ITIF | INFORMATION TECHNOLOGY & INNOVATION FOUNDATION

November 15, 2021

To: White House Office of Science and Technology Policy (OSTP)
National Science and Technology Council (NSTC)

From: Information Technology and Innovation Foundation (ITIF)

Re: Request for Input on the Development of a National Strategic Plan for Advanced Manufacturing (FR Doc. 2021-21644)

The Information Technology and Innovation Foundation (ITIF) is pleased to submit these comments in response to the National Science and Technology Council's request for comment on the development of a national strategic plan for advanced manufacturing.

ITIF is an independent, nonprofit, nonpartisan research and educational institute focusing on the intersection of technological innovation and public policy. Recognized by its peers in the think tank community as the global center of excellence for science and technology policy, ITIF's mission is to formulate and promote policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress.

1) Which emerging science and technology areas will be key to the next generation of advanced manufacturing for global competitiveness, sustainability, and environmental challenges?

In addition to these goals, the administration should add national security and productivity. As the Department of Defense (DOD) Office of Industrial Policy reports, there are significant and widespread technological and production challenges in critical areas related to the defense industrial base. And most of these are in the areas of dual-use technologies.[1]

In addition, boosting productivity is the most important economic task if the United States is to raise living standards for all, especially in the face of large numbers of retiring baby boomers. Over the last decade, according to the Bureau of Labor Statistics, U.S. manufacturing labor productivity growth has stagnated, likely for the first time in history, growing more slowly than overall U.S. productivity.[2] This is a crisis and implies a focus on technologies including robotics, autonomous systems, AI, and materials science. Of these, robotics is perhaps the most important because of its significant potential to boost productivity. But critically, the focus should be on all robotics, not just robotics that complement workers. As such, NSTC should

[1] U.S. Department of Defense, "Fiscal Year 2020 Industrial Capabilities Report to Congress" (OSD A&S Industrial Policy, January 2021), https://www.businessdefense.gov/Portals/51/USA002573-20%20ICR_2020_Web.pdf.

[2] Robert D. Atkinson, "US Manufacturing Productivity Is Falling, and It's Cause for Alarm," *Innovation Files*, July 12, 2021, https://itif.org/publications/2021/07/12/us-manufacturing-productivity-falling-and-its-cause-alarm.

recommend broadening the mission of NSF's National Robotics Initiative, which currently only funds research on robotic technology that complements rather than replaces workers, even though the latter on average generate greater productivity gains.[3] But, overall, process technology innovation should receive more attention as it is a key way to boost productivity and enable U.S. production in the face of lower-cost offshore alternatives.

In addition, while it's useful for the federal government to attempt to identify these S&T areas, the risk is that the process will overlook certain key technologies. Any S&T implementation process—such as joint industry-university research partnership programs—should be flexible and respond to industry interests and needs.

2) What should be the near-term and long-term technology development R&D priorities for advanced manufacturing, the anticipated timeframe for achieving the objectives, and the metrics in assessing progress toward the objectives?

The most important priority should be to foster the development, commercialization, and utilization of these technologies by firms in the United States. Research results such as peer-reviewed scholarly papers published should not be the focus for the simple reason that publicly published research results are available for use by U.S. competitors. Useful metrics could be changes in tech transfer metrics (patents, licenses, etc.) from universities and national labs and new product and process technology adoption as reported by the National Science Foundation (NSF) BRDIS survey. Another useful metric would be more Manufacturing Extension Partnership (MEP) surveys on SME manufacturers' uptake and adoption of smart manufacturing technologies.

3) What are examples of technological, market, or business challenges that may best be addressed by public-private partnerships, and are likely to attract both participation and primary funding from industry?

We would suggest that this is not the right framing. Rather than try to anticipate what kinds of challenges industry will want to address, it is much better to design programs and processes in ways that require industry engagement so that their interests are elicited organically. For example, in designing any university research center programs, require that federal funding is contingent upon some level of industry matching funds (for smaller firms especially that might take the form of in-kind contributions). Likewise, when deciding on new industry-led research centers, like the Manufacturing USA Institutes, rely on a bottom-up process whereby industry proposes topics and centers. On that point, the Manufacturing USA network of Institutes of Manufacturing Innovation has been tremendously successfully, and it should be a point of priority for the

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[3] Robert D. Atkinson, "Why Federal R&D Policy Needs to Prioritize Productivity to Drive Growth and Reduce the Debt-to-GDP Ratio," *Innovation Files*, September 12, 2019, https://itif.org/publications/2019/09/12/why-federal-rd-policy-needs-prioritize-productivity-drive-growth-and-reduce.

Biden administration to further expand the network…bringing the extent of the network closer to the over 40 institutes originally envisioned.

4) How can Federal agencies and federally funded R&D centers supporting advanced manufacturing R&D facilitate the transfer of research results, intellectual property, and technology into commercialization and manufacturing for the benefit of society and ensure sustainability, national security, and economic security?

This question is a perennial one, and is in many ways quite simple: reward organizations that do this well. As it stands, the federal government does little to require the collection of commercialization and domestic manufacturing performance metrics. No wonder, commercialization is so uneven. For example, when ITIF last examined this, the metrics the Department of Energy (DOE) used to assess federal lab performance gave almost no weight to fed lab technology commercialization.[4] To date, federal labs and especially research universities have vociferously resisted even the collection of such metrics, much less their application, claiming they distort the real nature of research which is to discover knowledge. Their real motivation is to not be held accountable for showing results beyond peer-reviewed journal articles.

For example, the Office of Management and Budget (OMB) should require federal research agencies to report five years of data on their patent licenses and royalties as part of their annual budget requests. Federal agencies could do a better job of commercializing inventions and discoveries made in national labs and other federally funded research centers. Recent studies find federally funded university research is about five times more likely to result in a licensed patent technology than research funded at federal labs, and about seven times more likely to result in an active patent license. Requiring agencies to provide data on their licensing activities would apply pressure on lagging agencies and centers to improve and inculcate more competition among federal labs to inspire greater licensing activity.[5]

In addition, OSTP should direct NSF to partner with the National Institute of Technology and Standards (NIST) to develop a metric for universities to report entrepreneurship and commercialization information annually, including data on new business starts by faculty, spin-offs, license agreements, patenting, and industrial funding of research. The White House should then direct agencies to factor these metrics into their decisions to award research funds.

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[4] Matthew Stepp, "Testimony Before the Commission to Review the Effectiveness of the National Energy Laboratories" (ITIF, December 17, 2014), https://itif.org/publications/2014/12/17/testimony-commission-review-effectiveness-national-energy-laboratories.

[5] Stephen J. Ezell and Robert D. Atkinson, "ITIF Comments Responding to Administration Request for Information Regarding Federal Technology Transfer Authorities and Processes" (ITIF, July 2018), https://itif.org/publications/2018/07/30/comments-national-institute-standards-and-technology-regarding-federal.

5) How would you assess the state of the domestic advanced manufacturing workforce in the U.S? How can Federal agencies and federally funded R&D centers develop, align, and strengthen all levels of advanced manufacturing education, training, and certification programs to ensure a high-quality, equitable, diverse, and inclusive workforce that meets the needs of the sector and drives new advanced manufacturing jobs into the future?

Clearly more needs to be done to boost the advanced technology skills of the U.S. manufacturing workforce. But some of this challenge is a chicken-or-egg problem. With the dramatic decline in U.S. manufacturing output, factories, and jobs over the last two decades, many workers rationally looked to other industries and occupations for skill development.[6] At the same time, too many U.S. manufacturers, especially SMEs, have focused on competing through the "low-road"—low wages, rather than higher wages and more demand for skills and more complex process technologies.[7] Focusing principally on workforce development without addressing these two challenges is like pushing on a string; without stronger demand for these skills there will be less supply.

However, there are things the federal government can do to improve skill development. The most important is to ensure that existing and new federal manufacturing training programs be industry led. In addition, as ITIF has noted, more effort by the NIST MEP program and the Manufacturing USA Institutes on workforce development can play a key role.[8] Finally, one of the best federal technical education program, NSF's Advanced Technical Education program, is chronically underfunded.[9] NSTC should highlight the importance of this program. Additional funding for states for the acquisition of equipment and development of manufacturing curriculum is also needed.

6) How can the Federal government assist in the development of regional public-private partnerships to achieve greater distribution of advanced manufacturing clusters or technology hubs, particularly in underserved regions of the country? What outreach and engagement strategies are most useful in promoting development in underserved regions of the country?

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[6] Robert D. Atkinson, "A Dismal Future: The Projected Decline of U.S. Manufacturing," *Innovation Files*, October 4, 2021, https://itif.org/publications/2021/10/04/dismal-future-projected-decline-us-manufacturing.

[7] ITIF, "Building High-Performance SME Clusters for American Competitiveness in the 21st Century" (ITIF, December 5, 2018), https://itif.org/events/2018/12/05/building-high-performance-sme-clusters-for-american-competitiveness.

[8] ITIF, "Manufacturing Workforce Development and Strengthening Manufacturing Supply Chains: What Can States Do?" (ITIF, November 17, 2020), https://itif.org/events/2020/11/17/manufacturing-workforce-development-and-strengthening-manufacturing-supply-chains.

[9] Madeline Patton, "Recruiting manufacturers and students," *Community College Daily*, October 23, 2021, https://www.ccdaily.com/2021/10/recruiting-manufacturers-and-students/.

As ITIF has recommended, Congress should establish a national advanced technology hub program to provide significant amounts of federal funding, including for scientific and engineering research, to a select number of promising places.[10] Advanced manufacturing is subject to what regional economists term agglomeration economies. It is not spread out evenly and shallowly across the nation. Suppliers and other firms often want to be close to one other. Support institutions, like specialized community colleges and research universities, can play key enabling roles. As such, any federal program should resist the politically expeditious process of "peanut butter" policy (spreading out support far and wide to help many places but achieving real little change).

States would also benefit from developing and executing state-level manufacturing innovation strategies. In 2018, the State Science and Technology Institute (SSTI) and the Center for Regional Economic Competitiveness (CREC), supported by NIST's Manufacturing Extension Partnership (MEP), launched a novel Policy Academy designed to assist states with developing and refining strategies impacting their manufacturing industries.[11] While this represents a step in the right direction, federal support could go further; specifically by Congress authorizing a program, which could be administered by MEP, providing a grant of up to $300,000 per state—which would have a 2:1 federal-state matching requirement—to assist U.S. states with the development and execution of state-level manufacturing strategies.

7) How do we assess the adequacy of the domestic advanced manufacturing supply chain and industrial base? How can Federal agencies assist small and medium sized manufacturing companies to adopt advanced technologies and to develop a robust and resilient manufacturing supply chain? What steps can these agencies take to promote the development and diffusion of technology that augments worker skills (rather than substituting for them), and ensures that manufacturing jobs are good jobs?

The reality is that the federal government knows little about the advanced manufacturing supply chain, in large part because the Census does not collect this data. OSTP should work with NIST and Census to develop a more comprehensive Annual Survey of Manufacturers.[12] At minimum, Census should ask manufacturers to report on the top five product inputs they purchase, including the name of the company and the country it is headquartered in and the type of input. At the same time, OSTP should work with the Bureau of Economic Analysis to explore how its Input-Output (I.O.) modeling can be expanded and

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[10] Robert D. Atkinson, Mark Muro, and Jacob Whiton, "The Case for Growth Centers: How to Spread Tech Innovation Across America" (ITIF and Brookings, December 2019), https://itif.org/publications/2019/12/09/case-growth-centers-how-spread-tech-innovation-across-america.

[11] State Science and Technology Institute (SSTI), "Ten states selected for manufacturing-focused Policy Academy," news release, July 25, 2019, https://ssti.org/blog/ten-states-selected-manufacturing-focused-policy-academy.

[12] United States Census Bureau, "ASM," https://www.census.gov/data/tables/time-series/econ/asm.html.

improved to better understand the nature of the supply chain.[13] Compared to earlier periods, the current I.O. industry coverage is quite broad, covering industries at a very high level of aggregation. Finally, the administration should work to integrate results from DOD supply-chain surveys into broader supply-chain analysis.

Because supply chains cross state boundaries, MEP needs to develop more cross-state, sector-based MEP initiatives (e.g., MEP programs designed to support subtier automotive suppliers). In other words, MEP should take on more of a supply chain and sector-based focus, making the program more oriented around America's industrial clusters. Here, MEP has developed an explicit supply-chain optimization (SCO) initiative designed to help manufacturers build dynamic supply chains by developing a long-term strategy, increasing visibility throughout multiple supplier tiers, identifying and mitigating risks, conducting domestic supplier scouting, identifying enterprise resource planning systems that are compatible across supply chain tiers as well as affordable for SMEs, and understanding total cost of ownership (TCO) and other best practices that encourage strategic partnerships throughout the supply chain.[14] Such efforts should be expanded.

8) Are there useful models (at the international, national, state and/or local level) that should be expanded?

While there are many models around the world that the United States can learn from, we will list three:

- **Collaborative research and development credits.** Many nations offer more generous R&D incentives to companies for extramural research performed at universities, government labs or consortia.[15] U.S. tax policy actually does the opposite, providing a weaker R&D credit for extramural research than for intramural.

- **Industrial Ph.D. programs.** A very small percentage of Ph.D. graduates obtain jobs in academia in the first place.[16] Yet, STEM Ph.D. programs are still designed as if the typical doctoral candidate will be an academic researcher. Other nations, such as Denmark, have recognized this problem and

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[13] U.S. Department of Commerce Bureau of Economic Analysis (BEA), "Concepts and Methods of the U.S. Input-Output Accounts" (BEA, April 2009), https://apps.bea.gov/papers/pdf/IOmanual_092906.pdf.

[14] Thomas C. Mahoney and Susan Helper, "Ensuring American Manufacturing Leadership Through Next-Generation Supply Chains" (Manufacturing Foresight, June 2017), 28, http://mforesight.org/projects-events/supply-chains/.

[15] Matthew Stepp and Robert D. Atkinson, "Creating a Collaborative R&D Tax Credit" (ITIF, June 2011), https://itif.org/publications/2011/06/09/creating-collaborative-rd-tax-credit.

[16] Richard C. Larson, Navid Ghaffarzadegan, and Yi Xue "Too Many PhD Graduates or Too Few Academic Job Openings: The Basic Reproductive Number R0 in Academia" *Systems Research and Behavioral Science* Vol. 31, Issue 6 (2014): 745-750, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4309283/.

created industrial Ph.D. programs designed to educate Ph.D. students with the knowledge and skills more likely to be useful to industry.[17]

- **Industry-focused and led programs.** Other nations, as well as most U.S. state governments, focus their R&D and technology policies on areas of critical importance to industry and ensure that these programs are significantly influenced by industry. By and large U.S. federal programs do not do that. For example, NSF's Engineering Research Center program is structured in response to university interests, failing to require any cash match by industry. As a result, the program is limited in terms of its impact on manufacturers in the United States. The proposed NSF Directorate of Technology and Innovation that would be created by the Senate U.S. Innovation and Competition Act (USICA) would help move U.S. policy in the right direction (in contrast to the Science and Engineering Solutions directorate proposed by the House Science Committee), but only if the traditional NSF culture of supporting science for science's sake does not permeate it.

9) The current Strategy for American Leadership in Advanced Manufacturing has three top-level goals, each with objectives and priorities: (1) Develop and transition new manufacturing technologies; (2) Educate, train, and connect the manufacturing workforce; and (3) Expand the capabilities of the domestic manufacturing supply chains. Are these goals appropriate for the next 4-5 years? Are there additional top-level goals to consider?

ITIF believes that the principal top level goal should be for the United States to run a trade surplus in advanced manufacturing products and at minimum no trade deficit in all manufacturing products by 2030. While the United States ran a trade surplus in advanced technology products in 2000, it now runs an annual trade deficit of over $190 billion.[18] In addition, we believe the plan should set a goal for U.S. manufacturing labor productivity growth to grow by at least 3 percent a year within the next five years. Publicly announcing these goals would help focus the public, experts, industry, and policymakers on the importance of achieving them and on taking the needed steps.

10) Is there any additional information related to advanced manufacturing in the United States, not requested above, that you believe should be considered?

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[17] Roslyn Layton, "What The U.S. Can Learn From Denmark's Industrial PhD Program," *Innovation Files*, November 20, 2013, https://www.innovationfiles.org/what-the-u-s-can-learn-from-denmarks-industrial-phd-program/.

[18] Robert D. Atkinson, "Time for a New National Innovation System for Security and Prosperity," *Prism* Vol. 9 No. 2 (March 2021), https://www2.itif.org/2021-PRISM-9-2-new-national-innovation-system.pdf. (itif.org); U.S. Census Bureau, "Monthly U.S. International Trade in Goods and Services), October 5, 2021, https://www.census.gov/foreign-trade/Press-Release/2021pr/ft900_2108.pdf.

As ITIF has noted, manufacturing policy should focus on the "four 'Ts'": technology, trade, tax, and talent.[19] While overarching changes in tax policy for manufacturing are beyond the scope of this inquiry, we will note that two key provisions in the tax code that help manufacturers are set to expire soon: the ability to expense R&D in the first year and the ability to expense investments in machinery and equipment. Both provisions help manufacturers, especially publicly traded ones faced with short-term financial pressures, justify increased investment in R&D and capital equipment.

ITIF has also comprehensively detailed its full set of recommendations to support U.S. manufacturing in its May 2020 report "Policy Recommendations to Stimulate U.S. Manufacturing Innovation."[20]

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[19] Stephen Ezell and Robert D. Atkinson, "Fifty Ways to Leave Your Competitiveness Woes Behind: A National Traded Sector Competitiveness Strategy" (ITIF, September 2012), https://itif.org/publications/2012/09/20/fifty-ways-leave-your-competitiveness-woes-behind-national-traded-sector.

[20] Stephen Ezell, "Policy Recommendations to Stimulate U.S. Manufacturing Innovation" (May 2020, ITIF), https://itif.org/publications/2020/05/18/policy-recommendations-stimulate-us-manufacturing-innovation.