by broad groups of members and staff. It should also begin producing policy analyses (Futures Perspectives) on a pilot-basis to build the processes and capabilities to provide analysis of sufficient rigor to be useful to Congress on a time horizon relevant to the policymaking process.

3. **Expand capabilities.** During this stage, CFO should provide a full mix of products, having developed and institutionalized a process for producing Perspectives and forward-looking views of S&T topics potentially requiring congressional attention (Futures Scans). The primary concern for CFO during this third stage of development is effectively balancing congressional demand with internal capacity and navigating a complex set of partisan issues.

The proposed timeline and sequencing of expansion activities are meant to be indicative rather than prescriptive. CFO’s realized path for expansion will ultimately be driven by the resources it is provided and the congressional appetite for its services; it could be much faster or much slower than depicted. Regarding the resource constraints it may face during the early years of its operation, CFO should be careful not to over-promise relative to what can be reasonably provided in terms of the depth and breadth of its support. Navigating such resource constraints will be a key role for the Director.

Finally, the level of appropriations established for CFO will also guide its initialization and scaling decisions. Based on an illustrative analysis in Appendix 6, CFO may require funding of $8 million to run as viable pilot organization, $15 million to commence limited operations, and over $30 million to operate with a full suite of services to a broad constituency of congressional consumers. The ambition of its operations will in part be a function of its financial resources.
**Figure 35 | Sequencing of CFO expansion activities** (timing is indicative)

<table>
<thead>
<tr>
<th>Description</th>
<th>Create immediate value (first 6-24 months)</th>
<th>Build constituency (next 2-4 years)</th>
<th>Expand capabilities (ongoing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topics addressed</td>
<td>Develop expert networking capabilities while supporting Congress on most pressing issues</td>
<td>Provide broad policymaking support while engaging in targeted policy analysis</td>
<td>Providing full suite of Futures products, adapting offerings and issues covered as needs evolve</td>
</tr>
<tr>
<td>Products launched</td>
<td>Pressing issues relevant to most bipartisan committees</td>
<td>Pressing issues relevant to all S&amp;T-related committees</td>
<td>Full product coverage with deep expertise on existing congressional priorities</td>
</tr>
<tr>
<td>Futures ‘Network’</td>
<td>Futures ‘Support’</td>
<td>Futures ‘Scans’</td>
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<tr>
<td>Futures ‘On-call’</td>
<td>Futures ‘Briefs’</td>
<td>Futures ‘Perspectives’</td>
<td></td>
</tr>
<tr>
<td>Futures ‘Support’ (pilot with limited capacity)</td>
<td>Futures ‘Perspectives’ (pilot with limited capacity)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teams to build up</td>
<td>Senior team</td>
<td>Investigative Support</td>
<td>Research &amp; Analysis</td>
</tr>
<tr>
<td>Expert Networking</td>
<td>Research &amp; Analysis (early hires)</td>
<td>Risk &amp; Opportunities</td>
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<tr>
<td>Investigative Support (early hires)</td>
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</table>
CONCLUSION

“Laws and institutions must go hand in hand with the progress of the human mind. As that becomes more developed, more enlightened, as new discoveries are made, new truths disclosed, and manners and opinions change with the change of circumstances, institutions must advance also, and keep pace with the times.”

Thomas Jefferson, 1816

As of this writing, national headlines include: an IPO valuing a large technology company pursuing AVs at $24.3 billion; a White House directive to accelerate NASA’s timetable for returning humans to the moon “by any means necessary”; a set of internet regulations proposed to U.S. policymakers by Mark Zuckerberg; the second crash of a commercial Boeing jet after its software failed to receive a detailed review by the Federal Aviation Administration; a projection by DOE that China will have operationalized an exascale supercomputer – the world’s most powerful – a year before the U.S.; the discovery of hacking risks to AI in healthcare that could generate significant fraud; and levee systems overwhelmed by flooding across the American Midwest, to name but a few.

The scale, speed, and complexity of advancements in science and technology are escalating, whether or not the nation’s highest lawmaking body keeps pace. As the gap between the two widens, efforts to address Congress’s constraints become more urgent. Efforts that fail to make progress on the weakened capabilities atrophying the institution’s absorptive capacity will also fail to meaningfully improve legislative outcomes. Moreover, efforts to make marginal progress from the outside will yield only marginal internal change. Just as S&T issues are big and complex, so too is Congress. Enhancing its abilities to intake, assimilate, and make use of external knowledge requires “knowing its inner workings intimately.” As one former technology advisor in Congress reflected, “big institutional problems require big institutionalized solutions.”

The Congressional Futures Office presents one such institutionalized response. OTA exemplified a standard-setting approach in 1972 for S&T analytical services, inspiring other legislatures around the world to follow suit. Congress should again engage its imagination for a novel era. Rather than simply giving old solutions a new home, Congress can set a new global standard for meeting complex problems with informed policymaking. We intend through this report to offer a comprehensive analysis of the problem, but also to provide inspiration coupled with practical

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107 See Figure 36 for a summary comparing the key design elements of OTA, STAA and CFO
recommendations illustrated through CFO. We hope that this furthers the debate on what to do about the prospects for our lawmaking in an uncertain future.

Figure 36 | Comparison of OTA, STAA, and CFO key design elements

<table>
<thead>
<tr>
<th>Mandate</th>
<th>OTA (former)</th>
<th>STAA (current)</th>
<th>CFO (proposed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy</td>
<td>Activity-driven mandate (technology assessments)</td>
<td>Activity-driven mandate (technology assessments, S&amp;T program audits)</td>
<td>Problem-driven mandate (building absorptive capacity in Congress)</td>
</tr>
<tr>
<td>Predefined products using in-house expertise and expansive networks for a limited constituency on seniority-driven congressional priorities</td>
<td>Predefined products using primarily in-house expertise for a limited constituency on priorities determined by congressional leaders and Comptroller-General</td>
<td>Open-ended assortment of products primarily using networks of expertise for a broad constituency on widely-distributed congressional priorities</td>
<td></td>
</tr>
<tr>
<td>Product Design</td>
<td>Technology assessments and supporting materials (e.g., briefs, summaries)</td>
<td>Technology assessments, federal S&amp;T program audits, and innovations in audit practices</td>
<td>Products designed to primarily address heterogeneous and proximate congressional needs</td>
</tr>
<tr>
<td>Governance</td>
<td>Priorities driven by TAB, a body appointed by party leadership</td>
<td>Authority concentrated in Comptroller-General with limited congressional governance</td>
<td>Empowered Director chosen by a new Joint Committee on Science &amp; Technology (JCST)</td>
</tr>
<tr>
<td>Organizational structure</td>
<td>Organized by topical domain with internal subject matter experts</td>
<td>Organized by topical domain with internal subject matter experts</td>
<td>Organized by product with a combination of problem-focused and subject matter experts</td>
</tr>
<tr>
<td>Evaluation &amp; Adaptation</td>
<td>Learning through deep embeddedness in Congress, offset somewhat by pre-defined focus on technology assessment</td>
<td>Auditing culture with pre-defined products and a lack of embeddedness in Congress (GAO is host institution)</td>
<td>Learning through experimentation and deep embeddedness in Congress</td>
</tr>
</tbody>
</table>
“Representative government has broken down and disappeared in other countries. Here in the United States it remains on trial. Its survival may well depend on its ability to cope quickly and adequately with the difficult problems of a dangerous world.”

George Galloway, Library of Congress
On the Legislative Reorganization Act of 1946
# APPENDICES

## Appendix 1 | Research methodology

<table>
<thead>
<tr>
<th>Primary Research</th>
<th>Description</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structured interviews</td>
<td>Understand the problem and its causes across science, technology, and policy. Interviwees were drawn from Congress (current and former members and staff), former OTA staff, other congressional support bodies, executive branch agencies, academia, industry, science and civil society.</td>
<td>Science and technology policymaking is inherently systemic and requires engaging with and understanding a broad range of stakeholders.</td>
</tr>
<tr>
<td>User assessment</td>
<td>Explore the current needs of congressional members and staff as they relate to S&amp;T-specific policymaking, map current internal processes for engaging with S&amp;T-related topics, and obtain feedback directly from 'end-users' on potential solutions to diagnosed issues.</td>
<td>Direct user engagement enables rapid feedback in the design process, leading to recommendation that are better-tailored to addressing nuanced Congressional needs.</td>
</tr>
<tr>
<td>Data analysis</td>
<td>Conduct relevant analysis of data on congressional funding and resourcing levels, patents, think tanks, and committee partisanship.</td>
<td>Data analysis substantiates ideas surfaced from other research activities while generating new insights.</td>
</tr>
<tr>
<td>Literature reviews</td>
<td>Leverage existing bodies of academic work on political science, public administration, science communication, and management, along with primary sources such as those from OTA and Congress.</td>
<td>A significant body of evaluative work on OTA exists, along with work on alternative models of technology assessment domestically and internally, but lacks synthesis.</td>
</tr>
<tr>
<td>Secondary research</td>
<td>Case studies</td>
<td>Develop design alternatives from technology assessment models used internationally and among existing bodies that provide expertise to Congress.</td>
</tr>
<tr>
<td>Design frameworks</td>
<td>Identify and apply frameworks and research from product development, general management, and organizational design literature to structure the Design.</td>
<td>Institutional design is a cross-disciplinary challenge and thus benefits from incorporating the latest thinking from diverse fields.</td>
</tr>
</tbody>
</table>
Appendix 2 | Mapping of research methods to areas of inquiry

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Primary research</th>
<th>Secondary research</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structured interviews</td>
<td>User prototyping</td>
</tr>
<tr>
<td>Needs assessment</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>History and evaluation of OTA</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Alternative TA models</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Systemic and landscape analyses</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Decisions and Design</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
## Appendix 3 | European technology assessment and support bodies

<table>
<thead>
<tr>
<th>Country</th>
<th>Technology Assessment Institution</th>
<th>Founded</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Parliamentary Office for Evaluation of Scientific and Technological Options (OPECST), French Parliament</td>
<td>1983</td>
</tr>
<tr>
<td>Denmark</td>
<td>Danish Board of Technology Foundation (DBT)</td>
<td>1986</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Rathenau Institute of the Royal Netherlands Academy of Sciences</td>
<td>1986</td>
</tr>
<tr>
<td>European Union</td>
<td>Science and Technology Options Assessment (STOA), European Parliament</td>
<td>1987</td>
</tr>
<tr>
<td>Austria</td>
<td>Institute of Technology Assessment (ITA) of the Australian Academy of Sciences</td>
<td>1988</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Parliamentary Office of Science and Technology (POST), British Parliament</td>
<td>1989</td>
</tr>
<tr>
<td>Germany</td>
<td>Office of Technology Assessment at the German Bundestag (TAB)</td>
<td>1990</td>
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<tr>
<td>Switzerland</td>
<td>Centre for Technology Assessment Switzerland (TA-SWISS)</td>
<td>1991</td>
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<tr>
<td>Finland</td>
<td>Committee for the Future, Finnish Parliament</td>
<td>1993</td>
</tr>
<tr>
<td>Greece</td>
<td>Committee on Technology Assessment, Greek Parliament</td>
<td>1997</td>
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<tr>
<td>Norway</td>
<td>Norwegian Board of Technology (NBT)</td>
<td>1999</td>
</tr>
<tr>
<td>Sweden</td>
<td>Evaluation and Research Secretariat (ERS), Swedish Riksdag</td>
<td>2007</td>
</tr>
<tr>
<td>Catalonia (Spain)</td>
<td>The Advisory Board of the Parliament of Catalonia for Science and Technology, Catalan Regional Parliament</td>
<td>2008</td>
</tr>
<tr>
<td>Council of Europe</td>
<td>Committee on Culture, Science, Education and Media of the Parliamentary Assembly of the Council of Europe (PACE), Strasbourg</td>
<td>1948¹</td>
</tr>
<tr>
<td>Poland</td>
<td>Bureau of Research (BAS), Polish Parliament</td>
<td>1991¹</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>Analytical Department of the Council of Federations</td>
<td>1994¹</td>
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</tbody>
</table>

¹ Reflects year of establishment of technology assessment function (institution was founded earlier)
Appendix 4 | Variation in approaches for classifying technology assessment

<table>
<thead>
<tr>
<th>Classification of TA institution</th>
<th>Germany</th>
<th>Denmark</th>
<th>European Parliament</th>
<th>Finland</th>
<th>Belgium</th>
<th>France</th>
<th>Greece</th>
<th>Italy</th>
<th>The Netherlands</th>
<th>Norway</th>
<th>Sweden</th>
<th>United Kingdom</th>
<th>United States (OTA)</th>
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<tbody>
<tr>
<td>1 Committee model</td>
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<td>1 Office model</td>
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<td>2 Discursive model</td>
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<td>2 Instrumental model</td>
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<td>2 Combination of models</td>
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<td>3 OTA paradigm</td>
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<td>3 European variation of OTA</td>
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<td>3 Public TA</td>
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<td>3 Constructive TA</td>
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<td>4 Classical concept</td>
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<td>4 TA secretariat</td>
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<td>4 Participatory model</td>
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<td>5 Directly in parliament</td>
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<tr>
<td>5 Separate institution near parliament</td>
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<td>5 Independent institution</td>
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</tbody>
</table>
Appendix 5 | CFO staffing required to satisfy congressional demand

Based on reasonable assumptions for congressional demand and the operational intensity of its products, CFO may be able to fully meet demand for its most labor-intensive products (Futures Support and Futures Perspectives) with ~60 full-time technical staff. This number may increase to ~110 full-time technical staff if Congress were to make substantial use of technical expertise across most policy issues (the “high use” scenario below). This does not represent a recommendation for any particular level of staffing by the authors. Rather, it illustrates that the potential volume of requests should not represent a barrier to CFO pursuing a broad constituency.

Investigative Support and Policy Analysis Teams
Potential Staffing Requirements by Intensity of Congressional Use

<table>
<thead>
<tr>
<th>Volume of S&amp;T-related bills requiring CFO support</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legislative volume</td>
<td>Bills / year</td>
</tr>
<tr>
<td>Related to S&amp;T issues</td>
<td>Bills / year</td>
</tr>
<tr>
<td>S&amp;T issues demanding CFO support</td>
<td>Bills / year</td>
</tr>
</tbody>
</table>

**Investigative Assistance (Support) and Research & Analysis (Perspectives)**

<table>
<thead>
<tr>
<th>Support intensity per bill</th>
<th>Share of time spent per day</th>
<th>Supporting days per type</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigative Assistance ('Support')</td>
<td>[y] x [z]</td>
<td>Percentage</td>
<td>Author assumption (illustrative)</td>
</tr>
<tr>
<td>Minimal support</td>
<td>Days</td>
<td>0.25</td>
<td>25%</td>
</tr>
<tr>
<td>Exploratory engagement</td>
<td>Days</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>Serious engagement</td>
<td>Days</td>
<td>30</td>
<td>100%</td>
</tr>
<tr>
<td>Research &amp; Analysis (Perspectives)</td>
<td>Days</td>
<td>20</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Staffing required to completely satisfy demand**

<table>
<thead>
<tr>
<th>Intensity of use by Congress</th>
<th>High use</th>
<th>Moderate use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of bills by type of support:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal support</td>
<td>Percent</td>
<td>20%</td>
</tr>
<tr>
<td>Exploratory engagement</td>
<td>Percent</td>
<td>40%</td>
</tr>
<tr>
<td>Serious engagement</td>
<td>Percent</td>
<td>40%</td>
</tr>
</tbody>
</table>

| Number of support days: | | |
|-------------------------| | |
| Minimal support | Days | 48 | 96 |
| Exploratory engagement | Days | 1,921 | 1,921 |
| Serious engagement | Days | 11,524 | 5,762 |

| Total support days | Days | 13,493 | 7,779 |
| Support days per analytical staff | Days | 260 | 260 |

| Analytical staff required | FTEs | 52 | 30 |

<table>
<thead>
<tr>
<th>Research &amp; Analysis (Perspectives)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff required per bill</td>
<td>FTEs</td>
</tr>
<tr>
<td>Total support days per bill</td>
<td>Days</td>
</tr>
<tr>
<td>Total support days</td>
<td>Days</td>
</tr>
<tr>
<td>Support days per analytical staff</td>
<td>Days</td>
</tr>
</tbody>
</table>

| Analytical staff required | FTEs | 59 | 30 |

| Analytical staff (both products) | FTEs | 111 | 60 |
| Administrative staff (as of total) | Percent | 25% | 20% |
| Total staff required (both products) | FTEs | 148 | 80 |

**Notes:**

1. Includes all bills introduced, referred to committee, or referred by committee (whether or not there was a vote)
2. Assumes policy analysis only conducted for potential bills with reasonable likelihood of reaching a vote
3. Assumes utilization of external networks in lieu of large internal teams and committees to conduct analysis
4. Assumptions by scenario included below:
   - **Moderate use:** Medium-term scenario where CFO provides full suite of services covering S&T-related issues, but current congressional processes limit the scope of rigorous analysis
   - **High use:** Potential long-term scenario where congressional processes evolve to embed technical expertise in higher volume and with more rigor than supported by current capabilities

Source: Author analysis, OTA annual report (1993)
Appendix 6 | CFO initialization budget: minimally-viable vs full service

CFO may require funding of $8 million to run as viable pilot organization, $15 million to commence limited operations, and over $30 million to operate with a full suite of services to a broad constituency of congressional consumers. The ambition of its operations will in part be a function of its financial resources. This does not constitute a recommendation for a particular level of funding by the authors. Rather, it is meant to frame the scale of funding required for the organization to survive and make meaningful progress on its mandate.

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</thead>
<tbody>
<tr>
<td></td>
<td>Units</td>
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<td>FTEs</td>
<td>FTEs</td>
<td>FTEs</td>
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<td>Personnel</td>
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<tr>
<td>Director</td>
<td>Leadership</td>
<td>192,000</td>
<td>1.3 x</td>
<td>249,600</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>249,600</td>
<td>249,600</td>
</tr>
<tr>
<td>Chief of Staff</td>
<td>Leadership</td>
<td>160,000</td>
<td>1.3 x</td>
<td>208,000</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>208,000</td>
<td>208,000</td>
</tr>
<tr>
<td>Head of Product</td>
<td>Leadership</td>
<td>160,000</td>
<td>1.3 x</td>
<td>208,000</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>208,000</td>
<td>208,000</td>
</tr>
<tr>
<td>Head of Expertise</td>
<td>Leadership</td>
<td>160,000</td>
<td>1.3 x</td>
<td>208,000</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>208,000</td>
<td>208,000</td>
</tr>
<tr>
<td>Head of Systems</td>
<td>Leadership</td>
<td>160,000</td>
<td>1.3 x</td>
<td>208,000</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>208,000</td>
<td>208,000</td>
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<tr>
<td>Group Head</td>
<td>Product Teams</td>
<td>160,000</td>
<td>1.3 x</td>
<td>208,000</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>416,000</td>
<td>624,000</td>
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<tr>
<td>Product Head</td>
<td>Product Teams</td>
<td>128,000</td>
<td>1.3 x</td>
<td>166,400</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>332,800</td>
<td>499,200</td>
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<td>Network Managers</td>
<td>Expert Networking</td>
<td>128,000</td>
<td>1.3 x</td>
<td>166,400</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>685,600</td>
<td>998,400</td>
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<td>Staff Advisors</td>
<td>Investigative Support</td>
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<td>1.3 x</td>
<td>166,400</td>
<td>8</td>
<td>15</td>
<td>30</td>
<td>1,331,200</td>
<td>2,496,000</td>
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<td>Policy Staff</td>
<td>Research &amp; Analysis</td>
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<td>1.3 x</td>
<td>166,400</td>
<td>0</td>
<td>4</td>
<td>12</td>
<td>-</td>
<td>665,600</td>
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<tr>
<td>Expert Fellows [4]</td>
<td>Research &amp; Analysis</td>
<td>128,000</td>
<td>1.3 x</td>
<td>166,400</td>
<td>0</td>
<td>6</td>
<td>18</td>
<td>-</td>
<td>998,400</td>
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<tr>
<td>Futures Scanners</td>
<td>Risk &amp; Opportunities</td>
<td>128,000</td>
<td>1.3 x</td>
<td>166,400</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>-</td>
<td>665,600</td>
</tr>
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<td>Other administrative</td>
<td>21</td>
<td>42</td>
<td>85</td>
<td>3,827,200</td>
<td>7,363,200</td>
<td>14,560,000</td>
<td>5,102,933</td>
<td>9,817,600</td>
</tr>
<tr>
<td></td>
<td>Other administrative</td>
<td>21</td>
<td>42</td>
<td>85</td>
<td>1,275,733</td>
<td>2,454,400</td>
<td>4,853,333</td>
<td>1,275,733</td>
<td>2,454,400</td>
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<tr>
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<td>Total Personnel expenses</td>
<td>2,806,613</td>
<td>5,399,680</td>
<td>10,677,333</td>
<td>5,102,933</td>
<td>9,817,600</td>
<td>19,413,333</td>
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<tr>
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<td>Non-personnel expenses</td>
<td>2,806,613</td>
<td>5,399,680</td>
<td>10,677,333</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Expenses</td>
<td>7,909,547</td>
<td>15,217,280</td>
<td>30,090,667</td>
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</tbody>
</table>

FTEs: Full-time equivalents
[1] Range per Office of Personnel Management, "Salary Table No. 2019-SL/ST: Rates of Basic Pay for Employees in Senior-Level (SL) and Scientific or Professional (ST) Positions" (Jan 2019)
[2] Assume pay at modest premium to federal payscales to attract top technical talent
[3] Assumptions by scenario included below:
  Soft-launch: Minimally-viable level of funding to begin experimentation with Futures 'Network' and 'Support' but without rigorous policy analytic capabilities
  Low service: Most products offered but with limited coverage across population of congressional consumers; may require significant targeting of support
  Full service: Full offering of Futures products available to the general population of congressional consumers; staffing consistent with "Moderate" usage scenario from Appendix 4
[4] Staffing level reflects average number of Expert Fellows employed at any given time, although average tenure expected to be less than 1 year
[6] OTA non-personnel expenses equaled 55% of personnel expenses (OTA Annual Report, 1993); includes rental, communications & equipment; research contracts; staff travel; and other

Source: Author analysis, Office of Personnel Management (OPM), OTA annual report (1993)
Appendix 7 | CFO branding

Logo design by: Jae Young Kim
Interviews conducted by authors (41 in total)

Congress | Members and staff

Carlos Curbelo, Representative (former) (R-FL)
United States House of Representatives

Barbara Comstock, Representative (former) (R-VA)
United States House of Representatives

Julio Lainez, Legislative Director
Office of Representative Seth Moulton (D-MA)

Anderson Heiman, Senior Advisor for Technology and Trade
Senate Finance Committee; Office of Senator Ron Wyden (D-OR)

Dr. Robert Palmer, Staff Director (former)
House Science Committee

Shane Skelton, Legislative Staff (former)
House Budget Committee under Chairman Paul Ryan (R-WI)

William A. Stiles, Legislative Director (former)
House Science Committee

Ali Nouri, Legislative Director (former)
Office of Senator Al Franken (D-MN); currently President, Federation of American Scientists

Landon Zinda, Legislative Director
Office of Representative Tom Emmer (R-MN)

Andrew Woelfling, Legislative Director (former)
Representative John Dingell (D-CA); currently Director of Public Policy and Government Relations for Argo AI

Congressional Advisors | Providers of expertise within congressional ecosystem

Tim Persons, Chief Scientist,
Science, Technology Assessment, & Analytics (STAA), Government Accountability Office (GAO)

John Neumann, Managing Director
STAA Team, GAO

Chris Murray, Assistant Director
STAA Team, GAO
Karen Howard, Assistant Director
STAA Team, GAO

Kevin Kosar, Research Manager (former)
Congressional Research Service (CRS); currently Vice President of Policy at R Street

Deborah Stine, Science & Technology Policy Specialist
CRS, formerly Executive Director at President’s Council of Advisors on Science and Technology (PCAST), Executive Office of the President

Douglas Elmendorf, Director (former)
Congressional Budget Office (CBO); currently Dean of Harvard Kennedy School

Philip Joyce, Analyst (former)
CBO; currently Associate Dean at the Maryland School of Public Policy

Peter Blair, Executive Director
Division on Engineering and Physical Sciences of the National Research Council at the National Academies; former Assistant Director of OTA

Tech & Industry | Senior executives and government affairs

Jigar Shah, Co-Founder
Generate Capital

Chuma Ogunwole, Co-Founder & COO
Pyka

Brian No, Head of Public Policy
Spin, formerly staff for Senate Committee on Commerce, Science, and Transportation

John Kwant, Director of Government Relations
Ford Mobility and Advanced Technologies

Travis Moore, Founder and Director
TechCongress; formerly Legislative Director for Representative Henry Waxman (D-CA)

Executive Branch | Science and technology in executive agencies

Robert Margolis, Senior Energy Analyst
National Renewable Energy Lab

Tom Wheeler, Chairman (former)
Federal Communications Commission

John P. Holdren, Director (former)
White House Office of Science & Technology (OSTP)

Tom Kalil, Deputy Director of Technology and Innovation (former)
OSTP; currently Chief Innovation Officer at Schmidt Futures
Gerald Epstein, Senior Research Fellow
National Defense University; formerly OTA and OSTP

Brandon Hurlbut, Chief of Staff (former)
Department of Energy; currently Partner, Boundary Stone Partners

Science and Tech Policy | Academia and civil society

Betsy Cooper, Director
Aspen Tech Policy Hub at the Aspen Institute

David Guston, Founding Director
School for the Future of Innovation in Society at Arizona State University (ASU)

Zach Graves, Head of Policy
Lincoln Network

Michael A. Fisher, Senior Fellow
Federation of American Scientists

Kei Koizumi, Senior Advisor for Science Policy
American Association for the Advancement of Science (AAAS); formerly Assistant Director for Federal R&D at OSTP

Karen Akerlof, Affiliate Faculty
George Mason University

Chris Nehls, Senior Associate
Governance Program at Democracy Fund

Jonathan Mayer, Associate Professor
Princeton University; former Technology Advisor to Senator Kamala Harris (D-CA)

Mitch Weiss, Professor of Management Practice
Harvard Business School; formerly Chief of Staff at City of Boston, Mayor’s Office

Debora L. Spar, Baker Foundation Professor
Harvard Business School

David Eaves, Lecturer
Harvard Kennedy School; former Advisory Board Member at Code for America

Additional resources and events consulted

Generating Effective Technology Assessment for Congress, Lunch Discussion Series at Harvard Kennedy School (February 4, 2019)
Working lunch on improving science and technology expertise in Congress, hosted by Demand Progress and the Lincoln Network (January 31, 2019)

Technology Assessment Coalition, Google Group and digital community of tech policy experts (200+ members) interested in strengthening S&T expertise in the U.S. Congress. Discussions with this group are conducted under the Chatham House Rule and thus the identities and affiliations of specific members are not referenced in this report.
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49 Blair, P. D. (2014), "Congress’s own think tank: Learning from the legacy of the Office of Technology Assessment (1972–95)," Science and Public Policy, 41, pg. 450
51 Ibid, pgs. 1133-4
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58 Blair, P. D. (2014), "Congress’s own think tank: Learning from the legacy of the Office of Technology Assessment (1972–95)," Science and Public Policy, 41, pg. 452
60 Interview, March 6, 2019
63 Ibid, pg. 12
64 Blair, P. D. (2014), "Congress’s own think tank: Learning from the legacy of the Office of Technology Assessment (1972–95)," Science and Public Policy, 41, pg. 451
71 Ibid, pg. 41
73 Ibid, pgs. 3-4
74 Ibid, pgs. 3-4
78 Ibid, pg. 250
83 Ibid, pgs. 47-9
84 Ibid, pg. 29
85 Ibid pgs. 47-9
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290 Interview, February 19, 2019
292 Interview, February 6, 2019
294 Interview, February 26, 2019
296 Interview, February 6, 2019
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