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Why Effective Program Management Is the Engine of Scientific Research

For the better part of a century, federal research has fueled American prosperity by spurring invention, promoting economic competitiveness, and reinforcing national security. The success of this research can be seen in everyday life: technologies such as GPS in smartwatches and phones; durable and efficient materials used to make clothes and build cars; and pharmaceuticals and medical devices that improve health and extend lives. The story of these advances often involves scientists, research institutions at universities and companies, and entrepreneurs and investors.

One group this story consistently overlooks is the federal employees who wield a vitally important tool: high-performance program management. These workers, spread across the science agencies, have become an essential part of the engine of successful scientific research.

As a director on the Science, Technology Assessment, and Analytics team at the US Government Accountability Office (GAO), I have overseen several recent reports examining different aspects of the massive federal research enterprise. These reports have examined government recruitment of STEM talent, government and the evolving research profession, and, in 2024, the role of government program managers. Together, these reports attempt to make sense of how this extremely active enterprise actually works. More poetically, our goal echoes the American naturalist and philosopher Henry David Thoreau when he wrote, "It is not enough to be industrious; so are the ants. What are you industrious about?"

As federal agencies aim to create and manage innovative, impactful, and reproducible research and development, they must do so as careful stewards of billions of taxpayer dollars. Effectively managing and directing scarce resources and highly talented people toward goals that may seem far-fetched in the face of obstacles that may seem insurmountable requires significant skills. Across the five largest federal research agencies in the United States—the Department of Defense, the Department of Energy, Health and Human Services, NASA, and the National Science Foundation—as well as the Department of Veterans Affairs and the Environmental Protection Agency, program managers play an essential role in making taxpayer-funded research successful.

But what exactly is a program manager? Despite the fact that scientific research in the United States employs several million people and generates a significant amount of data about itself, the actual role of federal scientific program managers is hard to define. When GAO recently examined the work of this critical position at federal agencies, we found that most of the federal agencies we reviewed did not have a precise count of their own scientific program managers.

Position titles vary by agency and include "program manager," "program director," "program officer," and others. But some are not described as managers, even though that is their daily work. GAO's study found that program managers are active participants in the scientific process and are often hired into a management role through their diverse fields of expertise, retaining specialist titles such as "physical scientist" or "astronomer."

Even though they have a wide variety of titles and experience, the duties of scientific program managers are generally similar throughout the federal government.

Whether working on basic or applied research, these managers play crucial roles in guiding the projects funded by their agencies. Program managers lead the selection of research projects to fund by identifying topic areas and guiding the merit review process. After projects receive funding, managers monitor and evaluate the technical and scientific aspects of ongoing awards. And finally, they coordinate with funded researchers, other federal officials, and the broader research community to share information and best practices.

Across these agencies, program managers are the connective tissue of the country's entire research enterprise—seeking synergies among diverse skillsets, avoiding unnecessary duplication of research efforts, and ensuring that long-term projects get across the finish line. There are, of course, differences in the amount of authority given to different managers in different agencies. Because they are charged with selecting transformational research in critical program areas, program managers from the Defense Advanced Research Projects Agency (DARPA) and the Advanced Research Projects Agency-Energy (ARPA-E) are generally empowered with the authority, responsibility, and ability to make program- and project-level decisions, unlike program managers who have more incremental goals.

There are ample prominent examples of the effective work of program managers in action: mapping the human genome, discovering planets around distant stars, and rapidly developing numerous lifesaving pharmaceuticals. All these monumental efforts are examples of program managers successfully coordinating federally funded research over decades. Program managers navigate the unpredictability of complex science, for example, and guide the development of the systems, equipment, and processes needed to study exoplanets in regions beyond our solar system, billions of miles away from Earth. They facilitated the massive, multinational effort to sequence the more than 3 billion bases of DNA that make up the human genome—orchestrating perhaps the greatest feat in biomedical research history. And ultimately, their work ensures that these high-risk and high-profile programs move steadily forward, benefitting both the agencies that conduct the programs and the taxpayers who fund them.

Identifying key practices for scientific program managers

For scientific research to succeed, it isn't enough to just have program managers in place. They must be highly effective. In our report, GAO looked at what "highly effective" means, and what is required to manage successful and reliable research. Working with 79 program managers across 7 agencies, we identified 10 key practices that help program managers advance their agencies' goals, further science, and avoid unnecessary duplication.

These discussions revealed three broad categories of practices that effective program managers use to guide their work in the selection, monitoring, and coordination of research.

The first is that program managers must deliberately maintain expertise in relevant scientific areas as well as management practices. From time to time, program managers need to step outside of their immediate scientific field and see how experts in a range of fields are talking about different topics. Department of Defense program managers explained that going to conferences, engaging with researchers, and learning about the latest developments in their field of research is one of the most important aspects of their job. One DOD program manager told us that it may take years before new ideas appear in the scientific literature, so hearing presentations at conferences can be essential to staying up to date on the latest research. Another program manager at the National Institutes of Health said that maintaining the expertise needed to identify gaps in a scientific field is a key practice for the role.

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A second fundamental task of program managers is developing connections and facilitating collaboration. Practices that help program managers enhance collaboration with the scientific community and the public, as well as colleagues and leaders within and outside their own agencies, are essential to steer federal research from funding to impact. At the most basic level, program managers bring people together and share ideas. Developing connections among agencies, academia, and industry can avoid unnecessary overlap and duplication, provide insight into the needs of users of scientific information, and facilitate the transition of research into needed products and services. A Veterans Affairs program manager told us that program managers need training in areas as diverse as

federal budgeting and ethics, as well as on topics such as human participants and animal subjects in trials, but that ultimately, program managers must be proficient both in managing scientific research and in managing people.

Finally, in order to build strong research portfolios, program managers must simultaneously advance their agencies' research missions and scientific knowledge in general while ensuring their own accountability and that of federally funded researchers. Program managers may shape potential areas of study that advance agency missions and science through crafting funding opportunity announcements, selecting and overseeing projects, and connecting projects to follow-on research or commercialization possibilities. This requires both interagency and external awareness. NASA program managers described coordinating across NASA divisions and with the National Science Foundation on exoplanet research, which relies on resources and knowledge from both agencies—NSF funds ground-based observations and NASA funds space-based observations. A Department of Energy program manager from ARPA-E said they seek out colleagues from other DOE offices to understand where there is potential for overlap and when programs need to be repositioned.

What these observations suggest is that federal scientific program managers require high levels of scientific expertise when they enter critical positions in the government, but they must then develop other skills, expertise, and awareness to do their jobs well. To return to the words of Thoreau, the program managers are *industrious* about a great diversity of functions, all of which are required to foster research that delivers value to their agencies and the American people.

Communicating science and innovation

As program managers strive to build strong research portfolios, communicating the results and potential impacts of the programs they manage is a vital part of the advancement of science and innovation. In our discussions with program managers, they said that communication helps to shape agency research priorities, determine paths for possible follow-on research, and spur innovation and opportunities for commercialization among researchers and industry. One DOD official said that successful program managers must be able to communicate to potential partners, such as laboratories and businesses, how their research could translate to new avenues of basic research or help produce technologies that will meet defense needs.

Program managers we interviewed also emphasized building communication skills to help tailor messages to a variety of audiences, including agency leadership, Congress, and the public. Clear communication, a critical skill for any effective manager, is essential to building and maintaining public trust in science. The Pew Research Center found that public trust of science declined in the wake of the COVID-19 pandemic, and although it has risen slightly, it has not returned to prepandemic levels. Of note, only 45% of Americans viewed research scientists as good communicators. Effective communication could be better employed in the research community through a renewed emphasis on these skills in research management.

The research and development enterprise in the United States, along with the federal agencies that support it, is challenged by this era's accelerating change. Unless agencies and their program managers build resilience and adaptability—through renewed efforts in training, using new tools and resources, and developing communication skills—the broader research community is also vulnerable. Amid this environment of change, effective program managers will continue to be the keystone in the bridge between agencies' missions and the larger research community. They support research quality and build public trust while also advancing the missions of their agencies. Whether it is battling the next pandemic, unraveling the mysteries of the cosmos, or developing innovations that change the world, program managers provide critical guidance for research that will pay untold dividends in the future.

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