



# MANUFACTURING USA STRATEGIC PLAN

Advanced Manufacturing National  
Program Office

November 2019



### **About this Document**

This document is the strategic plan for Manufacturing USA, as required by the Revitalize American Manufacturing and Innovation (RAMI) Act of 2014.<sup>1</sup> After completion and submittal for clearance in 2019 there were two subsequent significant events which will influence Manufacturing USA's future activities. The first is that Congress reauthorized the program, making significant changes and adding new responsibilities and authorities. The second is the COVID-19 pandemic, exposing vulnerabilities in the nation's supply chains and the ability to produce essential products needed for the health, safety and national security of the nation. The next strategic plan will be informed by these factors.

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<sup>1</sup> Consolidated and Further Continuing Appropriations Act, 2015, Pub. L. 113-235, Title VII — Revitalize American Manufacturing and Innovation Act of 2014, codified at 15 U.S.C. § 278s(f)(2)(C). Note that there was a reauthorization in December 2019, after this plan was completed.



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# Manufacturing USA Strategic Plan

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## About Manufacturing USA

Manufacturing USA was created to improve the competitiveness of U.S. manufacturing by accelerating innovation and implementation of advanced manufacturing capabilities. Each institute creates the necessary focus and provides the state-of-the-art facilities needed to allow collaborative, pre-competitive development of promising technologies. An institute provides workforce education and training in advanced manufacturing. It also promotes the creation of a stable and sustainable innovation ecosystem for advanced manufacturing. The 14 current institutes are listed in Table 1.

The Departments of Defense, Energy, and Commerce have collectively committed over \$1 billion in the program, which has led to over \$2 billion in matching commitments of non-federal resources and funds. These large matching investments by industry, academia, and state and local governments demonstrate the strong demand for these unique public-private partnerships for advancing U.S. manufacturing capabilities.

The program will continue to be guided by federal agencies with interests in manufacturing, including Department of Energy, Department of Defense, Department of Commerce, the Department of Education (DOEd), Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA), the Food and Drug Administration (FDA), the Department of Labor (DOL) and the National Science Foundation (NSF).

### Vision

The vision for the Manufacturing USA Program is *U.S. global leadership in advanced manufacturing.*

### Mission

To support this vision, the mission of the Manufacturing USA Program is *connecting people, ideas, and technology to solve industry-relevant advanced manufacturing challenges, thereby enhancing industrial competitiveness and economic growth and strengthening our national security.* The DoD Manufacturing Innovation Institutes (MIIs) have the additional mission to develop innovative technologies that will ultimately aid the warfighter. The DOE Office of Energy Efficiency & Renewable Energy, Advanced Manufacturing Office also establishes Manufacturing Innovation Institutes to bolster U.S. energy efficiency and innovation.

Manufacturing USA coordinates and catalyzes public and private investment in precompetitive advanced manufacturing technology infrastructure. Manufacturing USA is designed to: 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 chain.



**Table 1. Manufacturing USA Institutes and Technology Areas**

<b>Institute</b>	<b>Technology Focus</b>	<b>Sponsoring Agency</b>	<b>Headquarters</b>	<b>Date Established</b>
<b>America Makes</b> The National Additive Manufacturing Innovation Institute	Additive manufacturing	DOD	Youngstown, Ohio	August 2012
<b>MxD</b> Manufacturing times Digital	Digital manufacturing and design/ Cybersecurity in Manufacturing	DOD	Chicago, Illinois	February 2014
<b>LIFT</b> Lightweight Innovations for Tomorrow	Lightweight materials manufacturing	DOD	Detroit, Michigan	February 2014
<b>PowerAmerica</b> The Next Generation Power Electronics Manufacturing Innovation Institute	Wide-bandgap power electronics manufacturing	DOE	Raleigh, North Carolina	January 2015
<b>IACMI</b> Institute for Advanced Composites Manufacturing Innovation	Fiber-reinforced polymer composites manufacturing	DOE	Knoxville, Tennessee	June 2015
<b>AIM Photonics</b> American Institute for Manufacturing Integrated Photonics	Integrated photonics manufacturing	DOD	Rochester and Albany, New York	July 2015
<b>NextFlex</b> America's Flexible Hybrid Electronics Manufacturing Institute	Thin flexible electronics devices and sensors manufacturing	DOD	San Jose, California	August 2015
<b>AFFOA</b> Advanced Functional Fabrics of America Institute	Sophisticated, integrated, and networked fibers, yarns, and fabric manufacturing	DOD	Cambridge, Massachusetts	April 2016
<b>CESMII</b> Clean Energy Smart Manufacturing Innovation Institute	Smart manufacturing	DOE	Los Angeles, California	December 2016
<b>BioFabUSA</b> Advanced Regenerative Manufacturing Institute	Engineered tissues and tissue-related manufacturing	DOD	Manchester, New Hampshire	February 2017
<b>ARM</b> Advanced Robotics for Manufacturing Institute	Transformative robotic technologies and education for manufacturing	DOD	Pittsburgh, Pennsylvania	January 2017
<b>NIIMBL</b> The National Institute for Innovation in Manufacturing Biopharmaceuticals	Biopharmaceutical manufacturing	DOC	Newark, Delaware	March 2017
<b>RAPID</b> Rapid Advancement in Process Intensification Deployment Institute	Modular chemical-process intensification for clean manufacturing	DOE	New York, New York	March 2017
<b>REMADE</b> Reducing Embodied-energy And Decreasing Emissions	Sustainable manufacturing with clean energy and carbon-emission reduction	DOE	Rochester, New York	May 2017



## Goals and Objectives

To realize the Manufacturing USA Program's vision, the agencies and institutes participating in Manufacturing USA collectively work toward achieving these four program goals based on the RAMI Act<sup>2</sup>:

Goal 1: Increase the competitiveness of U.S. manufacturing.

Goal 2: Facilitate the transition of innovative technologies into scalable, cost-effective, and high-performing domestic manufacturing capabilities.

Goal 3: Accelerate the development of an advanced manufacturing workforce.

Goal 4: Support business models that help institutes to become stable and sustainable.

As shown in Figure 1, the four Manufacturing USA Program goals are interrelated elements of a robust strategy for supporting manufacturing innovation to reduce the gap between early stage research and eventual commercial deployment in manufacturing. They are designed to facilitate the deployment of manufacturing innovations to allow the U.S. to advance its domestic manufacturing capability and capture the economic and national security benefits stemming from federal and private sector investments in fundamental research.

By catalyzing the collaborative, precompetitive development of promising technologies, the institutes create sustainable innovation ecosystems for advanced manufacturing through activities that include:

- Conducting (or funding) precompetitive research and development projects to reduce the cost, time, and technical uncertainty related to new manufacturing technologies and to improve existing technologies, processes, and products;
- Developing and implementing education, training, and workforce recruitment courses, materials, and programs;
- Developing new technologies, innovative methodologies, and improved practices for integrating and expanding supply chains;
- Engaging with small and medium-sized manufacturers (SMMs), including woman- and minority-owned manufacturing enterprises, as well as larger manufacturing firms; and
- Developing or encouraging shared state-of-the-art facilities and infrastructure to reduce the cost and risk of commercializing new technologies and to address relevant manufacturing challenges on a production-level scale.

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<sup>2</sup> Consolidated and Further Continuing Appropriations Act, 2015, Pub. L. 113-235, Title VII — Revitalize American Manufacturing and Innovation Act of 2014, codified at 15 U.S.C. § 278s.



<b>Goal 1:</b> Increase Competitiveness		
<b>Goal 2:</b> Facilitate Technology Transition	<b>Goal 3:</b> Accelerate the Manufacturing Workforce	<b>Goal 4:</b> Ensure Stable and Sustainable Infrastructure

**Figure 1. Interrelated Manufacturing USA Program Goals** — The four goals are interrelated elements of a robust strategy for supporting manufacturing innovation by reducing the gap between early stage basic research and commercial deployment in manufacturing. They facilitate the deployment of manufacturing innovations, allowing the U.S. to capture the economic and national security benefits stemming from federal and private sector investments in fundamental research.

### **Goal 1: Increase the competitiveness of United States manufacturing**

Achieving Goal 1 will increase the production of goods in the United States and strengthen American manufacturers’ ability to sell their goods domestically and to global markets. This requires fostering American leadership in advanced manufacturing research, innovation, and technology development. The Manufacturing USA Program is designed to do just that, by catalyzing advances in new technologies, production materials, processes, information, and products as well as development of workforce educational competencies by promoting shared contributions from the public sector, the private sector, and academia. Institutes are public-private partnerships that provide a mechanism to advance the development steps necessary for industry to benefit from early stage research.

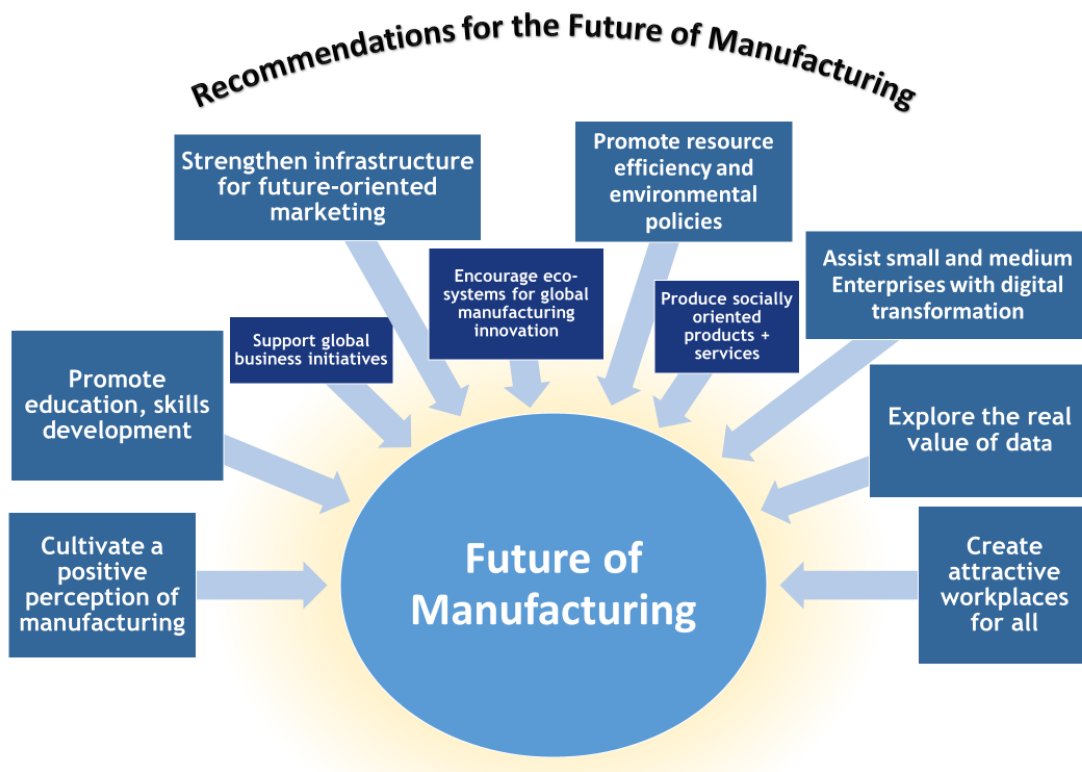
Strengthening domestic innovation ecosystems is critical to national competitiveness. Each institute creates and supports regional manufacturing ecosystems in a specific technology area. Communication among the institutes amplifies their impact on advanced manufacturing, benefitting the entire nation and improving the ability of the U.S. to compete for manufacturing investment. The interaction facilitates knowledge transfer between institutes that makes each operate more efficiently and increases the impact of Manufacturing USA’s outreach activities.

The 2018 World Manufacturing Forum Report identified 10 key recommendations for the future of manufacturing,<sup>3</sup> shown in Figure 2. Collectively, the mission and vision of Manufacturing USA are well aligned with these recommendations.

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<sup>3</sup> 2018 World Manufacturing Forum Report 2018: Recommendations for the Future of Manufacturing, World Manufacturing Forum, p. 75. <https://www.effra.eu/news/world-manufacturing-forum-publishes-report-future-manufacturing>





**Figure 2.** “Key Recommendations for the Future of Manufacturing” from the World Manufacturing Forum. Manufacturing USA’s institute activities align with 7 out of 10 recommendations. Manufacturing USA’s aligned activities are enlarged.

Manufacturing USA’s compounding impact lies in the range of U.S.-based partnerships it encourages. For example, building partnerships with small businesses promotes the broad diffusion of advanced manufacturing technologies throughout the U.S. supply base. This early participation enables the small businesses to join later in the technology commercialization and in the manufacturing supply chain. Partnerships with academia and workforce development programs provide a critical pipeline of skilled and knowledgeable workers for U.S. manufacturers. Altogether, Manufacturing USA encourages the creation of stronger domestic supply chain networks that in turn encourage U.S. manufacturers to produce more products in the U.S.

## **Goal 2: Facilitate the transition of innovative technologies into scalable, cost-effective, and high-performing domestic manufacturing capabilities**

The overall purpose of Goal 2 is to lower technical, economic, and social barriers that prevent the development of innovations by establishing innovation ecosystems containing sufficient resources and focused on attainable industry markets. Manufacturing USA institutes help industry adopt and scale complex advanced manufacturing technology to produce better products and services. Small and medium-sized manufacturers often do not possess the capital, personnel, or available time to pursue innovative technologies at scale; and large manufacturers with existing portfolios tend to be risk averse. Manufacturing USA institutes bring small and medium manufacturers into their ecosystems and diffuse risk, encouraging more investment and more research.



This “one-to-many” amplification of newly developed manufacturing capabilities is a key benefit of having connected institutes within the program. Collaboration between entrepreneurs and industrial manufacturing experts advances production technology to meet challenges facing the institutes, their members, and the larger U.S. manufacturing sector. The institutes promote partnerships that include small and medium-sized entities that would benefit from shared access to facilities. The institutes share their innovations with other institutes and with the broader manufacturing sector.

Institutes focus on specific technologies. The technologies are determined in two different ways. Institutes sponsored by agencies other than Commerce focus on topics that those agencies select with broad stakeholder input, in order to ensure that the funded institutes support those agencies’ missions. In contrast, Commerce-led institute topics are determined by “open-topic” competitions where any topics proposed and supported by industry sectors are considered. One benefit of this latter approach is that national priority areas identified by industry can be addressed even if there is no agency mission to cover the topic.

While specific technical topics are not discussed in this strategic plan, manufacturing priorities for the federal agencies are presented in the 2018 Strategy for American Leadership in Advanced Manufacturing.<sup>4</sup>

### **Goal 3: Accelerate the development of an advanced manufacturing workforce**

Goal 3 recognizes that a healthy manufacturing environment includes workforce development, improved job opportunities, and increased economic opportunity that results in higher wages for American workers. Manufacturers using advanced technology are hindered by a large gap between the skills needed for the jobs that will boost production and the skills possessed by current workers. This gap may only widen if workforce development does not keep pace with the changing skills needed for jobs that emerge when accomplishing Goals 1 and 2. Manufacturers cannot scale up new technologies domestically without sufficient domestic talent.

An important component in developing an advanced manufacturing workforce for the long term is nurturing the interest of young students in Science, Technology, Engineering, and Mathematics (STEM) topics. Increasing an early sense of excitement about STEM will widen the pipeline of students available for more specialized training and education. Part of the strategy for communications about program and institute activities includes outreach efforts, such as participation in Manufacturing Day, to improve the image of manufacturing careers and to correct inaccurate negative stereotypes about manufacturing employment.

Institutes help to train the workforce at all levels, while also demonstrating to instructors and administrators how to develop effective workforce training programs. These programs and initiatives support a coherent sequence of secondary to postsecondary courses while connecting students to registered and industry-recognized apprenticeship programs and other work-based learning and cooperative education opportunities. Such programs are aligned to allow students to seamlessly transition through each level of study. Further, the institutes are increasingly attending to the quality and alignment

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<sup>4</sup> Strategy for American Leadership in Advanced Manufacturing, 2018, NSTC.  
<https://www.manufacturing.gov/news/announcements/2018/10/strategy-american-leadership-advanced-manufacturing>.



of secondary and postsecondary career and technical education programs, in regions in which institutes are active, to help assure that technician education programs are established at scale, based on a realistic analysis of future skill demands.

With data on institute performance now available for a number of institutes,<sup>5</sup> it is clear that the institutes provide substantial education and workforce development (EWD) in advanced manufacturing, but that it is challenging to get industry to provide direct support for these efforts. Less than 1 percent of education and workforce development support comes from industry, as shown in table 2 below. This may be due to a company's unwillingness to support an effort where the entire manufacturing community is the beneficiary, rather than just the company providing funding. In any event, the data indicate the importance of the institutes in convening those groups with the resources to provide education and workforce development to the national manufacturing community. Institutes required to become independent of core federal funding will need to identify other sources of support to be able to continue their EWD efforts .

Table 2. Education and Workforce Development Funding Sources for Nine Institutes

<b>Total expenditures for EWD projects and activities operated by 9 institutes in fiscal year 2018 (\$1,000)</b>	<b>\$ 9,033</b>
<u>Base funding expended</u> : resourced by institute using base federal funding from the original cooperative agreement or technology investment agreement	<b>\$ 5,410</b>
<u>Commercial expenditures</u> : provided from industry, regardless of membership status	<b>\$ 66</b>
<u>Federal agency expenditures</u> : resourced from federal funding outside the base cooperative agreement or technology investment agreement funding	<b>\$ 1,152</b>
<u>State or local funding expended</u> : resourced from state or municipal government funding	<b>\$ 664</b>
<u>Other expenditures</u> : resourced from philanthropic organizations, nonprofits, foundations, or associations	<b>\$ 1,740</b>

#### **Goal 4: Support institute business models that help institutes become stable and sustainable**

To best support a viable and lasting U.S. innovation ecosystem, each institute funded under RAMI authority must develop a sustainable business model that delivers useful benefits to its members while also operating independently of federal base funding. Sufficient support from institute members and other sources provide a leading indicator of the formation of a healthy ecosystem of customers and industrial, academic, and government partners focused on that institute's technology space. Viewing the institutes

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<sup>5</sup>Manufacturing USA FY 2018 Annual Report, <https://www.manufacturingusa.com/reports/manufacturing-usa-annual-report-delivering-value-nation>, pp.13-14.



collectively, pursuit of this goal similarly serves to create a stable and sustainable program with broad, national benefit.

The institutes receive significant non-federal support for their activities. In FY 2018, the institutes exceeded the required sustainability target of a 1-to-1 match for their funding of institute expenditures. Total institute expenditures were \$496.9 million, with nonprogram matching expenditures totaling \$313.5 million and federal program funds totaling \$183.4 million — a match from industry, academia, and regional organizations of \$1.70 for each \$1 in base federal funding. These matching funds were expended for technology research and development efforts, capital-intensive efforts such as facility or manufacturing equipment purchases, institute operations, and education and workforce development programs.

Each institute works with its respective lead funding agency to establish and monitor sustainability. Funding from the lead funding agency supports an establishment and initial operating phase for new institutes. During this period, institutes conduct pre-competitive applied research to advance the manufacturing processes and systems associated with their specific technology areas and work towards creating manufacturing innovation ecosystems.

The startup phase includes activities such as:

- Recruiting members.
- Deciding how to share intellectual property.
- Developing technology roadmaps.
- Conducting advanced manufacturing research and development.
- Creating and demonstrating advanced manufacturing tools.
- Sharing pre-competitive knowledge among members.
- Developing curriculum and training programs for the workforce.

When participating in the institutes results in significant benefits for the members, they are motivated to remain engaged and to continue their memberships, and to help propel institutes into later phases of operation.

Since each institute operates within unique technology areas with a variety of stakeholders, the operational procedures at each institute will differ. The Manufacturing USA Program can provide great value by ensuring that best practices and hard lessons learned from unsuccessful efforts are both recorded and shared across the institutes. Sharing this type of information will help institutes reach sustainability more efficiently.



# Program Coordination and Reports

## Interagency and program coordination

Robust communication within Manufacturing USA at many different levels has improved operations and grown impacts of the program. New institutes are able to ramp up more quickly by leveraging lessons learned from more experienced ones. Existing institutes can define unique best practices by comparing membership models, industry sectors, and target stakeholders. Participating agencies can increase their engagement by identifying opportunities for which they are uniquely suited to deliver. Encouraging this internal communication is a strategy that will continue going forward, both in regular, formal interactions discussed below, and in informal or ad hoc situations.

Staff from Manufacturing USA institutes and participating agencies come together at least once a year for national meetings to share best practices and lessons learned, generate new ideas and collaborations, and identify cross-institute functions that enable established institutes to focus on their mission, and newer institutes to come up to speed quickly. The meetings also often include premeeting and parallel working sessions for specific interest groups, such as an executive session for institute directors and senior federal leaders and the Education and Workforce Development team. These meetings have proven to be productive for information sharing and idea generation, including formative dialogue on program direction.

The “Charter of the Institute Directors Council: Manufacturing USA,”<sup>6</sup> describes the formation and goals for the Manufacturing USA Institute Directors Council. In addition to face-to-face sessions at the national meetings, the council also meets by phone and engages with agencies. The council facilitates cooperation and collaboration among the institutes, with advice as needed from the Federal institute sponsors and agencies providing additional support to the institutes. Among the council’s stated responsibilities are the following:

- Promoting collaboration and cooperation among the institutes in support of the goals of Manufacturing USA;
- Facilitating communications/engagement among the institutes and between the institutes and the Federal government;
- Encouraging institute activities that leverage the diversity and strengths of the network to collaborate on cross-cutting activities;
- Recommending to the Network common policies/guidelines for Institutes; and
- Developing best practices and approaches for project calls involving two or more institutes and supporting as appropriate (with input from the respective project funding agency) joint project calls by institutes with existing resources.

The agencies involved in Manufacturing USA maintain regular contact. The Interagency Working Team, comprised of representatives from all agencies contributing to Manufacturing USA, focuses on

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<sup>6</sup> Charter of the Institute Directors Council: Manufacturing USA, Advanced Manufacturing Series, NIST AMS 600-1, 2016, <https://www.manufacturingusa.com/reports/charter-institute-directors-council>



management and coordination of the Manufacturing USA program on monthly calls. The office directors for the institute-sponsoring agencies also discuss higher level policy issues and actions on monthly calls.

## Program Assessment

**Benchmarking** U.S. manufacturers compete in a global marketplace where not all competitors are on a level playing field. Understanding of companies in other countries and the relative advantages enjoyed by each provides insights into the competition faced in the U.S. For example, South Korea, Germany, and Japan all have research more intensely focused on manufacturing than the U.S.,<sup>7</sup> creating attractive infrastructures or ecosystems for a company looking to scale up a technology into a full-fledged commercial product.

Furthermore, other countries are growing programs very similar to Manufacturing USA. The German Fraunhofer institutes have existed for decades and have permeated the culture of German manufacturing.<sup>8</sup> Made in China 2025 announced the intention to create 40 new manufacturing innovation institutes by 2025.<sup>9</sup> The United Kingdom, Australia, Brazil, France and many others have recognized the importance of manufacturing to national and economic security and are ramping up manufacturing innovation institutes. While all of these certainly change the competitive balance in the global marketplace, they may also offer the opportunity to learn practices that can benefit Manufacturing USA and, thereby, U.S. manufacturers.

All of this leads to the conclusion that benchmarking foreign efforts in improving manufacturing competitiveness is a necessary activity for Manufacturing USA.

**Independent Assessments** Manufacturing USA has found great benefit from external assessments of the program over the past several years. Feedback on the program, whether highlighting successes or recommending improvements, has been beneficial. Many of the findings of these previous assessments are positive and are summarized below in the section on “Progress Made in Achieving the Objectives from the 2016 Strategic Plan.” This type of positive reinforcement is not only encouraging, it allows new and maturing institutes to adopt best practices quickly. Recommendations for improvements have led to positive changes in the program, for example, broadening the inclusion of more agencies that do not fund institutes and defining a clear role for them in the program. Independent assessments include independent workshops and studies convened by the National Academies of Sciences Engineering and Medicine (NASEM).

Biennial Government Accountability Office (GAO) assessments are mandated by the RAMI Act. Manufacturing USA will continue to benefit from assessment and feedback from such unbiased, respected, and expert observers. A summary of these assessments and references are detailed in the External Assessments section.

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<sup>7</sup> See, for example, U.S. Manufacturing in International Perspective, Congressional Research Service, 2018. (<https://fas.org/sgp/crs/misc/R42135.pdf>); Manufacturing USA: A Third-Party Evaluation of Program Design and Progress, Deloitte, 2017 (<https://www2.deloitte.com/us/en/pages/manufacturing/articles/manufacturing-usa-program-assessment.html>)

<sup>8</sup> [https://en.wikipedia.org/wiki/Fraunhofer\\_Society](https://en.wikipedia.org/wiki/Fraunhofer_Society)

<sup>9</sup> Made in China 2025 Backgrounder, Institute for Security and Development Policy 2018, <https://isdsp.eu/publication/made-china-2025/>



**Metrics** One of the common themes of the third-party assessments of Manufacturing USA is the recommendation that there be improved measures, metrics, and targets to assess how well program goals and objectives are being met. However, Manufacturing USA is in a challenging position where institutes, having been continually launched since 2012, are in various stages of maturity while the sponsoring agency’s priorities may have shifted since the program’s inception. Furthermore, the reporting requirements of the RAMI Act only apply to DOC, though compiling a meaningful annual report requires collaboration with other agencies in the program, such as DOD and DOE, who themselves are subject to different authorities and requirements. An interagency team was chartered to identify additional and expanded metrics, which is being implemented for the 2019 annual report.

## **Communications**

Manufacturing USA provides extensive communications to various stakeholders through multiple media and non-traditional channels to broaden awareness and participation. These communications target U.S. manufacturers of all sizes who benefit from technology and workforce development as well as workers, educators, and students who benefit from education and workforce development opportunities. The program continues to grow its web and social media presence and develops content and articles for key media outlets and industry/trade publications. Through the website (ManufacturingUSA.com) and social media (LinkedIn and Twitter), Manufacturing USA engages the national ecosystem and provides educational content to highlight the role of Manufacturing USA for U.S. manufacturing, share news and successes from the institutes, inform potential new members about how to participate in institute activities, and update the manufacturing industry on the opportunities available through Manufacturing USA. In addition, each institute has its own strategies and communication channels to promote its own work and the benefits of membership, as well as engage with current and potential members. Manufacturing USA participates in select manufacturing conferences, expositions, and events to share stories and information about Manufacturing USA and the work of the institutes and their members to develop advanced manufacturing technologies and a skilled workforce in the U.S. In addition, RAMI requires a report from DOC to Congress each year describing the “performance of the Program,” which is created and distributed annually in partnership with the interagency team and the institutes.<sup>10</sup>

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<sup>10</sup> Consolidated and Further Continuing Appropriations Act, 2015, Pub. L. 113-235, Title VII – Revitalize American Manufacturing and Innovation Act of 2014, codified at 15 U.S.C. § 278s(g)(2).



## Progress Made in Achieving the Objectives from the 2016 Strategic Plan

The first strategic plan for the program, “National Network for Manufacturing Innovation (NNMI) Program Strategic Plan,” was published in 2016.<sup>11</sup> Since then, significant progress has been made in achieving the objectives laid forth. This section relies on previously published reports, some coming from the Manufacturing USA program itself and others coming from external assessment of the program, to highlight that progress.

### Annual Reports

Manufacturing USA has gone beyond its Congressional mandate in each of the past three years, delivering an annual report that not only summarizes the performance of the program, but also highlights the success stories coming out of each institute. These reports are thorough discussions of how the program is meeting its objectives. Several examples are mentioned below:

- The 2016 Annual Report<sup>12</sup> discussed a shared website that was established where the institutes collaborate and communicate, and several individual institutes began using NIST-provided sites for their own internal communications and collaboration, such as managing project calls. Cross-institute working groups, such as workforce development and education, also collaborated through these means, facilitating the sharing and documentation of best practices for addressing advanced manufacturing challenges.
- The 2017 Annual Report<sup>13</sup> highlighted the addition of six new institutes to Manufacturing USA, bringing the total to the current level of 14. These institutes are fostering U.S. leadership in advanced manufacturing research, innovation, and technology in fields from biopharmaceuticals, to chemical processing, to advanced robotics.
- The 2018 Annual Report<sup>14</sup> emphasized the substantial impact Manufacturing USA is having in nurturing future workers for science, technology, engineering, and mathematics (STEM) related work. Over 200,000 people participated in institute-led education and workforce development programs.

### External Assessments

Manufacturing USA has gained great benefit from independent assessments from GAO, Deloitte, and the National Academies of Science, Engineering, and Medicine. These studies have largely found that the program is achieving, or making significant progress toward, its objectives. Some highlights are below.

The RAMI Act requires an assessment of the program not less frequently than once every two years. There were two such assessments during the period covered by the previous strategic plan:

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<sup>11</sup><https://www.manufacturingusa.com/reports/national-network-manufacturing-innovation-nnmi-program-strategic-plan>

<sup>12</sup><https://www.manufacturingusa.com/sites/prod/files/Manufacturing%20USA-Annual%20Report-FY%202016-web.pdf>

<sup>13</sup> <https://nvlpubs.nist.gov/nistpubs/ams/NIST.AMS.600-3.pdf>

<sup>14</sup> <https://nvlpubs.nist.gov/nistpubs/ams/NIST.AMS.600-5.pdf>





- In December 2016, GAO<sup>15</sup> found that members were receiving a variety of benefits, such as access to intellectual property and networking opportunities. The GAO recommendation to clarify the responsibilities of participating agencies, including all relevant agencies, has led to increased participation from agencies that are not sponsoring institutes.
- In May 2019, GAO<sup>16</sup> mentioned that institutes support state-of-the-art facilities needed to enable development of promising technologies. They highlighted PowerAmerica’s installation of new equipment to enhance the ability to qualify and process silicon carbide devices at a foundry in Lubbock, Texas. Another example is an AIM Photonics foundry improvement project that led to the development and installation of new inline controls and test equipment, significantly improving yield and enabling commercial applications for companies as well as allowing companies to share expensive silicon wafer space on multi-project wafer runs.

“Manufacturing USA - A Third-Party Evaluation of Program Design and Progress,” from January 2017<sup>17</sup> reached the overarching conclusion that Manufacturing USA is working. Among other findings, the study team highlighted that the first eight advanced manufacturing institutes established between 2012 and 2016 had reached a critical mass of valuable connections among 1,200 participating companies, universities, and government agencies. Those connections were accelerating the innovation needed to develop new products and markets, helping alleviate a shortage of technically trained manufacturing workers, and building a sustainable national manufacturing research infrastructure.

The National Academies of Science, Engineering, and Medicine (NASEM) have conducted three assessments of various aspects of Manufacturing USA. A common theme across all these assessments is that the U.S. benefits from programs like Manufacturing USA that spur additional investment in manufacturing research. Some highlights are below:

- In May 2017, multiple participants in the NASEM workshop<sup>18</sup> emphasized the role of the manufacturing institutes in connecting university research to manufacturers, drawing new manufacturing technologies and techniques into small and large firms.
- In April 2019, when focusing on DOD-sponsored institutes, NASEM’s consensus study<sup>19</sup> stated that Manufacturing USA institutes are considered crucial and game-changing catalysts that are bringing together innovative ecosystems in various technology and market sectors critical to DOD and the nation.

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<sup>15</sup> GAO-17-230; <https://www.gao.gov/assets/690/683973.pdf>

<sup>16</sup> GAO-19-409; <https://www.gao.gov/assets/700/699738.pdf>

<sup>17</sup> Manufacturing USA A Third-Party Evaluation of Program Design and Progress; <https://www2.deloitte.com/us/en/pages/manufacturing/articles/manufacturing-usa-program-assessment.html>

<sup>18</sup> Securing Advanced Manufacturing in the United States, National Academies Press; <https://www.nap.edu/catalog/24875/securing-advanced-manufacturing-in-the-united-states-the-role-of>

<sup>19</sup> Strategic Long-Term Participation by DOD in Its Manufacturing USA Institutes, National Academies Press; <https://www.nap.edu/catalog/25417/strategic-long-term-participation-by-dod-in-its-manufacturing-usa-institutes>



- In May 2019, NASEM released the summary of another workshop<sup>20</sup> where multiple participants stated that networking and collaboration opportunities made possible by Manufacturing USA can yield great benefits.

In summary, the primary goals laid out in the 2016 Strategic Plan have been substantially achieved, with associated significant growth of institute membership led by industry, and progress toward the goals in manufacturing technology development and education and workforce training.

## Going Forward

Manufacturing USA will continue to grow in the coming years. The program will continue to work toward achieving the four RAMI Act goals, benchmark against other countries, and develop metrics for measuring performance of Manufacturing USA. The value of Manufacturing USA is in the work done by the institutes, and new institutes will be stood up as appropriate. For this last activity, the DOE is currently reviewing proposals for a new manufacturing innovation institute focused on cybersecurity.<sup>21</sup> The DOD has announced its intention to start a new institute on the topic of synthetic biology manufacturing for non-biological applications.<sup>22</sup> Membership and participation in the Manufacturing USA institutes is on an upward trend, with no indication of abating. The challenge going forward will be for the program to adopt strategies that allow Manufacturing USA to realize its purpose while accommodating the inevitable changes.

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<sup>20</sup> Revisiting the Manufacturing USA Institutes, National Academies Press;

<https://www.nap.edu/catalog/25420/revisiting-the-manufacturing-usa-institutes-proceedings-of-a-workshop>

<sup>21</sup><https://www.energy.gov/articles/doe-announces-70-million-cybersecurity-institute-energy-efficient-manufacturing>

<sup>22</sup><https://www.manufacturingusa.com/news/dod-announces-request-information-new-manufacturing-innovation-institute-dedicated-synthetic>