Response of The MITRE Corporation to the OSTP RFI to Improve Federal Scientific Integrity Policies

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Introduction

The MITRE Corporation is a not-for-profit company that works in the public interest to tackle difficult problems that challenge the safety, stability, security, and well-being of our nation through the operation of multiple federally funded research and development centers and labs, and participation in public-private partnerships. Working across federal, state, and local governments, as well as industry and academia, gives MITRE a unique vantage point. MITRE works in the public interest to discover new possibilities, create unexpected opportunities, and lead by pioneering together for public good to bring innovative ideas into existence in areas such as artificial intelligence, intuitive data science, quantum information science, health informatics, policy and economic expertise, trustworthy autonomy, cyber threat sharing, and cyber resilience.

MITRE is constantly advancing, assessing, leveraging, and communicating to a variety of audiences about a wide range of science & technology (S&T) capabilities and issues impacting numerous Federal agencies. Ensuring the integrity of these activities is foundational to our existence, and these experiences serve as the primary basis for this response.

MITRE also initiated a 2020 research effort[1] through its Great Power Competition strategic initiative, in collaboration with the National Science and Technology Council's Joint Council on the Research Environment, that focused on risks posed to the nation's S&T enterprise due to foreign collaboration and influence. Recommendations on this front inherently interact with those for ensuring integrity of S&T practices, so MITRE recommends taking an integrated planning approach that meets both objectives.

Q1: The effectiveness of Federal scientific integrity policies in promoting trust in Federal science

One aspect of accurately measuring the public's trust in Federal science is the availability of quantitative data, which has been hampered by current measurement limitations. For example, several studies measure the construct using single questions along the lines of "How much do you trust the things that scientists say about the environment?" A research project[2] by MITRE, working in collaboration with external partners, sought to develop a more advanced tool that could also be useful for baseline assessments, ongoing monitoring of trust in science, and as a "post-test" tool for assessing the impact of interventions (or, for that matter, societal and natural events).

More generally, the work underscored both the need and the feasibility of understanding different facets and drivers of trust in science, along with how this relates to other aspects of the information environment (e.g., conspiracy theories, social identities, cognitive styles, and personality). Future efforts to enhance and leverage these types of tools would enhance the government's assessment capabilities, leading to more effective practices.

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[1] Improper Influence in Federally Funded Fundamental Research. 2021. MITRE, https://www.mitre.org/sites/default/files/publications/pr-20-3351-improper-influence-in-federally-funded-fundamental-research.pdf.

[2] Hartman, R., Dieckmann, N., Sprenger, A., Stastny, B. and DeMarree, K. Modeling Attitudes Toward Science: Development and Validation of the Credibility of Science Scale. 2017. Basic and Applied Social Psychology, https://www.tandfonline.com/doi/abs/10.1080/01973533.2017.1372284?journalCode=hbas20.

Q2: Effective policies and practices Federal agencies could adopt to improve the communication of scientific and technological information

After a formal, in-depth review in 2018, MITRE provided recommendations to clarify ambiguities, address deficiencies, and streamline an agency's scientific integrity policy and guidance.[3] These recommendations can serve as a starting point for government-wide policies.

A predominant recommendation within this effort was for the agency to develop and implement a policy for the production of fundamental research communications (FRCs). The new policy would identify applicable agency scientific integrity policy, definitions, principles, scientific activities, code of conduct, and code of ethics, and conform with direction in the parent Department's policy on public communications. The intent was for the new policy to strengthen and clarify the criteria for distinguishing an "agency-initiate" FRC from an FRC that presents an individual staff member's "personal viewpoint or opinions." The new policy must also strengthen and clarify the standard notation for identifying and distinguishing the use of "research" versus "operational" data in FRCs, and the implications of using research or operational data in specific products. Similar requirements throughout the Federal S&T enterprise, combined with toolkits to properly guide agencies in the development of these policies and practices, would help agencies ensure accurate representation of new S&T knowledge and how agencies are using that knowledge within their programs.

MITRE also recommended the agency develop and widely disseminate a Peer Review Handbook for fundamental research communications (FRCs). The handbook should comply with the Office of Management and Budget's Information Quality Bulletin for Peer Review. It should (1) explain how to apply the criteria for "influential" categories (Influential Scientific Information [ISI] and Highly Influential Scientific Information [HISI]), which require more stringent peer-review; (2) outline roles and responsibilities for all steps in the peer review processes for ISI, HISA, and other FRCs; (3) provide a detailed description of the agency's peer review processes (including the more stringent ISI and HISI reviews); and (4) require peer review plans for ISI and HISI communications be publicly-available in advance of the peer review process.

MITRE has also recommended the agency develop and implement procedures for mission-specific data management, including authoritative definitions of "research" and "operational" data and its associated software code and documentation. This recommendation also included developing or updating policy on research and development transitions. The update should (1) simplify concepts and processes for transitioning research and development output to operations, application, and commercialization; (2) clarify the definition of mission-specific data records and specify the types of data that are included (or not included) in this definition; and (3) define maturity levels for this type of data, with the goal of defining two levels of maturity: research and operational. Finally, this recommendation includes producing a procedural document that consolidates, integrates, simplifies, and describes official processes for the end-to-end data-management life cycle. The new procedural documents should explain, in detail:

[3] Baggeroer, A., et al. Assessment of National Oceanic and Atmospheric Administration Scientific Integrity Policies and Procedures. 2018. MITRE, https://www.mitre.org/sites/default/files/publications/MITRE-DoC-NOAA-Assessment-Report.pdf.

- When and how data records are transitioned from research to operations, with the goal of consolidating initial operational capability and full operational capability into a single operational stage
- When and how operational data is archived in the agency's data centers
- When and how operational data and its associated software code and documentation are monitored, maintained, and updated
- When and how both research and operational data are made publicly accessible, with clear indications of their nature as either research or operational and the associated implications

Q3: Effective policies and practices Federal agencies could adopt to address scientific issues and the scientific workforce

The Federal scientific workforce spans numerous agencies and occupations that have overarching needs, as well as unique occupational requirements. A strategy that addresses the scientific workforce includes planning future needs and filling essential talent gaps, advancing recruitment and selection processes that efficiently results in the hiring of qualified individuals, identifying training and development plans in technical and core competencies, examining compensation structures, and supporting employees through cultural foundations.

To support professional development of Federal scientists and to support scientists of all genders, races, ethnicities, and backgrounds and advance the equitable delivery of the Federal Government's programs, MITRE recommends conducting a formal workforce assessment with an interagency pilot of up to 12 scientific occupations across the Federal workforce, with an emphasis in two areas: 1) developmental needs assessment; and 2) diversity, equity, inclusion, and accessibility (DEI&A).

To address the first area of developmental needs of the scientific workforce, the assessment will identify skill gaps that build the foundations for advancement. A high-level road map to address these gaps should be developed, including both specific strategies to grow the workforce in a manner that not only creates equal opportunities for all segments of American society, but also mitigates factors that discourage entry into and retention in scientific occupations by historically disadvantaged groups. Starting with a complete assessment of a small number of scientific occupations in the Federal workforce will create immediate opportunities in making both evidence-based decisions in investments in development of the scientific workforce and also in creating a more equitable environment that better recruits and retains diverse talent in a cost-effective manner. The assessment should provide a holistic view of these occupations with predicted gaps in both workforce size and competency.

Addressing DEI&A will also expand the supply of individuals that make up the scientific workforce. MITRE specifically recommends adding fields around disabilities (e.g., autism, physical disabilities) to the list of considerations for measuring and creating equity. MITRE's experience with developing and sustaining a diverse scientific workforce includes many studies that predict future demand will surpass future supply of scientific talent and also that—although some scientific fields, such as biotechnology, tend to be made up equally of men and women—

others, such as quantum, are 70% or more men. Moreover, scientific occupations in the Federal Government, like the private sector, tend to be dominated by White Americans, with Black, Indigenous, and People of Color unrepresented, and those qualified to perform a job but with disabilities dramatically underrepresented.

MIITRE's previous work across the Federal Government with scientific occupations, and also with topics relevant to DEI&A in the scientific community, have shown that addressing these challenges from a holistic approach can help to prevent the many redundant programs from stovepipes in the Federal Government.[3] For example, many Federal agencies focus on the same small subset of Historically Black Colleges and Universities (HBCUs) despite their being 100 HBCUs in the United States. Furthermore, MITRE's work with individuals on the autism spectrum has shown that these individuals are often more capable in STEM professions, solving problems many times faster than neurotypical individuals, but traditional hiring practices disadvantage them in the hiring process and typical development activities do not meet their developmental needs in the workplace[4]. These efforts will increase the supply of qualified scientific professionals.

Key policies and practices for developing a scientific workforce have been identified through MITRE work examining facets of the Federal workforce. These policies would address lessons as described in the below tenants.

- ***Use a holistic approach to understand the needs of the scientific community in the Federal Government:*** For example, use of designations in STEM fields to identify application of work across occupations (e.g., as is done in cyber) would allow for better workforce planning, creation of communities of practice, more efficient training needs analysis, and a greater sense of belonging in the Federal Government, especially for scientists at agencies with few individuals in their specialties.
- ***Expand the pool of applicants for scientific positions:*** Recruit with intention using evidence-based practices, including tracking the return-on-investment of recruiting initiatives. This should include interventions such as efforts to target neurodiversity, recruitment from HBCUs beyond the D.C. metro area, developing and supporting a skilled technical workforce, removing educational requirements no longer relevant as industries mature (e.g., when a PhD is no longer necessary and lower-level degrees or work experience are sufficient to fully demonstrate proficiency, or graduates with non-traditional but related STEM degrees).
- ***Attract and retain talent*** through the recruitment and selection processes that efficiently result in the hiring of qualified individuals. This will include key practices relevant to the scientific Federal workforce such as:
    - ***Branding around meaningful work***. The Federal Government can compensate for the pay differential with the private sector by advertising the unique, complex scientific challenges solved by the Federal Government; the importance of civil service to the safety and security of the nation; the work-life balance offered by Federal positions; student loan repayment programs; and the affordability of many

[4] For more information on the GEAR Center Neurodiverse Federal Workforce pilot program see https://www.performance.gov/blog/mitre-neurodiversity-pilot/ and https://nfw.mitre.org/.

Federal job locations outside of Washington, D.C. Attracting employees based on engagement with the mission will also improve retention.

  - ***Influencing policies to increase stay-rates of foreign-born scientists:*** Stay-rates have been dropping in critical scientific areas, especially among doctoral recipients. Our research identified both a need to address improper foreign influence while also retaining the "best and brightest," including foreign-born scientists. Policies should work to address both.
  - ***Streamlining efforts:*** The Federal Government's workforce efforts in STEM are both stove-piped and redundant across Federal agencies, resulting in both gaps in coverage and duplicative efforts. As such, the Federal agencies compete with each other for the same talent while other talent pools are neglected. A holistic inventory of recruiting efforts would enable more efficient recruiting by increasing the size of the talent pool and the likely acceptance rate.

- ***Modernize the compensation system where necessary:*** Pay for the person, not just the position. Conduct a compensation study to determine whether a new, government-wide Alternative Pay Systems for scientific careers deemed hard-to-fill or hard-to-keep, would assist with recruiting and retention. FDA Cures is an exemplar.
- ***Explore reskilling and upskilling opportunities:*** Address key workforce gaps through upskilling and targeted approaches (e.g., fellowships). MITRE recommends using a combination of public-private partnerships such as Intergovernmental Personnel Act (IPA) assignments, as well as building upon lessons learned from existing Federal reskilling programs, such as the Federal Cyber Reskilling Academy and best practices from the private sector.[5] Although many reskilling programs are unsuccessful,[6] selecting candidates with both aptitude and interest in the new field, then supporting them from job placement through full proficiency in the role can help to increase both performance and retention in the new role.

Q4: Effective practices Federal agencies could adopt to improve training of scientific staff about scientific integrity and the transparency into their scientific integrity practices

Improving scientific integrity and transparency requires identifying and addressing integrity-related competencies across levels and roles in an agency. Moreover, training on scientific integrity should be targeted to different audiences and needs to address key competency needs. Such targeting is not only more cost effective, but also provides staff with skills they can apply on the job in their roles, which increases the efficacy of the training in changing behaviors. For example, we worked with a federal agency to enhance a data upskilling program to improve the data science capacity and capabilities of their workforce. The agency's goal was to build a data science–fluent workforce that addresses the evolving need for data science and analytics

[5] Weber, L. Why Companies Are Failing at Reskilling. 2019. Wall Street Journal, https://www.wsj.com/articles/the-answer-to-your-companys-hiring-problem-might-be-right-under-your-nose-11555689542. Accessed July 16, 2021.

[6] Ibid.

capabilities. MITRE supported this work by identifying critical data science competencies (e.g., research methods, statistics, ethics), conducted a gap analysis to identify data science gaps in its workforce, and developed a strategy for closing key gaps through formal training, experiential activities, capstone projects, mentoring, and on-demand learning. While the program was mostly targeted towards upskilling scientific staff, during the gap analysis MITRE also found the need for the program to upskill leaders and non-scientific staff to have some proficiency in data science competencies (beyond those in scientific positions). This work included research of leading practices in data science upskilling. This methodology would be effective in addressing the integrity needs of the scientific community.

Q5: Other important aspects of scientific integrity and effective approaches to improving trust in Federal science

Enhancing the public's trust in Federal science requires two thrusts: (1) ensuring the integrity of the science itself (including how it is communicated to other scientists and used in operations) and (2) ensuring the science is being explained properly to *nonscientific audiences*.[7] The majority of the government's prior scientific integrity endeavors, and indeed this RFI, predominantly focuses on the first thrust. That is an understandable first step as it is foundational to the effort. But going forward, MITRE recommends significantly enhancing efforts on the second front as well, as this is the part that the public actually sees and drives their individual analyses. While the Federal Government cannot dictate how this is done, it can serve as an example for others to follow. Discussion of three common concerns and actions the Federal Government can take to help overcome each is provided in the following paragraphs.

S&T knowledge is often conveyed in diametric terms; *this is what the science says, you should believe it* (or not). In reality, science is neither true nor false but instead has graduated levels of consensus.[8] "The very nature of scientific discovery is a series of hits and misses, then arguing about those hits and misses until the learned community coalesces around a solidly proven idea. Sometimes, though not very often, that proven consensus ends up being disproven decades later!" Scientists (and science agencies) that convey more certainty in their findings than is warranted are contributing to the public's distrust of science when those findings are later shown to be false or are only accurate in specific conditions. Going forward, the government should not only state the new finding but also convey where that finding stands within science's evolutionary process.

Discussing the role of science within policymaking also, unfortunately, suffers from similar diametric messaging: either the policymaker "trusted the science" in their decisions (if the author agreed with the decision) or they were "anti-science" (if they did not). In most every situation of *actual policymaking*, which differs significantly from lobbying or advocating for preferred policy outcomes, there are many considerations beyond just the science. Consider our recent history with COVID-19 as an example. The recommendation from a pure science aspect would have been to completely shut everything down and isolate everyone until the threat passed. But doing

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[7] Blackburn, D. When and How Should We "Trust the Science?" 2021. MITRE, https://www.mitre.org/sites/default/files/publications/pr-21-1187-when-and-how-should-we-trust-the-science_0.pdf.

[8] Ibid, p.3.

so would have created extremely negative consequences for the nation's financial and security considerations, not to mention increasing other types of health issues. Policymakers had to find the right balance amongst all of these considerations, adjusting over time as conditions changed. The same analysis and balancing occur in all actual policy decisions, which is not normally reflected in government communications—and certainly not within the reactions of those advocating from a single perspective. Proper scientific analysis should play a large role in these debates but overplaying its hand by promoting its infallibility or dominance is wrong—in fact, it is downright unscientific. The Federal Government needs to better explain all influences within these policy decisions, and how they determined the role and proper influence science should properly have held at the time of the decision.

Finally, S&T has become weaponized within partisan politics, by politicians from both political parties as well as by outcome-focused advocacy organizations. Each occurrence, no matter if their statement is positive or negative towards S&T, generally leaves half of the population that hears it reactively distrustful of the message being conveyed. It is easy to conjecture how this is having a negative impact on the public's trust of S&T and its use by Federal agencies. S&T is inherently apolitical, and it is in the nation's interest for it to be treated as such by everyone. While Federal S&T agencies cannot directly influence these partisan efforts, they can take actions to minimize their impact by proactively providing descriptive information about its findings that is understandable to the nonscientific community. For example, in addition to publishing a formal technical report or journal article, agencies could also produce a flyer tailored to general audiences that explains the findings, the certainty of those findings, and the meaning or potential impact of the findings. The availability of this non-partisan, readily understandable material will help interested citizens accurately understand the S&T without it being provided through the lens of influencer operations.