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Response of The MITRE Corporation to the NIST RFI regarding Federal Technology Transfer Authorities and Processes (CAP Goal #14)

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Introduction

"The Federal Government invests approximately $150 billion annually in research and development (R&D) conducted at Federal laboratories, universities, and other research organizations,"[1] creating a federal R&D ecosystem consisting of thousands of scientists and engineers working to create breakthrough capabilities or to solve some of the most significant scientific challenges on a national and global scale. Unlike research conducted by the private sector, where there is often a direct internal pathway to commercialization, capability gains from federal research must first be transferred to programs of record or commercial entities that can create and sustain products that are available for acquisition.

Within federal R&D programs, transfer of federal advancements for private-sector purposes has historically been an afterthought – if such transfer was contemplated at all. In decades past, federal agencies largely developed and maintained their own capabilities internally, and thus focused on evolving their research into government off-the-shelf (GOTS) capabilities.[2] More recently, as federal activities have expanded and acquisition practices have shifted to favoring commercial off-the-shelf (COTS) capabilities, the need to transfer federal advancements to the private sector has substantially grown. Federal technology transfer ("the process of transferring technology from its origination to a wider distribution among more people and places"[3]) practices have not grown correspondingly, limiting the ability of federal research to have positive impacts on agencies' operational capabilities. Enhanced attention to federal technology transfer will help overcome this common "valley of death," thus enhancing the effectiveness of federal research investments.

Simultaneously, private-sector innovators have grown more reliant on federally funded basic and early-stage advance research. They rely on the federal government to sponsor this riskier research, focusing instead on latter-stage development and its higher likelihood return on investment (ROI). Federal R&D investments have thus become a critical component of the nation's innovation ecosystem over the past two decades.[4] Federal technology transfer efforts are the critical enablers of this practice – as federal technology transfer efforts are enhanced, the ecosystem produces more capabilities, which in turn enhances the nation's economy and security.

Even absent the focused attention now called for in the President's Management Agenda (PMA), the nation has long reaped the benefits of federal technology that has been adopted and adapted by the private sector. The laser, the internet, and global positioning system are prime examples of capabilities derived from programs initially funded with federal R&D investment and then transferred to the private sector. Thousands of smaller scale technologies have also led to products that are used in our daily lives and have made key contributions to our national economy. Much more will be achieved if activities supporting Cross-Agency Priority (CAP) goal 14 succeed.

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[1] https://www.nist.gov/tpo/return-investment-roi-initiative (accessed July 17, 2018)

[2] Federal research gains eventually found their way into the private sector, which then leveraged them for additional purposes.

[3] https://www.federallabs.org/learning-center/what-is-t2 (accessed July 17, 2018)

[4] https://www.mitre.org/sites/default/files/publications/pr-15-3060-innovation-landscape-government-future-role_0.pdf

MITRE is a not-for-profit, non-commercial company chartered to operate in the public interest. Our focus is on solving problems for a safer world. For the past 60 years, we have advanced federal and national needs by operating multiple federally funded research and development centers (FFRDCs). The breadth of our work gives us a unique insight across missions and across functional and technology domains. Our charter, and our systems thinking perspective, has made it possible for us to see challenges from a federal, state and local, academic and private sector point of view. An important aspect of our public interest nature has been to create opportunities for technology transfer and commercialization of the results of our work and our applied research to create value for government and private sector organizations, and to contribute to the economy. MITRE's Intellectual Property (IP) Management and Licensing team has investigated and addressed, at our multi-FFRDC level, many of the same strategies that the CAP goal addresses at the national level. Insights gained from these efforts serve as the foundation for MITRE's response to this Request for Information (RFI).

In our experience, there are many challenges and opportunities involved in effectively transferring federally developed technology, knowledge, and capabilities. Many of these can and should be addressed in the short term, within existing legal and policy frameworks via improved communications and the reinforcement of best practices. Other challenges require legislation and changes to existing policy frameworks; these are obviously more difficult and time-consuming to implement but could yield longer term benefits for the nation.

Questions Posed in the RFI and by NIST

1. ***What are the core Federal technology transfer principles and practices that should be protected, and those which should be adapted or changed?***

Successfully meeting the technology transfer goals within the PMA will require attention focused on a number of principles and practices throughout the government, such as:

- Enabling a capable federal R&D ecosystem
- Supporting transfer-driven innovation program funding
- Overcoming technology transfer risk concerns
- Engaging in strategic collaboration
- Delivering guidelines and training
- Ensuring technology breadth and readiness
- Communicating technology transfer successes

Each is described in the following subsections.

Enabling a Capable Federal R&D Ecosystem (Goal A and Strategies 2, 3, and 4)[5]

A fundamental requirement for transferring federally funded technologies to the private sector is the *continued availability* of new federally developed breakthroughs and capabilities. Innovative IP has a usefulness shelf life—if the government wishes to increase the amount of IP transferred to the private sector over the coming years, it must continually develop new IP that is attractive externally. As federal researchers fulfil their directed objectives, they should strive to do so in a manner that encourages portability of new capabilities rather than narrowly designing only to meet sponsor-directed requirements.

A second requirement is for the private sector to have *knowledge of* these advancements. Federal agencies must proactively disseminate information about their IP to the private sector, rather than continuing to hold it close or assuming that it will eventually get out on its own. Hence, agency management should take steps to actively require dissemination of their IP, such as making it an explicit requirement in research grants and FFRDC sponsoring agreements, or ensuring that their internal researchers protect, publish, and present their work externally to create visibility for their recent advancements. It is critical that federal R&D initiatives be made visible and details broadly communicated with appropriate technology scouts supporting corporations and venture capitalists.

The resulting third requirement is for federal agencies to *actively support the transfer* of their capabilities. Agencies should strive to make obtaining licenses as painless as possible, and encourage conversations between licensees and federal researchers that helps the former understand and leverage their newly obtained capabilities quickly. This support should become as critical a component of program and personnel evaluations as managing cost and project risk are currently.

Supporting Transfer-Driven Innovation Program Funding (Goal B and Strategies 2 and 4)

While the prior recommendation focused on enhancing the majority of federal research endeavors, attention must also be given to alternative federal approaches that were specifically developed to assist with public-private innovation. These approaches have been highly successful in not only overcoming federal capability gaps but also in creating small businesses and/or generating new license revenue that has been reinvested in additional research.

Small Business Innovation Research (SBIR) programs have provided novel contributions to the federal R&D ecosystem, and have created new businesses that have generated additional economic value for the nation. Entities receiving SBIR funds are generally not the traditional recipients of federal R&D funding, and are typically underfunded to the point that the only way they can survive is to focus on innovative approaches compared with more traditional paradigms. Federal Cooperative Research and Development Agreements (CRADAs) have provided similar yields on longer term research endeavors. FFRDCs serve as both key research partners to their agency sponsors (and other agencies that leverage those FFRDCs) and as less constrained, more rapidly adaptable extensions of their agency sponsors.

[5] Items in parentheses show alignment between this concept and elements stated in CAP Goal 14. Goal A/B/C refers to the three sub-goals listed in CAP Goal 14; Strategies 1-5 refers to the five strategies listed in CAP Goal 14.

Hence, all three play important roles in the R&D ecosystem and in technology transfer to the private sector, and should continue to be prioritized.

Other existing or pilot programs to support technology transfer (such as the Small Business Voucher Program, the Technology Commercialization Fund, and Small Business Technology Transfer programs) are similarly worthy of protection and funding for the longer term. These programs foster increased private-sector access to federal innovations and facilitate joint projects that can result in new products and jobs. Further protection of other programs, such as the Department of Energy's Energy Investor Center and the Department of Homeland Security's (DHS) Transition to Practice program, which increase the visibility of the innovations and capabilities of the federal laboratories, is also recommended, as they leverage federal R&D funding across agencies more broadly. These programs all support raising awareness of the opportunities for commercialization that exist from federal research, and offer some minor funding and other support to would-be entrepreneurs.

Overcoming Technology Transfer Risk Concerns (Goal A and Strategies 1 and 4)

Many senior and mid-level staff at federal agencies, both those tasked with developing new capabilities and operationally focused agencies that use the new technologies, incorrectly view technology transfer as inherently risky, or even as out of scope for federal endeavors. These institutional barriers have substantially limited the transfer of federally developed technologies. New guidance and training will help overcome this mind-set, help separate real from perceived risks, and provide guidance on how to optimally manage risks in the future.

Additionally, agencies should develop new approaches (such as trade secret licensing) to transfer innovations in areas not conducive to traditional patenting (such as cyber and artificial intelligence). Doing so will help open up new avenues for technology transfer that have historically suffered from the "not possible or appropriate" mind-set. Without such a mechanism, some entire innovation families may not be readily licensable, thereby foregoing a valuable opportunity. In addition, the inclusion of trade secrets in a license can increase the value of the license substantially.

Finally, well-meant and important restrictions, such as International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations, have often been implemented in a manner that is too restrictive, thus limiting the transfer of useful capabilities. Broad ITAR categorization means that even relatively innocuous software developed with federal funds is routinely restricted, requiring an enormous effort to acquire an export license. (For example, many commercial companies will not accept software with ITAR restrictions, so this situation frequently leads to licensing delays and lack of execution.) A reassessment of these restrictions and procedures would likely yield greater transfer opportunities while still protecting sensitive capabilities.

Engaging in Strategic Collaboration (Goals A and B and Strategies 2 and 4)

Many federal employees are of the mind-set (created by real or perceived views gained through acquisition or conflict-of-interest training) that they must refrain from talking with the private sector to protect the integrity of future acquisitions. While all must follow the law, government interactions with

the private sector, are necessary for healthy research planning and eventual technology transfer. The government should instead promote opportunities for regular interactions between its researchers and the private sector, as such interaction has proven to increase the likelihood of technology transfer and the commercialization of new technologies. An effective partnership with relevant and appropriate commitments is needed to benefit successful transfer outcomes.

An example of an effort at overcoming this mind-set is Argonne National Laboratory's Technologist in Residence Program, which enables scientists employed by the private sector to work alongside government employees during the later stages of technology development. Similarly, the Defense Advanced Research Projects Agency (DARPA) hosts Demo Days, providing DARPA staffers with an outlet to share their work with defense companies, commercial startups, universities, government agencies, laboratories, and other Department of Defense (DoD) partners. The American Council for Technology – Industry Advisory Council's Institute for Innovation also hosts events and online resources to facilitate information exchange and to foster public-private collaboration.

Delivering Guidelines and Training (Goal A and Strategies 1 and 4)

The government should update guidelines for federal technology transfer, providing additional clarifications regarding its aims and expectations, and outlining and giving clear examples of any restrictions. In this way, the government would ensure that researchers throughout the federal government are working toward the same objectives. This approach would also serve to eliminate local agency-specific interpretations of rules, which have historically added unnecessary restrictions and complications.

Following closely behind these guidelines should be revamped training for agency managers, researchers, and contracting officers. These training programs should highlight government-wide expectations while providing demonstrations and/or case studies to prove that technology transfer concepts are indeed actionable, and that the result is valuable outcomes for the nation. Doing so will help ensure that implementations are aligned across multiple agencies, and will aid in measuring progress against CAP goals.

Ensuring Technology Breadth and Readiness (Goal A and Strategies 1 and 4)

As previously mentioned, applied federal R&D is often targeted to meet an agency's specific requirements. Little thought is given throughout the development stages to how other agencies, much less the private sector, could also adapt and use the project's outcomes. While the capability resulting from the development of technology may meet the sponsoring agency's specifications, technical staff at receiving companies or institutions frequently must retrace multiple development stages and adjust elements so that the technology can be leveraged in other contexts. Refocusing expectations for federal research processes can overcome this issue; broadening the deliverable outcomes will inevitably ensure that results are more easily transferrable.

Technology transfer planning should not begin when the project is completed (though that is most often the case). Rather, it needs to begin at the initial conception of each project. Such an approach may drive

the development and use of standards and open architectures, as well as enable partnerships that can help build in adjustable processes during development. Transfer paths and user commitments[6] will become stronger, and IP and potential licensing opportunities can be identified throughout the project.

Communicating Technology Transfer Successes (Goal C and Strategies 4 and 5)

The Executive Office of the President and individual federal agencies will need to regularly highlight technology transfer success stories for these efforts to gain traction and to encourage other agencies and researchers to follow the highlighted examples. DHS's Transition to Practice Program could be mined for lessons learned for broader application.

2. What are the issues that pose systemic challenges to the effective transfer of technology, knowledge, and capabilities resulting from Federal R&D? Please consider those identified in the RFI as well as others that may have inhibited collaborations with Federal laboratories, access to other federally funded R&D, or commercialization of technologies resulting from Federal R&D.

3. What is the proposed solution for each issue that poses a systemic challenge to the effective transfer of technology, knowledge, and capabilities resulting from Federal R&D? Please consider the approaches identified in the RFI.

Inherent difficulties in identifying and leveraging available technologies (Goals A and B and Strategies 1, 2, and 4)

One roadblock, for potential licensees and federal R&D program managers alike, is not knowing the details of ongoing research programs across the government. Federal research is distributed, and so too are the projects that generate results. While TechLink, the Federal Laboratory Consortium, and perhaps other efforts, gather, organize, and share information about technologies available for license, no substantial capability exists to determine what research projects exist and describe their goals. A government-wide capability to overcome this gap would likely yield an ability for researchers across the government to collaborate more fully, while simultaneously providing the private sector insights into emerging capabilities much earlier. This enhances the chances of establishing CRADAs and other such agreements for the private sector to take advantage of the government's emerging capabilities.

Simplifying Federal IP Licensing (Goal C and Strategies 2 and 4)

Once the private sector identifies available federal IP, licensing the IP can be cumbersome. Each agency negotiates licenses in its own way, requiring private-sector entities attempting to license IP to follow a

[6] https://www.mitre.org/sites/default/files/publications/5-managing-research-projects.pdf

variety of unique pathways and overcome a variety of unique obstacles. A government-wide baseline approach (with agency-specific additions or alterations when necessary) would ease the burden on private-sector entities and government agencies alike.

Developing Incentives for Technology Transfer (Goal B and Strategies 2 and 3)

There is currently a lack of incentives for federal programs, or federal employees, to transfer technologies beyond their originally intended purpose. Developing approaches to recognize (or even reward) such efforts more fully would encourage a change in mind-set and attention, with greater numbers of transfers surely to follow. Management must incentivize inventors to transfer the technology they develop.

A related issue is that many private-sector entities feel disincentivized to license federal technology because they believe the drawbacks from federal red tape will outweigh their expected benefits. Incentive programs that overcome that mind-set and provide additional benefits for licensing federal technology should raise private-sector interest. While these incentives could be financially based, that is not necessarily required – enabling licensees to begin collaborating with federal entities during the latter stages of research programs, and/or allowing federal employees to briefly lend technical assistance to new licensees, would also enhance interest. (For example, Product Development Partnerships[7] are helping to advance drug development for neglected diseases.)

This is a complex idea that would likely require legal and policy adjustments. Studies on potential changes to determine the efficacy of such concepts, and resulting economic benefits, would be worthwhile.

4. ***What are other ways to significantly improve the transfer of technology, knowledge, and capabilities resulting from Federal R&D to benefit U.S. innovation and the economy? What changes would these proposed improvements require to Federal technology transfer practices, policies, regulations, and legislation?***

Additional ideas and concepts for the government to consider include:

- Understanding the temporal aspects of new technology
- Enhancing technology transfer to enhance the ROI of federal R&D
- The role of technology transfer in creating the future economy

Each is described in the following subsections.

[7] Mahoney, R.T., "Product Development Partnerships: Case studies of a new mechanism for health technology innovation", Health Research Policy and Systems 2011 9:33. https://doi.org/10.1186/1478-4505-9-33

Understanding the Temporal Aspects of New Technology

A key consideration within federal technology transfer decisions is that private-sector interest in available technologies will change over time. National impacts and ROI from transfer activities will also vary depending on when the transfer occurs. For example:

- Antenna designs generally have a long lifetime, so it likely makes sense to patent and expend time and effort to develop ideal licensing agreements. It is in the best interest of both agencies and the private sector to get these correct.
- Cybersecurity programs generally have much shorter lifetimes, so it makes more sense to get the technology into the public domain as rapidly as possible. It is in the best interest of both agencies and private sectors to focus predominantly on speed to market.
- Sensitive military applications may have a temporal sweet spot. In many areas, the private sector will eventually catch up to the military's "generation-skipping" new capabilities. While keeping these capabilities close-hold initially is in the best interest of the nation (for security purposes), at some point transferring the capabilities may have greater national impact (due to economic gains).

While this concept is easy to understand in general terms, it is much more difficult to develop recommendations and best practices that properly account for these temporal phenomena. MITRE recommends a focused effort to overcome this gap.

Enhancing Technology Transfer Also Enhances the ROI of Federal R&D

The ROI of federal R&D is directly impacted by the extent to which the resulting capabilities are leveraged for both their intended and additional purposes. An October 2017 workshop held by the National Academy of Science ("Returns to Federal Investments in the Innovation System")[8] highlighted the continuing need for federal R&D and the transfer of the results of that R&D to the private sector. If the United States is to regain its historical technological supremacy, it needs to enhance the ROI of its R&D investments. Efforts to improve our technology transfer efforts will support this national need as well.

The Role of Technology Transfer in Creating the Future Economy

Government-wide technology transfer efforts should also consider how decisions on what to emphasize and how to license technologies could directly drive the nation's future economies. Analyses could be performed to identify upcoming federal capabilities that could be strategically supported to drive transformations in the nation's economy. A perfect example is the internet – originally developed to foster information exchange within the DoD, but once it became public it completely transformed global businesses. Are there other technologies hidden in government labs that could produce similar gains?

[8] https://www.nap.edu/read/24905/chapter/1#8 (accessed July 25, 2018)

5.[9] ***How do we best measure federal ROI on its Technology Transfer investments?***

Measuring the ROI from the transfer of federal technology depends on its purpose. If the transfer was predominantly driven so that federally developed technologies become available (and supported) for federal procurements, the measurable of primary interest will be the impact associated with technology adoption for the federal operational entity. Assessing ROI on technologies transferred for other purposes is much more complex.

The ultimate metric of federal technology transfer ROI is economic impact, a relatively heavyweight metric requiring manual and labor-intensive extraction, collection, and conversion. A study by Swearingen and Slaper in 2012[10] outlines a methodology for estimating sales/revenue generated and jobs created using two case studies drawn from the DoD. A major criticism of this approach is the use of "multiplicative factors" to assess the various indirect and induced effects. The development of guidelines to standardize the intermediate steps in the calculation would help create a baseline against which comparisons across different technology transfer initiatives could be made. Ultimately, such an evidence-based approach would help investment managers identify optimal paths for licensing specific innovations to achieve given outcomes.

Other metrics of interest could include the number of IP disclosures, copyright assertions, trade secret assertions, patents filed, patents issued, and technologies made available for license; technologies licensed; license revenue received; cumulative license value; and the number of CRADAs and other agreements established. For all these intermediate metrics, time is also an important variable, not only as the bounding window across which to capture statistics but also in terms of cycle time from the start of award.

At MITRE, measuring federal ROI in a meaningful way could mean developing an instrumented environment that can allow decision makers insight into the status of technology transfer efforts on at least a semi-annual basis. In such an environment, a study to assign metrics would not need to be commissioned; the output of a portal could be simply shared with all who need to see it. While this improved visibility of metrics would facilitate tracking, it could also, more importantly, be used to help set goals to motivate technology transfer offices and all the staff associated with them.

Finally, a key metric that MITRE tracks is the impact the license had on the safety and security of the nation. While we want to license our technology to those who can use it, and while we can cite many examples of where we have licensed technology designed for one purpose into domains that we had never anticipated, we consider our technology transfer to be most valuable when our technology is used to support the safety and security of the nation.

[9] This question doesn't appear in the RFI, but NIST requested thoughts during one of their listening sessions.

[10] Swearingen, W.D. and Slaper, T.F., "Economic Impacts Of Technology Transfer: Two Case Studies From The U.S. Department Of Defense," June 2012. https://techlinkcenter.org/wp-content/uploads/2017/06/Swearingen-and-Slaper-Economic-Impacts-of-DoD-Tech-Transfer-June-2012.pdf

Recommended Next Steps

FFRDCs are a resource that the government can use while moving forward to meet the CAP goals. That is precisely what FFRDCs are designed to do – they sit on the government side of the table, but have more built-in flexibility than federal agencies and interact more regularly with the private sector. They are therefore a means for the government to quickly pilot and/or implement new concepts under the federal umbrella, which can generate momentum for the remainder of the federal R&D ecosystem to build upon.

Initial activities could include:

- Convene cross-FFRDC meetings[11] to discuss current technology transfer practices and generate best practices, as well as identify other items (such as online repositories, technology transfer science fairs, etc.) that CAP Goal 14 stewards could immediately leverage.
    - Such meetings could be organized with different groups of participants:
        - FFRDC operators only – enables open dialogue among the operators on best practices, lessons learned, and ongoing issues, without raising impact concerns
        - FFRDC operators, federal agencies, and the public – provides opportunities to investigate technology transfer from all three key perspectives
        - FFRDC operators and their sponsors – enables the development of consensus best practices and discussions on how the nation can obtain even greater value from the FFRDC model
- The Office of Science & Technology Policy, National Science Foundation, and FFRDC sponsors could review the technology transfer language in existing FFRDC sponsoring agreements to identify best practices and limitations, then develop recommended baseline language for use in future sponsoring agreements. Doing so will help ensure that the government's FFRDCs are better able to support their sponsors, and this CAP goal, in the future.

[11] MITRE has convened prior cross-FFRDC meetings and would be happy to do so again.