ASME MANUFACTURING GENERAL POSITION PAPER



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Background

The United States has long thrived on its ability to manufacture goods and sell them in domestic and global markets. Manufacturing plays a vital role in almost every sector of the U.S. economy, stretching from aerospace to pharmaceuticals and beyond. Advanced manufacturing, the incorporation of innovative and emerging technologies to improve the desired processes or products, is an engine of America's economic power and a pillar of its national security.

Advances in manufacturing enable the economy to continuously improve as new technologies and innovations increase productivity, develop new products, and create entirely new industries. As stated in Executive Order of the President, No. 13806, Presidential Executive Order on Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States: "A healthy manufacturing and defense industrial base and resilient supply chains are essential to the economic strength and national security of the United States." One in seven U.S. private sector jobs depends on the U.S. manufacturing base¹ and in 2018, manufacturers contributed \$2.33 trillion to the U.S. economy. However, manufacturing today stands at a crossroads between the "dirty, dark, and dangerous" manufacturing jobs of the past, and the new, high-skill/high-wage jobs of the future. As manufacturing worldwide enters a season of renaissance, the potential exists for the U.S. to reemerge as the global leader in advanced manufacturing, creating high-skilled, high-wage jobs here at home. Other countries such as China, Germany, and England have already begun to seize this moment and have successfully instituted innovative, 21st century advanced manufacturing polices, whereas the U.S. is just beginning to lay its own groundwork. While the U.S. has made progress in recent years with the creation of the Manufacturing USA program and the passage of the Revitalize American Manufacturing Innovation (RAMI) Act, there is still much more that needs to be done to ensure that the United States remains globally competitive in this new, high-tech field of advanced manufacturing.



For America to remain a global technology leader, there must be continued, sustained investment in the scientific and engineering enterprise especially as it relates to advanced manufacturing. The lack of proper investment has the United States falling behind in critical measures of technology, education, innovation, and highly skilled workforce development. This is especially worrisome given that new, emerging manufacturing technologies are spurring growth in the demand for highly-skilled, high-paid workers. Over the next decade, it is predicted that "nearly 4½ million manufacturing jobs will likely be needed, and 2 million are expected to go unfilled due to the skills gap."² For the United States to be able to confront these

challenges, we need to commit to sustained investment in advanced manufacturing. If the United States does not act now, we will fail to reap economic rewards of global manufacturing activity, with dire long-term consequences.

Investing in manufacturing process research and development that leverages technologies of the future such as artificial intelligence, digital manufacturing, and electrification of transportation and workforce development to meet the manufacturing challenges of the future will have significant short- and long-term impacts. The jobs produced by manufacturing activities are generally high-wage and represent an entry point into the middle class for a significant portion of the workforce. A healthy manufacturing and defense industrial base and resilient supply chains are essential to the economic strength and national security of the United States. Gaps in this sector can result in limited or non-existent domestic supply of critical protection for the warfighter against specific threats.³ The United States must seize this opportunity and commit to meaningful long-term investment in the future of U.S. advanced manufacturing or we will see the continued erosion of the U.S. manufacturing base and a diminished U.S. share of the global market for the next generation of manufactured goods.⁴



http://www.themanufacturinginstitute.org/Research/Facts-About-Manufacturing/Economy-and-Jobs/Jobs-Supported/Jobs Supported.aspx
http://www.themanufacturinginstitute.org/wp-content/uploads/2020/03/MI-DI-The-jobs-are-here-where-are-the-people.pdf
Executive Order of the President, No. 13806, "Presidential Executive Order on Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States", July 21, 2017.
Ibid





MANUFACTURING PIPELINE

Recent research indicates that over the ten years spanning 2018-2028, there will be more than 4.6 million manufacturing jobs that will need to be filled⁵. But the way the U.S. STEM-capable workforce pipeline currently stands, less than 50% of those jobs [2.2mill] will be able to be filled by the end of the decade. Delving into what this means at the economic level, this skills shortage puts up to \$2.5 *trillion* of US economic output at risk over the decade.

Unfortunately this dearth of a capable workforce has far reaching implications beyond simply the United States' immediate ability to produce and provide essential goods to its populace. The absence of a robust, qualified workforce pipeline creates a downwards cycle, dis-incentivizing US-based companies to keep building up the sector, because it raises the issue: Why build a factory in the US if there is not a sufficient workforce to support it?

But taking a step back, to appropriately address this lack of qualified workforce pipeline, it is first essential to understand where this shortage is stemming from. In the U.S., manufacturing jobs have historically held the erroneous connotation of being low-skilled labor that is less profitable, and consequently, less desirable. However, there is a lot more to the manufacturing sector than factory line work, running the gamut of all competencies and skill levels.

The introduction of emerging and advanced technologies have caused a shift in the skills sought after in the manufacturing sector. Along with innovative new ways of advancing the industry, these new technologies also bring with them the misguided belief that they have eliminated lower-skilled jobs in the manufacturing sector. Fortunately this is not necessarily the case. While



it is true that these emerging technologies such as artificial intelligence and digital twin have changed what these lower-level jobs look like, with the introduction of this technology also comes a new need for workers to maintain these technological applications that did not previously exist with their more manual analog predecessors.

5 https://www.themanufacturinginstitute.org/wp-content/uploads/2020/03/MI-DI-The-jobs-are-here-where-are-the-people.pdf





another challenge facing the pipeline is that the older generation of capable workers are retiring at a guicker pace than the sector is hiring. Consequently, the manufacturing sector is unable to overcome the churn rate. This so-called "silver tsunami" of retirees represents a crisis to the manufacturing sector. As the National Science and Technology Council recently noted, "America's manufacturers need highly-skilled technical workers with excellent critical thinking and innovation skills to maintain a the needs of the day. competitive advantage in the global marketplace and adequately support the development of advanced manufacturing technologies. It is clear that education beyond high school is required for high-paying manufacturing jobs."6

Further adding to this challenge is that the US currently relies guite heavily on foreign talent to feed its manufacturing pipeline. In its 2016 Science and Engineering Indicators report, the National Science Foundation (NSF) found that from 1993 to 2013, the number of foreign-born college-educated workers employed in science and engineering occupations in the United States rose 10.7 percent⁷. Building on this, the Government Accountability Office and NSF have consistently reported that the U.S. remains dependent on foreign talent for a large percentage of highly skilled workers to perform the critical tasks needed to sustain key parts of our industrial base, particularly aerospace and defense, two industries central to US economic welfare and national security. This strong dependence on foreign talent is of concern, because as other nations develop their production and design capacity and are therefore better able to educate and retain the best science and engineering talent, the US' ability to attract foreign talent will decline.

In conjunction with seeking new skilled workers, As the manufacturing workforce becomes increasingly more global and technologydriven, it is essential that the U.S. aligns its K-12, undergraduate, and graduate core curricula and education systems to better address the knowledge and skill requirements of its 21st century workforce. However, just preparing our students to meet the skills-gap isn't enough. The U.S. must also invest in training programs for experienced workers so that our current workforce is better equipped to meet

> Research and education in advanced manufacturing require expansion to meet the current and future needs of the nation. We must also encourage more diversity in our manufacturing engineers and technicians, attracting more women and underrepresented minorities and creating an inclusive and equitable manufacturing community. While some of these issues have suffered decades of neglect and will take decades to correct, all require immediate attention and a national commitment to improvement.



6 "Strategy for American Leadership in Advanced Manufacturing," National Science and Technology Council, October 2018. 7 https://www.nsf.gov/statistics/2016/nsb20161/#/report/chapter-3/immigration-and-the-s-e-workforce

MANUFACTURING SCALE-UP

Another casualty of the lack of manufacturing talent in the US is its ability to scale up in times of need. Over the past several decades, a large proportion of US industry has started offshoring and outsourcing a lot of its essential manufacturing and production. As the National Association of Manufacturers noted, from 2015 to 2016, U.S.-manufactured goods exports fell 5.9 percent with significant decline to the top six markets, including Canada, Mexico, China, Japan, the United Kingdom, and Germany.⁸

Off-shoring has been partly due to a lack of suitable talent domestically, and partly due to economic reasons. Thanks to lower labor costs and tax incentives it was often times more cost effective to outsource and/or offshore these processes rather than pay the higher costs to manufacture domestically, which has resulted in long, lean supply chains based out of a select few countries.

During times of quiet and economic wellbeing, these long, lean supply chains allowed corporations to maximize the economic benefits. However, during times of crisis, such as the Covid-19 pandemic, the lack of duplicative supply chains severely constrained many processes. At the height of the Covid-19 pandemic in spring 2020, many of the countries that served as the primary hub for essential supply chains shut down or were forced to significantly reduce operations. The result was that the majority of supply chains touching on US essential goods were negatively impacted, which led to mass shortages of goods across the consumer package goods, healthcare and other industries.

Another challenge that arises when US industry prioritizes the outsourcing and offshoring of manufacturing processes is that the domestic manufacturing industry is simply not prepared or able to scale up and respond to the need in a timely manner. After being neglected for so long, the U.S. manufacturing sector lacks the workforce, facilities, supplies and overall investment to produce at least enough goods to fill the immediate domestic need. While trade and tax policies such as lower tax rates and protection against unfair trade practices are important to business in general, these policies will have little effect on the U.S. manufacturing sector if our domestic manufacturing base is not adequately equipped to handle the demands of the day.

A suitable measure to help avoid this problem is stronger investment in Public-Private Partnerships such as the Manufacturing USA program. The landscape for high tech manufacturing has evolved, where research and development now require well-designed public-private partnerships to capture the economic advantages of advanced manufacturing within thriving innovation ecosystems. In order for the U.S. to compete with other nations that are investing heavily in advanced manufacturing technologies, our domestic policies need to support a robust and sustainable manufacturing R&D infrastructure.

8 https://www.themanufacturinginstitute.org/wp-content/uploads/2020/03/MI-DI-The-jobs-are-here-where-are-the-people.pdf





INTERNATIONAL COMPETITION

The United States attained its position as a world leader in R&D through substantial, dedicated Federal funding for our research universities and national laboratories. However, there is a clear disconnect between the government's commitment to R&D and the lack of adequate and sustained investment to ensure that research impacts global and domestic markets. Due to sporadic and insufficient federal investment in advanced manufacturing R&D, many of the scientific discoveries and technological innovations made in the U.S. are further developed and manufactured overseas, where public-private partnerships are more plentiful and better funded. A 2018 report by the Interagency Task Force stated:



"Many nation states have implemented coherent investment plans and tax policies, such as Germany's Industry 4.0 initiative, forcing U.S. firms to compete against nation states with wellresourced policies to support their domestic industries. In this environment, the lack of a coherent U.S. industrial policy puts domestic suppliers at a disadvantage, amplified by the trade policies of some U.S. competitors that violate trade norms of reciprocity and open competition."

The NSF's most recent [2020] Science and Engineering Indicators noted that the US ranked 10th globally in R&D intensity, a ratio of R&D : GDP. It further explained that the EU, China, United States, India, Japan, and South Korea together produce more than 70% of the worldwide refereed Science and Engineering publications.

A deeper dive into key global manufacturing competitors will find that Germany has long recognized the importance of manufacturing, a fact most acutely demonstrated through the Fraunhofer institutes. The Fraunhofer program is a network of 76 Institutes, with an annual budget of 2.6 billion euros (around 2.9 billion dollars). By comparison, the U.S. has invested roughly \$1 billion in manufacturing basic and applied research *since* 2012 - even though Germany's economy is roughly one-third that of the U.S.

Similarly, China's *Made in China 2025* program will dedicate at least \$300 billion in manufacturing investments over five years. These figures are somewhat concerning given the United States' global science and technology leadership. The Manufacturing USA program was designed to fill the same role as the German Fraunhofer program, with sixteen Institutes established since 2012, compared to the Fraunhofer program's 76 Institutes. Not far behind, China has established 22 institutes, with plans for 45 active institutes by 2030.



RECOMMENDATIONS

The "manufacturing capacity and defense industrial base of the United States have been weakened by the loss of factories and manufacturing jobs, so too have workforce skills important to national defense. This creates a need for strategic and swift action in creating education and workforce development programs and policies that support job growth in manufacturing and the defense industrial base."

To address these shortcomings and create a robust and agile manufacturing, ASME is pleased to present the federal government and policymakers with its recommendations, which are as follows:

1. INVEST IN A STEM-CAPABLE WORKFORCE

- Expand programs such as the National Science Foundation Graduate Research Fellowship Program with a special focus on manufacturing-relevant careers.
- Strengthen tax incentives for workforce development and continuing education, including those at the graduate level, both for employers and employees.
- Conduct a high level review of the health and sustainability of the U.S. high-tech workforce to ensure that education and immigration policies are working to expand the number of highly-skilled workers in STEM fields.
- Support community colleges and technical schools to ensure worker training programs provide the next generation of technically skilled workers.

2. SUPPORT A DOMESTIC ADVANCED MANUFACTURING SECTOR

- Fully-fund the Manufacturing USA program to encourage and sustain the formation of R&D partnerships among government, industry, and universities.
- Encourage and sustain the formation of R&D and STEM education partnerships among government, industry, and universities.
- Create globally competitive incentives for corporations to maintain or establish domestic manufacturing capabilities and rapidly scalable capacities in industry sectors critical to the health and well-being of the U.S. economy and population.
- Invest in research and development aimed at creation of transformative advanced manufacturing technologies that will enable rapid scale-up of manufacturing capacities of critical goods to meet domestic needs in times of a national emergency.

3. PROMOTE MANUFACTURING INNOVATION AND COMPETITIVENESS

- Expand Manufacturing USA program to 45 Institutes, with a long-term plan of achieving parity with the public-private partnership infrastructure of other countries.
- Expand Manufacturing Extension Program with minimum funding levels of \$750 million annually
- Commit to long-term federal investment in engineering and scientific research and support a balanced portfolio of engineering and scientific research among the physical and life sciences.

CONCLUSION

Manufacturing has tremendous potential in sparking economic growth and job creation in the U.S. In addition to being a critical part of the U.S. national security apparatus, innovation pipeline, and process for job creation. Manufacturing holds the promise for the establishment of entirely new industries and the reinvention of new methods of doing business.

The U.S. maintains leadership in a range of machinery and equipment manufactured goods, as well as in the pharmaceutical, transportation, food processing, and electronic products industries, with each sector slated for future expansion fed by global demand from expanding and emerging markets. Other countries have already recognized the importance of spurring the creation of new products and industries - particularly in energy technology sector - and have taken steps to ensure a healthy science and engineering workforce and a competitive market for attracting investment. ASME Manufacturing Public Policy Task Force recommends the U.S. invest in a stemcapable workforce, support a domestic advanced manufacturing sector, and promote manufacturing innovation and competitiveness.





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