Flexing Pittsburgh's Robotics Prowess

Positioned to help meet America's greatest manufacturing challenges

Part Two: by Henry Lenard

Pittsburgh's transformation from dying steel town to a global robotics powerhouse has it positioned to help meet America's greatest manufacturing challenges.

According to the Advanced Robotics for Manufacturing Institute (ARM), the three biggest obstacles for the U.S. in 2022 are the lack of a skilled labor force; incorporating robotics and automation; and supply chain issues.

The ARM Institute was started in January 2017 with the awarding of a U.S. Department of Defense contract to Pittsburgh's Carnegie Mellon University as part of the Manufacturing USA network. ARM operates as a separate non-profit entity with more than 330 consortium members.

"It's easy to understand why the DoD chose Pittsburgh as the home of a national institute for robotics," ARM CEO Ira Moskowitz said. "Pittsburgh can claim itself of the birthplace of the robots that are in use today across the nation and the globe. Those robots that directly address dull, dirty and dangerous jobs, and automate industrial activities for all types of organizations. Having the ARM Institute in Pittsburgh amplifies the region as a leading worldwide center in robotics."

ARM is one of nine Manufacturing Innovation Institutes funded by the Department of Defense, and part of the Manufacturing USA network, which encompasses a total of 16 such institutes, sponsored by either the U.S. Departments of Commerce, Defense or Energy.

These entities are public-private partnerships that each have distinct technology focus areas but work towards a common goal: To accelerate U.S. advanced manufacturing as a whole and secure America's future through manufacturing innovation, education and collaboration.

ARM's mission is to create and then deploy robotic technology by integrating the diverse collection of industry practices and institutional knowledge across many disciplines – sensor technologies, end-effector development, software and artificial intelligence, materials science, human and machine behavior modeling, and quality assurance – to realize the promises of a robust manufacturing innovation ecosystem.

Looking at American manufacturing's top challenges in 2022, even pre-pandemic, the lack of a skilled workforce was one of the greatest obstacles facing American workers.

A 2021 study by Deloitte and The Manufacturing Institute found that as many as 2.1 million American manufacturing jobs will be unfilled through 2030 and noted that nearly 500,000 manufacturing jobs are open today. The report warns the worker shortage could potentially cost the U.S. economy as much as $1 trillion by the end of the decade in lost revenue and production.

An increased use of robotics within an advanced manufacturing environment will be critical to the U.S. According to ARM, this will only occur if there is a concerted effort to develop the needed workforce.

To that end, ARM launched the federally-funded www.roboticscareer.org, a site that connects students and workers with leading U.S.-based robotics education programs for manufacturing careers. Introduced in April and updated daily, this no-cost resource lists approximately 12,000 programs from more than 1,800 educational organizations in the U.S.

The workforce issue also plays into the challenge of incorporating robotics and automation. Many American manufacturers, particularly smaller and medium-sized ones, struggle with finding both robotics expertise, beyond systems integrators, and robots that best meet their needs.

According to ARM, nearly half of all American manufacturers haven't adopted any form of robotics technology.

Large manufacturers, such as those in the automotive and aerospace industries, have successfully deployed robots for years for vehicle assembly. These industrial robots have worked well because of the relatively repetitive nature of their tasks.

SMMs (small and medium manufacturers) usually don't operate in an environment where they can dedicate a robot to a single task as many are contract manufacturers with changing product requirements. SMMs need robots that are highly flexible and easily re-programmable to perform multiple tasks. Also, SMMs don't always have the factory floor space capacity to cage industrial robots, so collaborative robots are a better fit for these needs.

To address this challenge, ARM has worked on dozens of projects, funded by the Department of Defense, to address these issues, as well as others that increase worker safety.

One prime example is ARM's ongoing "Systematic Robotics Application Assessment Method and Tools for Decision-Making" project. It addresses the issue of the lack of robotics technology by many SMMs. The project seeks to minimize the risk of adopting robots by improving the methods and assessment tools for evaluating readiness levels for robotic applications.

This project is expected to culminate in the creation of a software platform that will host a set of methods and tools for evaluating robotic solutions and empower American manufacturers to better implement the right solution for a given manufacturing process.

The results of this and the other projects (Projects - Advanced Robotics for Manufacturing (arminstitute.org) are available to be used by all members of the ARM Institute Consortium.

ARM is also actively addressing the supply chain challenge confronting U.S. manufacturers.

In the summer of 2020, the DoD tasked ARM with finding robotic solutions to mitigate the COVID-19 pandemic and create a critically needed technical foundation to respond to future similar crises.

Already this year, ARM has worked on 10 pandemic-related projects, including some directly targeting supply chain issues, such as domestic production of personal protection equipment (PPE). ARM formed numerous national teams,

drawing from diverse industries and technologies, to address the myriad of supply chain shortages.

“Many of Pittsburgh’s robotics companies are members of ARM’s consortium. This provides them with unprecedented access to manufacturers across the U.S., allowing them to build relationships with both organizations and government entities that may have been challenging to form otherwise,” said Moskowitz of the importance of ARM to the city.

“In return, ARM consortium members and the federal government are exposed on a regular basis to the bounty of robotics innovation and organizations in Pittsburgh,” added Moskowitz.

Also tackling the country’s manufacturing challenges is CMU’s National Robotics Engineering Center (NREC), an operating unit within the school’s Robotics Institute.

NREC is an innovative model for academic-industry collaboration founded 25 years ago to catalyze robotics research, development and commercialization. CMU was joined by NASA, the state of Pennsylvania, the city of Pittsburgh, local foundations and other partners to create NREC.

A typical NREC project includes a rapid proof-of-concept demonstration followed by an in-depth development and testing phase that produces a robust prototype with intellectual property for licensing and commercialization. Throughout this process, NREC applies best practices for software development, system integration and field testing.

“When companies or government entities need a unique, novel or complex solution for their products or processes, NREC is the place to go,” NREC Director Herman Herman said. “From concept to commercialization, NREC’s tech transfer process matures cutting-edge research into practical solutions, providing value while solving challenging problems.”

A report released by CMU earlier this month celebrating NREC’s milestone anniversary credits the center for its role in the dramatic transformation of the regional economy of Pittsburgh and the global robotics industry as a whole.

The report found that CMU's NREC was a key driving force in the emergence of Pittsburgh's "Robotics Row," which includes over 80 companies focused on

robotics, artificial intelligence and related technologies. Robotics Row is located along the Allegheny River from NREC's base in the city's Lawrenceville neighborhood to the Strip District neighborhood. Many of these companies have ties to NREC, with a significant number founded or created by NREC alumni. Those NREC-affiliated companies today are valued at more than $18 billion.

"The impact of Carnegie Mellon's NREC has been game-changing, not just for igniting a thriving technology industry in Pittsburgh and western Pennsylvania but also for revolutionizing robotics and catalyzing its impact across the globe," said CMU President Farnam Jahanian.

"As NREC marks its first 25 years and plans for the future, the report's findings reinforce what insiders have always known: NREC's innovations have transformed entire industries and are helping to solve some of humanity's greatest challenges," said Jahanian.

Among the report's finding are NREC's impact on a global scale. The center's technologies have been licensed more than 450 times by organizations in 31 countries, and its robots have been deployed on all seven continents, saving lives and revolutionizing operations in numerous industries.

Another Pittsburgh entity that will be working to address those manufacturing challenges is CMU's new Robotics Innovation Center (RIC) and Manufacturing Futures Institute, announced this past May. The RIC will be part of CMU's Robotics Institute and separate from its NREC.

It is being funded through a $150 million grant from the Richard King Mellon Foundation, the largest single grant in the foundation's 74-year history. Half of the grant is the lead gift for a new cutting-edge science building on CMU's campus and the remainder will seed the new RIC at the nearby Hazelwood Green, which also houses ARM.

The Hazelwood Green site was first developed as a steel mill in 1884 by the former Jones & Laughlin Steel Company. The mill was last known as the LTV Coke Works, which closed in 1998.

The RIC will provide CMU robotics researchers with roughly 150,000 square feet for research, integration, iteration and commercialization. Reconfigurable high

bays, multiple testing facilities, a unique large-footprint testing area and flexible spaces that address robotics systems at different scales are planned.

"The technologies developed at the Robotics Innovation Center will ripple across every part of our society and economy, impacting fields including health care, transportation, national security, education, agriculture and retail," said Martial Hebert, dean of CMU's School of Computer Science.

The facility is also expected to include pre-incubator space for the next generation of CMU-affiliated robotics companies.

"The Hazelwood community has been waiting for more than 18 years, since the J&L mill closed, for the site to become a source of jobs once again. And this past year reinforced the important of local manufacturing to a healthy region." Richard King Mellon Foundation Director Sam Reiman said at the time of the grant's announcement.

"This historic investment is the first of many steps to achieve our vision of making Pittsburgh a global leader in advanced and additive manufacturing, robotics, and the creation of technology jobs that are accessible to the entire community," said Reiman.

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See also: Part One

The Fall & Rise of Pittsburgh
From Dying Steel Town to Global Robotics Hub
Pittsburgh is now a top robotics research hub in the U.S. and an industry leader worldwide.