Ohio's innovation economy

Ohio's Technology Sector

- Ohio's technology sector consists of more than 28,000 business establishments employing 819,000 workers, according to a recent study by Battelle Memorial Institute.
- The Battelle study also found that:
  - Employment in this sector increased 45% from 1995 to 2001—compared to 38% for the nation.
  - Technology sector employment is 14% more concentrated in Ohio than nationwide.
  - Just under half of the workers in this sector work in service industries, and these industries grew at a more rapid pace from 1995 to 2001—123%, compared to 8% for manufacturing.

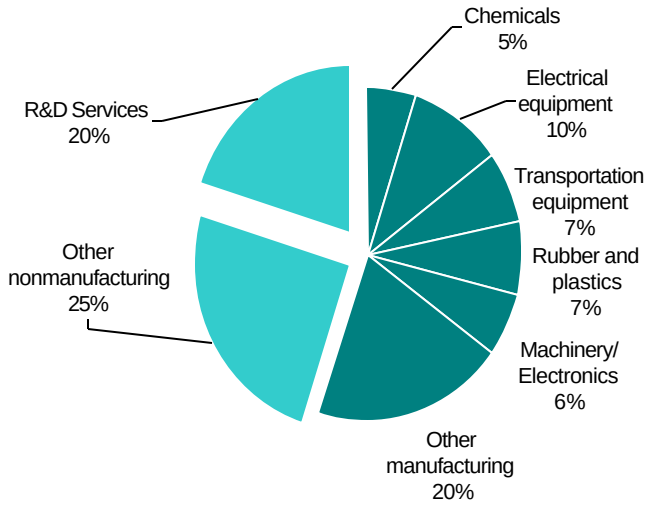
Corporate R&D Expenditures

- Ohio's private-sector spent $6.5 billion on R&D in 1999. This represents 1.8% of the state's gross state product.
- 2,255 companies are involved in R&D activities.
- Large businesses (500 or more workers) accounted for 80% of this $6.5 billion expenditure; however, the $871 million spent by Ohio companies with 25 to 49 workers is relatively high—18% of the U.S. total in this employment size category.
- About 55% of industry-performed R&D in Ohio is conducted by manufacturing companies (see pie chart, upper right).
- Ohio ranks 10th, among the 50 states, in corporate R&D performance, and is a leader in several specific industries:
  - 1st in plastics and rubber; and electrical equipment.
  - 2nd in professional, scientific, and technical services behind California; and second in primary steel behind Pennsylvania.
  - Top 5 in aerospace; clay & glass; and fabricated metals (missing data for several states limits a more precise ranking).

Patents

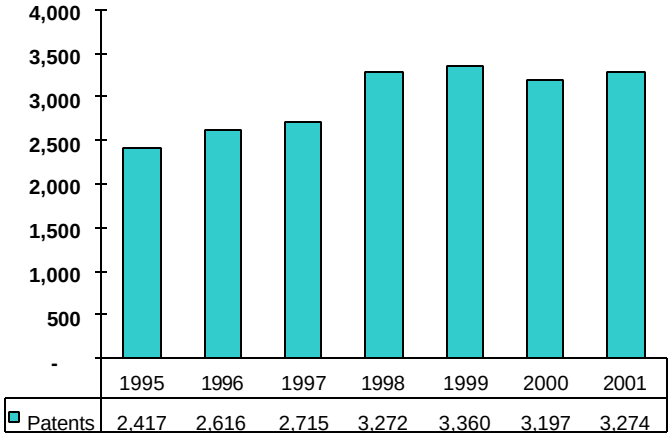
- Ohio ranked 9th among the 50 states in 2001 based on a total of 3,274 inventor patents.
- Procter & Gamble, typically, accounts for 10% of the statewide patent total.

R&D Expenditures by Sector



Source: National Science Foundation, 1999

Ohio Inventor Patents



Source: U.S. Patent and Trademark Office

Ohio Patent Leaders

Company	Patents	Key Categories
Procter & Gamble	1,642	personal care, food, cleaners, medical
General Electric	603	jet engine parts; lighting systems
Goodyear	390	tires, PVC foam, and composites
General Motors and Delphi	263	ignition, brake, and air bag systems

Source: U.S. Patent and Trademark Office, 1997 - 2002

Patents continued….

According to U.S. Patent and Trademark data, for the five-year period from 1997 to 2001, 34 organizations were credited with 50 or more Ohio-based patents.

- 16 are Fortune 500 companies (5 have Ohio headquarters);
- 5 are international firms (2 recently closed major research facilities);
- 3 are universities and 2 are federal agencies.

Ohio ranks 6th among the 50 states in university patents issued from 1975-1998:

- Six Ohio universities are on a list of the top 100 patenting universities: Ohio State University (263 patents), Akron University (146), the University of Cincinnati (100), Case Western Reserve University (93), the University of Toledo (64), and the University of Dayton (64).

The Top Ten strategic technologies by 2005, according to Battelle Memorial Institute:

1. **Human genome mapping** and genetic-based personal identification and diagnostics will lead to preventive treatment of diseases and cures for specific cancers.
2. **Super materials**. Computer-based design and manufacturing of new materials at the molecular level will mean new, high-performance materials for use in transportation, computers, energy, and communications.
3. Compact, long-lasting and highly portable energy sources, including **fuel cells and batteries** will power electronic devices of the future, such as portable personal computers.
4. **Digital high definition television**. This important breakthrough for American manufacturers — and major source of revenue — will lead to better advanced computer modeling and imaging.
5. **Electronic miniaturization for personal use**. Interactive, wireless data centers in a pocket calculator-size will provide users with a fax machine, telephone, and computer capable of storing all the volumes in their local library.
6. Cost-effective **"smart systems"** will integrate power, sensors, and controls. They eventually will control the manufacturing process from beginning to end.
7. **Anti-aging products** that rely on genetic information to slow the aging process will include aging creams that really work.
8. Medical treatments will use highly accurate sensors to locate problems, and **drug delivery systems** will precisely target parts of the body — such as chemotherapy targeted specifically to cancer cells to reduce the side effects of nausea and hair loss.
9. **Hybrid fuel vehicles**. Smart vehicles, equipped to operate on a variety of fuels, will select the appropriate fuel based on driving conditions.
10. **Edutainmen**t. Educational games and computerized simulations will meet the sophisticated tastes of computer-literate student

Source: "Technology Forecasts," Battlelle, 1995 press release.

Federal Research and Development in Ohio

- Approximately $3.7 billion in federal R&D funds are spent each year in Ohio.
- Ohio ranks 5th among the 50 states in terms of the amount of federal R&D dollars received annually.
- The Department of Defense accounts for 60% of the federal R&D dollars spent in the state.
- NASA accounts for an additional 20% and Health and Human Services 11%.

Federal R&D units in Ohio – some examples:

- EPA's National Risk Management Research Laboratory's headquarters is located in Cincinnati. It conducts research to prevent, control, and remediate problems that threaten human health and the environment.
- In September 2002, the federal government announced the creation of the Homeland Security Research Center to be located at the Cincinnati EPA research facility. The new research center's mission includes protecting the nation's drinking water supply and developing monitors and test kits for detecting early signs of a biochemical attack.
- NASA's Glenn Research Center in Cleveland conducts research on propulsion technology for general aviation and high-performance aircraft. The center also conducts propulsion-related research on materials and instrument controls.
- Wright-Patterson Air Force Base, located near Dayton, is home to five research directorates:
  - Air Vehicles
  - Materials and Manufacturing
  - Sensors
  - Propulsion
  - Human Effectiveness
- The Delaware Forestry Sciences Laboratory, located north of Columbus, is a unit of USDA's Forest Service. It conducts research on forest ecosystem management.
- The Vehicle Research and Test Center, part of DOT's National Highway Traffic Safety Administration, is located in East Liberty—near Marysville. It conducts research on crash avoidance, crashworthiness, and biomechanics.
- The Lake Erie Biological Station conducts research on aquatic ecosystems for the Department of the Interior.
- USDA's ARS Research Facility at the Ohio Agriculture R&D Center on the Wooster campus of The Ohio State University studies technologies that protect field crops against damage from pests and other adverse environmental conditions.

Battelle Memorial Institute

Battelle Memorial Institute, which began operations in 1929, is headquartered in Columbus. Battelle focuses on technology development and commercialization, education and community service. Battelle **employs 7,500 people worldwide with a staff of 2,000 in Columbus.** The Institute inserts technology into systems and processes for manufacturers; pharmaceutical and agrochemical industries; trade associations; and government agencies supporting energy, the environment, health, national security and transportation.

Battelle and the national laboratories it manages or co-manages for the U.S. Department of Energy won nine awards in R&D Magazine's prestigious annual R&D 100 Awards for 2002. The awards, considered the Oscars of the technology world, recognize the most significant scientific achievements for 2001.

Battelle Columbus won two of these nine awards—one for an environmentally friendly PVC plasticizer, a joint entry with the Ohio Soybean Council, and one for chemical processing/wastewater hardware.

NASA Glenn Research Center

NASA Glenn's main missions include designing scientific experiments for the orbiting space station and developing better aircraft engines**. More than 2,000 people there work in space science and aeronautics-related jobs.**

The Center has been recognized for many cutting-edge contributions. NASA Glenn has won many awards including an Emmy, a Collier Trophy, and NASA's Government Invention of the Year award in 1996 and 2002. Of the116 R&D 100 Awards given to NASA, 81 of these have been for research and technology development at Glenn. Glenn's winners for 2002 were a propulsion system simulation software program and an art restoration technique using atomic oxygen.

In 2000, Cleveland State University prepared an economic impact study for the NASA Glenn Research Center. The study estimated the following statewide impacts:

- Total Output Impact: $1,155 million;
- Total Employment Impact: 12,062 jobs;
- Of the $1,155 million, $394 resulted from direct impact and $761 resulted from indirect and induced spending impact;
- In FY1998, 12,062 jobs were generated in Ohio through Glenn's activities. Of these, 2,045 resulted from direct impact (civil service employees at the Center) and 10,017 resulted from indirect and induced impacts.

Wright-Patterson Air Force Base

Wright-Patterson Air Force Base is the foremost research and development center of the United States Air Force, the source for nearly every major innovation in U.S. military aviation and a major catalyst for high-tech growth in the Dayton region.

The Air Force Research Laboratory (AFRL) at Wright-Patterson is responsible for many of the century's most dramatic innovations in avionics and composites and a prominent source of technology transfer from military to civilian commercial use.

Wright-Patterson employs 22,000 people, including 15,000 civilians—making it the largest single-site employer in the state of Ohio—and is responsible for another 17,000 jobs through subcontracting and supply, according to the Dayton Regional Development Alliance.

Edison Technology Centers

Edison Technology Centers link industry with academia and government in partnerships to strengthen industrial competitiveness through technological innovation. Each of the Centers offers capabilities in specific technologies including: advanced manufacturing, polymers, materials and processes, welding and materials joining, biotechnology, and environmental.

There are currently seven Edison Centers.

CAMP, Inc.-Cleveland
CAMP, Inc. provides manufacturing, engineering, technical management, and other services for manufacturers seeking to become more productive, more competitive and more profitable.

Omeris- Cleveland, Columbus, Cincinnati
Omeris promotes the growth of the Ohio biomedical/biotechnology industry.

EISC, Inc.-Toledo
EISC moves Ohio companies toward world-class excellence through manufacturing modernization.

Edison Materials Technology Center-Kettering
EMTEC provides problem-solving and applied research in materials and processing technologies including metals, ceramics, composites and polymers.

Edison Welding Institute (EWI)-Columbus
EWI provides materials joining and engineering expertise to manufacturers throughout the United States.

TechSolve, Inc.-Cincinnati
TechSolve provides assistance to manufacturers and manufacturing-related businesses.

Ohio's IT Alliance**-** Dayton
Ohio's IT Alliance provides regional economic development programs designed to support Ohio's extensive information technology (IT) industry.

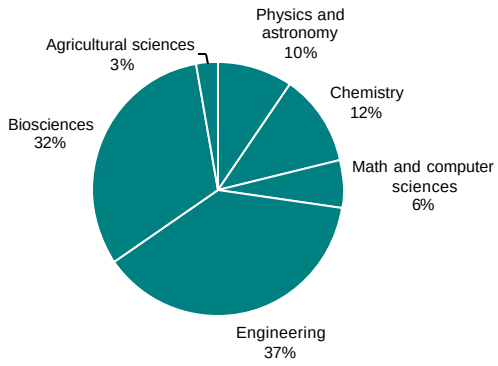
High-Tech Workers

Ohio's Technology Sector

	Value Added (millions)	Employment	Location Index
Technology-Intensive Inds	**$14,450**	**191,574**	**0.8**
Computer and data processing	$5,408	77,772	0.8
Aircraft and parts	$1,792	19,768	0.9
Communications equipment	$1,519	9,061	0.8
Industrial inorganic chemicals	$1,019	8,493	2.1
Research and testing	$958	30,122	0.8
Industrial organic chemicals	$951	6,268	1.1
Computer and office equipment	$877	9,710	0.6
Measuring and controlling	$753	14,951	1.2
Electronic parts	$657	11,518	0.4
Drugs	$509	3,802	0.3
Search and navigation eqpt	$7	106	0.0
Other Technology Inds	**$30,434**	**356,069**	**1.4**
Technology Sector Totals	**$44,884**	**547,643**	**1.1**

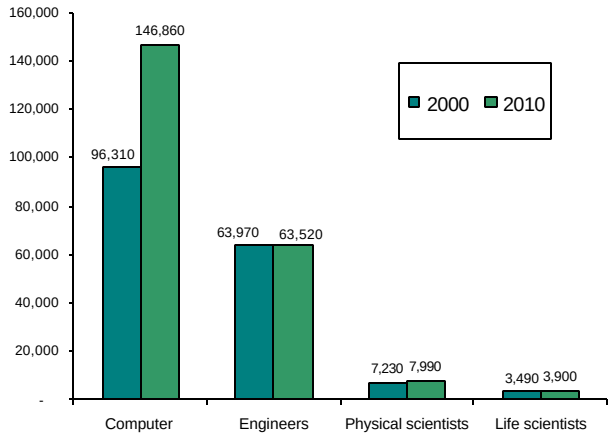
Source: IMPLAN, MIG, 1999

Science and Engineering Doctorates



Source: National Science Foundation, 2001

Science and Engineering Workers



Source: Ohio Bureau of Labor Market Information

Technology Sector Industries

- Battelle's study of Ohio's technology sector incorporates a federal government definition that encompasses 31 industries. Eleven are considered "technology intensive" industries. To make this list, an industry must have a concentration of scientific, technical, and engineering workers that is at least five times the national average.
- These 11 industries employ 192 thousand Ohio workers, according to the latest federal government estimates.
- The two non-manufacturing industries—computer and data services and research and testing—employ the largest number of workers and have the fastest growth rates. Combined they are expected to add 43 thousand jobs by 2010.
- Three of the eight manufacturing industries—measuring and controlling equipment and inorganic and organic chemicals—have location index numbers greater than one indicating that their share of total employment is greater in Ohio than the nation.
- Compared to the technology-intensive group, the remaining 20 high-tech industries, as a group, are relatively concentrated in Ohio. Highly concentrated technology industries include motor vehicles, soaps and detergents, paints and varnishes, electrical industry machinery, and special and general industry machinery.
- Overall, Ohio's technology sector contributes $45 billion to the state's gross state product—13% of the total, and employs one out of every 12 workers.

Academic Researchers

- Each year the National Science Foundation publishes the number of science and engineering doctorates awarded by major field of study. In 2001, Ohio was one of seven states credited with more than one thousand S&E doctorates.
- Researchers at 26 public and private colleges and universities spent $919 million on R&D activities in 2000. Ohio State University accounted for close to 40% of this total, while Case Western Reserve and the University of Cincinnati—the 2nd and 3rd ranked institutions—each attracted about 20% of the R&D total.
- The total number of graduate students in science and engineering was 19,294 in 2000, ranking Ohio as a top 10 state.

Scientists and Engineers

- There were 64,000 engineers working in Ohio in 2000. Eight percent of the nation's industrial engineers and 5 percent of the mechanical, materials, and environmental engineers are employed in Ohio.
- Jobs in computer-related occupations are expected to increase 52 percent from 2000 to 2010.