Pillar I: Supply-Chain Resilience

“This crisis and this recovery expose a long-term hollowing-out of our country’s industrial base, which happened over years and decades.”

—Brian Deese, Director of National Economic Council
June 23, 2021
Section Overview

A history of offshoring production has eroded the U.S. manufacturing base and weakened our nation’s ability to meet the medical and economic needs of all Americans, especially in times of crisis. In crafting a forward-looking strategy of innovation and resilience within our supply chains, we must learn from COVID-19 pandemic and the near past. From activating local designers and producers in times of need, to connecting R&D investments with manufacturing capabilities that rapidly scale and commercialize innovations across regions, below is a set of actionable recommendations to strengthen and improve our supply chains.

Fortifying Medical Supply Chains: Lessons to Learn from COVID-19

From March to August 2020, local designers, engineers, and manufacturers operated more than 600 prototyping and digital fabrication facilities in every state to produce over 8 million units of personal protective equipment (PPE)—all on their own initiative. This network overcame limited access to government funding for grassroots manufacturing and unclear regulatory approval for novel PPE to meet the needs of millions in their communities. Our nation’s responsiveness to disasters would increase with the creation of a federally defined, state-activated U.S. Prototyping and Manufacturing Reserve to tap into networked, community-based production capacity. The Federal Emergency Management Agency (FEMA), in partnership with the Department of Defense (DoD) and Small Business Administration (SBA), could determine tiered certification standards for participating in the reserve. A lead administrative agency would be designated to formalize, support, and coordinate the network’s actions. As distributed PPE manufacturers struggled by the dearth of standardized designs, one other rapid response measure could include creating a Digital Stockpile of Open-source Blueprints for making medical and emergency supplies and devices. This library should be manufacturing-agnostic, include designs for low-resource environments, offer plain-language instructions for users, and provide complete manufacturing requirements and testing guidance.

Even before the pandemic, our country faced national drug shortages that needlessly cost thousands of lives and nearly $500 million every year. Causes of the majority of drug shortages are still classified as “unknown” because of the secrecy of pharmaceutical supply chains. A joint initiative by the DoD, the Department of Health and Human Services (HHS), and the Food and Drug Administration (FDA) could chart a different course. With a $5 billion investment over five years, this initiative would improve medical access for vulnerable populations, stabilize drug pricing, and enable responsive, end-to-end, and on-demand drug production—production that, by year two, would cover up to half of the FDA’s list of 223 essential medicines. Initiative investments would achieve these outcomes by capitalizing on emerging innovations such as 3D printing, on-the-spot drug fabrication, and continuous flow manufacturing technologies, while securing key supply-chain components produced overseas like Key Starting Materials (KSMs) and Active Pharmaceutical Ingredients (APIs).
Revitalizing the Manufacturing Ecosystem

The decades-old mantra of “innovate here, produce there” has stymied our nation’s technological progress. As Japan, Germany, Korea, Taiwan, and China have realized the benefits of “manufacturing-led” innovation systems, our nation, lacking the capacity to produce newly developed technologies at scale, has failed to reap the maximum benefits of our unmatched investments in R&D. Instead, we have endured threatening setbacks such as a semiconductor shortage that will cost U.S. automakers $100 billion with corresponding job losses. Our nation’s trade deficit in advanced-technology goods grew from $130 billion in 2019 to $191 billion in 2020, with import levels up in almost every product category by late 2020.

The 16 Manufacturing USA Institutes were established to try to remedy these shortcomings. We therefore applaud your 100-day Supply Chain Review Report’s recommendations for new Manufacturing USA Institutes devoted to high-capacity batteries and semiconductors. However, we also appreciate the need for additional systemic changes to bolster our nation’s advanced-manufacturing ecosystem and achieve long-term competitiveness. To date, our nation has asked much of the Institutes: to develop revolutionary advanced manufacturing technologies, revive regional manufacturing ecosystems, modernize small and mid-sized manufacturers’ (SMMs) processes, and digitally upskill the workforces of entire sectors. The Institutes have made remarkable progress on each of these goals. But they need additional support. Because the government designed Manufacturing USA to end after five years, the Institutes were too thinly capitalized to fully realize their missions. In the meantime, declining workforce-development programs have diminished the supply of workers capable of using new technologies, adding more systemic barriers to upgrading manufacturing processes. SMMs have particularly struggled to accumulate the needed capital or know-how to compete in the modern era, reducing overall supply-chain efficiencies.

With these issues in mind, a more resilient supply chain depends on the restoration of American leadership in manufacturing. The following recommendations offer a roadmap for distributing the benefits of modern manufacturing to underinvested regions across the country and ensuring the longevity of our nation’s ambitious, diverse, and cutting-edge R&D ecosystem:

**Action 1: Empower SMMs with digital manufacturing**

A supply chain is only as strong as its weakest links. Right now, U.S. SMMs have become one of those weak links. Productivity of SMMs has consistently lagged productivity of larger firms. One reason for this is that SMMs have struggled to realize the significant productivity, innovation, and time-to-market speed gains of digital manufacturing. Continuous integration of advanced manufacturing technology into our nation’s supply chains is crucial to long-term competitiveness and resiliency. But manufacturing firms, especially SMMs, will not marshal the significant amounts of capital needed to bring in new technologies unless the efficiency and financial gains
of those technologies are fully demonstrated. To address many of these shortcomings, the U.S. Innovation and Competition Act of 2021 (USICA) authorized the Manufacturing Extension Partnership (MEP) with $2.4 billion for workforce development, training, and cybersecurity for small manufacturers. The MEP should therefore use these funds to create Regional Technology Demonstration Centers (RTDCs) where companies can see new technology prototypes in action, demonstrate and test those technologies, and train their employees to use them. These Centers should emulate Germany’s Industrie 2.0, which created over 300 “use cases” that detail how SMMs in different sectors could digitize their manufacturing processes. The MEP could develop similar use cases tailored to the United States that include guidance on recommended levels of technical workforce readiness, outline infrastructure needed for network capabilities and security, and present applications of new technologies in manufacturing (e.g., application of artificial intelligence to support predictive maintenance, quality inspection, and production scheduling).

Another barrier preventing SMMs from adopting digital manufacturing is a reliable supply of workers trained in the new skills required to utilize new technologies. The RTDCs could function as hubs for regional workforce development, in partnership with the Institutes as well as local economic-development agencies, area community colleges, and technical high schools. The Institutes should receive additional core funding to develop skill roadmaps in their respective focus areas and to identify best practices in workforce education, such as certifications for advanced manufacturing fields or an online manufacturing education “commons”. Implementing these roadmaps and best practices through the RTDCs would increase the supply of workers capable of adopting digital manufacturing.

A third barrier is cybersecurity. Every day, malicious software and compromised “Internet of Things” (IoT) sensors pose more threats to supply-chain integrity. Yet SMMs lack the financial and technical resources to protect themselves. The Supply Chain Cybersecurity Initiative (SCCI) is taking an innovative and proactive approach to cybersecurity by using “wargaming” techniques to continuously model supply-chain networks and their dynamic threat environments. The MEP should leverage this approach for the manufacturing supply chain, partnering with the Cybersecurity and Infrastructure Security Agency (CISA) on a pilot project that tests the capacity of a wargaming approach to improve security across SMM networks.

A fourth barrier is obtaining sufficient funding for manufacturing technologies, which are capital intensive, especially in the energy sector. Over the last few decades, national banking models have virtually eliminated the local banking relationships that used to sustain small manufacturers. Re-imagining financing support for SMMs is a crucial investment in our supply chain, underscored in this Listening Session with Startups in Critical Industries. The administration should therefore explore a range of options for financing advanced manufacturing equipment and technologies: a more robust tax credit for manufacturing competitiveness or advanced manufacturing equipment investments; a U.S. Treasury “Made in America” bonds program reminiscent of 1940’s Series E
war bonds that enables citizens to support key industries they believe in (e.g., climate-tech, microelectronics, bioeconomy etc.) with low-cost patient capital; or a banking function, perhaps building on the U.S. EXIM Bank’s existing authority or through incentivized private lenders. The Industrial Finance Corporation Act of 2021 is an important long-term opportunity to coordinate financial support for SMM’s, while turning the government a profit on taxpayer dollars. A more immediate, novel approach may be for the U.S. Treasury to encourage states to use portions of the American Rescue Plan Act’s $10 billion allocation to the State Small Business Credit Initiative (SSBCI) to support SMMs with low-interest loans and seed funding, generating a local abundance of solutions for priority sectors. Regardless of the path forward, decision-makers should explore the range of comparable programs that exist in peer and competitor nations and U.S. states, such as Germany’s local community-controlled banks, the United Kingdom’s Business Bank and Patient Capital Program, and Massachusetts and Indiana’s state manufacturing capital equipment assistance programs.

Action 2. Strategically Govern the Manufacturing USA Network

For nearly a decade, the Institutes have operated within silos instead of functioning as a network, thereby foregoing the cost- and knowledge-sharing that could dramatically scale manufacturing processes. Enhanced collaboration between the Institutes would unlock new capabilities within the American manufacturing industry, but it will require a strategic approach that revisits foundational features of the Manufacturing USA network. This section provides an overview of a few of these critical changes, including how the Institutes are funded, how their specialties can be coordinated among one another, and how R&D agencies can better harmonize early-stage development with the Institutes’ later-stage deployment. The scale of coordination required for a revitalized advanced manufacturing strategy requires White House leadership.

Renewal of contracts for individual Institutes should be performance-based and rooted in transparent and fair evaluation processes. The DoD has commissioned the National Academies to design evaluation standards and metrics for adjudicating funding decisions. The Department of Energy (DOE) should exercise their authority for rigorous merit review of existing and new Institutes. Criteria for contract renewal could, for example, (1) assess the long-term continuing need for a given Institute in the context of emerging agency priorities; (2) evaluate the strengths and weakness of alternatives to the Institute (e.g., Federally Funded Research and Development Centers (FFRDCs), National Labs, or contractors); (3) examine the performance of the Institute in meeting agency priorities for technology, supply-chain, production, and workforce development; and (4) review trends in the annual operations and performance of the Institute.

The Institutes must also collaborate more closely with one another. Each Institute is currently organized around a particular technology area. But modern manufacturing firms need packages of technologies—additive manufacturing and robotics and digital production—to remain competitive. Achieving efficient technological integration will require work to ensure
interoperability as well as iterative testing and demonstration of new technology packages. The National Institute of Standards and Technology’s (NIST) Office of Advanced Manufacturing (OAM) should convene Institute-sponsoring agencies and an executive panel of Institute directors to establish a new Manufacturing USA program element devoted to combining Institute technology advances and distributing packages of combined technologies to firms. One related instantiation of this would be to create a Dual-institute Center for current Good Manufacturing Practice (CcGMP) between the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) and BioFabUS to ensure the latest biomanufacturing technologies are sufficiently de-risked and commercialized.

Relatedly, harnessing the economic benefits of investments in R&D for AI, high-performance computing, and other manufacturing-related technology areas requires the work of R&D agencies to be connected to follow-on work at the Institutes. Unfortunately, this is not the case today. R&D agencies focus on early-stage research while Institutes separately focus on later-stage development. The National Science Foundation’s (NSF) Directorate for Technology, Innovation, and Partnerships is an important start for coordinating the nation’s R&D ecosystem. However, the White House Office of Science and Technology Policy (OSTP) should develop common technology-development roadmaps for R&D agencies, Institutes, and Manufacturing USA industry members to follow.

We as a nation must also address the dearth of data tracking manufacturing performance, especially data tracking production advances made by competitor nations. It took our country’s leadership years to understand how Japan’s quality production system enabled that country’s firms to capture automotive and consumer electronics markets in the 1970s and 1980s. Yet we did not learn from our mistake: we still know very little, for instance, about the regional scale-ups system in China. NIST, with support from the International Trade Administration (ITA) and other information agencies within the Department of Commerce, should create a new manufacturing traded sector analysis unit (ITIF, 2021) to evaluate the state of U.S. manufacturing competitiveness. This should include analyses of key U.S. producers and suppliers, global market competitors, and global production trends, as well as development of measures for tracking manufacturing performance.

Finally, the lack of intra-Institute and interagency coordination—coupled with the importance of forward-looking market-competition analysis—underscore the need for dedicated White House leadership in designing a more comprehensive advanced-manufacturing strategy for the nation. Consistent with pending legislation, the administration should create an Advanced Manufacturing Office (AMO) within the National Economic Council equipped with adequate staff and budget to coordinate the numerous manufacturing-related programs within the Manufacturing USA network and across the federal agencies. One possible priority area for the AMO would be to explore new intellectual property (IP) frameworks to generate regional
economic benefits and better incentivize partnerships with academia and industry. The IP frameworks of the Fraunhofer Institutes provide a model that the AMO could build on.

Action 3. Prioritize Institute Focus on Heterogeneous Semiconductor and Biotechnology Manufacturing

Semiconductor and biotechnology manufacturing are two of the most important industries of the future, with broad economic ramifications across health care, clean energy, military systems and much more. Global chip revenues have doubled in importance over the last three decades, increasing from 0.25% to 0.5% of global GDP and 1.2% of U.S. GDP. The bioeconomy contributes an estimated 5.1% of GDP, a number that is also expected to dramatically increase in the near future. To ensure the United States maintains leadership in both of these sectors, the administration should:

- **Establish a new Institute devoted to the cutting edge of semiconductor manufacturing.** From breakthroughs in sensor technology to memory and storage capabilities, innovation in computing will depend on harnessing heterogeneous computing: the harmonization of specialized chips with different computing paradigms into larger systems. Accordingly, part of the $52 billion in proposed USICA funding for semiconductor manufacturing should establish an [Institute for Scalable Heterogeneous Computing](https://www.frascati.fraunhofer.de/en) to provide a centralized coordinating function between early-stage agency research and manufacturing capacities. While progress made by large American firms on semiconductor manufacturing is promising, positive results are often proprietary to the firm in question and do not necessarily improve the broader innovation ecosystem for SMMs. A new Institute would ensure help capture the full scope of the broader R&D ecosystem by integrating, scaling, and standardizing the efforts of large private enterprises, SMMs, and DoD and DOE research on post-Moore computing (e.g., STARnet, Ncore, JUMP, E2CDA, ERI). This Institute would explore energy-efficient ways to integrate and package specialized chips, develop software to handle novel computing paradigms, assist with the development of physical design and verification tools for quality control, and help down-select computing technologies most likely to scale up from end to end.

- **Better coordinate work on the bioeconomy across existing Institutes, federal programs, and non-governmental partners.** Further progress in engineered biology requires a new class of manufacturing techniques and specialized workers. To reduce U.S. dependence on petroleum-based products, the OSTP and the National Security Council (NSC) should launch a four-year, $15 billion [National Bioeconomy Manufacturing and Innovation Initiative](https://www.whitehouse.gov). The joint initiative would first establish a National Bioeconomy Coordination Office within the White House to work with federal agencies on bioeconomy priorities. The initiative would then facilitate investments in cutting-edge R&D on genome
editing, DNA sequencing, and non-destructive measurement techniques to enhance our nation’s ability to control and manipulate biology. Additional R&D investments could catalyze the creation of foundational and publicly available tools for biological engineering, including standardized measurement techniques, design software, data-analysis pipelines, a national network of low-cost sequencing facilities and data repositories. The initiative would also spread innovation regionally through coordinating existing agency bioeconomy efforts and creating bioinnovation hubs, graduate and postgraduate training opportunities, and biomanufacturing training and reskilling programs.

There is a pressing need for large-scale, forward-looking investments in our nation’s manufacturing capacity. For too long we have offshored the benefits of American innovation. During COVID-19, local producers took it upon themselves to manufacture PPE and other needed goods. In the future, these networks should be activated and supported by the government. Similarly, we are just now beginning to appreciate the full strategic importance of providing SMMs with demonstration facilities, workforce training, and cybersecurity assistance. Unlocking our nation’s full advanced manufacturing potential will require support for SMM modernization. Finally, the broader advanced manufacturing ecosystem must be improved, a process that should be informed by a thorough understanding of our global manufacturing competitiveness. American can no longer afford to miss opportunities for Institutes to productively partner with R&D agencies and among themselves. The White House can and must facilitate the seamless integration of these moving parts into a cohesive national strategy for advanced manufacturing.