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Office of Science and Technology Policy
EEOB
1650 Pennsylvania Avenue, NW
Washington, DC 20504

RE: SI-FTAC RFI

To Whom it May Concern:

IEEE-USA appreciates the opportunity to provide thoughts on steps the OSTP can take to improve scientific integrity.

IEEE is the world's largest technical professional society, representing nearly 400,000 technology professionals world-wide. Our members include computer programmers, aerospace engineers, electrical engineers, and many other types of experts involved in the electro-technology fields. IEEE's library of technical publications, IEEE Xplore, contains over 5 million documents, including many of the seminal works on technological innovation. IEEE is also one of the world's leading standards organizations, with a portfolio of nearly 1,200 active technology standards. Since its founding by Thomas Edison and Alexander Graham Bell, IEEE has sat squarely at the center of technological innovation, first in the United States, and now worldwide.

IEEE members understand the importance of research to the innovation process. They also understand that the American economy is increasingly built on technological innovation and scientific inspiration. As such, it is essential that the public trust in those innovations. Instances of fraud and unethical behavior by those responsible for conducting research, while rare, undermine that trust and thereby weaken the foundation upon which American prosperity is built.

Because of this, it is important that the federal government take steps to strengthen engineering and scientific integrity. OSTP is uniquely placed to lead those efforts.

However, it would be a mistake to assert that it is OSTP's job alone to enforce scientific integrity measures. OSTP's reach is limited, as are the tools it has at its disposal. Ensuring that research is honest, accurate, and ethical is the responsibility of everyone in the research ecosystem, not just the government.

OSTP's most useful role, in general, is as a convener – that is, OSTP can pull the far-flung parts of the federal government together in a coordinated way, bringing the massive resources of the federal government to bear in tackling difficult problems.

OSTP has been playing that role to enhance research integrity for more than a decade. As noted in the RFI, government research agencies have already adopted rules to strengthen research integrity as a result of past OSTP efforts. This was a necessary and important step towards creating both formal rules and, perhaps more importantly, cultural norms within the federal research system that enhance research integrity.

Having created these rules, the next step would be to standardize, clarify, and publicize them. While integrity rules are relatively consistent across federal research agencies, they are not identical. That is to be expected, but it also creates confusion. OSTP can play a useful role helping agencies standardize their rules so that every federal

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researcher faces the same rules regardless of which agency or agencies they are working with. This would also make the rules easier to enforce.

A standard set of federal research integrity rules will also be easier to promote. Different rules at different agencies makes it hard to discuss those rules without getting caught up in the differences between them. One set of rules for the whole government would make it much easier for researchers and those researchers' professional societies to focus on the intent of the rules, rather than nuanced differences across agencies.

It is important to note, however, that the OSTP is limited in what it can do on its own. OSTP, for example, has limited authority over privately funded research, which represents the majority of research spending in the United States. The integrity of this research is at least as important to society as federally funded research. Similarly, OSTP has limited authority over state-funded research, which is becoming an increasingly important part of the public research world.

On the other hand, there are a host of organizations outside of the government which are already working in this space. These organizations play a crucial role in enhancing research integrity across entire professions, and have been doing so for decades.

Professional societies, like IEEE, exist to help specific parts of the American workforce succeed. Among our responsibilities is enhancing our members' professional qualifications, which includes helping them understand how to do their job properly. IEEE's efforts to provide continuing education for our members extends well beyond exposing them to the latest technology. It includes helping them understand the ethical obligations that come with their work, and the impact their work will have on society.

OSTP's greatest strength is its ability to pull together different groups to achieve a common aim. In the integrity space, this ability has been mostly used to pull together the federal research agencies to adopt rules enhancing research integrity. OSTP should now use this ability to bring the private-sector into the discussion by partnering with professional societies to promote integrity-enhancing policies across, not just the federal government, but all of American society.

Societies like IEEE already play a central role in promoting professionalism within our membership. Moreover, as voluntary associations we are better positioned to create informal cultural norms of behavior that, ultimately, may be more important to preventing ethical lapses than formal rules and regulations.

IEEE has been promoting technical professional integrity since very early in our history, which began in 1884 at the start of the electro-technology revolution. We have at our disposal a host of tools that can be used to improve the integrity of technological research – in fact, that's what they have been doing since the beginning.

**PUBLICATIONS:**

As OSTP has noted, dissemination of research findings is an important part, perhaps the most important part, of the research process. Technological and scientific discoveries build on each other, but only if the results of research are shared widely and quickly. Technical publications exist to disseminate findings. Within IEEE, our 200 journals and library of 5 million technical articles are among the most read and cited technical publications in the world.

Beyond spreading new ideas, not-for-profit publishers like IEEE also play a crucial role in validating and enhancing the quality of those ideas, which includes protecting against unethical behavior. These include:



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*Peer-Review:* The first line of defense against dishonest research is the peer-review process. Prior to publishing technical findings, researchers must submit their results to a panel of their peers who are empowered to assess if the results are reasonable. Peer-review panels consider the validity of the research process, examine checks researchers put in place to protect against bad results, consider the results relative to previous work, and evaluate the legitimacy of the researcher's conclusions in light of the experiments they conducted. Reviewing other researchers' work is a vital and necessary part of a professional's career, and of the research process itself. It is also the best defense against sloppy work, invalid research methodologies, and flawed findings.

Non-profit publishers like IEEE invest considerable financial resources, time, and energy in creating and empowering peer-review panels. Reviewers are not compensated for their work (which can be substantial), but rather volunteer to serve out of a sense of professional responsibility and a sincere concern for research accuracy and integrity.

Importantly, peer-reviewers act out of a sense of responsibility for their fields of research. Their loyalty is, usually, to their profession – which is also where the loyalty of not-for-profit associations lays. IEEE is able to find hundreds of engineers and scientists each year who are willing to devote many hours of work to reviewing research without any specific return primarily because we are seen as being devoted to promoting their profession. In other words, because we are allied with them, IEEE and other not-for-profit associations are able to marshal the army of volunteers required to maintain the extensive peer-review system that has been built up around the globe over the past 200 years.

More than 200,000 scholarly journal articles and over 300,000 conference papers are sent through formal IEEE peer review processes each year, and that number continues to grow substantially. In addition to requiring thousands of reviewers themselves, this effort also involves hundreds of editors, professional staff, and significant expenses in software and systems to operate, secure, and police the process.

Partnering with professional societies may allow OSTP to tap into this network to promote research integrity, but it is unlikely that OSTP could replicate our existing networks primarily because the government sits outside of our well-established professional communities.

*Reproducibility:* The scientific method requires that researchers publish the results of their work not only to spread those discoveries, but also to allow other researchers to replicate their results. This is essential to verify that the first researcher's results were not just the result of random chance, measurement errors, biased samples, or other research errors. Replicating other researcher's work is also an important check against research integrity. History has shown that dishonest researchers can fake research and research results, but they cannot fake results obtained by other researchers who try to replicate their experiments. In fact, a number of major cases of research fraud have been uncovered in exactly this way.

The federal government has recognized the importance of reproducing research and has invested in efforts to improve research reproducibility.

IEEE has also invested heavily in our own efforts to make it easier to reproduce research by extending the archival published research record beyond technical papers to include software and datasets. These tools have led to the creation of virtual laboratories in which, at the click of a mouse, software-based simulations can be immediately run to reproduce results.



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Reproducing research demands work that is often under-rewarded in academic settings. By definition, reproducibility involves research that does not rise to the level of novelty that many scientific publications require. Such follow-on work also drives little commercial interest or revenue for for-profit publisher. Not-for-profit publishers are, therefore, key participants in advancing reproducibility in science, and IEEE is seeking ways to encourage this necessary work and to provide appropriate publishing outlets for the results.

*Validating*: Perhaps most importantly, not-for-profit publishers have a unique ability to independently assess the validity of published works for the purpose of detecting fraudulent or flawed papers. IEEE publications are only as valuable as the quality of work in them. This gives us a strong motivation to ensure that only the highest quality research papers are published. Moreover, we are able to respond aggressively to papers that don't meet our standards. We can remove papers found to be lacking, and can exclude researchers from future publications when we find fraud or other deliberately unethical behaviors. And we do.

Most importantly, the government simply cannot play this role alone. Should questions be raised about the work of a government researcher, any response taken by the government would have to use legal channels, which are cumbersome, expensive, and slow. There are times when this is helpful, and subjecting researchers to legal consequences for deliberate fraud is both appropriate and is a valuable deterrent. But the government cannot act as quickly or definitively as professional societies and has less authority over researchers in the private sector.

*Adjudicating Disputes*: Technical publications play the key role in settling professional disagreements between researchers by providing a neutral forum to present their evidence. Scientific truths must always be tested, no matter how well-established they are. Technical journals have been providing a means to do this for hundreds of years. As the pace of discoveries continues to increase, this role will only become more important. By encouraging federal researchers to engage in these debates, to question scientific truths, and challenge new claims, OSTP can help improve the quality and effectiveness of scientific disagreements.

*Archiving and Preservation*: Accurately preserving the history of ideas is vital to understanding contemporary standards and behavior. Like other professional societies, IEEE considers the preservation of the technical scientific record as part of its core mission and is dedicated to archiving practices regardless of their ongoing commercial value.

**PROFESSIONAL ETHICS:**

Unethical behavior is, unfortunately, not only found in the publishing world. Maintaining the public's trust in technology and scientific discoveries requires proper professional conduct throughout individuals' professional careers. Here too, professional societies have a powerful role to play, especially when paired with government action.

IEEE, like many other professional societies, maintains a Code of Ethics that seeks to hold IEEE members to a high standard of professional behavior. As a voluntary association, we have a greater ability to enforce ethical rules because our members have chosen to join our organization. They have voluntarily chosen to submit to our ethical rules, which were created and are enforced by their peers. Because of this, private associations have far greater freedom to act than other parts of the technological and scientific community.

Our Code of Ethics extends beyond basic legal norms and requirements that the law not be violated. It includes an expectation that IEEE members will consider the impact of their work on society and prioritize the public's safety in



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their work. IEEE members, for example, are required, as a condition of their membership, to treat others respectfully and not discriminate. These are broad rules that extend beyond the more rigid and narrow laws controlling researchers' behavior.

Companies, universities, and the government can, and should, demand high ethical standards, but are limited by the necessarily legal nature of enforcement efforts. Companies are limited in how they can respond to unethical behavior from their employees and will often prioritize the company over either the profession or broader society. Professional societies, on the other hand, have much more latitude to enforce voluntary codes of conduct that extend beyond strict legal rules, and we have a clear motive to do so as unethical behavior harms our members. Ensuring that the public holds our members in high esteem and trusts their work is necessarily a priority for IEEE, which makes our Code of Ethics a priority as well.

**NORMS of BEHAVIOR:**

The true value of voluntary and enforceable Codes of Ethics, like those maintained by IEEE and most professional societies, is not in enforcing the rules or punishing those who violate them. This is important but represents a failure of the real purpose of voluntary codes of behavior, which is to establish behavior norms for our professions that prevent violations in the first place.

Norms, by definition, are not hard and fast rules, but rather broad expectations that communities apply to themselves. Professional societies are uniquely able to create and enforce these expectations specifically because societies are run for and by professionals. We are in the business of creating communities, and the rules that govern them. Formal and informal rules of behavior create expectations that, in time, can define a profession for its members in ways that laws or regulations simply cannot.

For example, IEEE members are required, as a condition of their membership, to avoid soliciting or accepting bribes. While this is a common-sense rule in the United States, it may not be in other parts of the world. But to be an IEEE member, engineers cannot accept bribes even if bribes are acceptable in their country. Similarly, IEEE members are expected to prioritize public safety, even if an individual's employer tells them to prioritize profits.

**RECOMENDATIONS**

Maintaining the integrity of technological and scientific research is a vitally important job, one which OSTP cannot do alone. Partnering with professional societies would allow the Office to leverage the unique role societies play in the STEM world to accomplish much more than the government can do on its own. IEEE recommends that OSTP take the following actions to promote a stronger partnership between professional societies and the federal research enterprise.

- Encourage active membership in professional societies. Federal employees and researchers should be encouraged to join the appropriate society for their field. Membership in professional societies promotes leadership and professional training, but also encourages ethical behavior. Broader membership would help extend ethical norms more deeply into the research ecosystem.
- Encourage federal researchers to play roles in technical publications and conferences. Federal researchers have important roles to play in helping to disseminate discoveries and ideas. Technical publications and conferences are the primary way these ideas are transmitted to the broader engineering and scientific communities, and the public.



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- Encourage technical societies to develop, publicize, and enforce strong codes of conduct for their members. OSTP can utilize its ability to convene experts to help professional societies voluntarily strengthen their codes of ethics by learning best practices from each other. OSTP can also assist smaller societies in creating enforceable codes of conduct.
- Highlight efforts to promote research integrity by professional societies. Individual scientists and engineers devote considerable time and energy to enforcing and promoting the integrity of their work. Peer-review efforts alone consume tens of thousands of hours of volunteer time annually. These efforts are essential, but the public rarely hears about them. OSTP is much more able to educate the public about the research process than are individual societies. The Office has a unique role to play in working with the press to help the public understand the research process, and the work being done to protect it.

OSTP's role in educating the public is likely to become more important as time goes on. Engineering and science are both becoming more complicated and specialized every day. This makes it harder for the average person to understand both technology and science. Over time, cutting edge engineering and science will likely become ever more incomprehensible to the public, which, in turn, will make efforts to promote public trust in STEM research ever more important.

Professional societies, including IEEE, know this and are already working to highlight the great work being done by our members, but more is needed. Institutions, processes, and rules that promote research integrity need to be strengthened, and these efforts need to be communicated to the public. The role of peer-review, for example, in the scientific process is much easier for the public to understand than is many of the papers that are being reviewed. Helping the public trust the research process will help the public trust the research itself.

Sincerely,

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