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A Profile of Advanced Manufacturing in Northeast Ohio

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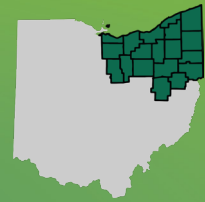
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A PROFILE OF ADVANCED MANUFACTURING IN NORTHEAST OHIO



With the highest job multiplier of any sector, contributing four additional jobs for every person employed in the industry, manufacturing is a powerhouse with a rich history in Northeast Ohio (NEO). A sub-set of technology-intensive manufacturing called Advanced Manufacturing—based upon a definition from Brookings Institute consists of 35 industries—ranges from automobile manufacturing to natural resource extraction and even computer system design. In essence, advanced manufacturing incorporates new technologies which make manufacturing vital and competitive in global markets.

The National Strategic Plan for Advanced Manufacturing asserts advanced manufacturing's status as a sector of "fundamental importance to the economic strength and national security of the United States."¹ Research- and technology-intensive products produced by advanced manufacturing have the most potential to spin-off to become new industries, with a job multiplier of 16 additional jobs generated per one advanced manufacturing job.²

This brief provides an overview of trends in employment, gross regional product (GRP), productivity, and wages for such industries in NEO. NEO trends are compared to the state of Ohio and the United States.

TRENDS

NEO is a \$234 billion economy overall, with the manufacturing sector as a major contributor to its output. In 2017, manufacturing industries provided nearly \$42 billion to GRP (18%), which is 5% higher than its employment share (13%)—while advanced manufacturing industries alone contributed \$21.8 billion, over half of manufacturing output.

Ohio is one of the nation's leaders in both manufacturing and advanced manufacturing, hosting the third largest manufacturing workforce.⁴

In 2017, advanced manufacturing industries across the state employed 308,580 people, 45% of the manufacturing employment, while NEO employed 109,100 people (42% of the region's manufacturing workforce).

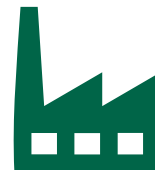
ADVANCED MANUFACTURING EMPLOYMENT TRENDS

Despite Ohio's abundant manufacturing employment pool, trends show an overall decline in recent years. During the 2008 recession, advanced manufacturing employment in NEO, statewide, and nationally all declined rapidly (10.9% in Northeast Ohio and 11.2% in Ohio). Employment slowly increased over the next seven years before flattening out; all three regions have not regained pre-recession employment amounts. In 2017, Northeast Ohio employed 57% of its 2000 workforce, while Ohio employed 65% and the United States 72% (Figure 1). Such employment losses illustrate a dramatic restructuring of advanced manufacturing industries, which now rely more heavily on technology and automation rather than labor.

Motor Vehicle Parts accounted for the most substantial portion of advanced manufacturing employment in NEO, employing over 17,000 people in 2017 (16% of these industries). *Other General Purpose Machinery* employed nearly 11,000 workers, while *Navigation, Measurement and Control Instruments* (6,680 employees), *Other Miscellaneous* (5,990 employees), and *Foundries* (5,970 employees) were the third through fifth advanced manufacturing industries.

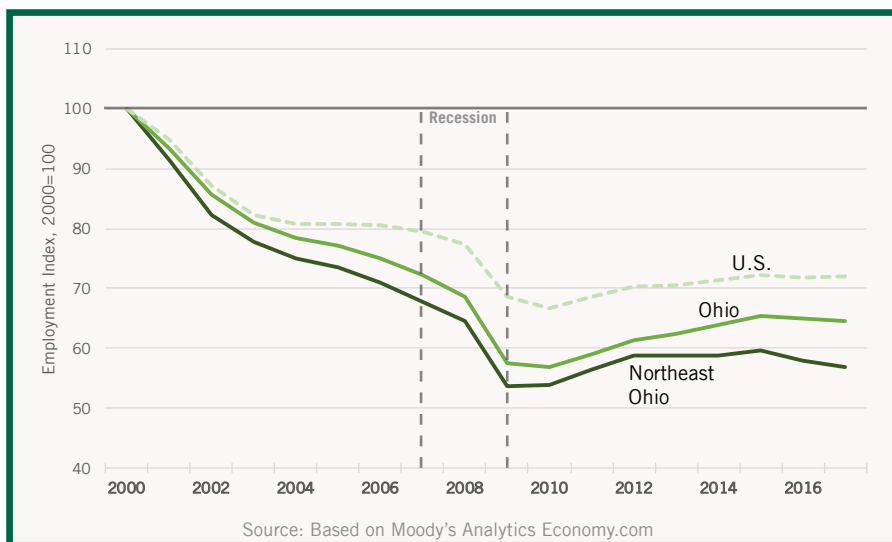
Northeast Ohio³ is defined as the 18-county area including Ashland, Ashtabula, Columbiana, Cuyahoga, Erie, Geauga, Huron, Lake, Lorain, Mahoning, Medina, Portage, Richland, Stark, Summit, Trumbull, Tuscarawas, and Wayne counties.

In 2017, all manufacturing contributed \$42 billion to Northeast Ohio output, over half produced by advanced manufacturing



Although each of the top five advanced manufacturing industries in NEO grew over the past five years, their growth rate lagged behind Ohio and the United States. Across NEO, 3,640 jobs were gained sector-wide in 15 industries—as compared to 20 industries in Ohio and 23 industries in the United States. At the same time, 7,355 jobs were lost in 20 industries in NEO, resulting in a net loss of 3,715 advanced manufacturing jobs. In the end, advanced manufacturing saw a 3.3% decrease in employment from 2013 to 2017, while Ohio and the nation both experienced growth (3.4% and 2%, respectively).

FIGURE 1. Advanced Manufacturing Employment Trends, 2000 to 2017



¹A National Strategic Plan for Advanced Manufacturing. Executive Office of the President. National Science and Technology Council. February, 2012.

²Advanced Manufacturing: A Snapshot of Priority Technology Areas Across the Federal Government. Product of the Subcommittee for Advanced Manufacturing of the National Science and Technology Council. April 2016.

³Northeast Ohio is defined as an 18-county area that includes Ashland, Ashtabula, Columbiana, Cuyahoga, Erie, Geauga, Huron, Lake, Lorain, Mahoning, Medina, Portage, Richland, Stark, Summit, Trumbull, Tuscarawas, and Wayne counties.

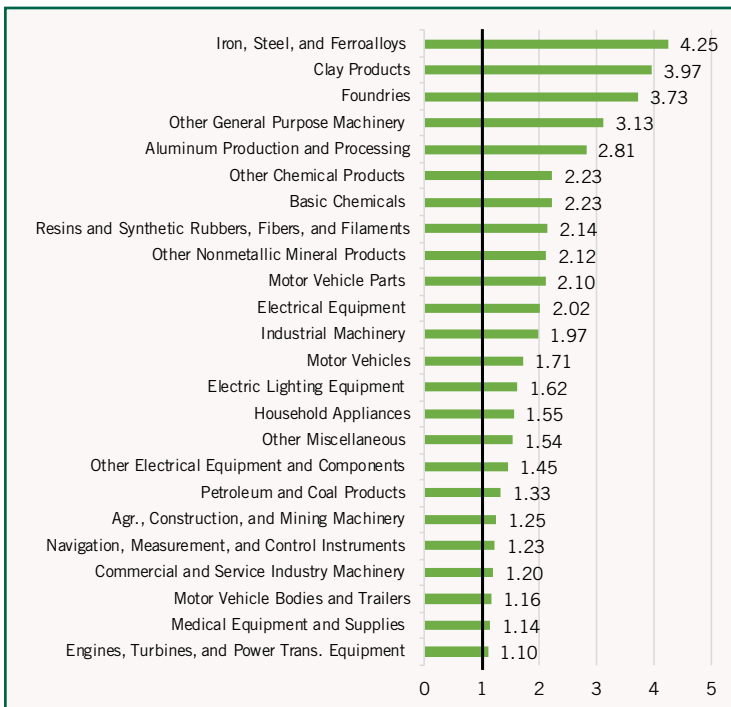
⁴JobsOhio. Advanced Manufacturing. 2019. <https://jobsohio.com/industries/advanced-manufacturing/>

Location quotients for NEO's advanced manufacturing industries are depicted in Figure 2. Location quotients (LQs) measure industry specialization in a region relative to the national economy. If an industry has a higher concentration in the regional economy (LQ > 1), it indicates that the industry is part of the regional economic base, producing goods for export outside the region and thereby generating wealth for the region.

In NEO, 24 of the 35 advanced manufacturing industries had an LQ greater than 1.0.⁵ The region had high employment concentrations in several industries, including *Iron, Steel, and Ferroalloys* (LQ=4.3), *Clay Products* (LQ=4.0), *Foundries* (LQ=3.7), *Other General Purpose Machinery* (LQ=3.1), and *Aluminum Production and Processing* (LQ=2.8).

Location Quotients (LQs) measure how concentrated industries are compared to national averages. An industry with greater share of employment than the nation has a LQ > 1.

FIGURE 2. NEO Advanced Manufacturing Industries with Location Quotients >1, 2017



Source: Based on Moody's Analytics Economy.com

OUTPUT TRENDS

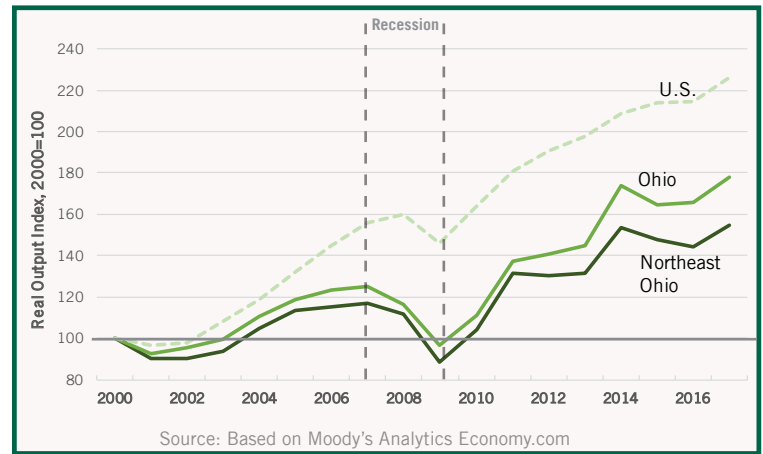
Long-term, the output (GRP) of NEO's advanced manufacturing sector increased despite the 43% job loss in the sector (Figures 1 and 3). Between 2000 and 2009, NEO output fell 12% and employment declined by 46%; Ohio followed this trend, with output and employment declining by 4% and 43% respectively. Nationally, output declined due to the 2008 recession but remained higher than 2000 levels. In 2017, NEO produced 154% of its 2000 output, while Ohio produced 178% and the United States 226%. These post-recession output trends emphasize the overall restructuring which resulted in decreased labor and heavier reliance on technologies to drive output.

The industry with the greatest GRP in NEO was *Petroleum and Coal Products*, with a total GRP of nearly \$3.2 billion in 2017 (15% of advanced manufacturing GRP). *Basic Chemicals* and *Motor Vehicle Parts* each had a GRP of over \$2.1 billion. *Aerospace Products and Parts* and *Other General Purpose Machinery* had the fourth- and fifth-largest GRPs

in Northeast Ohio, at \$1.7 billion and \$1.3 billion respectively. Four out of these five industries surpassed the United States in growth in NEO, with *Basic Chemicals* displaying 50% growth between 2013 and 2017 and *Aerospace Products and Parts* displaying a staggering 96% growth.

Across all advanced manufacturing industries, NEO experienced 8% growth, while Ohio experienced 13% and the United States experienced 3%. Between 2013 and 2017, NEO saw a decrease in GDP of \$1.17 billion across 17 advanced manufacturing industries and an increase in GDP of \$2.77 billion across 18 advanced manufacturing industries—yielding a net GDP gain of \$1.6 billion.

FIGURE 3. Northeast Ohio Advanced Manufacturing GDP Trends, 2000 to 2017



Source: Based on Moody's Analytics Economy.com

LABOR PRODUCTIVITY TRENDS

From 2000 to 2017, productivity (output per employee) in the sector increased by a factor of 2.78 in NEO, compared to 2.68 in Ohio and 2.96 in the U.S. Since 2014, productivity growth in NEO peaked at higher levels than statewide growth.

Overall, productivity increases for advanced manufacturing industries reflects rapid productivity growth in the computer industry and wider adoption of computer technologies by manufacturing companies.⁶ Automation technologies based on robotics, 3D printing, the Internet of Things, and advanced analytics are expanding and re-defining manufacturing's future. Advanced analytics, based on data captured from plant floor machinery and processes is used to improve product quality, reduce production delays, and improve new products' time-to-market. The widespread adoption of 3D printing is an industry changer for prototyping; it is estimated that by 2020, 75% of manufacturers worldwide could use 3D-printed tools, jigs, and fixtures for the production of finished goods.⁷ Current manufacturing adoption of 3D printing is concentrated in aerospace and aviation, customized medical devices and implants, and automotive manufacturing.⁸

Nevertheless, sustained productivity growth for advanced manufacturing industries will depend on the availability of skilled workers; 84% of executives report talent shortages in U.S. manufacturing industries.⁹ Manufacturing companies should share positive news about growing wages, career opportunities, technologies, and job security to attract and retain top talent—which will improve existing perceptions about manufacturing's prospects.

⁵ The advanced manufacturing industries with a location quotient lower than 1.0 were: *Magnetic and Optical Media, Pesticides, Fertilizers, and Other Agricultural Chemicals, Other Transportation Equipment, Aerospace Products and Parts, Semiconductors and Other Electronic Components, Communications Equipment, Railroad Rolling Stock, Pharmaceuticals and Medicine, Computers and Peripheral Equipment, Ship and Boat Building, and Audio and Video Equipment.*

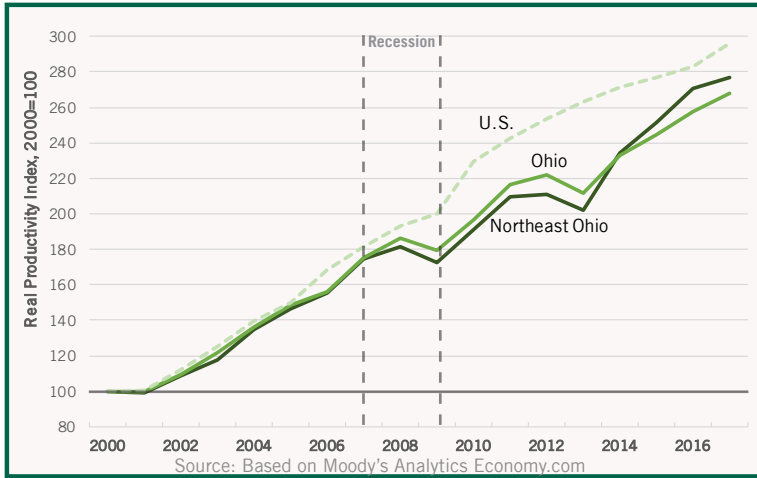
⁶ Houseman, S. The Decline of U.S. Manufacturing Employment—Automaton and Trade. *Upjohn Institute*. April 2018, 25(2).

⁷ Gartner, Predicts 2017: 3D Printing Accelerates. November 15, 2016

⁸ Piazza, M. and Alexander, S. Additive Manufacturing: A Summary of the Literature. *Urban Publications*. 2015. Paper 1319

⁹ Exponential technologies in manufacturing. Deloitte. Singularity University. Council on Competitiveness. April 15, 2018.

FIGURE 4. Northeast Ohio advanced manufacturing productivity trends, 2000 to 2017



AVERAGE WAGES IN ADVANCED MANUFACTURING

In 2017, the average wage for NEO's advanced manufacturing sector of \$70,127 was 26% higher than the average wage for all other manufacturing (\$55,830). Nationwide, advanced manufacturing wages were higher, with a differential of 49% between advanced manufacturing and all other manufacturing (\$79,958 in advanced manufacturing versus \$53,503). The highest-paying advanced manufacturing industry in Northeast Ohio was *Pharmaceuticals and Medicine* (\$149,445), followed by *Basic Chemicals* (\$120,261), *Resins and Synthetic Rubbers, Fibers, and Filaments* (\$99,236), and *Aerospace Products and Parts* (\$93,592).

The average wage of Northeast Ohio's advanced manufacturing sector is 26% higher than the average wage for all other manufacturing.



The most substantial pay gap was in *Computer and Peripheral Equipment*; here, U.S. average wages were drastically greater. The average wage for *Computer and Peripheral Equipment* in NEO was \$83,937, while it was \$193,219 in the U.S. This wage disparity reflects the high-wage jobs in this industry on the East and West Coasts. U.S. average wages also surpassed NEO by a large amount in *Petroleum and Coal Products*; *Communications Equipment*; *Navigation, Measurement, and Control Instruments*; *Semiconductors and Other Electronic Components*. Meanwhile, average wages for the region surpassed U.S. averages by the largest amounts in *Pharmaceuticals and Medicine*; *Basic Chemicals*; and *Household Appliances*.

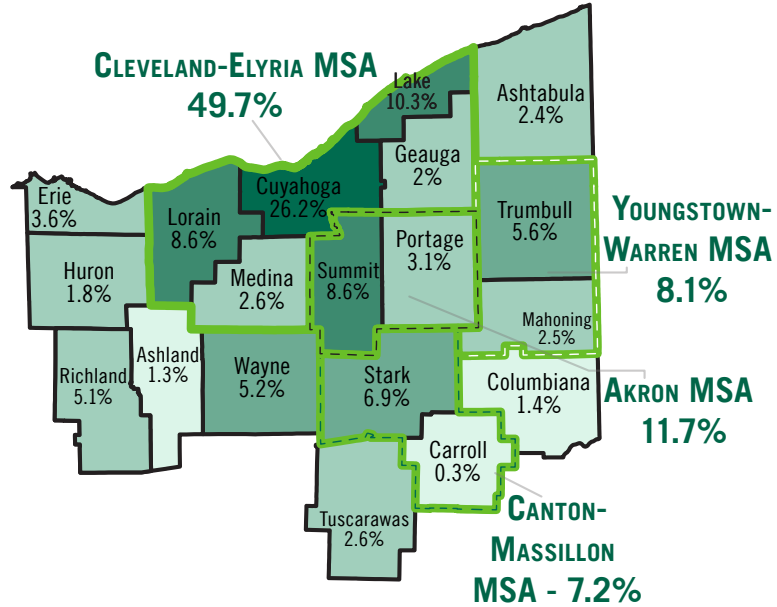
Advanced manufacturing industries in Northeast Ohio employed 109,100 people, 42% of the regional manufacturing workforce



ADVANCED MANUFACTURING EMPLOYMENT BY COUNTY & MSA

In 2017, the Cleveland-Elyria-Mentor Metropolitan Statistical Area's (MSA) advanced manufacturing sector captured 49.7% of total advanced manufacturing employment in Northeast Ohio (Map 1). The Akron MSA's advanced manufacturing accounted for 11.7%; the Canton-Massillon MSA, 7.2%¹⁰; and the Youngstown-Warren MSA, 8.1%.

MAP 1. Percentage of NEO Advanced Manufacturing Employment by County and MSA, 2017



NEO experienced a decline in advanced manufacturing employment between 2013 and 2017. The Youngstown-Warren MSA—primarily Mahoning County—suffered the most significant relative loss, with more than 12.5% of advanced manufacturing jobs disappearing in the five years. Cuyahoga County, however, lost the highest total jobs, giving up nearly 3,000 positions over the same five-year period.

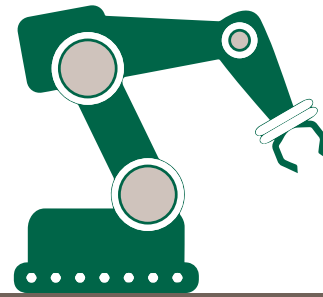
Despite these overall losses, ten counties in the 18-county Northeast Ohio region gained advanced manufacturing jobs during this time. Three of these counties (Stark, Richland, and Erie) reported only minimal gains. Wayne County experienced the highest rate of growth in advanced manufacturing employment at 21.8%.

CONCLUSIONS

- Thirty-five (35) advanced manufacturing industries in NEO provided nearly 109,100 jobs (42% of the total manufacturing workforce in the region) and \$21.8 billion in GRP (52% of the manufacturing output).
- Declining employment trends in these industries reflect trends in Ohio and the U.S. Despite lost jobs, output in NEO's advanced manufacturing sector recovered in 2011 after the 2008 recession.
- As manufacturing companies adopted new technologies, they substantially increased their productivity while restructuring after the recession. Talent attraction and retention is a key challenge for new technology-intensive manufacturing processes.
- On average, advanced manufacturing industries paid 26% higher wages than all other manufacturing. Manufacturing companies striving to achieve new levels of output and keep pace with global competition should increasingly turn to one of their most important assets—people—to drive further growth. ⚙️

¹⁰ Carroll County is not part of Northeast Ohio but is included in this section to demonstrate an accurate portrayal of the Canton-Massillon MSA. Here, the advanced manufacturing employment in Northeast Ohio and by county excludes the *Railroad Rolling Stock* due to data limitations.

SUMMARY DASHBOARD



Northeast Ohio Advanced Manufacturing (AM) 2017

35
industries

109,100
jobs

42%
of total
manufacturing
workforce

\$21.8
billion in gross
regional
product

52%
of total
manufacturing
output

Highest Paying AM Industries

Average Annual Wages

Pharmaceutical	\$149,445
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Basic Chemicals	\$120,261
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Resins & Synthetic Rubbers, Fibers	\$99,236
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Largest AM Industries

Annual Employment

Motor Vehicle Parts	17,010 employees
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Other General Purpose Machinery	10,830 employees
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Navigation, Measurement, & Control	6,680 employees
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