SCIENCE, TECHNOLOGY ASSESSMENT, AND ANALYTICS AT GAO

SEPTEMBER 2022 UPDATE

GAO

U.S. GOVERNMENT
ACCOUNTABILITY OFFICE

STAA BY THE NUMBERS

STAA's interdisciplinary STEM expertise provides Congress with timely and relevant analysis of complex science & technology (S&T) issues. Since the team's founding in 2019...

46
Issued 46 technology assessments and short-form explainers on S&T issues

10
Testified 10 times on S&T issues and provided S&T support for 25 other GAO S&T-related testimonies

147
Issued 28 audit reports with 147 recommendations, 36 of which agencies have implemented

78
Provided engineering sciences insight for 78 GAO reports

23
Worked with 23 congressional committees

280
Leveraged expertise of 280 leading experts in 19 of our technology assessments

2
Collaborated on 2 jointly-issued reports with the National Academy of Medicine, with another in progress

129
Grew staff from 49 people in fiscal year 2019 to 129 people as of July 2022
  ↳ Staff expertise spans from S&T policy analysts to physical scientists, and from engineers to communicators

420
Spoke at more than 420 external events

100
Staff collectively hold 100 advanced STEM-related degrees, including 32 PhDs as of July 2022

STAA KEY MILESTONES

pre-2019
GAO issued technology assessments for nearly two decades.

2019
STAA established and began to expand.

First joint report issued with the National Academy of Medicine.

First STAA testimony on S&T issues.

Innovation Lab founded.

2020
First Polaris Council annual meeting.

First joint S&T report with another GAO team.

Innovation Lab staffed.

2021
Artificial Intelligence Accountability Framework issued.

Team reaches 116 staff.

2022
Improper Payment Integrity Simulator deployed.

Team expects to reach 149 staff by September 2022.

2023
Continue collaboration with the Organisation for Economic Co-operation and Development to support technology assessment.

Team expects to reach 165 staff.

TABLE OF CONTENTS

Abbreviations

AI Artificial Intelligence

R&D Research and Development

S&T Science and Technology

STEM Science, Technology, Engineering, and Mathematics

A MESSAGE FROM STAA'S MANAGING DIRECTORS

From smartphones, automobiles, and internet-connected home devices, to the bioengineered vaccines that preserve life, we live in a world inextricable from science and technology (S&T). In light of the uncertain and complex nature of these revolutionary changes, Congress will continue to face difficult decisions related to S&T and the innovation economy—decisions that will continue to shape the future of U.S. competitiveness, health, welfare, and security in this century and beyond.

Since 2019, GAO's Science, Technology Assessment, and Analytics (STAA) team has built and continues to expand its capacity to provide Congress with the foresight, oversight, and insight on the most pressing S&T issues of our time. This report provides a snapshot of STAA's work and people, in support of Congress's S&T information needs. Further, we highlight the broad array of interdisciplinary and cross-sector S&T experts we collaborate with to foster deep, yet timely understanding of these issues.

GAO's strategic planning and continuous outreach activities as well as requests and mandates from Congress shape our work. We provide a wide range of products and services that correspond with the scope and scale of the issues as well as how quickly the information is needed. These include foresight-oriented technology assessments, oversight-focused S&T audits, insight-oriented best practices and just-in-time technical consultations on critical and emergent issues. In accordance with congressional modernization goals and GAO's own strategic plan, we also continue to bring new digital capabilities and evidence-based policymaking

techniques to GAO and Congress through our Innovation Lab.[1]

Looking to fiscal year 2023, we will focus on a number of S&T issues that will impact our nation. Forthcoming work includes emerging infectious diseases; artificial intelligence applications; nutritional science and equity; energy, environment, and transportation; U.S. manufacturing and supply chain; national research policy, security, and evaluations; and national and homeland security S&T capabilities.

We will also continue to provide innovative ways to more efficiently and effectively communicate with Congress and the federal S&T community—be it through confidential and just-in-time S&T technical consultation to Members, staff, and Committees, or externally-focused writing or speaking events. Strengthened by our foundation in GAO and augmented by external partnerships, STAA will continue to develop and deliver timely, in-depth, and sophisticated S&T content tailored to best serve the emerging needs of Congress in this century and beyond.

TIMOTHY M. PERSONS, PhD
Chief Scientist of GAO
and Managing Director
Science, Technology Assessment,
and Analytics

JOHN NEUMANN
Managing Director
Science, Technology
Assessment,
and Analytics

OUR WORK

GAO's Interdisciplinary STEM Expertise Provides Congress with Timely and Relevant Analysis of Complex S&T Issues

GAO has provided Members of Congress and their staffs with expertise, institutional knowledge, and objectivity through its products and services for over a century. Building on its decades-long record of providing Congress with nonpartisan, fact-based, and nonideological S&T analysis, GAO created the STAA team to increase the depth and breadth of GAO's capacities to provide research and policy analysis on current and emerging legislative S&T issues. STAA works independently and also partners with GAO's other mission teams on various S&T issues. These other GAO mission teams carry S&T-related oversight portfolios which include cybersecurity and information technology, healthcare, space, weapons systems, nuclear, environmental, and natural resources.

With the creation of STAA, GAO further enhanced its ability to address key congressional S&T interests. Since 2019, STAA has worked with 23 congressional committees. STAA testified ten times on S&T issues—with the first of these testimonies occurring in 2019—and provided S&T support to 25 other GAO S&T-related testimonies. Through our work, we provide:

- **Foresight:** we anticipate breakthroughs with the opportunities and risks they present to the nation.

- **Oversight:** we evaluate S&T to help Congress improve the performance of government, ensure transparency, and save money—part of GAO's core mission.

- **Insight:** we reveal critical knowledge about complex research and technology in our best practices guides, and government accountability and analytics through experimentation.

See appendix I for STAA's diverse and wide range of S&T issues and products.

As we head into fiscal year 2023, we will continue our focus on emerging and complex S&T issues. To do so, we will rely on as well as grow our interdisciplinary Science, Technology, Engineering, and Mathematics (STEM) expertise so that we continue to provide Congress with timely and relevant products and services (see figure 1).

FIGURE 1 *Our interdisciplinary expertise brings complex S&T issues into focus*
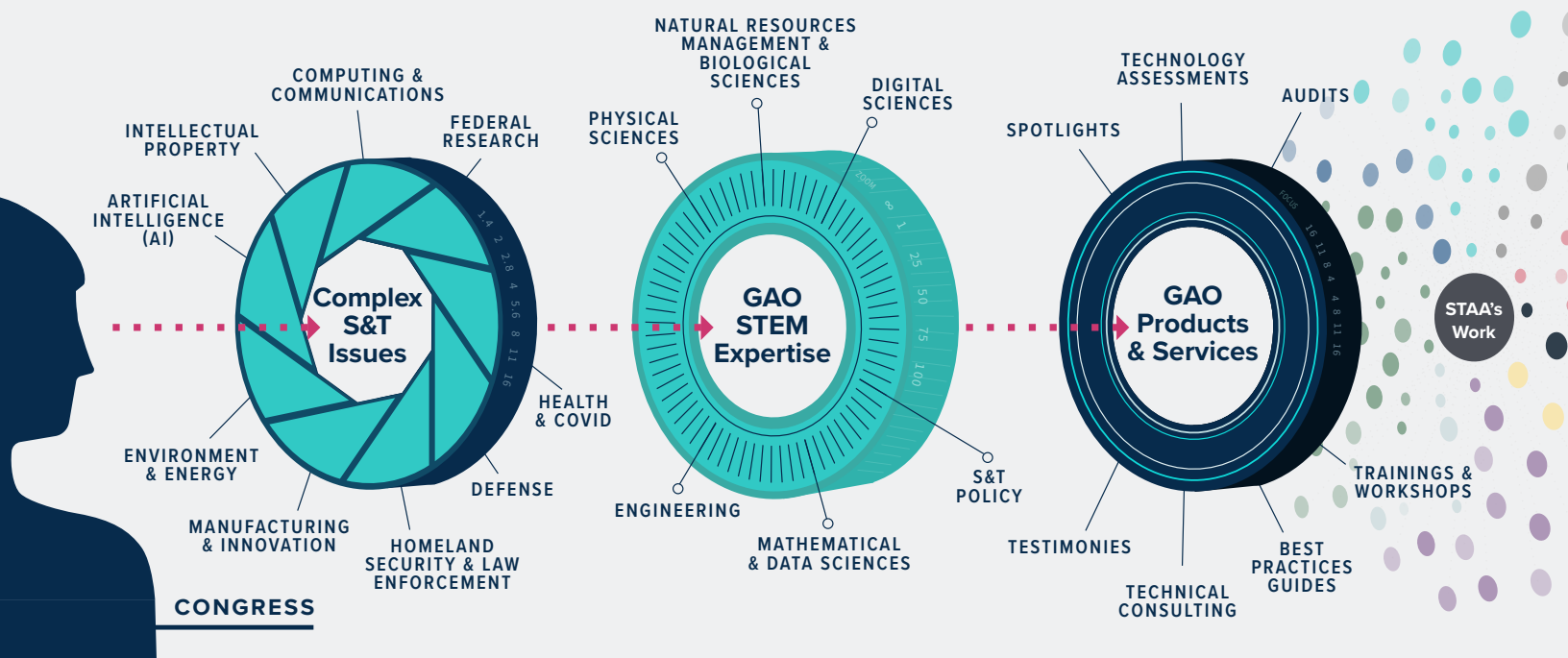
Source: GAO. | GAO-22-900426

S&T FORESIGHT WORK

We assess S&T breakthroughs along with the opportunities and risks they present to the nation

Our goal is to conduct in-depth analyses on emerging S&T issues by offering Members and their staffs foresight—context, status, benefits and challenges, and policy options—into key technologies (see figure 2).[2] We accomplish this by communicating accurate, balanced, and timely information on how emerging S&T issues may affect our society, the environment, and the economy. For this work, we have two primary product types:

Technology Assessments: thorough and balanced analysis of how technological innovations affect society, the environment, the economy, and the present and anticipated consequences posed by these innovations. The effects of these innovations can have policy implications. Thus, we have included policy options in most of our technology assessments. These policy options reflect input from external S&T experts as well as subject matter experts from other GAO mission teams. We have issued 12 technology assessments since 2019 and are presently working on more.

Science & Tech Spotlights: a newer product type that provides short and concise information on scientific or technological topics for policymakers and the public, includes potential opportunities and challenges, and raises key policy questions. We have issued 34 S&T Spotlights since 2019.

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Our goal is to provide foresight through detailed assessments of a wide range of sciences and technologies.

KAREN HOWARD
Director, Science and Technology Assessment, STAA

BRIAN BOTHWELL
Director, Engineering and Technology Assessment, STAA

FIGURE 2 *STAA's foresight work*

Source: GAO, based on data as of 7/15/2022. | GAO-22-900426

Note: Each colored circle represents a specific foresight-oriented report that STAA has led. GAO issues hundreds of reports every year.

To help Congress stay ahead of technological developments and their implications, we are conducting forward-looking assessments that provide analyses of the potential promise and risk that certain emerging technologies could have on life in the United States—including those critical to health and national security. This work includes technology assessments on fusion energy, precision agriculture, utility scale energy storage, and carbon management; as well as pandemic origins, persistent chemicals, and forensic attribution of chemical weapons. We also plan to assess transportation and energy innovation; and how AI is used in the healthcare sector—such as gene editing and brain-computer interfaces.

CLOSER LOOK

Computing and Communications in the Digital Age

Quantum Information — TA

Blockchain — TA

5G — TA

Ocean Minerals

Alternative Data Storage

Cells

Plastics Waste Recycling

Non-Fungible Tokens

Deepfakes

Agile

5G

Extended Reality

Quan Informa

Counter Aircra

Alternative Navigation,

Blockchain & Distributed Ledger Technologies

Chemi Weapo

Quantum Computing and Communications: Status and Prospects

GAO-22-104422

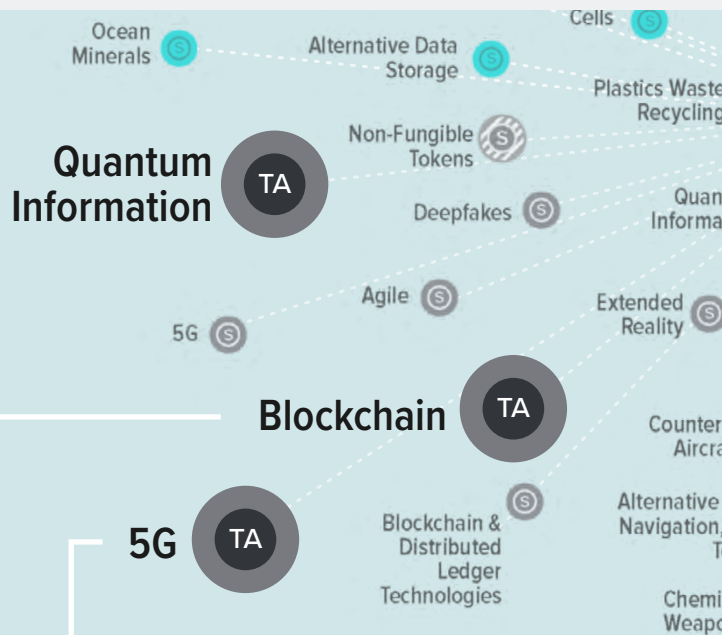**Blockchain: Emerging Technology Offers Benefits for Some Applications but Faces Challenges**

GAO-22-104625

An STAA Senior Engineer explains 5G technology, March 2020

What is 5G? A GAO Science and Technology Explainer

Watch the video on gao.gov

S&T OVERSIGHT WORK

We evaluate S&T to help improve government performance, ensure transparency, and save money

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Our goal is to assess the effectiveness and efficiency of the federal government's use of S&T to help inform congressional oversight.

CANDICE WRIGHT
Director, Science and
Technology Oversight, STAA

GAO's oversight work helps to ensure that federal agencies effectively, efficiently, and equitably manage and fund their programs.[3] STAA's work covers the full lifecycle of S&T discovery and innovation, from basic research to manufacturing and commercialization. We also address issues such as intellectual property protections and enhanced competitiveness. Through our regular environmental scanning and outreach, we are able to focus on the oversight areas of greatest interest to Congress and that we believe best support the effectiveness of the federal government's role in S&T (see figure 3). Specifically, our work evaluates:

- agencies' management, coordination, and results of federal research and development (R&D);

- agencies' efforts to address crosscutting federal R&D challenges, including S&T workforce challenges;

- federal efforts to address key intellectual property issues and administration of the patent and trademark system; and

- federal efforts to support U.S. competitiveness in the global innovation economy.

Since 2019, we have issued 28 audit reports, with 147 recommendations—36 of which agencies have implemented.

FIGURE 3 *STAA's oversight work*
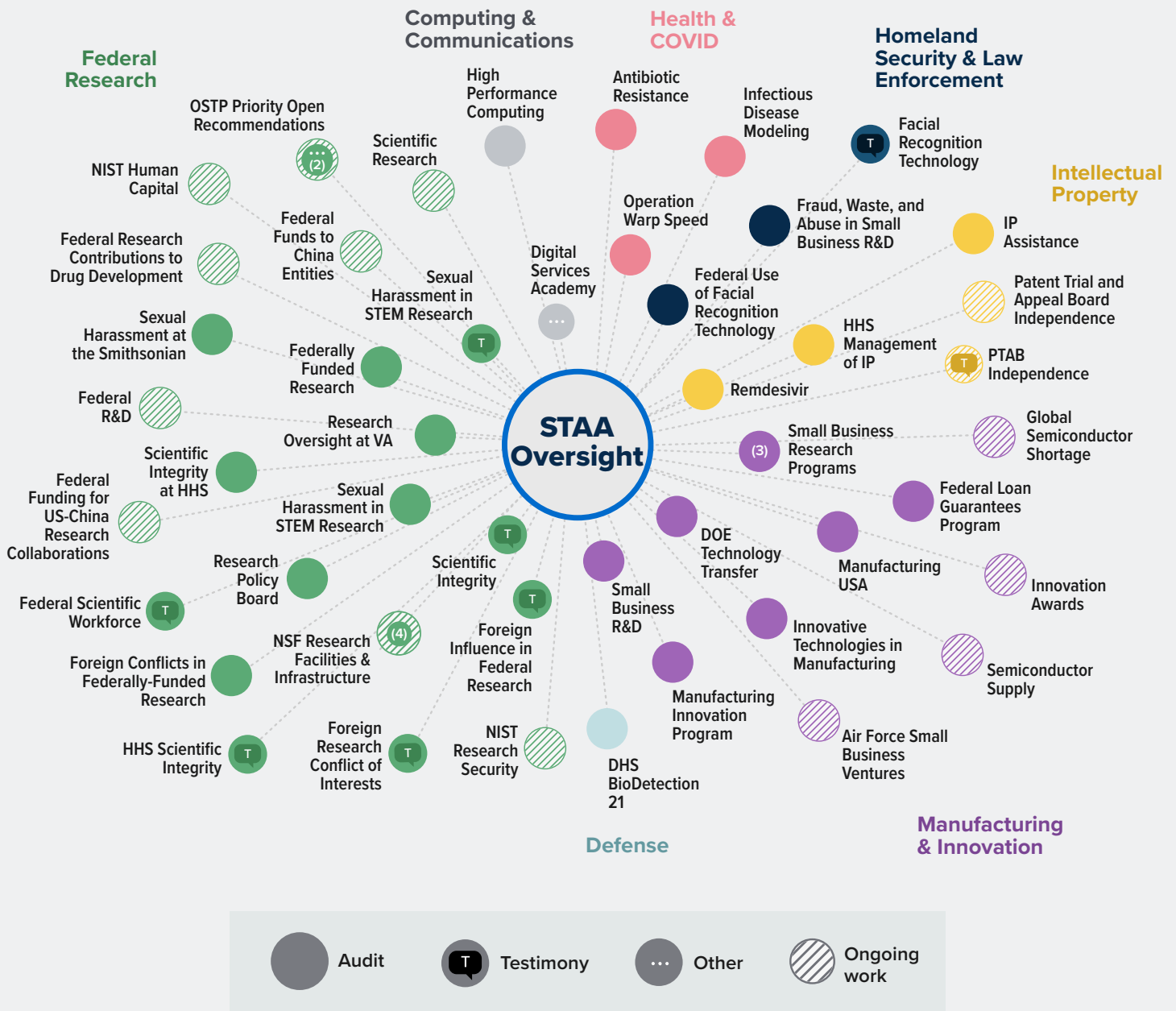
Source: GAO, based on data as of 7/15/2022. | GAO-22-900426

Note: Each colored circle represents a specific oversight-oriented report that STAA has led. GAO issues hundreds of reports every year.

To review the effectiveness of the federal government's S&T role, our ongoing oversight analyses address issues that touch our everyday lives, such as work on the global semiconductor shortage. We also examine issues central to the United States' ability to innovate and stay competitive. For example, we assess federal R&D funding for national S&T initiatives. Additionally, we provide information to policy makers as they consider the right balance between collaboration and potential national security issues, such U.S.-China research

collaboration. As we look toward the future, we plan to continue our work on the S&T workforce, federal investment in research infrastructure, federal agencies' development and application of AI, manufacturing, and other cross-cutting federal S&T issues.

CLOSER LOOK

Examples of STAA's Federal Research Reports

Federal Scientific Workforce

Foreign Influences in Federally Funded Research

HHS Scientific Integrity

R&D

Federal Funding for US-China Research Collaborations

Scientific Integrity at HHS

Sexual Harassment in STEM Research

Research Policy Board

NSF Research Facilities & Infrastructure

Foreign Research Conflict of Interests

Science and Technology: Strengthening and Sustaining the Federal Science and Technology Workforce
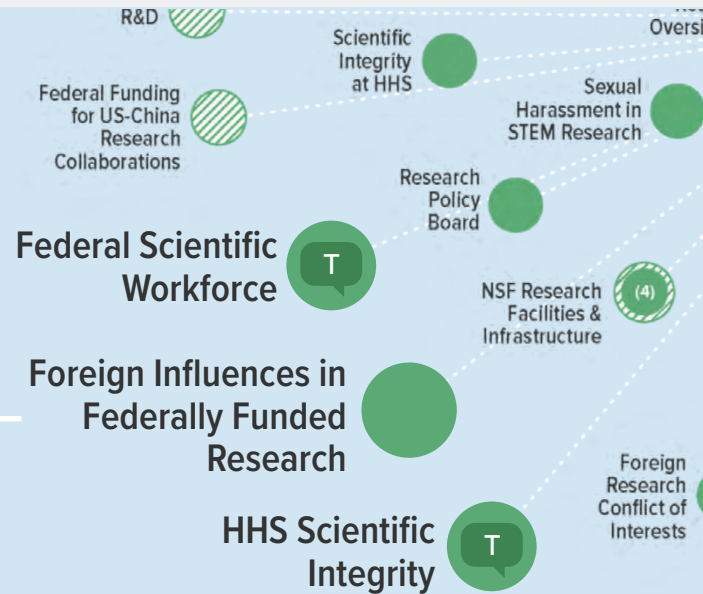
GAO-21-461T

Federal Research: Agencies Need to Enhance Policies to Address Foreign Influence

GAO-21-130

Scientific Integrity: HHS Agencies Need to Develop Procedures and Train Staff on Reporting and Addressing Political Interference

GAO-22-105885

S&T INSIGHT WORK

We develop best practices guides to help ensure programs are as effective and efficient as possible

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>
> Our goal is to provide insight—through the use of best practices guides—to the federal audit community that implements or uses technology for government R&D and S&T projects.

BRIAN BOTHWELL
Director, Engineering
and Technology
Assessment, STAA

GAO's insight work helps federal agencies better manage multiple aspects of programs to help ensure they meet their goals.[4] STAA's work is especially geared toward government-wide R&D programs that develop complex, technically advanced systems. We have issued best practices guides on cost, schedule, agile software development, and technology readiness.

These guides are directed towards auditors in GAO and other government agencies, agency officials responsible for developing agency policies, and program managers at agencies that do not have their own policies for these topics. Users rely on the guides to (1) promote the development of reliable schedule and cost estimates so that programs are more likely to be completed on time and on budget, and (2) help assess the maturity of technologies to determine whether and when a system is likely to work as intended. GAO leverages STAA to support audits throughout the agency, whereby STAA's experts contribute their engineering sciences insights to other GAO teams' evaluations of federal programs. Since 2019, STAA has contributed its expertise to 78 GAO reports, as shown in figure 4.

OUR BEST PRACTICES GUIDES SUPPORT A CROSSCUTTING MIX OF GAO WORK
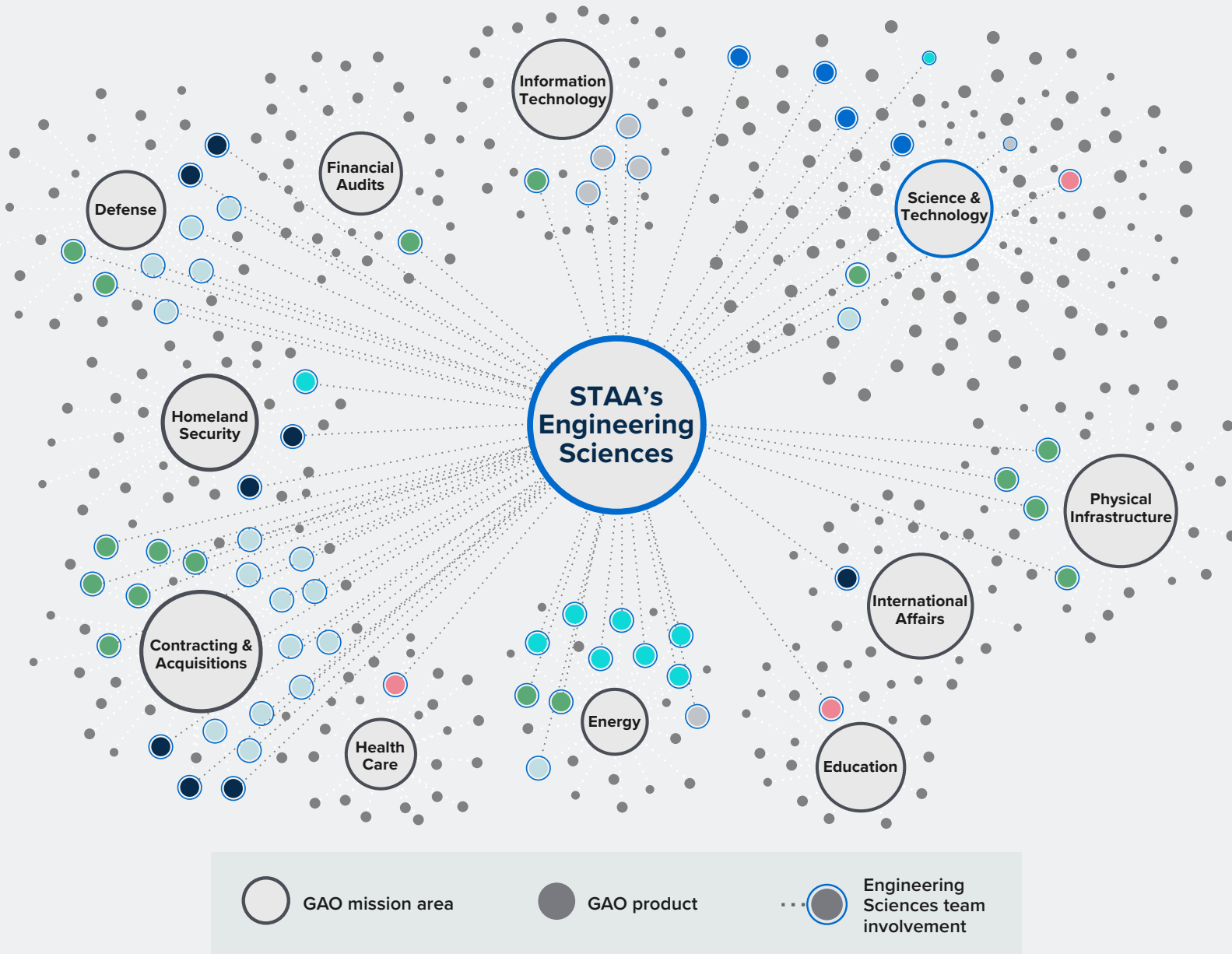
Source: GAO, based on team data from 2019–2022. | GAO-22-900426

Note: Each colored circle represents a specific insight-oriented report that STAA's Engineering Sciences group has supported. GAO issues hundreds of reports every year.

Our work encompasses all sizes of federal programs, including multi-billion dollar programs that are vital to our national security. Below are examples where STAA has or is contributing expertise to other GAO mission teams.

Our **cost guide** has been used by STAA and other GAO mission teams to evaluate:

- the Missile Defense Agency, which plans to spend about $10 billion annually on the Missile Defense System. We found that the Missile Defense Agency continues to omit the military services' operations and sustainment costs from the program life-cycle cost estimates. This omission limits decision makers' insight into the full financial commitments needed for affordability and funding determinations.

- the Air Force Space Command's analysis of where to best locate this Command.[5]

- the F-35 aircraft program's $15 billion modernization. The F-35 aircraft is expected to be used by the U.S. Air Force, Marine Corps, Navy, and others. F-35 is a family of fifth-generation strike fighter aircraft with stealth technology, advanced sensors, and computer networking capabilities.

Our **schedule guide** has been used by STAA and other GAO mission teams to evaluate:

- the Navy's Columbia Class Submarine, a $128 billion program that is a key element of the United States' strategic nuclear force.

- the National Nuclear Security Administration's plutonium pit production, a multi-billion dollar program to modernize U.S. nuclear warheads.

- the Defense Counterintelligence and Security Agency's National Background Investigation Services system, an information technology system under development for personnel vetting by the largest provider of background investigation services for the federal government.

We are partnering with GAO's information technology and cybersecurity experts to develop a new best practices guide for cloud computing information technology systems. We are also incorporating public comments to our Agile Assessment Guide on best practices for Agile adoption, execution, and controls.[6]

CLOSER LOOK

Examples of STAA-produced Best Practices Guides

Agile, Explained: Software Bottlenecks

Watch the video on gao.gov

Digital Cost Guide

GAO-20-195G

Digital Schedule Guide

GAO-16-89G

S&T INSIGHT WORK

Technology is advancing every day. We believe oversight should, too.

Our **Innovation Lab** fosters sophisticated technical work to address key oversight challenges and bolster the advanced analytic capabilities of the federal accountability community.[7] As the only entity of its kind within the legislative branch, the Lab has state-of-the-art capabilities to perform cloud-based experiments. In that platform, the Lab explores emerging technologies in areas such as AI, digital ledger technology (blockchain), cloud services, zero trust architectures, and extended reality. Located within GAO Headquarters, we created an interactive Lab space designed to enable innovation and enhance GAO's oversight effectiveness and efficiency.

The Lab also collaborated across GAO to create an AI Accountability framework to identify key practices to help ensure accountability and responsible AI use by federal agencies and other entities involved in the design, development, deployment, and continuous monitoring of AI systems.[8] To develop this framework, GAO convened a Comptroller General Forum with AI experts from across the federal government, industry, and nonprofit sectors. In another instance, the Lab is also partnering with GAO's information technology and cybersecurity experts conducting research on advances that help cybersecurity keep up with the evolving cyber risks.

One way the Innovation Lab enhances evidence-based policy-making is by combining data science and digital delivery. For example, in January 2022, GAO launched a new web-based Antifraud Resource, which STAA supported through its digital expertise, combined with GAO's fraud experts. GAO built this web resource based on its existing Conceptual Fraud Model to help federal officials and the public better understand and help combat federal fraud. In a second example, the Lab helped pioneer an interactive web-based resource— the ID Verification Controls Simulator. This simulator, deployed in July 2022, helps federal agencies improve controls in their programs and

> "
> The Innovation Lab aims to proactively enhance the future of accountability by applying data science and emerging technology to key oversight-related challenges.

TAKA ARIGA
Chief Data Scientist of GAO and Director, Innovation Lab

prevent improper payments.[9] Based on a body of GAO's work on data protection, the simulation tool allows users to build their own hypothetical federal program and configure a system of identity verification controls to stop improper payments to artificially-generated applicants. Use of this tool can aid federal agencies in factoring how various tradeoff decisions could play out when verifying applicant identities. This tool also identifies errors that could result in improper payments. We built our simulation based upon an existing methodology from the Joint Financial Management Improvement Program. Lastly, for internal GAO use, the Lab

created an automated, web-based tool to monitor congressional activity and link this activity to related GAO-issued reports and products. This tool, when fully operational, will enhance STAA's and GAO's ability to meet congressional information needs. For example, we have linked issues such as digital identity verification, AI, and location-based privacy protection to immediate congressional needs. This tool could additionally help inform the nature and scope of potential future S&T-related work.

FIGURE 5 *STAA's Innovation Lab supports evidence-based policymaking*
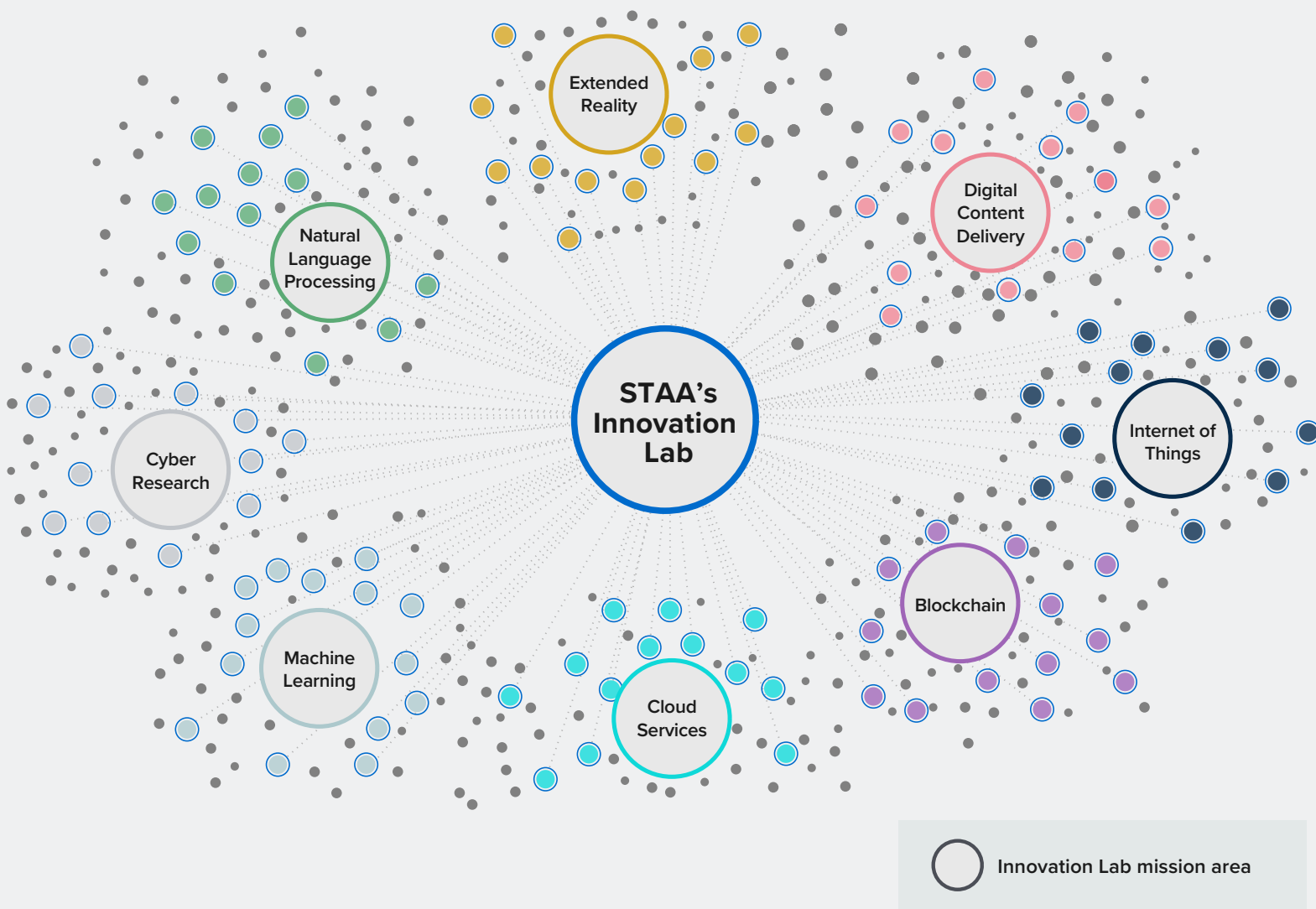
Through these projects, GAO is leveraging the Innovation Lab's capabilities. The Lab will continue to create problem-driven, data science products that enhance GAO's ability to support Congress' evidence-based policymaking, including the testing and adoption of new technologies to proactively inform Congress. Specifically, the Lab plans to prototype emerging technologies to gain understanding of potential use cases, such as blockchain, robotic process automation, and extended reality.

CLOSER LOOK

Using Natural Language Processing to Help GAO Respond More Quickly to Congressional Interests

Natural Language Processing

Machine Learning

Natural Language Processing

Digital Ledger

Graph Database

Digital Content Delivery

5G

Cloud Services

Internet of Things
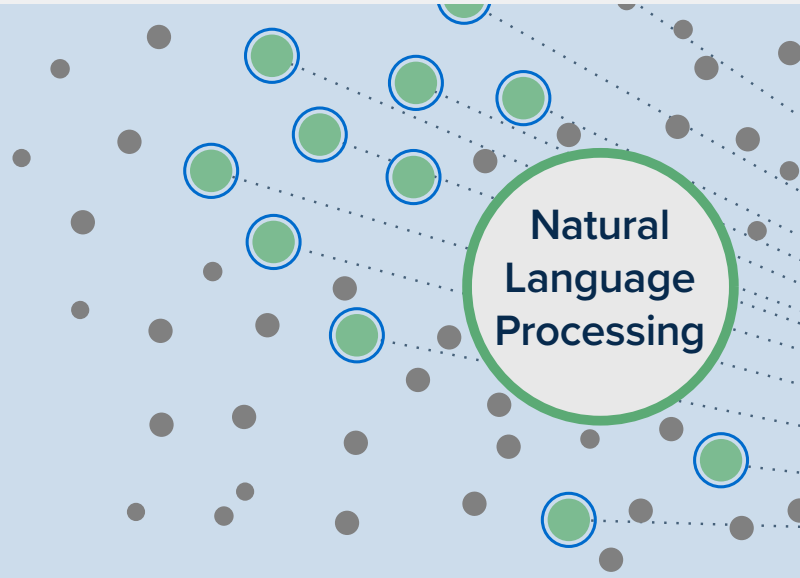
Project Sia

Automated congressional activity monitor

Exploring Congressional Activity

Each row in Sia represents one entry (item of congressional activity) on one Congressional committee page. In the example here, we have filtered the entries to the closest available GAO

Topic Analysis

For the selected word, Sia then performs an analysis of distinct topics. These are presented on a chart to show clusters of related words. Those words that are closest to are context and synonyms projection of potentially hundreds of word-relationship dimensions and so related words will sometimes be visually separated.) Congressional website, fo

Sia provides a summary of each topic based on the word that is most "central" to a cluster. This word will often, but not always, provide a concise summary of the cluster under the high-level keyword "health." A few examples include "pension" (retirement healthcare benefits); occupational health (FOU); Becarra (the confirmation of the Sec healthcare.

Terms Closely Associated with 'Health'

Project Titan

GAO report explorer

Project Wordworkr

GAO style implementation drafting tool

S&T NETWORKING & COLLABORATIONS

We share information and create opportunities for diverse analyses of complex S&T issues

We value the need for external networking and collaboration with S&T experts. To stay abreast of emerging S&T issues, we maintain our unique access to expertise and information in the federal government as well as significant access to external expertise. For example, we preserve GAO's standing relationship with the National Academies as well as cultivate access to academic, nonprofit, and private-sector expertise. We also sustain these relationships for the reciprocal sharing of S&T knowledge. Some examples include:

- **Polaris Council:** STAA meets annually with an advisory council called the Polaris Council—composed of S&T policy leaders and key experts—to seek their input and feedback on STAA's foresight-oriented body of work. (See Appendix II for more information on this Council).

- **National Academies:** We held or are planning to hold expert meetings for 19 of our 22 Technology Assessments, and we have consulted with 280 experts on these assessments as part of our partnership with the National Academies. Three of these assessments represented such a close collaboration that we recently issued two products jointly with the National Academy of Medicine, and a third product is similarly planned to issue later this year.

- **Organisation for Economic Co-operation and Development:** Over the next year, we will continue our collaboration to support technology assessment.

We also continue to build awareness of our S&T work and collaborate with additional external groups, including academia. For example, in May 2022, the U.S. Comptroller General, STAA leadership, and GAO's cybersecurity experts spoke at an S&T symposium hosted by the Lincoln Network; and, in June 2022, STAA participated in a diversity in technology roundtable at the Berkeley Center for Law and Technology.

> "
> Our goal is to support congressional understanding of S&T issues in a manner that is modern and responsive to today's demands, because tomorrow's policies and the American people depend on it.

JESS SMITH
Director, Communications and Operations, STAA

To share our publications, services, and work, we have participated in over 420 external speaking engagements since 2019, with almost 90 of these occurring in 2022. STAA experts presented at these events, which often included private-sector and academic thought leaders, and resulted in engaging discussions on our S&T assessments and findings.

We have also offered trainings to the congressional staff community for several years. In early 2022, we collaborated with the Congressional Staff Academy on a series of multi-part courses. In these courses, GAO experts led presentations on complex issues—specifically, AI and blockchain (see figure 6). This STAA-led collaboration—grounded in GAO's complex findings and agency recommendations—provided training to hundreds of congressional staff in a format that encouraged real-time questions and discussion. This new effort falls within GAO's continuing outreach to ensure congressional awareness of GAO as an S&T resource.

We have also continued our outreach to Congress to foster awareness of our products and services. The Comptroller General regularly meets with committee leaders and discusses their interest in GAO's work, including STAA's work. GAO executives, including STAA, also regularly engage

FIGURE 6 *STAA STEM experts presenting to congressional attendees on blockchain technology*
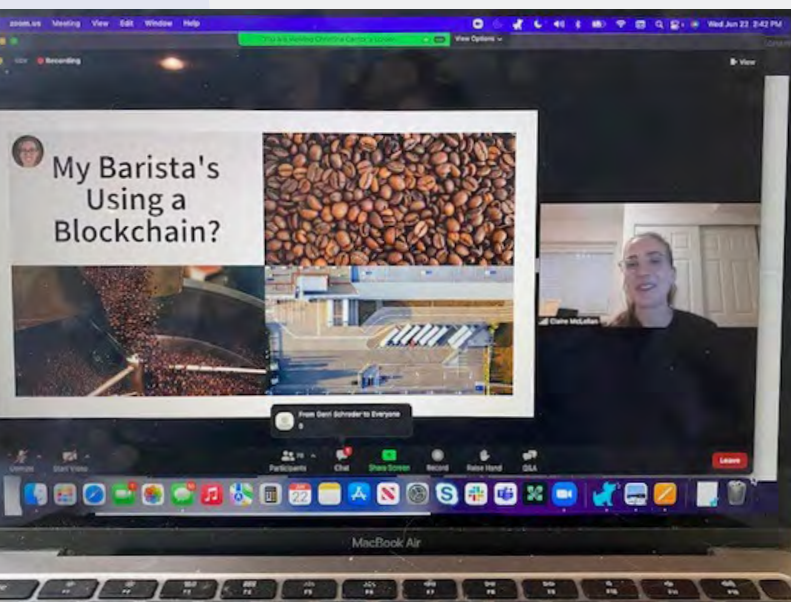
with key committees to understand their oversight and legislative agendas and how GAO can help. For example:

- In October 2020, at the request of the House Committee on Administration, STAA hosted an S&T policy symposium for the House of Representatives to provide information to Members and staff on a range of topics, such as COVID-19, 5G wireless technology, congressional modernization, and the innovation economy. The committee included the symposium in the New Member Orientation Training that was provided to all incoming Representatives of the 117th Congress.

- In spring 2022, GAO's Office of Congressional Relations held interviews with congressional staff that have oversight of federal S&T-related programs. The respondents reported interest in a broad range of S&T issues that could impact our nation, including consumer-oriented concerns with the metaverse, supply chain issues related to electronics and semiconductors, and health technologies used to support aging populations. We have ongoing or future work planned for many of these issues and will continue working with the Congressional Staff Academy on related, near-term trainings.

Anticipating needs farther into the future, we are exploring new services to help Members and staff better plan for the rapidly changing S&T environment. Examples of services that will help us make our work more timely, relevant, actionable, and understandable include:

- even more extensive just-in-time technical consultation services to Members, committees and staff;

- expanded S&T-related trainings through a wider variety of partnerships; and

- new events for S&T foresight such as closed-door workshops that bring together Members, agency officials, nonprofit executives, and industry leaders.

TWO EXAMPLES OF STAA'S INTERDISCIPLINARY SUPPORT TO CONGRESS

Our interdisciplinary approach helps GAO target its STEM expertise through STAA to focus on complex and relevant S&T issues of interest to Congress, as shown in the following two case studies.
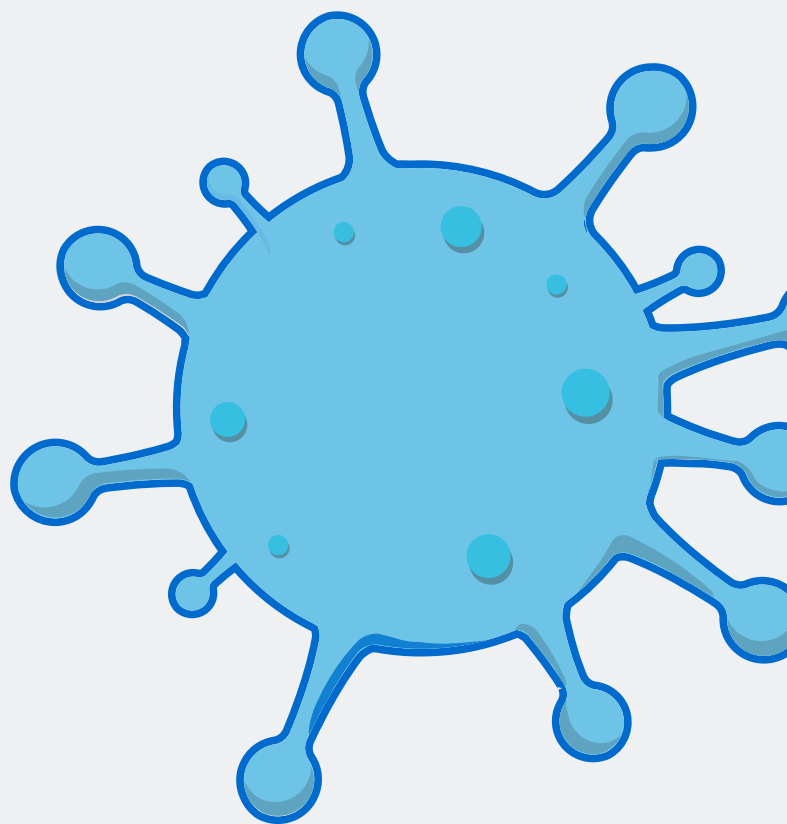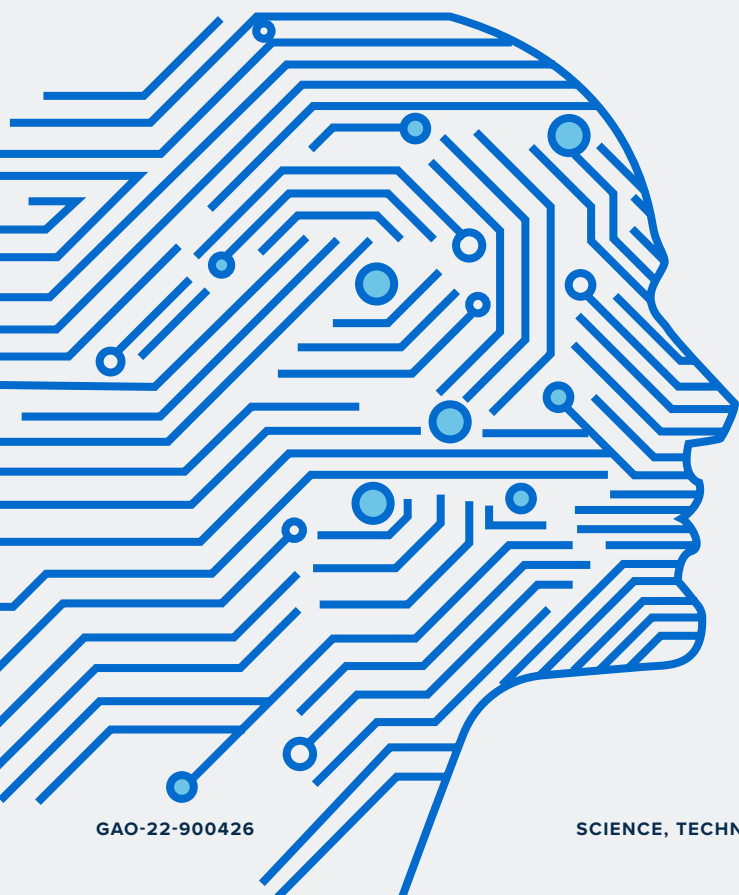
STAA's Interdisciplinary Support to Congress on Artificial Intelligence Technology and Its Implications

As the nation continues to reckon with the profound effects AI is having and will have on government and the public, GAO has assessed and will continue assessing the opportunities and challenges posed by this technology. In a digital world that increasingly depends on algorithms to fuel decision-making, we are often asked either implicitly or explicitly to trust AI systems. How do we know that AI is doing its job appropriately? Drawing on data scientists, software engineers, policy analysts, attorneys, and other specialists, STAA has developed a body of work to help answer this important question. We share examples of this work below.

GOAL

Provide Congress, the federal audit community, and the public with comprehensive updates on the policy implications of AI technology—a widely used technology for which no national guidance exists for its responsible use and implementation by federal agencies.

GAO collaborated with the National Academy of Medicine to assess the use and deployment of AI in health care through a series of three in-depth Technology Assessments. We issued Technology Assessments of drug development and patient care, and a third on medical diagnostics is ongoing.

AI in Drug Development (GAO-20-215SP)
AI in Patient Care (GAO-21-7SP)

GAO developed an AI Accountability Framework to help managers ensure accountable and responsible use of AI in government programs and processes.

The White House included GAO's AI Framework on its government-wide website (AI.gov) as guidance for all federal agencies to use in AI implementation.

AI Oversight Framework (GAO-21-519SP)
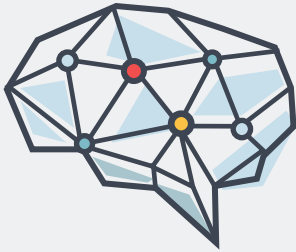
GAO's data scientists, including machine learning experts, serve as thought leaders to provide real-time insight on AI to the federal and international audit community—what it is, how to use it, pitfalls, and how to make it scalable for expanded use. STAA's Chief Data Scientist has provided just-in-time technical consultation to Congress on AI issues, and will lead internal GAO training on the framework.

GAO hosted a roundtable discussion of private and public sector technology leaders, academics, and nonprofit leaders, then produced a report that provided insight into the possibility of establishing a digital services academy. A digital services academy could provide a talent pool to help meet the federal government's need for digital expertise.

Digital Services Academy (GAO-22-105388)

STAA HELPS THE HILL BETTER UNDERSTAND AI

Across four AI policy seminars, over 500 congressional staff registered with the Congressional Staff Academy to learn from GAO experts about this topic.

"Excellent presentation and introduction to AI! I liked that the instructor used real life examples to explain mathematical concepts—like algorithms and the lamp example. Very helpful."

One attendee's response to STAA's March 2022 AI policy seminar

LOOKING FORWARD

Because of AI's transformative nature and its potential application to so many aspects of our lives—such as agriculture, manufacturing, and defense—STAA plans to continue to provide foresight, oversight, and insight work in this area. For example, we recently initiated a Technology Assessment on AI in environmental modeling and plan to apply our AI framework to review a government program. We have taken the first of many steps on the journey of AI accountability.

STAA's Interdisciplinary Support to Congress during the COVID-19 Pandemic

When the COVID-19 pandemic hit, GAO was well-positioned to respond with timely and interdisciplinary expertise. Drawing on our biologists, chemists, data scientists, public health specialists, statisticians, and many others, STAA issued 21 COVID-19-related products, with the first issued in March 2020.[10] These included issues such as infectious disease modeling, social distancing, wastewater surveillance, vaccine development, and long COVID.

GOAL

Help Congress and the public better understand the complexities of vaccine readiness and help GAO management track COVID-19 threat levels nationwide for GAO's internal operations.
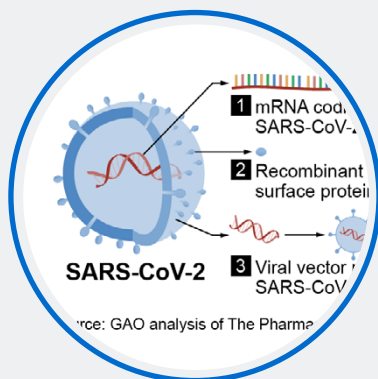
To provide foresight, our biologists, chemists, and other scientists kept pace with rapidly evolving biomedical science to convey key COVID-19 and public health-related knowledge to Congress through just-in-time technical consultation, technology assessments, and S&T spotlights.

Vaccine Development (GAO-20-538SP)
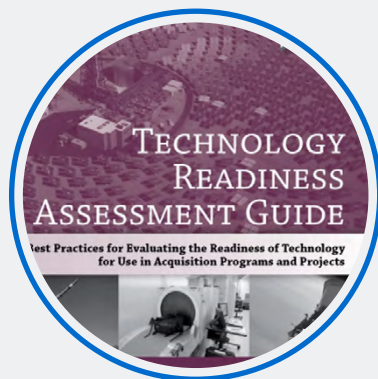
To provide insight, our engineering professionals, together with biologists and policy analysts, applied our technology readiness best practices in real-time to assess vaccine technology readiness.

Technology Readiness Assessment Guide (GAO-20-48G)

To provide oversight, our policy analysts and scientists audited the federal program known as Operation Warp Speed, reviewing the manufacturing readiness of vaccines.

Operation Warp Speed (GAO-21-319)
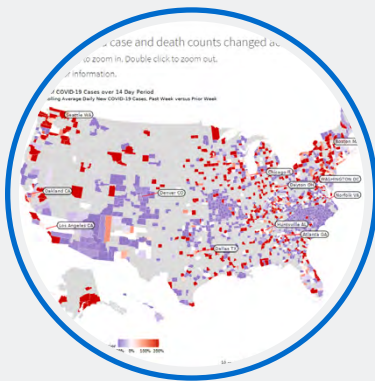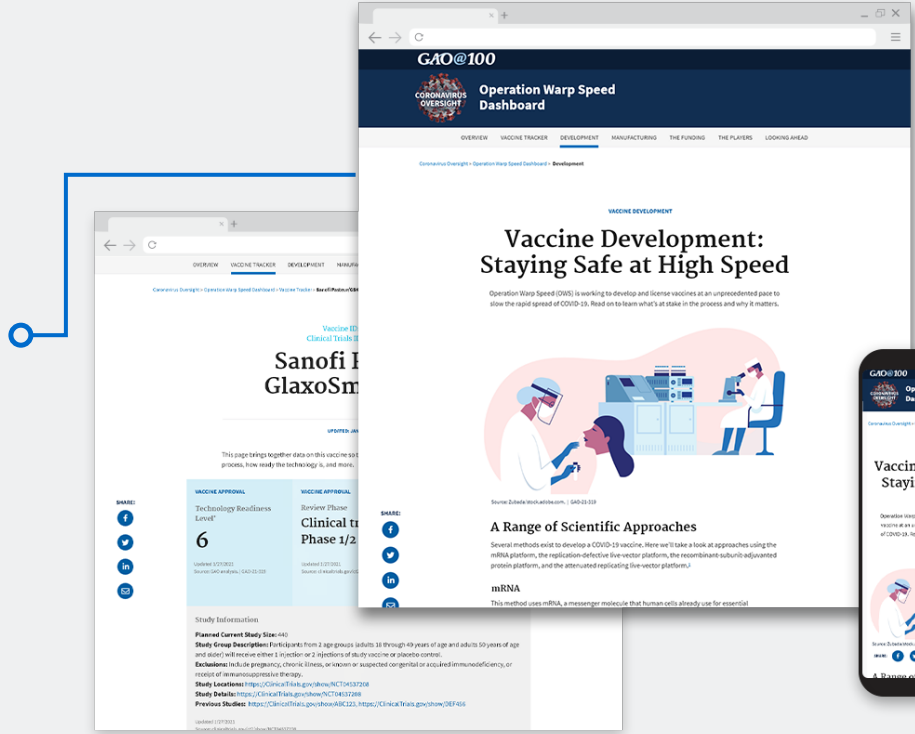
To provide insight for GAO's internal operations, our Innovation Lab data scientists automated a digital COVID-19 dashboard quickly to support risk-management and pandemic-related decision-making for all GAO office locations.

STAA HELPED TRACK COVID-19 VACCINES

We assessed the development of COVID-19 vaccines and presented our findings in an interactive online public dashboard by leveraging our prior technology readiness work, the Innovation Lab, and our program evaluation experience. This dashboard was the first of its kind for GAO.

LOOKING FORWARD

We strive to be nimble to continue work in this area as well as meet other urgent needs to review federal readiness, response, and management of emerging infectious diseases.

OUR PEOPLE

STAA's Growth in Interdisciplinary STEM Expertise Supports a Wide Spectrum of Congress's S&T Information Needs

Growing Our Staff to Support a Wide Spectrum of S&T Work

The past three years have led to significant growth in STAA's capacity. Since 2019, our staff has grown from 49 people to 129 people, as of July 2022. By the end of fiscal years 2022 and 2023, we plan to reach a total of 149 staff, and 165 staff, respectively (see figure 7). We continually assess optimum staffing levels for the team based on congressional needs. Our continued growth—including hiring entry-level and mid-career specialists from across the nation—is commensurate with our goals to bolster our strategy for interdisciplinary S&T policy analysis. We will continue to build a staff with diverse expertise to support a wide spectrum of S&T work.

FIGURE 7 *STAA staff levels and planned increases through fiscal year 2023*

JOB CATEGORY

- Natural Resources Management and Biological Sciences
- Physical Sciences
- Engineering
- Mathematical & Data Sciences
- S&T Policy Analyst
- Digital Sciences
- Information & Arts
- Administration & Management
- Projected new hire
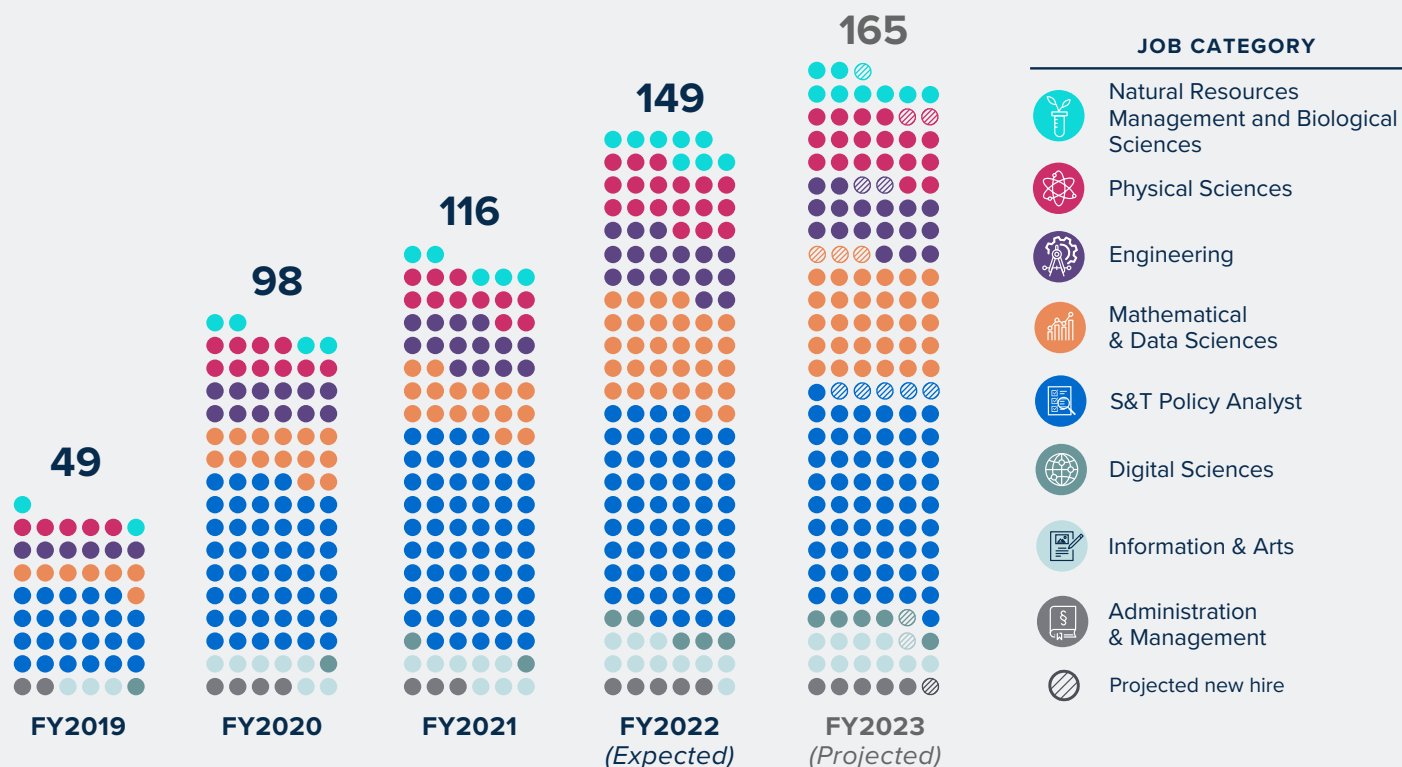
Source: GAO (data); antoniofrancois/Singh Villasra/stockgood/Skellen/YuriyAlt_Art/stock.adobe.com (icons). | GAO-22-900426
Note: Figure includes staffing data as of 7/15/2022. FY22 expected numbers and FY23 projected numbers are estimates and subject to change.

Our robust mix of expertise helps support our ongoing and planned work. STAA's staff expertise spans from S&T policy analysts to physical scientists, from engineers to communicators. Collectively, our 129 staff hold 100 advanced STEM-related degrees, including 32 STEM-related PhDs, as of July 2022. Specifically, the programmatic knowledge of our S&T policy analysts sits alongside the technical knowledge of our S&T specialists, in areas including engineering, mathematics, physical sciences, and digital sciences.

Leveraging Federal Hiring Flexibilities

To ensure STAA continues to attract and nurture the diverse interdisciplinary expertise required for evolving S&T needs, we plan to leverage two flexible hiring authorities starting in fiscal year 2023. First, we are creating an entry-level pathway to hire data science students through undergraduate and graduate internships. Second, for more advanced and specialized expertise needed on a temporary basis, we are pursuing the appointment of GAO S&T Fellows and Intergovernmental Personnel Act detailees.[11] Both of these flexible hiring authorities could help STAA more adeptly support requests from Congress.

Valuing Our People

For the second year in a row, GAO ranked number one in the best places to work for mid-size federal agencies, according to the latest rankings issued in July 2022 by the Partnership for Public Service. Issued yearly, the Partnership's rankings provide insights into federal employees' satisfaction with their jobs and offices. GAO has consistently placed among the top five overall since 2005. GAO also has consistently ranked number one in diversity for mid-size federal agencies.

As with GAO as a whole, STAA is proud to highlight our diversity of expertise as well as our diversity of professional experiences and skill sets that we bring to our work. Below are some of our team, their varied professional skill sets, and examples of the type of work they have supported.

Featured STAA Staff

CINDY KORIR-MORRISON

STEM EXPERTISE
Infectious Diseases, Microbiology

STAA WORK HIGHLIGHTS
COVID-19 Vaccine Development Spotlight; Regenerative Medicine Technology Assessment; Social Distancing During Pandemics Spotlight; Vaccine Development Technology Assessment

ADAM WELLS

STEM EXPERTISE
Data Science

STAA WORK HIGHLIGHTS
Federal Procurement Data System data pipeline; Pandemic Origins Technology Assessment; Project Wordworkr

Featured STAA Staff continued

AARON SHIFFRIN

STEM EXPERTISE
Biopsychology, Chemistry, Environmental Science and Engineering, Mathematics, Molecular Science

STAA WORK HIGHLIGHTS
Advanced Manufacturing; Genetically Engineered Crops; Precision Agriculture Technology Assessment; Public Access to Federally Funded Research Results; Radioisotope Power Systems for Deep Space Exploration

KRISTIN HOOK

STEM EXPERTISE
Animal Behavior, Behavioral Ecology, Biology, Biostatistics, Evolutionary Biology

STAA WORK HIGHLIGHTS
Regenerative Medicine Technology Assessment

ELIOT FLETCHER

STEM EXPERTISE
Biology, Genetics, Military Science, Neurobiology, Radiation Biology

STAA WORK HIGHLIGHTS
Coronaviruses Spotlights; Forensic Algorithms Technology Assessments; Opioid Vaccines Spotlight

IN CLOSING

Since STAA's inception in 2019, our nation has experienced considerable advances and challenges in S&T, including the COVID-19 pandemic that took over 1 million American lives and significantly impacted our national well-being. Given the anticipated exponential growth of scientific advances, it is critical that policymakers and the public have access to timely and nonpartisan analysis of complex S&T issues. At GAO, we have leveraged the depth, breadth, and diversity of knowledge of STAA's interdisciplinary team and external stakeholders to do just that— offering rigorous foresight, oversight, and insight of S&T issues and evidence-based analysis. We will continue to provide sound, sophisticated, and useful work that is grounded in GAO's core mission values to serve Congress and the public. GAO staff who made major contributions to this report are listed in appendix III.

STAA's S&T Portfolio Is Diverse and Wide-Ranging

FIGURE 8 *S&T Issues STAA Has Worked on since 2019*

Environment & Energy
- Forever Chemicals
- Fusion Energy
- Precision Agriculture
- Decarbonization
- Solar Cells
- Water in Agriculture
- Utilitiy Scale Energy Storage
- Satellite Constellation Environmental Effects
- Plastics Waste Recycling
- Nuclear Microreactors
- Consumer Electronics Recycling
- Technology Readiness Guide
- Ocean Minerals
- Alternative Data Storage
- Ocean Energy

Computing & Communications
- Extended Reality
- Non-Fungible Tokens
- High Performance Computing
- Quantum Information
- Digital Services Academy
- Blockchain
- Deepfakes
- 5G
- Blockchain & DLT
- Agile

Tools & Best Practice Guides
- AI Accountability Framework
- Agile Guide (2)
- Technology Assessment Handbook (2)
- Cost Guide
- Research Policy Board
- Research Oversight at VA

Federal R&D
- Federal Scientific Workforce

Federal Research
- NSF Research Facilities & Infrastructure (4)
- Scientific Research
- Federal Research Contributions to Drug Development
- Sexual Harassment in STEM Research (2)
- NIST Human Capital
- OSTP Priority Open Recommendations (2)
- Scientific Integrity (3)
- Federal Funding for US-China Research Collaborations
- Foreign Influences in Federally Funded Research (3)
- Sexual Harassment at the Smithsonian
- Federally Funded Research
- NIST Research Security
- Federal Funds to China Entities
- Chemical Weapons

Defense
- DHS BioDetection 21
- Counter-Uncrewed Aircraft Systems
- Alternative Positioning, Navigation, and Timing Technologies
- Chemical Weapons
- Hypersonic Weapons

Health & COVID
- Infectious Disease Modeling
- AI in Health Care (3)
- Contact Tracing
- Contact Tracing Apps
- Pandemic Origins
- Data & Modeling
- Vaccine Safety
- Digital Vaccine Credentials
- Coronaviruses
- Long COVID
- Diagnostics & Testing
- Vaccine Development (2)
- Wastewater Surveillance
- Modeling
- Opioid Vaccines
- Antibiotic Resistance
- CRISPR
- Genomic Sequencing
- Operation Warp Speed
- Social Distancing
- Herd Immunity
- Regenerative Medicine
- E-Cigarettes
- Brain Computer Interface
- Air Quality

Manufacturing & Innovation
- Remdesivir
- Sustainable Chemistry
- Federal Loan Guarantees Program
- Manufacturing USA
- Probabilistic Genotyping
- Forensic Algorithms (2)
- IP Assistance
- Fraud, Waste, and Abuse in Small Business R&D
- Facial Recognition Technology (2)
- Manufacturing Innovation Program
- DOE Technology Transfer
- Small Business R&D
- Innovative Technologies in Manufacturing
- HHS Management of IP
- Air Force Small Business Ventures
- GAO's S&T Support to Congress
- Innovation Awards
- Small Business Research Programs (3)
- Global Semiconductor Shortage
- Therapeutic Incentives
- Semiconductor Supply
- Patent Trial and Appeal Board Independence (2)
- Zero Trust Architecture

Operations

Intellectual Property

Homeland Security & Law Enforcement

Source: GAO, based on data as of 7/15/2022. | GAO-22-900426

Note: Each colored circle represents a specific report that STAA has led. GAO issues hundreds of reports every year.

Legend: ● Issued work ◎ Ongoing work ◉ Issued & ongoing work

The Polaris Council

The Polaris Council's mission is to advise on STAA's work on emerging science and technology (S&T) issues as they pertain to technology assessment and foresight issues and practices, and help ensure this work is sound, sophisticated, and useful to Congress and the public.

The Council achieves this mission by providing long-term, multi-dimensional, and mutually-beneficial working relationships between STAA and leading S&T experts. Members use their deep domain expertise to help shape how STAA initiates and conducts its technology assessment and foresight work and advise on emerging or emergent S&T issues that may need to be brought before Congress to better support it in the furtherance of a more proactive and evidence-based policymaking posture. The Polaris Council meets annually to discuss trends and issues relevant to STAA's efforts to support Congress on S&T issues, helping us to ensure that we provide relevant, fact-based, nonpartisan foresight, insight, and oversight on key issues and related policy implications.

Polaris Council Members - Annual Meeting with GAO (October 14, 2021)

Jeffrey M. Alexander
Senior Manager, Innovation Policy
RTI International

Robert D. Atkinson
President
Information Technology and Innovation Foundation

Mojdeh Bahar
Associate Director for Innovation and Industry Services
National Institute of Standards and Technology

Duane Blackburn
Deputy Director, Center for Data-Driven Policy
MITRE

James-Christian Blockwood
Executive Vice President
Partnership for Public Service

Marjory S. Blumenthal
Senior Fellow and Director, Technology and International Affairs Program
Carnegie Endowment for International Peace

William B. Bonvillian
Lecturer
Massachusetts Institute of Technology

Dan Chenok
Executive Director, Center for the Business of Government
IBM

Thomas M. Connelly
Executive Director and CEO
American Chemical Society

Robert Cook-Deegan
Professor in the School for the Future of Innovation in Society, The Consortium for Science, Policy and Outcomes, College of Global Futures
Arizona State University

Patricia J. Culligan
Matthew H. McCloskey Dean of the College of Engineering, Professor of Civil Engineering
University of Notre Dame

Victor Dzau
President
National Academy of Medicine

Gerald Epstein
Distinguished Research Fellow, Center for the Study of Weapons of Mass Destruction
National Defense University

Kay Firth-Butterfield
Head of Artificial Intelligence and Machine Learning
Member of the Executive Committee
World Economic Forum

Robert M. Friedman
Vice President for Policy and University Relations
J. Craig Venter Institute

Polaris Council Members - Annual Meeting with GAO (October 14, 2021), Continued

Zach Graves
Head of Policy
Lincoln Network

Kaye Husbands Fealing
Dean of the Ivan Allen College of Liberal Arts
Georgia Tech

Tom Kalil
Chief Innovation Officer
Schmidt Futures

Marcia McNutt
President
National Academy of Sciences

Michael H. Moloney
CEO
American Institute of Physics

Sudip Parikh
Chief Executive Officer and Executive Publisher,
Science Journals
American Association for the Advancement of
Science

Eric M. Pierce
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Oak Ridge National Laboratory

Arti Rai
Professor of Law and Faculty Director
Center for Innovation Policy
Duke University School of Law

Daniel Sarewitz
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Arizona State University

Stephanie S. Shipp
Deputy Director and Professor, Biocomplexity
Institute and Initiative, Social and Decision
Analytics Division
University of Virginia

Douglas Sicker
Senior Associate Dean of Computing, and Professor
of Computer Science and Electrical Engineering
University of Colorado, Denver

Chris Tyler
Director of Research and Policy, Department of
Science, Technology, Engineering and Public Policy
(STEaPP)

University College London (UCL)

Steve Welby
Executive Director and Chief Operating Officer
Institute of Electrical and Electronics Engineers

David E. Winickoff
Senior Policy Analyst and Secretary
Working Party on Bio-, Nano-, and Converging Technology
Organisation for Economic Co-operation and Development

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In addition to the contacts named above, Jessica Cobert Smith (Director), Lisa Gardner (Assistant Director), Ryan Han, Laura Holliday, Anika McMillon, Donna Morgan, Christopher Murray, Aaron Shiffrin, and Shenandoah Sowash made key contributions to this report. Eric M. Larson and Claire McLellan also contributed to this report.

End Notes

[1]The data contained in this report span from the time that GAO formed the STAA team in January of 2019, through July 15, 2022.

[2]GAO Strategic Plan 3.4.1: Identify, analyze, and assess emerging S&T issues through technology assessments to enhance congressional knowledge and understanding, including policy implications.

[3]GAO Strategic Plan 3.4.2: Assess the management and results of federal investment in science and technology, and the effectiveness of efforts to protect intellectual property and foster global competitiveness and innovation.

[4]GAO Strategic Plan 3.4.3: Create best practices and frameworks for evaluating research and development and science and technology projects.

[5]GAO, *U.S. Space Command: Air Force Should Develop Guidance for Strengthening Future Basing Decisions*, GAO-22-106055 (Washington, D.C.: June 2, 2022).

[6]Agile software development emphasizes early and continuous software delivery to refresh software and deliver enhanced or new functionality to users on a regular and frequent basis.

[7]GAO Strategic Plan 4.2.1, 4.2.5, 4.3.3: Continue to enhance outreach to broaden and strengthen relationships with the Congress and audited entities. Leverage data, technology, staff, and process improvement to continually enhance GAO's communication, products, processes, and programs. Enhance tools that integrate crosscutting enterprise data to facilitate more agile, cost-effective, and data-driven decision-making.

[8] GAO, *Artificial Intelligence: An Accountability Framework for Federal Agencies and Other Entities*, GAO-21-519SP (Washington, D.C.: June 30, 2021).

[9]The Joint Financial Management Improvement Program is a cooperative venture between the Department of Treasury, the Office of Management and Budget, the Office of Personnel Management, and GAO.

[10]COVID-19 related reports: Scientific Integrity: HHS Agencies Need to Develop Procedures and Train Staff on Reporting and Addressing Political Interference, GAO-22-104613; Scientific Integrity: HHS Agencies Need to Develop Procedures and Train Staff on Reporting and Addressing Political Interference, GAO-22-105885; Biomedical Research: Information on Federal Contributions to Remdesivir, GAO-21-272; Operation Warp Speed: Accelerated COVID-19 Vaccine Development Status and Efforts to Address Manufacturing Challenges, GAO-21-319; Exposure Notification: Benefits and Challenges of Smartphone Applications to Augment Contact Tracing, GAO-21-104622; Infectious Disease Modeling: Opportunities to Improve Coordination and Ensure Reproducibility, GAO-20-372; Vaccine Development: Capabilities and Challenges for Addressing Infectious Diseases, GAO-22-104371; Science & Tech Spotlight: Long COVID, GAO-22-105666; Science & Tech Spotlight: Wastewater Surveillance, GAO-22-105841; Science & Tech Spotlight: Vaccine Safety, GAO-21-342SP; Science & Tech Spotlight: Coronaviruses, GAO-20-472SP; Science & Tech Spotlight: CRISPR Gene Editing, GAO-20-478SP; Science & Tech Spotlight: Social Distancing During Pandemics, GAO-20-545SP; Science & Tech Spotlight: COVID-19 Modeling, GAO-20-582SP; Science & Tech Spotlight: COVID-19 Vaccine Development, GAO-20-583SP; Science & Tech Spotlight: COVID-19 Testing, GAO-20-584SP; COVID-19: Data Quality and Considerations for Modeling and Analysis, GAO-20-635SP; Science & Tech Spotlight: Contact Tracing Apps, GAO-20-666SP; Science & Tech Spotlight: Herd Immunity for COVID-19, GAO-20-646SP; Science & Tech Spotlight: Genomic Sequencing of Infectious Pathogens, GAO-21-426SP; Science & Tech Spotlight: Digital Vaccine Credentials, GAO-21-534SP.

[11]The Intergovernmental Personnel Act provides for the temporary assignment of personnel between the federal government and state and local governments, colleges and universities, among others.

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