

## ADVANCED MANUFACTURING

	FY 2019 Actual	FY 2020 (TBD)	FY 2021 Request
BIO	\$4.50	-	\$7.16
CISE	41.27	-	39.41
EHR	-	-	2.00
ENG	138.14	-	140.00
MPS	113.94	-	113.78
OISE	-	-	0.50
<b>Total</b>	<b>\$297.85</b>	<b>-</b>	<b>\$302.85</b>

### 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, and opening new industries. Advanced manufacturing uses innovative technologies to create products and processes with higher performance, fewer resources, and/or new capabilities. NSF programs accelerate breakthroughs in manufacturing materials, technologies and systems through fundamental, multidisciplinary research that transforms manufacturing capabilities, methods and practices.

NSF invests in the Administration's Industry of the Future research and development priority area, advanced manufacturing, to increase U.S. prosperity, as well as our competitiveness, security, and quality of life. Specifically, 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 remote sensing.

Today, NSF invests in fundamental research to create new capabilities for chemical and materials synthesis and processing; advanced semiconductors, quantum and optical device design, fabrication and manufacturing; smart manufacturing systems; safe, productive, and collaborative worker-technology interactions; and many other areas of advanced manufacturing. NSF invests in communities and experiential programs to grow and nurture a STEM-enabled manufacturing workforce. 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 such as biotechnology, synthetic biology, sustainability, artificial intelligence, robotics, sensing, internet of things, data science, and computer modeling. NSF's Big Idea investments in FW-HTF, HDR, and URoL also contribute to advanced manufacturing.

In FY 2020, NSF begins a new effort to enable leadership in future manufacturing by creating knowledge in new sectors based on emerging areas—such as biomanufacturing, cybermanufacturing, and ecomanufacturing—and enable a new generation of manufacturing industries.

### **Goals**

1. Support groundbreaking discoveries for advanced manufacturing that lead to products and processes with higher performance, fewer resources, and/or new capabilities.
2. Create knowledge based on emerging areas to enable a new generation of manufacturing industries that do not exist today, will be compatible with human needs, and will make U.S. manufacturing competitive far into the future.
3. Attract, educate, train and reskill/upskill workers, from K-12 to college and industry, for the manufacturing workforce of the future.
4. Leverage industry partnerships to advance research, transition it to practice, develop the workforce, and create and maintain research infrastructure.

### **FY 2021 Investments**

NSF research accelerates 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 they will lead to advantages such as less time to market, new performance attributes, cost savings, energy savings, and/or reduced environmental impact.

- *Advanced Manufacturing research:* Continued investments in advanced manufacturing include fundamental research on highly connected cyber-physical systems and activities that develop new methods, processes, analyses, tools, or equipment for new or existing manufacturing products, supply chain components, or chemicals and materials. In FY 2020 and FY 2021, the Emerging Frontiers in Research and Innovation program plans to support two areas of advanced manufacturing research: Distributed Chemical Manufacturing (DCheM) and Engineering the Elimination of End-of-Life Plastics (E3P).
- *Future Manufacturing research:* Initiated in FY 2020, the Future Manufacturing investment is 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:* To prepare the advanced manufacturing workforce, NSF invests in the Advanced Technological Education, Faculty Early Career Development Program, Grant Opportunities for Academic Liaison with Industry, Research Experiences for Undergraduates, and Research Experiences for Teachers programs, as well as manufacturing engineering education in research projects. NSF support for Non-Academic Research Internships for Graduate Students and I-Corps™ provides students with industrial and entrepreneurship experience.
- *Translation:* NSF speeds translation of fundamental discoveries in advanced manufacturing into products and processes through its Engineering Research Center, Industry–University Cooperative Research Center, and Partnerships for Innovation programs, as well as through NSF Small Business Innovation Research and Small Business Technology Transfer programs. In addition, NSF coordinates with other agencies and participates in the Manufacturing Innovation Institutes, particularly by connecting them to universities and community colleges.