

ADVANCED MANUFACTURING

Advanced Manufacturing Funding¹

(Dollars in Millions)

| | FY 2020 | FY 2021 | FY 2022 |
|------------------|-----------------|-----------------|-----------------|
| | Actual | Estimate | Request |
| BIO | \$8.48 | \$7.16 | \$17.16 |
| CISE | 42.37 | 42.22 | 42.22 |
| EHR | 1.45 | 2.00 | 2.00 |
| ENG | 127.99 | 117.37 | 174.37 |
| MPS | 160.62 | 123.03 | 123.13 |
| SBE | 0.75 | 0.50 | 3.50 |
| TIP ² | 26.58 | 24.63 | 54.63 |
| OISE | 0.50 | 0.50 | 0.50 |
| IA | 5.06 | 1.00 | 1.00 |
| Total | \$373.80 | \$318.41 | \$418.51 |

¹ Funding displayed may have overlap with other topics and programs.

² FY 2020 and FY 2021 funding for TIP is shown for comparability across fiscal years.

Overview

Manufacturing is essential to almost every sector of the U.S. economy, from medicine to information technology to transportation. Breakthroughs in manufacturing spur the economy by increasing productivity, enabling new products, opening new industries, and creating well-paying jobs. Advanced manufacturing uses innovative technologies to create products and processes with higher performance, fewer resources, and/or new capabilities. NSF programs accelerate advances in manufacturing materials, technologies and systems through fundamental, multidisciplinary research that transforms manufacturing capabilities, methods, and practices.

NSF invests in advanced manufacturing to increase future U.S. prosperity, as well as the Nation's competitiveness, security, and quality of life. NSF support will:

- Advance competitiveness through groundbreaking discoveries that lead to manufacturing innovations;
- Secure the supply chain by growing and maximizing the use of U.S. resources (including raw materials, knowledge, and workforce);
- Grow the manufacturing workforce by broadening pathways and fostering communities; and
- Rapidly translate discoveries into useful products and create jobs through collaborations between researchers, entrepreneurs, and industry.

Since its founding in 1950, NSF has pushed the frontiers of manufacturing, sparking breakthroughs from nanomaterials and computer-aided design to 3D printing and blockchain, as well as tools for real-time, in situ feedback and sensing.

Today, NSF invests in fundamental research to create new and sustainable capabilities for chemical and materials synthesis and processing; fabrication and manufacturing of advanced semiconductors, quantum devices, and optical devices; discovery and manufacture of alternative materials with lower environmental impact than plastics; distributed and smart manufacturing systems; safe, productive, and collaborative worker-technology interactions; and many other areas related to advanced manufacturing. NSF invests in communities and experiential programs to grow and nurture a STEM-enabled manufacturing workforce.

Advanced Manufacturing

NSF also invests in industry partnerships and entrepreneurship to speed manufacturing innovations to the marketplace.

NSF's advanced manufacturing research intersects, builds upon, and contributes to related investments in biotechnology, synthetic biology, sustainability, artificial intelligence, robotics, sensing technologies, the Internet of Things, data science, and computational modeling. Similarly, NSF's investments in the FW-HTF, HDR, and URoL Big Ideas are bolstered by advanced manufacturing research.

In FY 2020, NSF launched the Future Manufacturing effort to enable leadership in the new manufacturing sectors of bio-manufacturing, cyber-manufacturing, and eco-manufacturing by creating knowledge that enables a new generation of manufacturing industries.

Goals

1. *Advanced Manufacturing Research*: Support groundbreaking discoveries for advanced manufacturing that lead to products and processes with higher performance, new capabilities, and using fewer and more sustainable resources.
2. *Future Manufacturing Research*: Increase knowledge in emerging areas to enable a new generation of manufacturing industries that do not exist today, that are compatible with human needs, that make U.S. manufacturing competitive far into the future, and that build in resilience to global disruptions for the Nation's manufacturing infrastructure.
3. *Workforce Development*: Attract, educate, train and reskill/upskill workers, from K-12 to college and industry, for the manufacturing workforce of the future.
4. *Transition to Practice*: Leverage industry partnerships to advance research and transition research results to practice.

FY 2022 Investments

NSF investments accelerate advances in manufacturing with emphasis on multidisciplinary research that fundamentally alters and transforms manufacturing capabilities, methods, and practices. NSF investments will make producing next-generation products and services more efficient and sustainable and will lead to advantages such as less time-to-market, new performance attributes, cost savings, energy savings, and reduced environmental impacts.

Advanced Manufacturing Research

Continued investments in advanced manufacturing include fundamental research on highly-connected, adaptable, resilient, safe, and secure cyber-physical systems, i.e., engineered systems that are built from, and depend upon, seamless integration of computation and physical components. Investments also support activities that develop new methods, processes, analyses, tools, or equipment for new or existing manufacturing products, supply-chain components, or chemicals and materials, including replacements for mainstay materials such as plastics that cause environmental harm. NSF plans to support advanced manufacturing research in next-generation manufacturing infrastructure as part of a broader effort to design and renew national infrastructure.

Future Manufacturing Research

Initiated in FY 2020, the Future Manufacturing investment advances fundamental research to enable manufacturing that (a) does not exist or is not possible today, or (b) exists or is possible only at such small scales that it is not yet viable for mass production.

Workforce Development

To prepare the advanced manufacturing workforce, NSF invests in the Advanced Technological Education, Faculty Early Career Development, Grant Opportunities for Academic Liaison with Industry, Research Experiences for Undergraduates Sites and Supplements, and Research Experiences for Teachers Sites and Supplements programs, as well as in manufacturing engineering education in research projects. NSF support for Non-Academic Research Internships for Graduate Students (INTERN) and NSF Innovation Corps (I-Corps™) provides individuals with industrial and entrepreneurial experiences. These programs help equip workers with the knowledge and skills needed for well-paying careers in high-technology industries.

Transition to Practice

NSF speeds translation of fundamental discoveries in advanced manufacturing into products and processes through its Engineering Research Centers, Industry-University Cooperative Research Centers, and Partnerships for Innovation programs, as well as through the NSF Small Business Innovation Research and Small Business Technology Transfer programs. In addition, NSF coordinates with other agencies and participates in the Manufacturing USA Institutes, particularly by connecting them to universities and community colleges.