

## **The Chemical Industry relationship to Advanced Manufacturing in the United States**

### **Issues and recommendations**

#### ***Summary:***

Manufacturing, one of the leading drivers of the US economy, is under continued pressure from foreign interests, who are already making substantial investment in new technologies for the 21<sup>st</sup> century and working to increase their dominance in advanced manufacturing sectors critical to the economic future of the United States. The integration of new digital and modular technologies into the manufacturing sector has improved process efficiency and decreased the environmental footprint. Further gains require an increasingly advanced workforce that understands the role of these technologies and can innovate for improved performance. AIChE has direct interest in the investment in advanced manufacturing, as new manufacturing technologies impact the production of chemical products and change the way the process industries function, and thus becomes a critical component of developing a well trained workforce prepared to compete in a global economy.

#### ***Overview of the US Manufacturing Economy***

Manufacturing accounts for \$2.3 trillion of GDP, employs 12 million people, and supports local economies throughout the United States. Manufacturing drives 20 percent of the nation's capital investment, 30 percent of productivity growth, 60 percent of exports, and 70 percent of business R&D and almost 10 % of direct employment. It generates even broader economic activity and employment in related sectors with indirect employment typically estimated at 3-4 times direct.

The COVID-19 pandemic has underscored manufacturing's role in providing products that are critical to health, safety, national security, and the continuity of multiple industries. It has also revealed the extent to which globalized supply chains are exposed to shocks and disruptions that can hamper the US economy. These events have deepened the importance for the United States of domestic manufacturing and resilient supply chains as we face ever greater global competition from rising nations who are leaning into the industries of tomorrow.

To keep pace with technological change, manufacturing organizations are demanding workers with increased digital literacy. They highlight an increasing need for a workforce skilled in advanced manufacturing technologies including online process control, modularization, and automation to reduce energy and materials usage and increase resilience, creating more sustainable processes.

#### ***Global response to advanced manufacturing***

While US business and the US government have recognized the importance of American leadership in advanced manufacturing and have invested in the relevant technologies, other industrialized nations are similarly seeking competitive advantage in this space. We can see this in the rapid advancement in technologies as varied as electric vehicles and batteries, additive

manufacturing (3D printing), biomedical and biomanufacturing technologies, digitization and artificial intelligence.

EU based companies are leading in renewable energy technologies. Japanese manufacturers are advancing the role of robotics and advanced electronics. China is aggressively seeking to dominate multiple advanced manufacturing sectors including batteries, electric vehicles, additive manufacturing, biotechnology, artificial intelligence and renewable energy technologies production.

### ***Growth and US investment in Advanced Manufacturing***

To respond to these challenges, increasingly US manufacturers are adopting Advanced Manufacturing, a term that encompasses the use of innovative technologies to improve existing products and processes through information, automation and networking, in-process sensors for quality control, and the use of modular systems that increase resiliency. Advanced Manufacturing creates opportunities for greater efficiency and productivity while reducing energy and materials consumption and improving the sustainability of the manufacturing enterprise. Additional benefits include lower risk process design and deployment, lower capital risk, reduced operating costs due to yield improvements and energy footprint reductions, Increased resilience due to more distributed and more robust manufacturing footprint and increased profitability. Advanced manufacturing provides broader employment opportunities than traditional manufacturing as well.

The US Government created a network of advanced manufacturing institutes under the Manufacturing USA program to facilitate public private collaboration and workforce development in technologies that touch every industrial sector in the US including biomanufacturing, advanced materials, sensors and electronics, cybersecurity, process intensification and robotics. These institutes have leveraged federal investments with equivalent private sector investments to foster collaboration, training and education and technology innovation in advanced manufacturing.

### ***The critical role of Manufacturing USA Institutes***

Manufacturing USA Institutes are driving innovations across multiple technology platforms that improve US competitiveness, expand manufacturing and related employment and facilitate more efficient use of energy and input materials, contributing to a reducing climate footprint for American manufacturing. To remain competitive and support manufacturing and its employment and ensure secure and resilient supply chains the US will need to accelerate its leading role in advanced manufacturing, which will require ongoing private/public sector collaboration. Federal investments, matched by private sector contributions, have helped to foster greater pre-commercial innovation that companies are often hesitant to invest in. A recent CRS report indicates that federal spending on the institutes is anticipated to be \$1.2 billion while private sector contributions to fund the institutes is anticipated to reach \$2.4 billion, doubling the federal contribution.

The RAPID Manufacturing Institute® is a Manufacturing USA institute set up as a private-public partnership between the American Institute of Chemical Engineers (AIChE) and the Department of Energy (DOE) Advanced Manufacturing Office (AMO). RAPID works collaboratively with

manufacturers, national laboratories, and academic and other research institutions to transform the process industries by advancing Modular Chemical Process Intensification (MCPI) to drive greater productivity and energy and materials efficiencies, leading to enhanced profitability, increased reliability, and a smaller environmental footprint.

### ***AIChE support of Advanced Manufacturing***

The American Institute of Chemical Engineers recommends that Congress further leverage the productive investments to date in the Manufacturing USA institutes in order to ensure an ongoing, robust collaborative US innovation development pipeline. We encourage Congress to:

- Continue and expand predictable support for Manufacturing USA programs to ensure ongoing public-private collaboration on critical advanced manufacturing technologies, especially in areas of process intensification, biotechnology, and sustainability. Institutes have now fully developed their organizational structures and have established robust private sector relationships and collaborations allowing them to be more efficient and productive in their endeavors.
- Enhance the programs' emphasis on technology transfer initiatives with an emphasis on engaging small and medium enterprises to improve resilience in the process industries.
- Expand the programs' workforce development initiatives to help ensure that the industries of tomorrow have the workforce to enable them to flourish. The shortage of trained workers has been highlighted by our post-pandemic recovery. These efforts should also seek to diversify the STEM workforce to provide professional opportunities to more Americans and give companies access to a broader workforce pool.

### ***ABOUT AIChE***

AIChE is a professional society of more than 60,000 members in more than 110 countries. Its members work in corporations, universities and government using their knowledge of chemical processes to develop safe and useful products for the benefit of society. Through its varied programs, AIChE continues to be a focal point for information exchange on the frontier of chemical engineering research in such areas as nanotechnology, sustainability, hydrogen fuels, biological and environmental engineering, and chemical plant safety and security. More information about AIChE is available at [www.aiche.org](http://www.aiche.org).