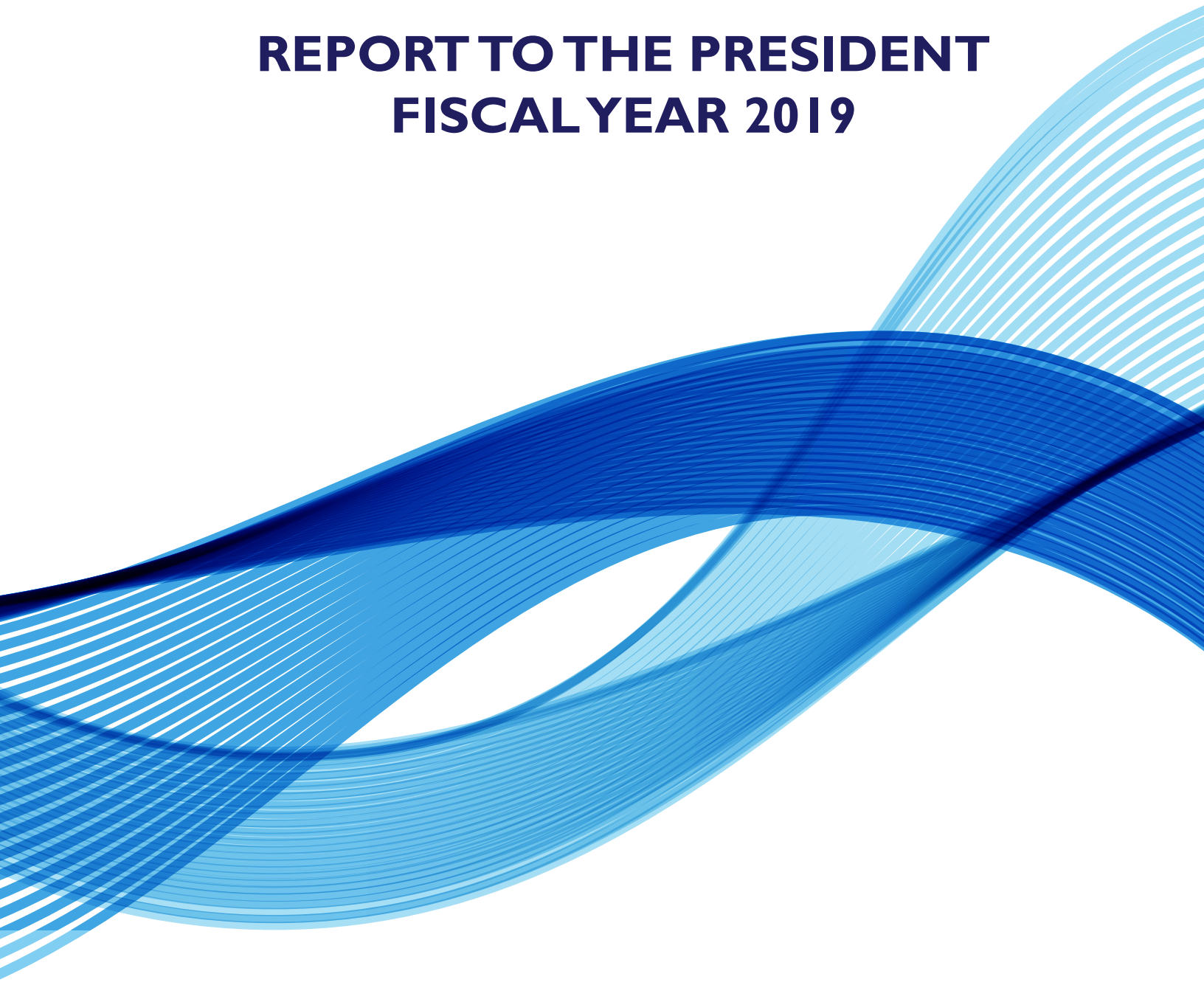
IDA SCIENCE AND TECHNOLOGY POLICY INSTITUTE

REPORT TO THE PRESIDENT FISCAL YEAR 2019



The Institute for Defense Analyses is a nonprofit corporation that operates three Federally Funded Research and Development Centers. Its mission is to answer the most challenging U.S. security and science policy questions with objective analysis, leveraging extraordinary scientific, technical, and analytic expertise.

LETTER FROM THE DIRECTOR OF STPI

Dear Mr. President:

It is my pleasure to present to you this congressionally mandated report of activities of the IDA Science and Technology Policy Institute (STPI) for fiscal year 2019. As a federally funded research and development center, we are well-positioned to provide the Executive Office with in-depth, objective, fact-based analysis on a wide variety of science and technology policies and trends with discretion and free of conflicts of interest.

STPI's analyses in fiscal year 2019 ranged across many topics, including biodefense and pandemic preparedness, quantum information science, space technology, and science, technology, engineering and mathematics (STEM) education. As in previous years, STPI also provided analyses for other executive branch agencies, including the National Institutes of Health and the National Science Foundation.

I am pleased to deliver this report summarizing the diversity of issues our staff has tackled over the past year in support of the Executive Office of the President. On behalf of all of my colleagues, I thank you for the opportunity to serve our government and to help advance our Nation's research and development endeavor.

Kristen M. Kulinowski, Ph.D.

ABOUT THE SCIENCE AND TECHNOLOGY POLICY INSTITUTE

The Science and Technology Policy Institute (STPI) was established by Congress in the National Defense Authorization Act for Fiscal Year 1991 (P.L. 101-510) 1991 as a federally funded research and development center (FFRDC) under the name Critical Technologies Institute. In 1998, Congress renamed the Institute as part of the National Science Foundation Authorization Act of 1998 (P.L. 105-207), which also assigned STPI the following duties:

- Assembly of timely and authoritative information regarding significant developments and trends in science and technology research and development in the United States and abroad.
- Analysis and interpretation of the information with particular attention to the scope and content of the Federal science and technology research and development portfolio as it affects interagency and national issues.
- Initiation of studies and analyses of alternatives available for ensuring the long-term strength of the United States in the development and application of science and technology.
- Provision, upon the request of the Director of the White House Office of Science and Technology Policy (OSTP), of technical support and assistance
  - to committees and panels of the President's Council of Advisers on Science and Technology, and
  - to interagency committees and panels of the Federal Government concerned with science and technology.

Consistent with congressional direction, STPI provides analyses of significant science and technology policies and developments in the United States and abroad for OSTP, its primary sponsor, and for other Federal Government organizations with science and technology responsibilities. To ensure the continued relevance of its work, STPI meets frequently with the Director and staff of OSTP. Such close coordination—coupled with a flexible tasking process—ensures that STPI focuses on OSTP's top priorities and emergent problems.

To address STPI's broad science and technology charter, STPI researchers possess educational training and professional experience across the spectrum of disciplines and sectors. The majority of degrees among STPI's research staff are in mathematics, physical and life sciences, and engineering, with law, social science, communication, and history rounding out the staff's educational background.

CONTENTS

TECHNOLOGY ASSESSMENTS AND STRATEGIES

Quantum information science

Quantum information science (QIS) applies fundamental laws of physics to the acquisition, transmission, and processing of information in order to generate new knowledge and technologies that will expand the U.S. industrial base, provide new employment opportunities, and bolster the economy and national security. As part of the effort to expand American leadership in QIS, the White House Office of Science and Technology Policy (OSTP) asked STPI to project future demand for PhD workers trained in QIS across industry, government, and academia. In response, STPI constructed a QIS workforce supply model and a demand model, both of which project a set of potential workforce trajectories over the next decade. STPI also estimated the cost to the Federal Government of generating (i.e., funding) new skilled entrants into the quantum workforce.

STPI also helped OSTP host the first QIS Program Day at the Eisenhower Executive Office Building. Additionally, STPI provided support for the National Science and Technology Council (NSTC) Subcommittee on QIS and the new National Quantum Coordination Office by researching and identifying the landscape of current and future Federal quantum programs. STPI also summarized QIS research and development (R&D) needs for the Subcommittee on Economic and Security Implications of Quantum Science.

Artificial intelligence strategy

The multi-agency Networking and Information Technology Research and Development (NITRD) Program is the Nation's primary source of federally funded work on advanced information technologies (IT) in computing, networking, and software. In September 2018, the NITRD coordination office published a Request for Information (RFI) in the Federal Register on the strategic priorities listed in the *2016 National Artificial Intelligence Research and Development Strategic Plan*. OSTP asked STPI to analyze responses to the RFI by the seven "strategies" presented in the 2016 Strategic Plan and the six "priorities" presented in the 2018 Artificial Intelligence (AI) Summit report—and to perform a textual analysis of the frequency of terms occurring within the responses. STPI grouped the results into seven areas that span workforce, data diversity, bias, privacy, research planning, public-private partnerships, and investment.

Batteries

Advanced rechargeable batteries are widely used across the economy in information and communication technologies, grid storage, and electric vehicles. The U.S. battery supply chain has a number of vulnerabilities, from critical mineral mining, mineral processing, intermediate component manufacturing and cell assemblage, to battery production and integration into end-use technologies. Due to their pervasive use within increasingly integrated domestic information, energy, transportation, and security infrastructures, OSTP asked STPI to assess risks to the supply chain for lithium ion batteries used in electric vehicles. Using open source literature STPI characterized the lithium ion battery supply chain for electric vehicles from mineral mining and processing, through battery

component and cell development and integration, vehicle production, and recycling and reuse. STPI used a whole-of-supply-chain-approach to consider risks for the market that could be mitigated by Federal policy actions, in particular, considerations where policy options at one step in the supply chain may complicate preferred outcomes at another point, or where policy options that address economic and security concerns do not align.

Automated vehicles

Automated vehicles (AV) use a combination of sensors, cameras, radar, and AI to travel between destinations without a human operator. They are predicted to enhance the safety and mobility of the American public, expand the American economy, and improve global competitiveness. OSTP asked STPI to provide assistance in understanding the status of surface AV R&D and the role of the Federal Government in its development. STPI drafted a request to agencies for information regarding their roles, responsibilities, and activities for AV R&D; organized the information; and supported development of the report entitled *Ensuring American Leadership in Automated Vehicle Technologies*. The report contains an overview of Federal AV policy; legal, outreach, and research activities; and 10 principles to guide and unify Federal approaches to advance AV R&D.

Pandemic preparedness

Modeling is an approach used to describe how an infectious disease outbreak is behaving or predict how it might behave in the future. The complexities of human behavior and social dynamics are integral in the spread of infectious disease, as are abstract variables, such as social justice, trust in government, and bias. These elements of social dynamics are not yet incorporated into bio-incident forecasting models, thus impairing the reliability of the predictions and the government's ability to manage the response. The NSTC Subcommittee on Biological Defense Research and Development charged its Pandemic Prediction and Forecasting Science and Technology (PPFST) Working Group to identify the research needed to incorporate bio-behavioral variables into bio-incident modeling. OSTP asked STPI to assist the PPFST working group in determining the bio-behavioral science and technology capabilities and resources required to advance disease modeling. With the working group and others, STPI facilitated a workshop entitled Behavioral Risk Modeling for Pandemic Prevention and Response, summarized the output from the workshop, and contributed to development of the white paper *Grand Challenges for Advancing Behavioral Risk Modeling for Pandemic Prevention and Response*. This NSTC document provides national research, science, and technology policy recommendations to integrate behavioral dynamics into infectious disease models to comprehensively project disease transmission dynamics.

Biodefense

The National Biodefense Strategy (NBS) outlines a plan and set of objectives to counter the threats that can occur from naturally occurring events, accidental events, and deliberate biological terrorism events. The NBS published in September 2018 prioritizes and coordinates Federal biodefense initiatives from 2018–2023. OSTP asked STPI for assistance in developing new metrics and a Science and Technology Roadmap for measuring progress and effectiveness of efforts to implement the NBS. STPI conducted policy analyses to map alignment of the NBS to the NBS Implementation Plan, identified areas of alignment between the NBS and the Implementation Plan, and created a methodology for developing metrics, milestones, and end states that would guide mandatory annual NBS evaluation activities. STPI briefed OSTP sponsors, National Security Council (NSC) and Office of Management and Budget (OMB) officials, and the interagency committee charged with coordinating implementation of the NBS. The results of STPI's efforts were used to create new processes and methods for metrics development that will allow policy makers and appropriators to make informed decisions about progress in achieving the NBS goals and objectives.

Foreign investments

The Committee on Foreign Investment in the United States (CFIUS) is an interagency body that assists the President in overseeing the national security aspects of foreign direct investment in the U.S. economy. OSTP, a voting member of CFIUS, asked STPI to provide technical review of cases, analyses, and process improvement recommendations in support of this role. STPI staff reviewed appropriate case materials and highlighted open questions or concerns presented by the proposed transaction. STPI assisted OSTP in developing and documenting a case review process, created a case tracker, and helped estimate resource requirements as the caseload increased under the new legislation. STPI expert analyses have informed OSTP input on cases before the committee. Additionally, STPI reviewed current OSTP processes for onboarding and assigning subject matter experts to CFIUS cases, transmitting weekly case updates, and completing quick turnaround requests—and made recommendations for process improvements.

SPACE TECHNOLOGY AND POLICY ASSESSMENTS

Enabling and critical technologies for space

The National Space Council (NSpC) asked STPI to examine critical and enabling space technologies. The findings were compiled into an overview of the role of space technologies within the broader national security context and included nine areas of critical importance for the U.S. national security, civil space, and commercial space enterprises.

Lunar landing system

The NSpC staff asked STPI to assess the commercial accessibility of NASA's draft Broad Agency Announcement (BAA) for development of a human lunar landing system. STPI compared the BAA and salient parts of the contract against previously utilized Space Act Agreements and BAAs viewed by some in the space community as commercially friendly. Combining these assessments with interviews with government and industry stakeholders, STPI determined that the BAA's technical requirements could be seen as overly prescriptive, some criterial for successful performance were unclear, and government acceptance of operational control of the resulting spacecraft, but not liability for operational failures caused by the government, posed issues for industry.

National space nuclear power and propulsion

Space nuclear power and propulsion (SNPP) systems are considered critical to meeting the Nation's goals in space. OSTP asked STPI to evaluate commercial activities in the SNPP domain, assess whether there is need for a top-down national strategy for SNPP, and if necessary, support OSTP in developing the strategy. Specifically, STPI assisted an interagency working group in developing a Presidential-level space policy directive that includes SNPP, and wrote 12 issue briefs on SNPP that were being considered by the working group in producing its recommendations. These documents provided independent insights into the nature and future of the use of space nuclear power.

Planetary protection

The potential for biological contamination from the transport of terrestrial and extraterrestrial materials has been heightened by space missions of high international visibility, such as the OSIRIS-Rex mission to the asteroid Bennu and the Mars 2020 mission. Planetary protection to prevent cross-contamination is governed by Presidential Directive/National Security Council Memorandum Number 25 (PD/NSC-25) and international treaties. OSTP asked STPI to conduct a technical assessment of the process, challenges, and opportunities associated with ensuring planetary protection; a policy assessment that included review of all relevant international treaties, policies, laws, and Presidential and agency policies; and examine possible updates to PD/NSC-25. STPI held discussions with over 50 stakeholders in relevant fields and reviewed the literature on planetary protection and pertinent topics, including laws/regulations, biology, biosafety,

and risk assessment. This research revealed findings and challenges in four areas: disagreements in the community regarding the goals, approaches, and implementation procedures; challenges related to backward contamination; lack of clarity regarding the role of the private sector; and lack of transparency in planetary protection. STPI briefed its findings to a NASA external review committee, and held several discussions with committees of the House and Senate space subcommittees, the National Academy of Sciences, and other expert bodies.

Utilization of asteroid-based natural resources

Near-Earth asteroids are important destinations for potential human exploration, in situ resource utilization, and science research in deep space. NASA asked STPI to assess the ability of the United States and other countries to extract and utilize asteroid-based natural resources to support space exploration, and the timeframe in which resource extraction could occur. STPI determined that while asteroid mining is likely a critical component of the sustained human presence in deep space necessary to bring the solar system into Earth's economic sphere, asteroid mining is currently a nascent activity—and only one U.S.-based organization has published an end-to-end plan. The analysis suggested that, given the decade or longer timeline over which use of asteroid-based resources is likely viable and the uncertainty of returns, it is not realistic to expect private markets to fund the development of these technologies. The data suggest that in the near-term, the government has an important role to play in creating the knowledge and infrastructure necessary to develop and utilize space-based resource extraction.

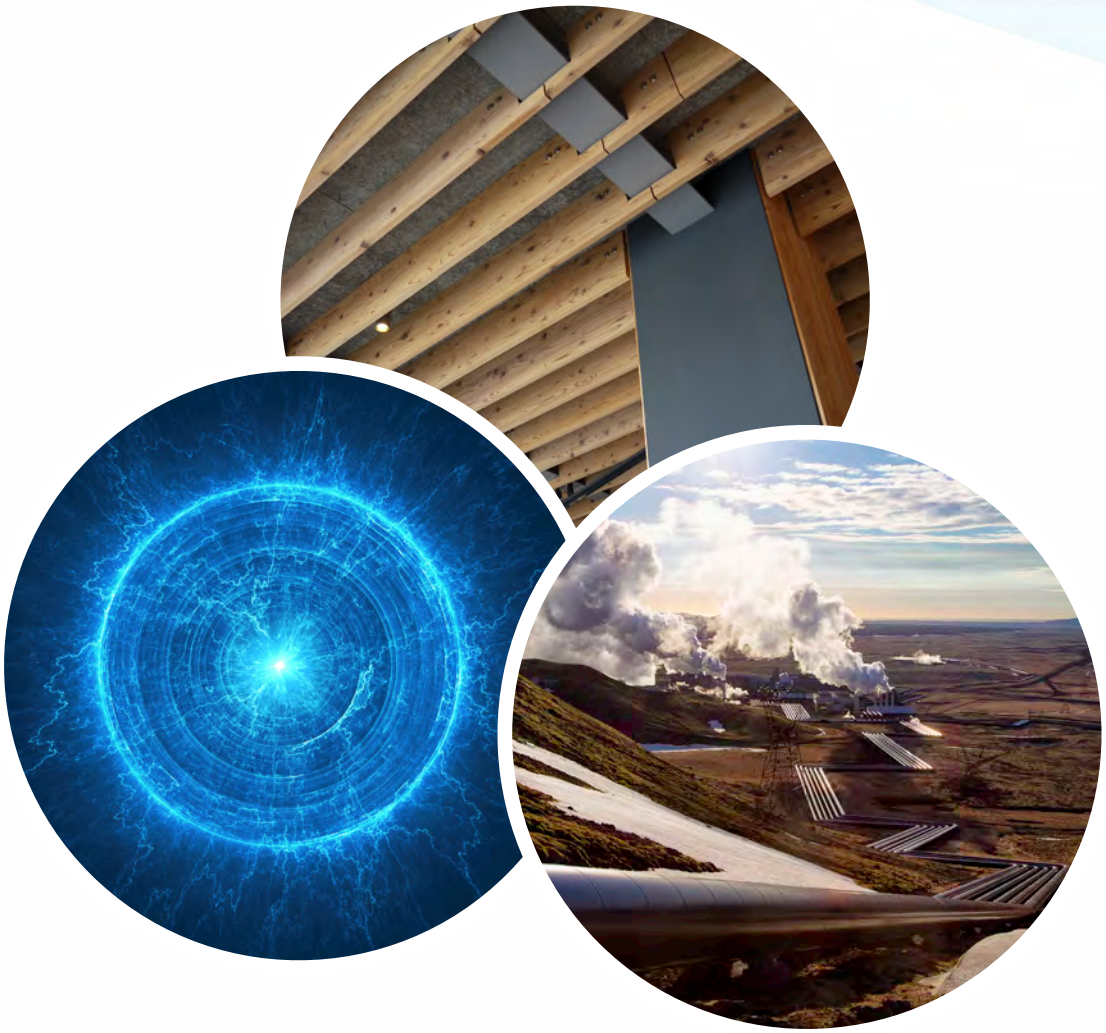
Space situational awareness science and technology

Following STPI's 2018 assessment of current and emerging trends in space situational awareness (SSA)—the tracking of objects in Earth orbit—and space traffic management (STM)—the oversight, coordination, regulation, and support of space activities—OSTP requested STPI's assistance as OSTP worked to meet Goal 1 of the National Space Policy Directive – 3: to advance SSA and STM. Specifically, OSTP asked STPI to assess Federal agency R&D priorities, activities, and research gaps against the operational SSA/STM mission. Using data obtained through interviews with stakeholders from government, industry, and academia and a survey of Federal agencies with mission-related SSA/STM research activities, STPI created a map of the SSA/STM research enterprise.

Space weather

In 2018, the Space Weather Operations, Research, and Mitigation (SWORM) Subcommittee of the NSTC released the Space Weather Phase 1 Benchmarks. The benchmarks specify the nature and intensity of extreme space-weather events and provide a point of reference from which to improve understanding of their effects. In 2019, OSTP asked for STPI's assistance to update the Nation's strategy for space weather resilience. Specifically, STPI worked with OSTP, the SWORM subcommittee, and stakeholders to design and write the goals, objectives, and high-level actions of the U.S. National space weather strategy. Following publication of the *U.S. National Space Weather Strategy and Action Plan*, OSTP asked STPI to assist in the development of an implementation roadmap that specifies concrete actions, deliverables, timelines, and leadership to implement the strategy. STPI participated in a National Science Foundation (NSF)/NASA project on the next steps to space weather benchmarks—the first action called for in the strategy—and drafted the results of an expert panel and other stakeholder events into recommendations that refine the benchmarks. These results will inform future updates to benchmarks and the risk analyses that departments and agencies perform as part of their efforts to build space weather resilience.

INFRASTRUCTURE ASSESSMENTS



RESILIENCE

Resilient buildings: re-occupancy and immediate occupancy policy issues

Buildings and infrastructure systems function as interdependent systems that provide services to a community. During and after a hazard event, the damage to building systems and their potential degradation and failure could dramatically alter a community's recovery from a disaster. In 2018 the National Institute of Standards and Technology (NIST) Immediate Occupancy Report, *Research Needs to Support Immediate Occupancy Building Performance Objective Following Natural Hazard Events*—co-authored by NIST and STPI researchers—was submitted to Congress. Subsequently, STPI assessed existing occupancy policies and regulations at the State and local levels and explored the feasibility of implementing higher performance standards. To assist NIST in identifying improvements in the quality and timeliness of building performance assessments, STPI also conducted a technical analysis of tools and methods currently used to assess buildings after a hazard.

Resilience to electromagnetic pulses

Electromagnetic pulses (EMPs) can potentially damage or disrupt critical components of the Nation's electric infrastructure and cause a grid security emergency. Executive Order 13865, *Coordinating National Resilience to Electromagnetic Pulses*, gives OSTP an important role in coordinating executive branch actions to assess, prioritize, and manage the risks of EMPs. OSTP asked STPI to investigate the conditions under which the President should declare a grid security emergency to allow the Federal Government to control the largely privately owned electric grid. STPI, working with an interagency working group, reviewed the emergency plans of major grid reliability organizations and scientific literature on plans for grid security emergencies caused by other threats, and developed a timeline for geomagnetic disturbances that could cause EMPs. STPI then overlaid the possible actions that could be taken and assessed the advantages and disadvantages of each.

EARTH SCIENCE

Geothermal energy

The Department of Energy (DOE) Geothermal Technologies Office (GTO) established the Frontier Observatory for Research in Geothermal Energy (FORGE) initiative to enable cutting-edge research on, and technology development for, Enhanced Geothermal Systems—engineered subsurface reservoirs from which geothermal heat is harvested to generate electricity. The GTO asked STPI to research, design, and develop a roadmap that describes discrete actions that could be carried out throughout the 5-year FORGE implementation phase at the Milford, Utah geothermal site. The roadmap identifies three critical research areas that are necessary to overcome key technical challenges and facilitate reliable and reproducible enhanced geothermal systems. The research areas are stimulation planning and design, fracture control, and reservoir management. Following the release of the FORGE Roadmap in February 2019, STPI presented the roadmap at a DOE webinar and published an informational summary in the Geothermal Research Council newsletter.

Marine geospatial data

The Federal Government collects and disseminates many types of marine data for use by marine industries, researchers, the public, and governments. The NSTC Ocean Resource Management subcommittee (ORM SC) is charged with coordinating the timely public release of Federal unclassified ocean-related data and other information consistent with the *Executive Order Regarding the Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States*. OSTP asked STPI to provide analytic support on the design and implementation of a data call to Federal agencies responsible for geospatial data sets identified by the ORM SC. STPI designed and implemented the data call, compiled and synthesized data provided by agencies, and collected additional publicly available data. These data were tabulated and used to coordinate the release of Federal unclassified ocean-related geospatial data.

WATER SCIENCE

Great Lakes

The Great Lakes—Superior, Michigan, Huron, Erie, and Ontario—are the largest group of freshwater lakes on Earth by total area, contain 21 percent of the world's surface fresh water by volume, and border eight States. As such, the Great Lakes are an important source of fresh water, biodiverse flora and fauna, and economic benefit, primarily through fishing, shipping, and recreational activities. Through the 2019 Commerce, Justice, Science, and Related Agencies Appropriations Act, Congress asked OSTP to provide an evaluation of Federal, university, and water institutes' Great Lakes research programs and capabilities for interdisciplinary research. OSTP asked STPI to collect and organize the requested data. STPI identified publicly available data and, where necessary, interviewed water research staff on the current large lake fleet capabilities, projected fleet requirements and costs through 2022, and the feasibility of collaboration between Federal agencies and research institutes to conduct the research. The results of this research were used in the report OSTP provided to Congress in 2019.

RESEARCH

Research environment

It has been longstanding U.S. policy for access to the products of fundamental research to remain unrestricted to the extent possible. To more effectively coordinate Federal activities related to the safety, integrity, and productivity of the research environment, the Director of OSTP chartered the NSTC Joint Committee on the Research Environment (JCORE) to bring together the NSTC Committee on Science and the Committee on Science and Technology Enterprise to coordinate interagency work related to improving the safety, integrity, and productivity of research settings. STPI activities for each of the JCORE subcommittees informed the content and organization of the White House Summit of the Joint Committee on the Research Environment in November 2019. The Summit highlighted an integrative approach to policy recommendations and best practices that improve the safety, integrity, productivity, and security of the U.S. research environment.

R&D infrastructure

The NSTC Subcommittee on R&D Infrastructure coordinates policies and strategy related to R&D infrastructure investments. OSTP asked STPI to continue its technical and administrative support to the Subcommittee. In 2020, STPI served as the Executive Secretary of the Subcommittee and supported strategic planning activities of the Subcommittee on R&D Infrastructure. STPI also assisted OSTP in convening an NSTC-wide conference on *Building Bridges Across the Science and Technology Enterprise* to address pressing issues in the Federal science and technology enterprise. Conference participants discussed strategies for making effective portfolio management decisions, leveraging resources to ensure that federally funded R&D is accessible for public benefit, and defining best practices for evidence-based assessment of the government's return on R&D investments.

Advanced manufacturing workplace

Over the last decade, manufacturing practices have evolved to include automation and robotics, computation and computer-assisted processes, sensing and networking technologies, as well as new materials and capabilities. In 2016–17, STPI developed a definition of advanced manufacturing and a framework through which the National Institute for Occupational Safety and Health (NIOSH) might identify an advanced manufacturing workplace and evaluate its occupational safety and health status. The resulting report was published on the NIOSH website.

NIOSH asked STPI to examine in greater detail the state of the art for additive manufacturing, biomanufacturing, and the digitalization of manufacturing. STPI developed papers on each topic, determining that digitalization of manufacturing is an enabling technology that can be applied across industrial sectors, whereas additive and biomanufacturing are specific categories within advanced manufacturing. STPI also created a novel biomanufacturing taxonomy that reflects the types of processes currently in use.

Continuity of operations during a national emergency

The Director of OSTP is responsible for communications-related National Security and Emergency Preparedness (NSEP) under Executive Order 13618 (*Assignment of National Security and Emergency Preparedness Communications Functions*) and Presidential Policy Directive 40 (National Continuity Policy). OSTP asked STPI to conduct analyses in support of OSTP's NSEP responsibilities and to provide continuity-related support for executive branch policy. In 2019, STPI provided a range of analyses associated with OSTP/OMB Directive D-16-1, *Minimum Requirements for Federal Executive Branch Continuity Communications Capabilities*—a White House directive that sets executive branch requirements for continuity communications. The requirements set by this policy help to ensure that departments and agencies are able to communicate and accomplish their essential functions if they were required to evacuate Washington, D.C.

ECONOMIC ANALYSES

Industries of the future

OSTP identified five industries of the future on which to focus its science and technology policy efforts: AI, QIS, advanced manufacturing, advanced communications/fifth generation digital networks (5G), and engineering biology (later renamed "biotechnology"). OSTP asked STPI to estimate Federal, industry, and international R&D investments in these five industry sectors. STPI consulted OMB R&D data, gathered data from official Federal R&D statistical surveys and from industry reports, and developed a list of Federal programs that fund R&D. STPI provided a briefing to OSTP leadership and a report summarizing the findings.

Bioeconomy

The U.S. bioeconomy represents the infrastructure, innovation, products, technology, and data derived from biologically-related processes and science that drive economic, health, and public benefit. Example sectors of the bioeconomy are healthcare, pharmaceuticals, biotechnology, and agriculture. In phase one of this task, OSTP asked STPI to describe the existing elements and potential future direction of the broader bioeconomy and determine urgent and strategic needs the Federal Government should consider for promoting the socially responsible use of health data while protecting the privacy and security of such data. STPI conducted a series of policy, legal, and scientific analyses to describe elements of the bioeconomy, outlined potential economic and national security vulnerabilities, and identified urgent and strategic areas that the Federal Government should consider to promote and protect the U.S. bioeconomy. The results of these analyses were used to inform and help launch a formal interagency Bioeconomy Initiative.

To coordinate Federal efforts under the initiative, OSTP and NSC asked for STPI's assistance with interagency coordination and developing action documents. In response, STPI provided background materials for meetings; facilitated interagency working group discussions designed to solicit bioeconomy-related vulnerabilities and challenges from Federal subject matter experts; assisted OSTP with coordination of a Bioeconomy Summit with non-Federal stakeholders; and supported interagency technical writing groups in drafting an initial framework of an Executive order. These efforts informed Executive action documents on the bioeconomy.

Cislunar economy

The NASA Office of Strategy and Policy asked STPI to examine the present contours and future scale of demand drivers of lunar and cislunar activities external to government through 2040. STPI explored over a dozen markets, including lunar tourism (surface and cislunar), precious metals, and Helium-3.

Other than advertising, STPI identified no business case for commercial goods or services (excluding government contracts) that would be economically viable in the

timeframe of interest. STPI found that for individuals and households, small markets exist, or are likely to exist, for lunar rocks, burials on the Moon, and lunar artifacts, and potentially a small-to-moderate market for lunar tourism, although it is more uncertain that the other markets.

STPI also determined that these markets require capabilities that do not currently exist—for example, the ability to get humans to the Moon and the equipment to extract lunar rock. Other markets—such as mining lunar water to produce propellant—may have a narrow pathway to economic viability; decreasing launch costs may make it cheaper to transport water and propellant to the Moon as opposed to producing them in situ. STPI provided a report detailing these findings to NASA.

Costs and value of scientific collections

The NSTC Interagency Working Group on Scientific Collections (IWGSC) was chartered in 2006 to evaluate the state of object-based Federal scientific collections; foster Federal coordination of collection activities; and increase awareness of the importance and uses of collections. The IWGSC published *Scientific Collections: Mission-Critical Infrastructure for Federal Science Agencies* in 2009, and in 2019, NSTC asked the current IWGSC to revise that report. OSTP asked STPI to assist the IWGSC in drafting a report describing current Federal scientific collections, disseminating the report's findings through the internet, and estimating the costs and benefits of scientific collections. In response, STPI provided comprehensive numbers on Federal institutional scientific collections, an estimate of Federal expenditures on scientific collections, and a paper on the costs and values of Federal scientific collections.

FEDERAL PROGRAM AND PORTFOLIO ASSESSMENTS

GOVERNMENT PRACTICES

Technology transfer

Improvement in the transfer of federally funded technologies from lab-to-market is a cross-agency priority (CAP) in the President's Management Agenda. OSTP and NIST are co-leading activities to streamline technology transfer under the NSTC Lab-to-Market Subcommittee. OSTP asked STPI to support the Subcommittee by collecting data related to existing and recently initiated Federal activities, analyzing the results, and mapping them to CAP objectives and the Administration's R&D priorities. STPI also supported the development and prioritization of the Subcommittee's 2019 action plan and, with OMB, the General Services Administration, and other agency stakeholders, drafted a government-wide lab-to-market communications plan.

In a parallel activity, NIST asked STPI to provide technical and analytical support for its Return on Investment Initiative, a stakeholder engagement activity to improve commercialization and Federal R&D technology transfer. STPI reviewed background literature and reports on evaluation of intramural and extramural technology transfer and developed a concept model to support Federal agency development of measures and metrics to evaluate technology transfer activities.

Data sharing

The Federal Government collects data on individuals and organizations via administrative and survey data collection. With increasing motivation to use these rich Federal datasets to innovate and improve decision making, OSTP asked STPI to prepare background materials spanning the legal and technical landscape around data sharing for a roundtable on Accelerating Responsible Sharing of Federal Data. The background materials provide a review of the key legislation that governs collection, privacy, and sharing of Federal data; an overview of technical methods to increase privacy protections; and select initiatives that highlight current data sharing efforts. STPI staff reviewed literature and conducted interviews with Federal statistical agency employees at the Census Bureau, Bureau of Economic Analysis, and NSF to assess the current challenges for external researchers seeking access to Federal data. STPI analyzed the data and outlined select opportunities for policy to keep pace with the evolving data privacy and technology landscape. The background materials were used by OSTP, OMB, and the participants at the roundtable.

International science and technology cooperation

The International Science and Technology Cooperation Act of 2016, part of the American Innovation and Competitiveness Act, instructs the Director of OSTP to submit a biennial report on international science and technology cooperation efforts to the Senate Committees on Commerce, Science, and Transportation and Foreign Relations and the House Committees on Science, Space, and Technology and Foreign Affairs. OSTP asked STPI to assist the NSTC International Science and Technology Cooperation Subcommittee in developing the 2019 biennial report. STPI conducted

research and analysis of international cooperation efforts, provided a framework for agency input, drafted initial versions of the report, and coordinated the agency review process. The final report showcased high-level, strategic programs, as well as initiatives supported by substantial interagency coordination in three focus countries (United Kingdom, Israel, and Republic of Korea) and three science and technology areas of focus (infectious disease and pandemic research, big data systems and science, and ocean observation systems).

Federal prize authority

The America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Reauthorization Act of 2010 gives all agencies broad authority to conduct prize competitions in order to spur innovation, solve challenging problems, and advance their core missions. As of 2017, OSTP and the Federal science agencies are required to report their prize competitions biennially and to include crowdsourcing and citizen science activities conducted under the Crowdsourcing and Citizen Science (CCS) Act. OSTP asked STPI for assistance in completing its congressionally mandated 2017–18 progress report. STPI developed a data collection tool for mandated information from Federal agencies; performed data analysis, including trend analysis from previous years of reporting; and helped develop a report, including the supporting appendices. STPI found that 169 prize competitions were conducted by 18 Federal departments and independent agencies and 86 CCS activities were reported by 7 Federal departments and independent agencies. OSTP submitted the report, *Implementation of Federal Prize and Citizen Science Authority: Fiscal Years 2017–18*, to Congress.

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) ACTIVITIES

Inventory

A 2018 Executive order established the President's National Council for the American Worker to increase access to available job data so that American students and workers can make the most informed decisions possible regarding their education, job selection, and career paths. As part of this effort, OSTP requested that STPI identify and characterize government data resources on the U.S. education and labor force and create a data inventory that contains skills, occupations, and other characteristics of the worker that could be used in a potential job matching tool. Using data compiled by Federal agencies and non-Federal statistical groups, STPI compiled a catalog of Federal data resources and characteristics on workforce and education and provided it to OSTP in 2019.

Strategic plan

The America COMPETES Reauthorization Act charged the NSTC Committee on STEM Education (CoSTEM) with the coordination of Federal STEM education programs and OSTP with progress updates. To meet the COMPETES requirements, OSTP asked STPI to support CoSTEM activities by providing research, analysis, writing team support, and draft materials in support of the 2018–2023 Federal STEM Education 5-Year Strategic Plan, *Charting a Course for Success: America's Strategy for STEM Education*. This strategy was published in December 2018 and will inform the development of a Federal implementation plan.

AGENCY PROGRAM AND PORTFOLIO ASSESSMENTS

NATIONAL INSTITUTES OF HEALTH (NIH) OFFICE OF THE DIRECTOR

Grant writing support

NIH funds biomedical research through a competitive grant review process. The NIH Funding Disparity Working Group (FDWG) gathers new data to characterize the factors associated with a persistent disparity in obtaining investigator-initiated NIH Research Project Grants (R01s). The FDWG found a disproportionate underfunding of some subgroups of R01 first-time applicants compared to other sub-groups and that the unfunded subgroups are less likely to resubmit their applications. NIH asked STPI to design, implement, and monitor a grant-writing intervention that would bring coaches from the National Research Mentoring Network together with NIH applicants in selected subgroups. STPI identified a cohort who would receive coaching and a control group, and held a workshop and web conferences to provide support for resubmission. The first mentoring process was launched in 2019, and the cohort will complete the resubmission phase in 2020. NIH will use the results of the intervention to inform future grant-writing support efforts.

Workplace climate survey analysis

In response to increasing reports of sexual harassment in academic science, NIH investigated the prevalence and severity of sexual harassment at NIH workplaces and at scientific meetings. As part of this effort, the NIH Scientific Workforce Diversity Office (NIH/SWD) provided survey questions and survey logic and asked STPI to code and administer an online survey and analyze the responses. The survey was completed by over 15,000 NIH staff. STPI provided results on the prevalence and types of sexual harassment reported through the questionnaire, demographic profiles of victims and perpetrators, populations vulnerable to sexual harassment experiences, elements of workplace climate contributing to sexual harassment, the reporting experience, and the likelihood of future harassment at NIH. In September 2019, the results of the survey were provided to NIH in over 900 pages of text and tables that would serve as a baseline for the development of strategies to reduce harassment at NIH.

NATIONAL CANCER INSTITUTE (NCI)

Cancer program analysis and evaluation

For this task with the NCI Center for Research Strategy (CRS), STPI (1) worked with NCI program management and stakeholders to conceptualize and define analyses and evaluations relevant to NCI cancer research programs; (2) worked with CRS to develop analysis/evaluation-related documents and training sessions useful to NCI staff, which synthesize information from multiple analyses and evaluation studies; and (3) worked with CRS on analysis/evaluation tasks related to unique NCI initiatives, such as the Beau Biden Cancer Moonshot or the Provocative Questions initiative. The primary focus of STPI's work in 2019 was assisting CRS in developing options for evaluating progress toward the goals and recommendations of the Moonshot. Three sets of documents relevant to potential future NCI evaluation options were produced: (1) STPI staff focused on developing draft logic models for larger-scale initiatives, especially initiatives intended to form collaborative networks; (2) STPI staff developed recommendation-level flow diagrams to illustrate the links between individual Moonshot recommendations, measurable indicators of progress toward realization of those recommendations, and the goals of individual Moonshot initiatives; and (3) STPI staff developed data collection templates as examples as to how NCI might require individual Moonshot principal investigators to report on an annual basis regarding their awards' progress and their contributions to meeting recommendation-level goals.

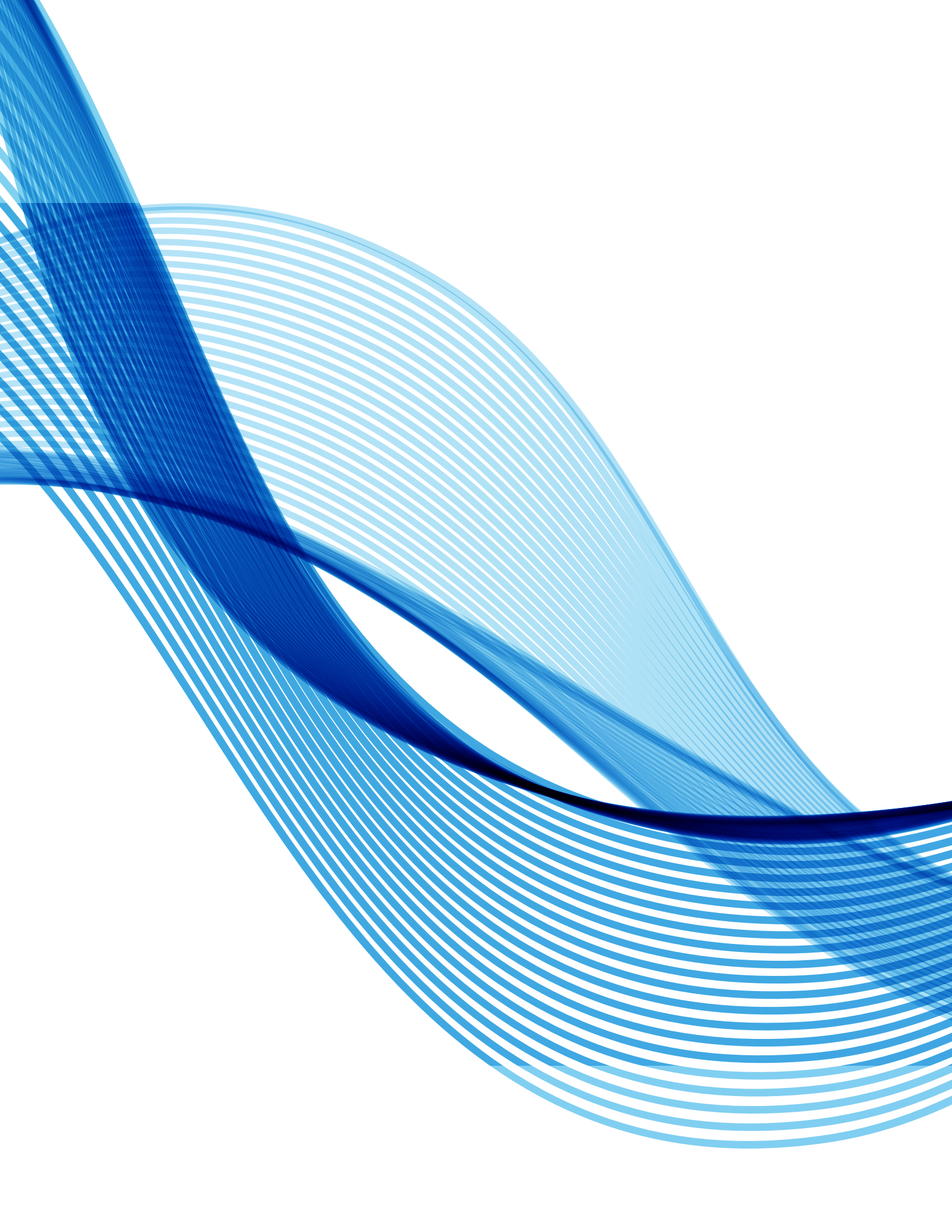
Informatics technology program evaluation

The Informatics Technology for Cancer Research (ITCR) Program is a trans-NCI program supporting investigator-initiated informatics technology development driven by critical needs in cancer research. The program, initiated in 2012, was first renewed in 2015. In support of a second renewal request, NCI required an independent evaluation of the program. In February 2018, NCI asked STPI to conduct three activities: (1) facilitate an expert panel process intended to provide evaluative insights regarding the program's rationale and impact to date; (2) survey current and former ITCR awardees to identify the program's role in fostering collaboration; and (3) conduct a set of case studies of ITCR impact at an award level. STPI completed the evaluation in 2019, and NCI used the recommendations to modify the ICTR program guidelines. The program was reauthorized and continued for a third iteration.

NATIONAL SCIENCE FOUNDATION (NSF)

Broadening participation research thematic evaluation

The NSF Directorate for Education and Human Resources aims to achieve excellence in U.S. STEM education at all educational levels, including a well-informed citizenry. In 2012, at the request of the Directorate, STPI developed a four-step research portfolio evaluation framework to assess research related to a specific theme or topic that spanned NSF's directorates. Elements of the framework include data collection, logic models, and other approaches that identify themes and thematic portfolios, and mechanisms to assemble the data into a portfolio. Subsequently, STPI was asked to apply that framework to three themes: cyberlearning, pre-K–5 science education, and broadening participation research (BPR). The BPR thematic evaluation, which began in 2014, subsequently expanded into a range of sub-studies in response to sponsor needs. Work in 2019 focused on the BPR thematic evaluation, identifying thematic areas covered by a portfolio of NSF BPR awards and assessing NSF's contribution to research advances in five BPR thematic areas.



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14. ABSTRACT

This report provides an overview of fiscal year 2019 activities at the IDA Science and Technology Policy Institute (STPI). STPI provides an independent, objective source of analyses for the White House Office of Science and Technology Policy and several other organizations in the Federal Government. The report provides highlights of STPI's projects in the following categories: technology assessments and strategies; space technology and policy assessments; infrastructure assessments; economic analyses; Federal program and portfolio assessments; and agency program and portfolio assessments.

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