THOMAS COSTABILE, P.E.
Executive Director
Tel: 1.212.591.7150
Fax: 1.212.591.7739
CostabileT@asme.org

The American Society
Of Mechanical Engineers
Two Park Avenue
New York, NY
10016-5990 U.S.A.
www.asme.org

July 30, 2018

Dr. Walter G. Copan
Under Secretary of Commerce for Standards and Technology
Director, National Institute of Standards and Technology
U.S. Department of Commerce
100 Bureau Drive
Gaithersburg, MD 20899

Attention: Docket ID Number: 180220199-819-01
Subject: ASME Response to National Institute of Standards and Technology Request for Information Regarding Federal Technology Transfer Authorities and Processes

Dear Dr. Copan:

On behalf of ASME, I am pleased to respond to NIST's Request for Information (RFI) on issues related to federal technology transfer priorities and processes. Founded in 1880, the American Society of Mechanical Engineers (ASME) is a not-for-profit scientific, educational, and technical organization that promotes the art and science of mechanical engineering to enhance safety and quality of life for all humankind. ASME's 130,000 volunteer members work to promote collaboration, knowledge sharing, career enrichment, and skills development across all engineering disciplines, toward a goal of helping the global engineering community develop solutions to some of the greatest societal challenges. In furtherance of its public safety mission, ASME also develops and maintains over 500 voluntary consensus standards, including standards for complex machinery such as boilers, pressure vessels, elevators and escalators and items as ubiquitous as nuts and bolts, and works closely with our volunteer community to advance the state of the art in mechanical engineering applications in manufacturing applications.

The ASME community looks forward to working with Congress and the Administration to optimize technology transfer programs and promote American innovation.

a) Core federal technology transfer principles and practices that should be protected, and those which should be adapted or changed;

Federal R&D funding is crucial to the nation's economic welfare and national defense. This funding encompasses both publicly supported laboratories operated directly or under the direction of federal agencies, as well as grants to non-profit research-performing organizations such as universities and research institutes. In particular, basic research - defined as research that is not directly motivated by specific applications and instead pursues new knowledge or understanding

- is almost exclusively dependent on government support. Basic research generally requires significant time for the acquired knowledge to impact the marketplace, but the impact has the potential to be large and transformative. Products that are now commonplace, such as smart phones, lithium ion batteries, and 3D printers, are the fruits of research funded by the federal government one or more decades ago. Since it is unknown how quickly new knowledge will be applied, there is often no apparent path for technology adoption, even from successful research projects.

Due to the inherent risks and timing of applicability associated with basic research, U.S. private enterprises cannot justify investments in research for which the promise of a revenue-generating application is not imminent. Hence, basic research is conducted only in a small number of commercial firms; applied research is more common but rare in most companies. Further, there are many more opportunities for government partnership in applied research overseas than are available domestically. This reality has led companies, especially large multi-national corporations, to move their innovation activities offshore so that product development is nearer to the location of manufacturing research and infrastructure, while lowering the cost of research. U.S. federal technology transfer practices should adapt to better support public-private research partnerships that foster domestic research. Further, there should be an emphasis on including small- and medium-sized American enterprises in innovation activities to accelerate economic impact of R&D investments and capture manufacturing tasks within the United States.

ASME strongly supports interagency investments in public-private partnership collaborative research efforts, including the Manufacturing USA program, manufacturing research at the National Science Foundation (NSF), Department of Energy (DOE) Energy Innovation Hubs and the Advanced Research Projects Agency – Energy (ARPA-E), and programs such as the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs that promote collaborative, interdisciplinary research in key emerging technologies for small businesses and nonprofit research institutions. Since these entities are usually the early adopters of new transformative technologies, the focus of SBIR and STTR are particularly pertinent.

Core technology transfer principles that programs should maintain include:

- Basic research and development (R&D) funding is critical to innovation and the creation of new and improved products and processes for the marketplace. Basic research funding starts the innovation pipeline, enabling progress in applied research and development efforts; without basic research there is no innovation and no technology to transfer. Thus, while it is not a technology transfer principle per se, the continuation and expansion of basic research funding is essential.

- Competitive extramural grant programs of the federal government (e.g., the National Science Foundation, U.S. Department of Energy, U.S. Environmental Protection Agency, National Institutes of Health, National Institute of Standards and Technology, National Aeronautics and Space Administration, and U.S. Department of Defense) are the mainstay of scientific and engineering research that leads to a broad range of economic and technological benefits for the nation, including technology innovation, workforce development, and national security.

There are currently federal funding sources at NSF, DOE, DOD, and NIH that will fund manufacturing research at all technology and manufacturing readiness levels, however, the funding is erratic and insufficient for national security and economic welfare purposes, making it difficult for industry and academia to maintain infrastructure and commitments in the area. The following suggestions could be implemented to better support basic and applied research in manufacturing:

- Just as set percentages of basic research funds are dedicated to SBIR and STTR programs, it may be desirable to dedicate a fixed fraction of basic and applied research funds to manufacturing. This can be done either through coordinated management of investments across agencies, or by requiring each relevant agency to dedicate a percentage of their basic and applied research funding to manufacturing activities. It is recognized that the manufacturing of interest to NASA may be different than that of the NIH, but manufacturing is broad and all agencies have an interest in a vibrant manufacturing sector.

- Engineering enrollment, especially in mechanical engineering, has more than doubled in the past five years. This has led to an increase in manufacturing faculty, but not in manufacturing funding. This situation may not be tenable for the university community. Because of the range of research levels within higher educational institutions, a range of approaches is needed to ensure that these faculty positions remain viable. At the research university-level, doubling of basic manufacturing research is a key step to maintaining a research-education balance. For teaching-intensive universities, educational grants or funds to work with local industry will continue to ensure an effective engineering education workforce. In order to continue educating a larger number of engineers, one place where all types of universities need federal support is in equipping and staffing manufacturing teaching and research laboratories.

- Ultimately, funding can be assured for manufacturing if a Manufacturing Research Foundation (MRF) is formed. The MRF could be organized in similar fashion to the National Science Foundation, with the Manufacturing USA program as a division, the MEP program as a division, and basic science and education activities as divisions, as examples. This could be established by re-allocating manufacturing-related funding from other agencies to the MRF so that it is revenue neutral and ensures a manufacturing focus without duplication across all federal manufacturing programs.

- The National Science Board (NSB) that governs the National Science Foundation has no manufacturing specialists; including such representation could ensure that manufacturing is considered at the proper level.

b) Approaches to improve efficiency and reduce regulatory burdens for technology transfer to attract private sector investment in later-stage R&D, commercialization, and advanced manufacturing;

Later-stage R&D efforts (those with 2-7 years before commercialization) must overcome the inherent unwillingness of private industry to make significant investments to research that has long-term benefit. While the private sector accounts for an estimated two-thirds of all R&D spending in the United States, the federal government still has an important role to play. It has

been noted that in the absence of later-stage R&D efforts, basic research is often transplanted overseas, developed offshore, and manufactured using the technical expertise generated during the later-state research efforts—not in the U.S. This allows other countries to reap significant economic benefit of American basic research, while the U.S. loses product development, manufacturing, and future technological progress based on the innovations. The federal government, by promoting greater activity in later-stage research by industry, will improve efficiency in technology transfer activities, keeping every stage of the innovation pipeline here in the U.S.

To overcome industry's reluctance to invest in later-stage R&D, the federal government must engage in public-private partnerships to ensure that research predominantly impacts American economic welfare and U.S. national security. For this reason, the federal government must make a commitment to continuously fund, expand, and make permanent important public-private partnerships that promote domestic technology transfer.

ASME supports federal technology transfer efforts to:

- Strengthen industry/academic/government partnerships to promote pre-competitive research and the flow of ideas between these parties, as exemplified by Manufacturing USA.
- Foster a regulatory environment that provides adequate protections for rights holders of intellectual property. For example, this can include language in federal funding opportunities that stipulates all partners in a project get non-exclusive rights to any IP that is generated.
- Stipulate communication between parties as conditions of research grants both on the basic research side and the application and development side.
- Support partnerships involving competitive programs that are both cost-shared and merit-reviewed, where the amount of cost sharing is commensurate with the technology's commercial maturity.
- Invest in partnerships that apply commercial technologies to meet government needs in areas such as defense, manufacturing, energy, education, workforce, and the environment.

c) Sustained partnering models and technology transfer mechanisms with the private sector, academia, federal agencies, states, and other public-sector entities to support technology development and maturation;

The U.S. manufacturing base in particular is significantly impacted by fluctuations in national strategy and R&D investment, and cannot maintain growth or innovate without a coordinated long-range plan that is competitive with other nations. There is currently an unmet need for sustained funding in the manufacturing sector. Other countries such as China, Germany, and England have successfully instituted innovative, 21st century advanced manufacturing polices and infrastructure, whereas the United States is just beginning to lay the groundwork. While the United States has

made major progress in recent years with the creation of the Manufacturing USA program, to stay competitive there needs to be sustained funding for the program and other federal public-private partnerships that promote technology transfer.

Unfortunately, funding for Manufacturing USA has not been sustained or grown to the extent that was envisioned with the creation of the program. Programs such as these can only achieve their full benefits to the federal government if they are sustained and follow a long-term plan for success. It is imperative that the federal government show sustained commitment to the advanced manufacturing sector so that industry and other stakeholders can invest in domestic technology transfer without fear that the federal government will eliminate or pull back from successful programs that were established using the government's convening power to attract industry investment. Working together on pre-competitive, pre-market solutions to national manufacturing concerns will quicken the technology transfer process once innovations have reached maturity.

ASME supports efforts, especially those through Manufacturing USA and the NIST Manufacturing Extension Partnership, to:

- Feed the innovation pipeline through both early-stage research, where it is too risky for industry to invest, and later-stage research and development, before the technologies are ready for industrial commercialization. This commitment is critical in fostering continuous transfer of R&D results into new manufacturing technologies.

- Provide global leadership in advancing fundamental research. This commitment allows the United States to monitor key areas of emerging technology that have the potential to become the next big manufacturing disruption.

- Act as a neutral convener through public-private partnerships, which shorten the timeframe for innovations to reach commercialization.

- Strengthen engineering curricula to provide students the tools they need to be strong in not only in the practice of engineering and research, but also in understanding how technology transitions to the market.

- Build a 21st century workforce capable of implementing these new technologies through informing technical curricula by research findings and fostering cooperative workforce development efforts in research projects.

- Diffuse new and emerging technologies into our Small and Medium Enterprises (SMEs). This ensures SMEs have access to advanced and emerging technologies so that domestic manufacturers can remain technologically competitive and the U.S. can remain globally competitive.

- Lead industry to invest in research and development for Department of Defense mission-critical systems, processes, and tools; a similar philosophy should apply for civilian applications such as the Department of Energy programs to develop more environmentally friendly technologies to meet national energy needs and enhance our energy security.

d) New approaches that will reduce or remove barriers, and enable accelerated technology transfer, with a focus on areas of strategic national importance;

The lack of a formalized technology transition process is a major barrier to adoption of new and innovative tools and technologies. Formalizing and strengthening existing processes to connect early-stage researchers with later-stage developers will fuel the transition of fundamental research to programs that will advance and mature the technologies so they are ready for U.S. industry to transition into new commercially viable manufacturing techniques, systems, and commercial products. The federal government's investment at each stage of the research pipeline is vital for rapid technological advancements, and a coordinated, strategic effort to transition technology from one stage to the next will result in a more rapid return on investment for the United States both in terms of economic growth and in strengthening our industrial base.

Key investments from the federal government to reduce barriers to technology transfer include:

- Supporting programs aimed at de-risking new technology deployment, especially those that do so through fostering collaborative environments that allow multiple stakeholders to work together on pre-competitive research and development with pre-arranged terms governing intellectual property.

- Engaging smaller suppliers. Data from the Census Bureau show that companies with fewer than 500 employees account for 99 percent of U.S. companies engaged in manufacturing. Furthermore, companies with fewer than 20 employees account for almost 75 percent of all manufacturers. SMEs make up a significant portion of the U.S. manufacturing enterprise, but because of their limited resources, SMEs often struggle to keep pace with emerging technologies and best practices.

- Building relationships between technology providers, users, and developers by investing in promising, yet relatively narrow technology areas where the risk is too high for a single company to invest.

- Developing a quick-track for qualifying entities to be considered for government contracts to quicken the technology transfer process.

- Sustaining and growing programs that successfully maximize the transfer of federal investments in science and technology into value for the United States, such as the network of manufacturing innovation institutes under the Manufacturing USA program. The program was created with the intention of establishing 45 institutes nationwide, each with a particular technology focus. The 14 established institutes have made huge progress in both the research and development of their individual technologies. Growing the program and offering sustained funding for the current institutes will ensure the United States is a technology leader in key emerging technologies.

e) Better metrics and methods to evaluate the ROI outcomes and impacts arising from federal R&D investment;

Each federal agency has its own set of metrics for evaluating the ROI outcomes and impacts arising from their R&D investments. Many are program/project specific and may be further defined by the researchers sponsored by the agencies. To arrive at an interagency set of metrics and methods inclusive of impacts on manufacturing, the formation of a national advanced manufacturing advisory board is needed for regular review of best practices and lessons learned by prior and ongoing federal technology transfer program efforts. This board would provide a mechanism for determining and periodically reviewing a set of metrics and methods that could be used across agencies. This board could be led by the interagency Advanced Manufacturing National Program Office or by the Manufacturing Research Foundation (as suggested in section a) and would evaluate sectoral challenges and provide implementation recommendations.

f) New approaches to motivate significantly increased technology transfer outcomes from the federal sector, universities, and research organizations.

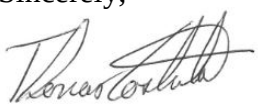
- Encourage partnerships to involve private organizations in addressing STEM education improvements.
- Encourage U.S. institutions of higher education to pursue more research partnerships directly with industry: i.e., pursue more applied research of direct interest to industry and in the process increase engineering workforce training.
- Leverage programs such as NSF's Broader Impacts Criterion to encourage large-scale, sustained partnerships among higher education institutions, museums, industry, content developers and providers, research laboratories and centers, and elementary, middle, and high schools to deploy the Nation's science assets in ways that engage tomorrow's STEM innovators.
- Create and formalize mechanisms for industry to leverage early-stage R&D investments made by the federal sector (e.g., NSF, DOE). Often, industry is unaware of the R&D investments made by federal agencies in existing and emerging technology areas. Consequently, promising research results never see the light of day in industry. By creating formal mechanisms for federal agencies to share information about funded research projects and their outcomes with each other and with industry-led public-private partnerships (e.g., Manufacturing USA institutes), technology transfer opportunities can be enhanced.

Conclusion

ASME appreciates the opportunity to provide comments on NIST's efforts to improve lab-to-market technology transfer. Improvements to the U.S. innovation ecosystem will require additional public and private investment backed by a sustained national strategy that positions federal assets to support innovation in key technology sectors—including manufacturing, energy, robotics, biotechnology, computer and information science, and many more. U.S. industry also faces competition from foreign state-sponsored entities striving to become leaders in many of these key

strategic technology areas, necessitating better coordination from existing government-industry technology partnerships and the exploration of new efforts to ensure return taxpayers investment in R&D. New and sustained efforts to bolster the domestic innovation ecosystem will have far reaching impact on American jobs, the economy, and national security. We are encouraged that NIST is assessing the necessary steps to ensure continued growth and leadership in technology transfer and look forward to seeing greater investment in basic research and successful applied programs that will allow American innovations to be commercialized into American inventions.

Sincerely,



Thomas Costabile, P.E.
Executive Director